

**18<sup>th</sup> annual Congress of the**  
**EUROPEAN COLLEGE OF SPORT SCIENCE**  
**26<sup>th</sup> - 29<sup>th</sup> June 2013, Barcelona – Spain**  
**BOOK OF ABSTRACTS**

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# Welcome

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Dear congress participant,

Since its creation one of the main aims of the ECSS has been to contribute to the unification of sport science. However, the tremendous growth in the field has produced further fragmentation. Is it possible to unify these fragmented areas? Are there common principles that bind them?

Reductionism has dominated research for over a century and has provided a wealth of knowledge, yet it is increasingly clear that a discrete biological function can only rarely be attributed to an individual molecule. Indeed, most biological characteristics arise from complex interactions: between proteins, cells, organisms, groups, societies, etc. A key challenge in the twenty-first century is therefore to understand the structure and dynamics of these complex interactions, as this will surely foster a new and better understanding between the different scientific disciplines.

The 2013 ECSS Congress in Barcelona seeks to help sport science make its own leap forward towards a comprehension of ourselves not as part of a technical world but as interacting parts of a consistent and coherent whole: nature. The 18th Annual Congress of the ECSS aims to contribute to the development of global approaches in the different specialized areas and to provide an even broader view of sport science. Hopefully, by moving from the whole to the parts and vice versa, sport scientists will be able to find the best paths through the field.

Barcelona is an open city: open to the sea, to culture, to the world and to science. What better place in which to join forces in unifying sport science.

Benvinguts a Barcelona,

Bienvenidos a Barcelona,

Welcome to Barcelona!

Natàlia Balagué & Carlota Torrents

*Congress Presidents*



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\* Clinical track

# Honorary session

## PS-HS01 Sport Science, in the World of Science

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### SPORT SCIENCE, IN THE WORLD OF SCIENCE

Saltin, B.

*Rigshospitalet and University of Copenhagen, Denmark*

In the world of science, sport science is one of the fields that have changed dramatically over the last century. From having had a sports medicine focus the science component has taken over and become enlarged; now encompassing most academic disciplines ranging from philosophy over biomedicine to advanced technology, sometimes also in combination. Ever since I published my first paper in 1960 and defended my thesis in 1964 I have been close to this transformation and I have noticed how my field, human physiology, has changed stepwise in many universities, first into exercise science and later into sport science. Regardless of these paradigmatic modifications, I have continued to do what I was taught. Thus, in this presentation I will highlight one area where major advances have been possible thanks to the reintroduction of the muscle biopsy technique and the developments of biochemical and molecular methods. Muscles from humans could be studied, unravelling both contractile and metabolic adaptations at the muscle fibre and subcellular levels, including key factors for the mechanisms by which these adaptations are regulated and their functional role. To me an important source of information and perspective originates from a study in Greenland. During 42 days Danes were crossing the ice with 5-7 daily hours of strenuous skiing and pulling a sledge. They were compared to traditional Inuit. Our hypothesis was that the higher fat combustion capacity in the Inuit was to be explained by key differences in their skeletal muscle metabolic machinery in both arms and legs. The 42 days of skiing on the ice improved the fat combusting capacity in the Danes' muscles, but they did not reach "Inuit status" when it came to some critical enzymes and the relative role of fat oxidation. The question is then: why not? Until the complete answers have been found, the researchers' task is not fulfilled. The fact that sport science today is hypothesis driven is one important reason why the field has got a voice in the world of science. For this voice to be heard and appreciated, the "why" and "how" questions of sport science also have to be attacked and solved.



# Wednesday, June 26th, 2013

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15:00 - 16:30

Invited symposia

**IS-PM07 Antioxidants in physical exercise: points and counterpoints \***

---

## OVERVIEW OF THE ROLE OF FREE RADICALS AND ANTIOXIDANTS IN PHYSICAL EXERCISE

Gratas-Delamarche, A.

*University of Rennes2*

Since the mid-70 when searchers (Davies et al. 1982) demonstrate that single bouts of exhaustive exercise can induce an acute state of oxidative stress, intensive researches have been conducted to clarify the role of oxidative stress in the exercise- adaptations of the human body. Oxidative stress was first defined by Sies (1985) as an « imbalance between the production of reactive oxygen species (ROS) and the occurrence of cell antioxidant defenses ». Since then, research in this area has grown spectacularly, showing that high levels of ROS produced during intense exercise result in oxidative stress and are associated with muscle damage and impaired muscle function. Exercise mode, intensity, and duration, as well as training and antioxidant intakes (AO) impact the extent of oxidation. Although a single bout of exercise often leads to an acute oxidative stress, in accordance with the principle of hormesis (Radak et al. 2008), such an increase appears necessary to allow for an up-regulation in endogenous antioxidant defenses. Now it is clear that humans that engage in long-term heavy exercise are more resistant to oxidative stress (Machefer et al. 2007). Evidence is growing that the continued presence of a small stimulus, such as low concentrations of ROS, can induce the expression of antioxidant enzymes and other defense mechanisms (Gomez- Cabrera et al. 2008). Thus within a concentration range, ROS are "friends" rather than "foes". Based on the abundant research done on this topic (Pternelj and Coombes 2011) this review seeks to give recommendations in daily antioxidant intakes for sportmen and active people. Nowadays there is a lack of evidence-for justifying antioxidant supplementation during usual exercise training. An adequate intake of vitamins and minerals through a varied and balanced diet remains the best approach to maintain the optimal antioxidant status in exercising individuals. References Sies H.: In: Oxidative stress, London: Academic Press; 1985: 1-8 Davies KJ, Quintanilha AT, Brooks GA, Packer L. Biochem Biophys Res Commun. 1982;107(4):1198-205. Pternelj TT, Coombes JS. Sports Med. 2011, 41(12): 1043-69 Machefer G, Groussard C, Vincent S, Zouhal H, Faure H, Cillard J, Radak Z, Gratas- sZ Grater . J Am Coll Nutr. 2007, 26(2):111-20. Gomez-Cabrera MC, Domenech E, Viña J. Free Radic Biol Med. 2008; 44(2):126-31. Radak Z, Chung HY, Goto S. Free Radic Biol Med. 2008; 44(2):153-9.

## ANTIOXIDANTS IN EXERCISE: WORSE THAN USELESS?

Gomez-Cabrera, M.C.

*University of Valencia*

Exercise causes oxidative stress. Antioxidants may reduce the adverse effects of exercise-induced reactive oxygen species (ROS). However, ROS are not only toxic but rather play an important role in cell signalling and in the regulation of gene expression in skeletal muscle. Thus, the supplementation with antioxidant vitamins during training has been recently questioned. Training studies conducted to determine whether antioxidant vitamins improve exercise performance have generally shown that supplementation is useless (1-3). However, recent evidence shows that antioxidants may have detrimental effects on performance. As early as 1971, it was shown that vitamin E supplementation (400 IU/d for 6 wk) caused unfavourable effects on endurance performance in swimmers (4). Malm and co-workers showed the deleterious effects of ubiquinone-10 supplementation on the performance of humans after a high-intensity training program (5). In 2002, it was shown that supplementation of racing greyhounds with 1g vitamin C a day for 4 wk significantly slowed their speed (6). Moreover, in a human study, the negative effects of ascorbic acid supplementation on the adaptive responses of endogenous antioxidant enzymes and stress proteins were demonstrated (7). Furthermore, it has been shown that supplementation with ascorbic acid to prevent delayed onset muscle soreness after exercise, does not preserve muscle function but hinders the recovery process thereby being detrimental to future performance (8). In an animal study, we found that vitamin C supplementation decreases training efficiency because it prevents exercise-induced mitochondrial biogenesis (9). These results have been subsequently confirmed in humans. Dr. Ristow's research group showed that antioxidant supplementation with vitamins C and E prevents the induction of molecular regulators of insulin sensitivity, mitochondrial biogenesis, and endogenous antioxidant defense by physical exercise (10). A large proportion of athletes take vitamin supplements, often large doses, seeking their beneficial effects on performance (11). The complete lack of any positive effect of antioxidant supplementation on physiologic and biochemical outcomes consistently found in human and animal studies raises questions about the validity of using oral antioxidant supplementation during training. C. Yfanti et al., Med Sci Sports Exerc 42, 1388 R. J. Maughan, Nutr Res Rev 12, 255 A. A. Theodorou et al., Am J Clin Nutr 93, 1373 I. M. Sharman et al., Br J Nutr 26, 265 C. Malm et al., Acta Physiol Scand 157, 511 R. J. Marshall et al., J Nutr 132, 1616S M. Khassaf et al., J Physiol 549, 645 G. L. Close et al., Br J Nutr 95, 976 M. C. Gomez-Cabrera et al., Am J Clin Nutr 87, 142 M. Ristow et al., Proc Natl Acad Sci U S A 106, 8665 J. Sobal et al., Int J Sport Nutr 4, 320

## ANTIOXIDANT SUPPLEMENTATION AND EXERCISE PERFORMANCE

Radak, Z.

*Semmelweis University*

In toxicology, hormesis is a dose response phenomenon characterized by a low dose of stimulation, high dose of inhibition, resulting in either a J-shaped or an inverted U-shaped dose response, which is a non-monotonic response. Recently we have extended the hormesis theory to free radical species which, level significantly modulated by physical exercise and we proposed that the effects of exercise in the context of free radicals can be described by the hormesis curve (1). Therefore, supplementation of antioxidants "on the

malfunctional side" of hormesis curve could be beneficial and can lead to delayed fatigue, enhanced performance and/or better regeneration. 1. Radak et al. *Biogerontology* 2005 6:71-5.

**15:00 - 16:30**

## Oral presentations

### OP-PM20 Nutrition [NU] 1

#### TRAINING INCREASES MUSCLE CARNOSINE LOADING BY BETA-ALANINE SUPPLEMENTATION

Bex, T., Chung, W., Baguet, A., Stegen, S., Derave, W.

*University Ghent*

TRAINING INCREASES MUSCLE CARNOSINE LOADING BY BETA-ALANINE SUPPLEMENTATION Bex, T.1, Chung, W.1,2, Baguet, A.1, Stegen, S.1, Derave, W.1 1: GHENT University (Ghent, Belgium), 2: Victoria University (Canberra, Australia) Introduction Carnosine occurs in high concentrations in human skeletal muscle where it works as a proton buffer and calcium regulator (Derave et al, 2010). Therefore, increased muscle carnosine concentration in athletes likely promotes high-intensity exercise performance. Beta-alanine (BA) supplementation over 4-10 weeks has consistently been shown to augment muscle carnosine concentration with 40–80%, but the effect of concomitant training on the loading efficiency is poorly understood. A one-legged training study found that carnosine loading after BA supplementation was not influenced by isokinetic training with limited training volume (Kendrick et al, 2009). Therefore, the aim of the present study was to investigate whether muscle carnosine loading via BA supplementation is enhanced by prolonged exercise training, by comparing loading in arm and leg muscles that are specifically trained in different athlete groups. Methods Participants (n=24; 9 cyclists, 7 swimmers and 8 controls) were supplemented with 6.4g/day of slow-release BA (Carnosyn, Natural Alternative International) for 23 days. Athletes were well-trained at baseline and trained at least 8 hours a week in their specific sports (cycling or swimming) during the supplementation period, whereas the controls were sedentary throughout. Measurements (before and after supplementation) included carnosine content in soleus, gastrocnemius medialis and deltoid muscles by proton magnetic resonance spectroscopy (1H-MRS). Results Cyclists (p = 0.026) and swimmers (p = 0.032) have a significantly higher absolute increase of carnosine after BA supplementation in the leg muscles compared to controls. In the deltoid muscle, a higher absolute increase of carnosine was found in the group of swimmers compared to cyclists (p = 0.025) and controls (p = 0.073). The highest relative increases in muscle carnosine were observed in the soleus muscles of cyclists (+94%) and the deltoid muscles of swimmers (+93%). Discussion We have shown that muscle carnosine loading is more pronounced in endurance-trained vs. untrained muscles. We observed a nearly doubling of muscle carnosine content in just 23 days in specifically trained muscles (calf muscle of cyclists and arm muscle of swimmers), which is markedly faster than ever observed (Derave et al, 2010). It remains to be determined whether differences in loading efficiency are due to the acute effects of muscle contractile activity on BA uptake and/or carnosine synthesis, or to the beneficial structural and metabolic properties of muscle induced by prior training. References Derave W, Everaert I, Beekman S, Baguet A. (2010). *Sports Med*, 40(3): 247 – 263. Kendrick I, Kim H, Harris R, Kim C, Dang V, Lam T, Bui T, Wise J (2009). *Eur J Appl Physiol*, 106:131-138.

#### REGULATION OF PGC-1 $\alpha$ AND FNDC5 EXPRESSION IN HUMAN SKELETAL MUSCLE: INFLUENCE OF EXERCISE VOLUME AND PROTEIN CONTENT OF THE DIET

Ponce-Gonzalez, J.G.1, Losa-Reyna, J.1, De La Calle-Herrero, J.1, Perez-Suarez, I.1, Santana, A.1, Holmberg, H.C.2, Calbet, J.A.L.1

*1. UNIVERSITY OF LAS PALMAS DE GRAN CANARIA. 2. SWSRC, Mid Sweden Univ, Sweden*

PGC-1 $\alpha$  overexpression in mouse skeletal muscle induces FNDC5, a membrane protein that is cleaved and secreted as irisin. Irisin causes browning of subcutaneous fat, increases basal VO<sub>2</sub>, reduces body weight and increases insulin sensitivity (Boström et al. 2012). In humans, it has been reported that FNDC5 is induced by exercise in skeletal muscle (Boström et al. 2012) and reduced with weight loss after bariatric surgery (Huh et al. 2012). The molecular and endocrine mechanisms that control muscle FNDC5 expression in humans remain unknown. Aim: To determine the role played by PGC-1 $\alpha$  in human skeletal muscle FNDC5 expression and to determine whether exercise and the protein content of the diet blunt the expected reduction in FNDC5 expression induced by weight loss. Methods: PGC-1 $\alpha$  and FNDC5 mRNA, and the protein levels of AMPK $\alpha$  (total and phosphorylated), PGC-1 $\alpha$  and SIRT3 (under PGC-1 $\alpha$  control) were determined in skeletal muscle by Real Time PCR (with two housekeeping genes) and Western blot, before (PRE), after four days of prolonged exercise with caloric restriction (PE+CR), and three days later under control diet (isenergetic with PRE) with reduced exercise (CD), in 15 overweight men. Muscle biopsies were obtained from both deltoid and one vastus lateralis muscles (135 biopsies in total). During PE+CR, subjects performed 45 min of one-arm cranking (at 15% of their maximal intensity) followed by 8 h walking each day, and only ingested 0.8 g per kg of body weight per day of either whey protein (n=8) or sucrose (n=7). Results: Compared to PRE, the whole-body fat mass and lean mass were reduced by 2.9 and 1.1 kg after PE+CR (P<0.05) while basal metabolic rate remained at the same level. AMPK $\alpha$  phosphorylation was increased by 26 and 54%, after PE+CR and CD, respectively in all muscles (P<0.05). PGC-1 $\alpha$  protein expression was reduced by 17% and mRNA by 26% (PRE vs CD, P<0.05). There was a good correlation between the mean values of PGC-1 $\alpha$  protein and mRNA expression levels (r=0.75, P<0.05, n=8). Compared to PRE, FNDC5 mRNA expression was decreased by 41 and 44% (after PE+CR and CD, respectively, P<0.05). Exercise, prevented the reduction of PGC-1 $\alpha$  and FNDC5 mRNA in the legs but not the arms. Similar changes were observed in SIRT3 protein expression which was related to PGC-1 $\alpha$  protein (r=0.94, P<0.001, n=8). FNDC5 mRNA paralleled PGC-1 $\alpha$  mRNA (r=0.90, P<0.001, n=8) and protein expression (r=0.92, P<0.001, n=8). The type of supplement ingested had no influence on PGC-1 $\alpha$  and FNDC5 mRNA changes. Conclusion: FNDC5 expression in human skeletal muscle appears to be under tight control by PGC-1 $\alpha$ . A negative energy balance causes an overall reduction of FNDC5 expression in the musculature which is attenuated by prolonged (several hours) but not short (45 min) low intensity exercise. Basal metabolic rate does not appear to be under control by muscular FNDC5 expression in humans. Granted by MEC (DEP2010-21866).

**FACTORS INFLUENCING SERUM CAFFEINE CONCENTRATIONS FOLLOWING CAFFEINE INGESTION**

Skinner, T., Jenkins, D., Leveritt, M., McGorm, A., Bolam, K., Coombes, J., Taaffe, D.

*The University of Queensland (Brisbane, Australia)*

**Introduction** The majority of studies investigating the potential for caffeine to improve exercise performance have used a dose of 3-6 mg/kg caffeine administered 1 h pre-exercise based on the assumption that peak circulating levels are achieved 1 h following ingestion, and that peak levels will provide the greatest ergogenic benefit. However, between-individual variations in caffeine concentrations following ingestion have been reported to be ~79% (Balogh et al., 1992). Therefore, the aim of this study was to determine whether differences in training status, body composition and/or usual caffeine intake influenced serum caffeine concentrations following caffeine ingestion.

**Methods** Trained cyclists and triathletes (n=14) and active (n=14) males aged 18-40 years (a) consumed a high carbohydrate meal the night before testing; (b) fasted overnight ( $\geq 12$  h); (c) refrained from caffeine consumption (including substances that potentially affect the metabolism of caffeine) and alcohol for 48 h; and (d) maintained a hydrated state. On arrival at the laboratory participants ingested a high carbohydrate meal (2.0 g/kg carbohydrates, 42.4 $\pm$ 0.6 kJ/kg) prior to consuming 6 mg/kg anhydrous caffeine. Peak, total and time to peak serum caffeine concentrations were determined from venous blood samples at baseline and 6 time-points over 4 h following intake. Body composition was assessed by dual energy x-ray absorptiometry and usual caffeine intake by a questionnaire. Results Peak serum caffeine concentrations (36 $\pm$ 7  $\mu$ mol/L) occurred 135 $\pm$ 36 minutes following ingestion. Trained cyclists/triathletes had similar (p>0.05) body composition but significantly lower (p=0.028) peak serum caffeine concentrations compared to active individuals (trained cyclists/triathletes=32 $\pm$ 5  $\mu$ mol/L, active=38 $\pm$ 8  $\mu$ mol/L). Percent body fat was significantly associated with area under the serum caffeine concentration curve (r=0.414, p=0.036) but not peak (r=0.345, p=0.085) or time to peak serum caffeine concentration (rho=0.147, p=0.474). When all participants were divided into tertiles according to daily caffeine intake there were no significant differences in peak (p=0.618), time-to-peak (p=0.225) or total serum caffeine concentrations (p=0.444).

**Discussion** Three findings from the study were evident: 1) highly trained endurance athletes exhibit lower peak caffeine concentrations than active males following caffeine ingestion; 2) higher % body fat was associated with higher concentrations of caffeine in the blood for 4 h following caffeine ingestion, and 3) the amount of caffeine consumed in a typical week does not appear to influence the concentration of caffeine in the blood following ingestion. Identification of the optimal conditions to ensure peak availability of caffeine within the blood and/or overcoming some of the variation in how individuals respond to caffeine requires consideration of the training status and body composition of the athlete.

**References** Balogh A, Harder S, Vollandt R, Staib AH. (1992). *Int J Clin Pharmacol*, 30(10), 383-387.

**MUSCLE CARNOSINE LOADING DOES NOT ENHANCE ENDURANCE CYCLING PERFORMANCE**

Chung, W.I, Baguet, A.I, Derave, W.I

*Ghent University*

**Introduction** To date, many studies show increased muscle carnosine concentrations and improved exercise performance with beta-alanine supplementation [1]. Most of these studies utilise short duration, high-intensity exercise protocols (< 20 minutes) as muscle carnosine is most commonly regarded as a pH buffer. However, improved muscle contractile function associated with increased muscle carnosine concentrations may also enhance endurance performance [2]. Therefore, we investigated the effect of beta-alanine supplementation on 1-h cycling time trial performance.

**Methods** Well-trained male cyclists (Age = 30.9  $\pm$  7.7 yr, VO<sub>2</sub>peak = 60.7  $\pm$  7.7 ml.min<sup>-1</sup>.kg<sup>-1</sup>; mean  $\pm$  SD) were supplemented with 6.4 g.day<sup>-1</sup> of either slow-release beta-alanine (BA; n=14) or placebo (PLA; n = 13) for six weeks. Muscle carnosine concentration (measured via proton magnetic resonance spectroscopy) in soleus and gastrocnemius, 1-h cycling time trial performance and physiological data during exercise were compared between baseline and post-supplementation. Results Muscle carnosine content was increased in both soleus (161%) and gastrocnemius (142%) after beta-alanine supplementation. No ergogenic effect of BA was found (p = 0.621), with both groups performing worse post-supplementation. BA was 1.9 seconds slower (p = 0.069), while PLA was 2.4 seconds slower (p < 0.01) in 1-h time trial performance following supplementation. No significant differences, induced from exercise, were found in blood bicarbonate and lactate, heart rate and RPE values.

**Discussion** Despite the largest ever reported increases in muscle carnosine concentrations, no ergogenic effect of beta-alanine supplementation was demonstrated on endurance cycling performance in well-trained male cyclists. Currently, the ergogenic benefit of beta-alanine supplementation seems to be limited to short duration, high-intensity exercise performance, which is likely related to the role of carnosine in pH homeostasis.

**References** 1. Hobson, R., et al., Effects of  $\beta$ -alanine supplementation on exercise performance: a meta-analysis. *Amino Acids*, 2012. 43(1): p. 25-37. 2. Dutka, T.L., et al., Effects of carnosine on contractile apparatus Ca<sub>2</sub>(+) sensitivity and sarcoplasmic reticulum Ca<sub>2</sub>(+) release in human skeletal muscle fibers. *J Appl Physiol*, 2012. 112(5): p. 728-36.

**KAYAK ROWING PERFORMANCE AND MUSCLE FUNCTION IS UNAFFECTED BY BETA-ALANINE SUPPLEMENTATION IN ELITE KAYAKERS**

Bech, S., Richter, E., Kiens, B., Nordsborg, N.

*University of Copenhagen*

**INTRODUCTION:** Beta-alanine supplementation may improve performance in untrained and moderately trained athletes (Smith et al. 2011), but only few studies have investigated elite level athletes Baguet et al. 2010). (The purpose of this study was to investigate the hypothesis that beta-alanine supplementation would improve 4-5 min intense exercise performance, repeated sprint ability and the ability to maintain a high muscular force generation.

**METHODS:** 10 males and 6 female national elite kayakers (age = 19.1 $\pm$  0.7 yr, height = 1.80 $\pm$  2.9 m, body mass = 76.0 $\pm$  3.5 kg, VO<sub>2</sub>max=4.1 $\pm$ 0.3) were randomly assigned in a double blinded manner to either placebo (PL) or a  $\beta$ -alanine (BA) treatment (6.4 g/day for 8 weeks). Participants performed a 1000 m test on day 1 and a 5x250m interspersed by 3 minutes rest on day 2. Before and after the 1000m test three 5 seconds maximal voluntary contractions (MVC) were completed and this were also done before and after the 5x250 and one 5 second MVC between each 250m. After 10 minutes of rest, a 2 minute MVC was performed followed by a time to exhaustion (TTE) at 40% of MVCpre. A muscle biopsy (Bergstrom needle modified with suction) was obtained from biceps brachii. Data were analyzed using repeated-measures ANOVA and the level of significance was set at P<0.05.

**RESULTS:** The 1000m performance was similar at baseline (BA: 255.0 $\pm$ 7.7 s; PL: 259.3 $\pm$ 9.7 s) and after 8 weeks supplementation (BA: 252.8 $\pm$ 6.6 sec (p=0.34, compared to baseline); PL: 259.4 $\pm$ 9.5). Likewise 5x250m mean power was similar in all conditions. Two minutes MVC peak force and fatigue index were also similar before and after beta-alanine supplementation. In addition, TTE at 40% of maximal MVC was also similar between groups at baseline (BA: 86.0 $\pm$ 4.8 sec; PL: 108.0 $\pm$ 20.3 sec) and after supplementation (BA: 104.8 $\pm$ 21.4 s; PL: 115.? $\pm$ 16.9 sec).

**DISCUSSION:** Kayak performance and muscle function was similar before and after eight weeks of beta-alanine supple-

mentation in Danish national level elite kayak rowers. Due to the relative low number of subjects, the small changes seen in 1000m for the BA group (255.0±7.7 s at baseline and 252.8± 6.6 s after 8 weeks) and the TTE at 40% MVC (86.0±4.8 sec at baseline and 104.8±21.4 sec after 8 weeks) may reach statistical significance if more subjects are included. REFERENCES Smith A., Stout J, Kendall K, Fukuda D, Cramer T. (2011). Amino Acids, DOI 10.1007/s00726-011-1158-x Bauguet A, Bourgois J, Vanhee L., Achten E., Derave W (2010)

### **EFFECTS OF A CARBOHYDRATE AND CAFFEINE GEL ON INTERMITTENT ENDURANCE PERFORMANCE IN RECREATIONAL TRAINED MALES**

Cooper, R., Naclerio, F., Allgrove, A., Larumbe-Zabala, E.

*University of Greenwich*

Introduction Intermittent endurance performance has been shown to improve with the ingestion of carbohydrate and caffeine. However, when caffeine and carbohydrate are combined their additive effects seem to be less clear. We investigated the effects of ingesting carbohydrate gels with and without caffeine on a ~90-min, 4 blocks intermittent endurance test (IET), in recreationally athletes. Methods 12 males (age 23±3 years, height 179±6 cm, body mass 79±10 kg) ingested three different doses of gel containing respectively 25 g of carbohydrate with (CHOCAF) or without (CHO) 100 mg of caffeine or a non-caloric placebo (PL) 1 h pre, immediately prior to start, and before the third block (~43 min) of the IET. Each block involved eleven sets of three repetitions of 60 m performed at <60; 80 and 60% of maximal aerobic speed respectively and one 15 m sprint. Blood glucose, rates of perceived exertion (RPE) and fatigue index (FI=100 x (slowest 15 m time – fastest 15 m time)/fastest 15 m time) were analysed. Results Glucose showed significant higher values (p<0.05) at block 2 and 3 for both CHOCAF and CHO while only for CHOCAF respect to PL at block 4. Additionally CHOCAF showed a better significant FI score (5.0±1.7) compared with CHO (7.6±2.6; p=0.006) and PL (7.4±2.4; p=0.005), a lower RPE (14.2±2) compared to PL (15.3±2; p=0.003) and a trend in respect to CHO (14.9±2.3; p=0.056) only after the 3rd block. No other significant interaction effects were observed. Discussion In conclusion, ingesting a gel containing 25 g carbohydrate with 100 mg caffeine 1 h before, prior and during an IET is effective to temporarily reduce fatigue and RPE while maintaining higher glucose levels at the final stages of an intermittent high intensity exercise. References Jeukendrup AE, (2004) Nutrition, 20, 669-77. Rowlands DS, Thorburn MS Thorp R. Broadbent MS, Shi X, (2008) J Appl Physiol, 104, 1709-19. Conger SA, Warren GL, Hardy MA, Millard-Stafford ML, (2011) Int J Sport Nutr Exerc Metab, 21, 71-84.

**15:00 - 16:30**

## **Invited symposia**

### **IS-PM13 Exercise and Training in COPD Patients \***

#### **GAS EXCHANGE DURING EXERCISE IN PATIENTS WITH COPD**

Barbera, J.A.

*Hospital Clinic, University of Barcelona*

Changes in arterial oxygen tension (PaO<sub>2</sub>) during exercise are highly variable in COPD. Assessments of ventilation-perfusion (VA/Q) relationships have shown that VA/Q distributions usually improve or remain unaltered during exercise, they do not worsen. Distributions of both ventilation and blood flow are more homogeneous on exertion than at rest. Nevertheless, some COPD patients, particularly those with more advanced disease, present a significant fall in PaO<sub>2</sub> during exercise. Such a decrease in PaO<sub>2</sub> has a multifactorial origin, although the most important is the ability to increase ventilation. Due to the ventilatory impairment, COPD patients have limited ability to increase ventilation during exercise that might be insufficient to offset increased CO<sub>2</sub> production leading to hypercapnia. Furthermore, limited ability to increase ventilation impedes the physiological shifting of the perfusion distribution towards alveolar units with higher VA/Q ratios, an effect that compensates for the impact of the fall in PvO<sub>2</sub>, which normally occurs during exercise, on end-capillary PO<sub>2</sub>. In turn, the value of PvO<sub>2</sub> is determined by the ability to adequately increase the cardiac output to attend metabolic demands. Therefore, any concomitant cardiovascular disease will further reduce exercise PvO<sub>2</sub>, the effect of which is further amplified by the underlying VA/Q inequality. In COPD, there is no significant limitation in the diffusion of oxygen from the alveoli to the capillary blood during exercise. In summary, the variable effect of exercise on PaO<sub>2</sub> in COPD is determined by the complex interaction between intrapulmonary VA/Q relationships and the ventilatory and cardiovascular responses.

**15:00 - 16:30**

## **Oral presentations**

### **OP-PM25 Physiology [PH] 2**

#### **OXYGEN AVAILABILITY IN THE BLOOD OF FOOTBALL PLAYERS DURING 12 DAYS OF ACCLIMATISATION TO 3600M**

Wachsmuth, N.B., Schmidt, W., Kley, M., Spielvogel, H., Aughey, R., Gore, C., Buchheit, M., Bourdon, P., Soria, R., Jimenes, J., Garvican, L.A.

*University of Bayreuth*

Introduction: Playing international football games at La Paz (3600m) is still under debate and many teams opt for a "fly in, fly out" strategy to use the 'physiological window' within the first hours at altitude, where performance is assumed to be less compromised. The key factor limiting performance at altitude is the reduced oxygen availability due to decreased arterial PO<sub>2</sub> (PaO<sub>2</sub>) and lower arterial oxygen content (CaO<sub>2</sub>). The aim of this study was to monitor the time course of changes in PaO<sub>2</sub> and CaO<sub>2</sub> and the corresponding haematological

adaptive responses in soccer players during 12 days of altitude acclimatisation. Methods: 39 football players of 2 teams, the Australian U16 National team (A: n=20, 16.0 ±0.4 years, sea level residents) and a Bolivian junior team native to La Paz (B: n=19, 18.1 ±1.0 years, participated in the study. Both groups stayed for 6 days at Santa Cruz (430m) followed by an altitude exposure (A=12 days) to La Paz (3600m). Haemoglobin mass (Hbmass), blood volume (BV), haemoglobin concentration (Hb), Hb-oxygen saturation (SO<sub>2</sub>), CaO<sub>2</sub>, and the acid base status were measured at sea level, 2h after arriving at 3600m (except Hb-mass) and up to 12 days (A) or 16 days (B) at altitude. Results: Hbmass (A:11.6 ±0.7g/kg, B:12.8 ±0.8g/kg) was significantly lower (p≤0.001) in A and slightly increased by 2.7 ±3.1%; p≤0.01 until day 12. It did not change in B, neither after descent to sea level nor at day 16 after return to altitude. Compared to sea level, BV decreased in both teams at altitude (A:-7.8 ±7.6% after 12 days, B:-4.6 ±3.6% after 16 days; p≤0.001). SO<sub>2</sub> was markedly reduced 2h after arrival at altitude (A:84.6 ±3.0% B:87.6 ±2.3%; p≤0.001) and increased the following days (A:90.4 ±1.7%, B:91.0 ±1.5%; p≤0.001). CaO<sub>2</sub> was clearly reduced directly after ascent (A:-2.3 ±0.7 ml/100ml; B:-2.1 ±0.8 ml/100ml; p≤0.001). In A, it was overcompensated at day 12 (+1.7 ±1.2 ml/100ml; p≤0.001) while in B baseline values were achieved at day 16. PaO<sub>2</sub> dropped to 43.9 ±2.6 mmHg in A and 48.2 ±3.4 mmHg in B immediately after arrival at altitude and increased to 56.1 ±2.2 mmHg (A) after 12 days and 60.0 ±2.6 mmHg (B) after 16 days (both p≤0.001), respectively. Conclusion: In A and in B oxygen availability (CaO<sub>2</sub> and PaO<sub>2</sub>) was lowest immediately after arrival at altitude. A physiological window allowing best performance at altitude at this time seems to be unlikely. The overcompensation of CaO<sub>2</sub> and the increase in PaO<sub>2</sub> until day 12 suggest a longer acclimatization process to be more beneficial than the "fly in, fly out" strategy. However, 12 days of acclimatisation are not sufficient to achieve the adaptive status of football players native to altitude.

### ARE RESTRICTIONS IN BLOOD FLOW AND OXYGEN SUPPLY TO THE HUMAN BRAIN A MECHANISM BY WHICH DEHYDRATION IMPAIRS MAXIMAL EXERCISE CAPACITY?

Trangmar, S.J.1, Chiesa, S.T.1, Stock, C.G.1, Kalsi, K.K.1, Secher, N.H.1,2, González-Alonso, J.1

BRUNEL UNIVERSITY

Introduction: During maximal exercise, a reduction in blood flow to the human brain may contribute to the development of fatigue by lowering O<sub>2</sub> supply and diminishing cerebral O<sub>2</sub> availability (1,3). It is presently unknown if dehydration exacerbates the influence of circulatory strain upon the human brain sufficiently to compromise cerebral VO<sub>2</sub>. We tested the hypothesis that dehydration accelerates the reductions in cerebral blood flow during incremental exercise, but without impairing brain VO<sub>2</sub>. Methods: Ten cyclists (VO<sub>2</sub> peak 59 ± 2 mL/kg/min) performed 3 incremental cycle ergometer exercise tests in a warm environment (35°C) in the following conditions: 1) euhydrated (control; maximal work rate (WR<sub>max</sub>) 336 ± 14 W), 2) dehydrated after 2 hours of sub-maximal cycling without fluid ingestion (DEH; 3.1 ± 0.3 % body mass loss; 222 ± 10 W), and 3) rehydrated after 1 h passive recovery with full fluid replacement (REH; 294 ± 15 W). Cerebral blood flow and velocity were assessed in the internal carotid artery (CBF) and middle cerebral artery (MCAv). Blood samples were obtained from the brachial artery and left internal jugular vein to measure a-vO<sub>2</sub> differences and for the calculation of VO<sub>2</sub>. Results: During control, CBF and MCAv increased from rest to 40% WR<sub>max</sub> (17 ± 2%; P<0.01) and declined gradually thereafter to baseline values. During DEH, CBF and MCAv declined earlier and were 12-23% lower than at the same workload in control; however, the a-v O<sub>2</sub> diff and O<sub>2</sub> extraction were higher (P<0.05), resulting in a similar brain VO<sub>2</sub> between conditions. The flow and oxygenation responses during REH were similar to control. In all trials, the declines in CBF and MCAv and vascular conductance during intense and maximal exercise were strongly correlated to reductions in PaCO<sub>2</sub> (r<sub>2</sub> ≥0.74, P≤0.01). This suggests PaCO<sub>2</sub> has a role in the observed cerebral vasoconstriction (2,4). Discussion: The present findings demonstrate that dehydration accelerates the decline in blood flow and O<sub>2</sub> supply to the human brain during incremental cycling exercise to the limit of tolerance. However, VO<sub>2</sub> was not compromised because of compensatory increases in cerebral O<sub>2</sub> extraction. A compromised brain VO<sub>2</sub> is therefore an unlikely mechanism underpinning the impaired exercise capacity in dehydrated individuals. However, it remains possible that dehydration impairs maximal exercise capacity independently of disturbances in aerobic metabolism. Supported by the Gatorade Sports Science Institute, PepsiCo, USA. References: 1. González-Alonso et al. (2004). *J Physiol* 557, 331-342. 2. Willie et al. (2012). *J Physiol* 590, 3261-3275. 3. Nybo et al. (2001). *J Physiol* 534, 279-286. 4. Sato et al. (2011). *J Physiol* 589, 2847-2856.

### ALTITUDEOMICS: PROLONGED EXPOSURE TO HIGH ALTITUDE AFFECTS THE SEVERITY OF SUPRASPINAL FATIGUE AND CORTICOSPINAL EXCITABILITY

Twomey, R.1, Goodall, S.2, Amann, M.3, Ross, E.Z.1, Deckerle, J.1, Lovering, A.4, Romer, L.M.5, Subudhi, A.6, Roach, R.6

1U-Brighton (UK), 2U-Northumbria (UK), 3U-Utah, 4U-Oregon, 5U-Brunel, (UK), 6U-Colorado

Introduction Severe, acute hypoxia leads to an increased development of supraspinal fatigue during whole body exercise. However, corticomotor responses to fatiguing exercise in prolonged hypoxia are not well understood. Cerebrovascular adaptations during acclimatisation may attenuate the severity of the acute response. We assessed cortical excitability and fatigue following cycling exercise after acute and chronic exposure to hypoxia. Methods Seven recreationally-active participants performed an identical bout of constant-load cycling (131±39 W, 10.1±1.4 min) on 3 separate occasions: 1) to exhaustion in acute normobaric hypoxia (AH; PIO<sub>2</sub>, 73.8±0.2 mmHg), 2) sea-level (SL; PIO<sub>2</sub>, 147.1±0.5 mmHg), and 3) after 14 d in chronic hypoxia (Mt. Chacaltaya, Bolivia) (CH; 5,260 m, PIO<sub>2</sub>, 75.7±0.1 mmHg). Arterial haemoglobin saturation (SaO<sub>2</sub>), cerebral oxygenation and blood velocity in the left middle cerebral artery (MCAv) were measured throughout exercise. Before and immediately after each trial, responses to transcranial magnetic stimulation and supramaximal electrical femoral nerve stimulation were obtained to assess corticospinal and neuromuscular function, respectively. Results For the knee extensors, maximum voluntary force and potentiated twitch force decreased after exercise in AH and CH, but not at SL (P<0.05). Cortical voluntary activation did not differ between conditions pre-exercise (94±7%, P=0.31), but was significantly reduced post-exercise in AH (-11%, P=0.01), though not at SL (-4%, P=0.30) or in CH (-6%, P = 0.17). Corticospinal excitability (resting motor evoked potential (MEP)) was twofold greater in CH compared to AH and SL (P<0.05). Post-exercise MEP amplitude was significantly reduced from pre-exercise baseline in CH but not in AH or at SL. In the final minute of exercise, SaO<sub>2</sub> was significantly lower (P<0.01) in AH (61±6%) than CH (82±5%) and SL (97±3%). The degree of cerebral deoxygenation during exercise in AH was greater than observed in SL and CH (P<0.05). Discussion Exercise-induced supraspinal fatigue, as quantified via changes in cortical voluntary activation, was alleviated after a period of acclimatisation to high altitude in comparison to exacerbated levels in acute hypoxia. This may be related to 1) an increased corticospinal excitability and 2) greater cerebral oxygenation, mediated by an improved cerebrovascular response to exercise, following prolonged exposure to high altitude. These novel data suggest that improvements in exercise performance after acclimatisation to hypoxia might, in part, be explained by an attenuated development of central fatigue.

### MUSCLE ISCHEMIC PRECONDITIONING REDUCES FEEDBACK FROM GROUP III AND IV MUSCLE AFFERENTS

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1) The Department of Medical Sciences, Sports Physiology Laboratory, University of Cagliari (Italy); 2) School of Sport and Exercise Sciences, University of Kent, Chatham Maritime, (UK); 3) Departmen

**INTRODUCTION** The primary aim of this study was to test the hypothesis that muscle ischemic preconditioning (MIP) reduces feedback from group III and IV muscle afferents measured indirectly by muscle metaboreflex. The second aim was to investigate whether the hypothesized reduction in afferent feedback (Crisafulli et al, 2011) causes a reduction of rating of perceived exertion (RPE) as predicted by the afferent feedback model of PE (Marcora, 2009) **MATERIAL AND METHODS** Nine healthy subjects visited the laboratory three times in a single-blind, randomized and counterbalanced experimental design. In a preliminary day they underwent a one leg incremental test up to exhaustion to detect Wmax then an experimental (EXP) and control (SHAM) session in separated days. To test muscle afferent activity, two post-exercise muscle ischemia (PEMI) were executed. PEMI involved: 3 min of baseline, 3 min of exercise at 70% of Wmax, 3 min of thigh occlusion followed by 3 min of recovery. MIP treatment during EXP or SHAM was executed between the two PEMI sessions. MIP involved 3 cycles of occlusion of 5 min at 220 mmHg separated by 5 min of reperfusion. During the SHAM session, occlusion was 20 mmHg. Cardiac output (CO), mean arterial pressure (MAP) and RPE during exercise were monitored during both PEMI sessions. **RESULTS** CO and MAP responses were significantly reduced after MIP (CO =  $6.92 \pm 1.81$  vs  $5.79 \pm 1.39$  l•min<sup>-1</sup> and MAP=  $109.25 \pm 9.85$  vs  $103.70 \pm 10.43$  mmHg). RPE was not affected by MIP ( $15.67 \pm 1.87$  vs  $15.56 \pm 2.07$ ). None of the parameters reported any statistical changes in the SHAM condition. **DISCUSSION** This study shows for the first time that MIP reduces feedback from group III and IV muscle afferents as indicated by a significant reduction in muscle metabo-reflex. Despite this reduced afferent feedback, RPE was unchanged. This finding provides further experimental evidence that feedback from III and IV muscle afferents is not a sensory signal for PE. **REFERENCES** Crisafulli A. et al J Appl Physiol. 2011 Aug;111(2):530-6. Marcora S. J Appl Physiol. 2009 Jun;106(6):2060-2.

### THE INFLUENCE OF BODY WEIGHT ON THE PULMONARY OXYGEN UPTAKE KINETICS IN PRE-PUBERTAL CHILDREN DURING TREADMILL EXERCISE

McNarry, M., Faulkner, J., Westrupp, N., Lambrick, D.

Swansea University

**Introduction** The prevalence of childhood obesity has increased at an alarming rate and is currently considered one of the most serious public health challenges of the 21st century (WHO, 2013). Whilst strategies to curtail and reverse this trend are acknowledged as being required, our understanding of the influence of obesity on exercise performance, and its mechanistic basis, is limited. Specifically, excess fat may exert a unique effect on performance; obese individuals exhibit a considerable functional limitation in motor activity yet their skeletal muscles are exposed to an inherent chronic strength training stimuli due to the excess weight (Salvadeo et al. 2010). The purpose of this study was therefore to assess the influence of obesity on the oxygen uptake (VO<sub>2</sub>) kinetics of pre-pubertal children during exercise. We hypothesised that obese (OB) children would demonstrate significantly slower VO<sub>2</sub> kinetics than their normal weight (NW) counterparts during moderate and heavy intensity exercise. **Methods** 18 OB ( $9.8 \pm 0.5$  y;  $24.1 \pm 2.0$  kg•m<sup>2</sup>) and 19 NW ( $9.7 \pm 0.5$  y;  $17.6 \pm 1.0$  kg•m<sup>2</sup>) children completed a graded-exercise test to volitional exhaustion and two constant work rate treadmill tests at both moderate (90% gas exchange threshold) and heavy ( $\Delta 40\%$ ) exercise intensities. Pulmonary gas exchange variables were measured throughout. Parameters describing the dynamic O<sub>2</sub> response were derived using a mono-exponential model with a time delay, constrained to exclude the visually identified slow component during heavy exercise. **Results** During moderate exercise, the phase II  $\tau$  (OB:  $30 \pm 13$  cf. NW:  $22 \pm 7$  s), mean response time (OB:  $35 \pm 16$  cf. NW:  $25 \pm 10$  s), phase II gain (OB:  $156 \pm 21$  cf. NW:  $111 \pm 18$  mL O<sub>2</sub>•min<sup>-1</sup>•km<sup>-1</sup>) and oxygen deficit (OB:  $0.36 \pm 0.11$  cf. NW:  $0.20 \pm 0.06$  L) were significantly lower in the NW children (all  $P < 0.05$ ). During heavy intensity exercise, the  $\tau$  (OB:  $33 \pm 9$  cf. NW:  $27 \pm 6$  s;  $P < 0.05$ ) and phase II gain (OB:  $212 \pm 61$  cf. NW:  $163 \pm 23$  mL O<sub>2</sub>•min<sup>-1</sup>•km<sup>-1</sup>;  $P < 0.05$ ) were similarly lower in NW children. A slow component was observed in all participants during heavy intensity exercise but was not influenced by weight status. **Conclusion** This study demonstrates that weight status significantly influences the dynamic VO<sub>2</sub> response at the onset of treadmill exercise in pre-pubertal children and highlights that the deleterious effects of being obese are already manifest pre-puberty. 1. Salvadeo D, Lazzer S, Busti C, Galli R, Agosti F, Lafortuna C, Sartorio A, and Grassi B. (2010) Am J Physiol - Reg, Integ Comp Physiol ,299, R1298-R1305. 2. WHO. (2013) Global Strategy on Diet, Physical Activity and Health.

### EXERCISE TRAINING PREVENTS RIGHT VENTRICULAR DYSFUNCTION AND MALADAPTIVE REMODELING IN EXPERIMENTAL PULMONARY ARTERIAL HYPERTENSION

Moreira-Gonçalves, D.1,2, Fonseca, H.2, Ferreira, R.3, Padrão, A.1,3, Vasques-Nóvoa, F.1, Gonçalves, N.1, Vieira, S.2, Moreno, N.1, Silva, A.F.1, Ferreira-Pinto, M.1, Schmidt, C.2, Bovolini, A.2

1 FMUP (Porto, Portugal); 2 CIAFEL (Porto, Portugal); 3 QOPNA (Aveiro, Portugal)

**Introduction:** Right ventricular failure (RVF) is the most common cause of death in patients with pulmonary arterial hypertension (PAH) (Bogaard et al., 2009). Growing evidences suggest that targeting RVF may be of benefit (Drake et al., 2011). Exercise training (ExT) is cardioprotective in left ventricular failure but its impact on RVF remains unknown. We investigated the effects of ExT on right ventricular response of rats submitted to monocrotaline (MCT)-induced PAH at several time points. **Methods:** Male Wistar rats were randomly divided in the following groups: i) sedentary injected with MCT (60 mg/kg, sc) or vehicle (SED+MCT and SED+Control), ii) 4 weeks-exercise training before MCT or vehicle injection (EXbefore+MCT and EXbefore+Control), iii) 4 weeks-exercise training after MCT or vehicle injection (EXafter+MCT and EXafter+Control) and iv) 2 weeks-exercise training after 2 weeks of MCT or vehicle injection (EXtreat+MCT and EXtreat+Control). After ending their respective protocols, animals were submitted to an exercise tolerance test and to RV echocardiographic (ECO) and hemodynamic evaluation. Samples from right ventricle and lungs were collected for histological, protein and RT-PCR analysis. **Results:** ExT improved exercise tolerance in all MCT-exercised groups. ECO revealed improved cardiac output in all MCT-exercised groups, but significantly only in EXbefore+MCT and EXafter+MCT. ExT protected against diastolic dysfunction and prevented RV maladaptive remodeling (normal SERCA2a protein levels, beta/alpha MHC isoform, ET-1 and VEGF mRNA). All MCT-exercised groups showed reduced cardiac fibrosis and inflammation. In contrast to SED+MCT, we found preserved activity and lower oxidative damage of the mitochondrial complex V. Survival rate was enhanced in all MCT-trained groups. **Discussion:** Our data suggest that ExT (performed at different time points of PAH-induced RV chronic pressure overload) averts cardiac dysfunction, modulates the main signaling pathways involved in RVF (Bogaard et al., 2009), and improves survival. These observations suggest that the exercise-induced benefits previously described in left ventricular failure (Conraads and Beckers, 2010) can be extended to RVF. **References** Bogaard HJ, Abe K, Vonk

Noordegraaf A, Voelkel NF. (2009). *Chest*, 135:794-804  
 Conraads VM, Beckers PJ. (2010). *Heart*, 96:2025-2031  
 Drake JI, Bogaard HJ, Mizuno S, Clifton B, Xie B, Gao Y, Dumur CI, Fawcett P, Voelkel NF, Natarajan R. (2011). *Am. J. Respir. Cell Mol. Biol.* 45:1239-47

15:00 - 16:30

## Oral presentations

### OP-PM26 Physiology [PH] 3

#### NEUROMUSCULAR ELECTRICAL STIMULATION ATTENUATES MUSCLE ATROPHY DURING LEG IMMOBILISATION

Dirks, M.L., Wall, B.T., Sniijders, T., Verdijk, L.B., Van Loon, L.J.C.

*Maastricht University Medical Centre + (MUMC+)*

**Introduction** Short periods of bed-rest or immobilisation, due to illness or injury, result in substantial skeletal muscle atrophy. Recently we have shown that a single session of neuromuscular electrical stimulation (NMES) increases muscle protein synthesis rates. We hypothesized that daily NMES can be used as an effective interventional strategy to prevent muscle atrophy during a short period of muscle disuse. **Methods** Twenty-four healthy young ( $22.9 \pm 0.7$  y) males participated in the present study. Volunteers were subjected to 5 days of one-legged knee immobilisation by means of a full leg cast with (NMES group;  $n=12$ ) or without (CON group;  $n=12$ ) supervised NMES sessions (40 min sessions performed twice daily). Two days prior to and immediately after the immobilisation period, single slice CT-scans of the quadriceps, DXA-scans, and single leg 1-Repetition Maximum (1RM) strength tests were performed to assess muscle cross-sectional area (CSA), leg lean mass, and leg muscle strength, respectively. Furthermore, muscle biopsies were taken to assess muscle fibre cross-sectional area (CSA), muscle fibre type specific satellite cell (SC) content, and mRNA and protein expression of selected genes. **Results** In the CON group, immobilisation reduced quadriceps CSA by  $3.5 \pm 0.5\%$  ( $P < 0.0001$ ), leg lean mass by  $0.8 \pm 0.6\%$  (representing  $147 \pm 72$  g lean tissue loss;  $P = 0.07$ ) and muscle strength by  $9.0 \pm 2.2\%$  ( $P < 0.05$ ). In contrast, no significant muscle loss was detected during immobilisation in the NMES group in terms of either quadriceps CSA ( $-0.8 \pm 0.4\%$ ;  $P = 0.07$ ) or leg lean mass ( $+1.9 \pm 0.7\%$ ;  $P < 0.05$ ). Changes in type I or II muscle fibre size or SC content were not detectable in either group. Muscle MAFBx and MuRF1 mRNA expression were increased following immobilisation in the CON group only ( $+48\%$ ;  $P < 0.001$ , and  $+56\%$ ;  $P < 0.05$ , respectively) whereas expression levels either declined ( $-34\%$ ;  $P < 0.01$ ) or did not change in the NMES group, respectively. Immobilisation led to an increase in myostatin mRNA expression in the CON group ( $+68\%$ ,  $P < 0.05$ ) but remained unchanged in the NMES group. No significant changes in myostatin protein content were observed. Myogenin and MyoD mRNA expression increased over time ( $P < 0.05$ ) but only reached significance in the NMES group ( $P < 0.05$ ), while myogenin protein content was elevated in the NMES group only ( $P < 0.05$ ). **Discussion** In conclusion, NMES represents an effective interventional strategy to attenuate muscle mass loss during a short period of muscle disuse. We speculate that this is attributed to a combination of a stimulation of muscle protein synthesis, suppressed muscle protein breakdown and an increased potential for SC differentiation.

#### VASTUS LATERALIS FASCICLE BEHAVIOUR DURING ECCENTRIC CYCLING IN RELATION TO MUSCLE DAMAGE

Peñailillo, L., Blazevich, A., Nosaka, K.

*Edith Cowan University*

**Introduction** Eccentric exercise induces muscle damage, but confers a protective effect on subsequent bouts of the same or similar exercise (1). The mechanisms underpinning this protective effect are unclear. It is possible that muscle-tendon behaviour during exercise is not the same between the initial and secondary eccentric exercise bouts. B-mode ultrasound technique has been used to assess muscle-tendon behaviour in vivo during exercise (2). The present study used the ultrasound technique to compare between the first and second eccentric (ECC) cycling bouts for vastus lateralis (VL) fascicle behaviour in relation to muscle damage. **Methods** Eleven untrained men ( $27.1 \pm 7.0$  y) performed two bouts of ECC cycling (ECC1, ECC2) for 10 min (60 rpm) at 65% of the maximal concentric cycling power output ( $190.8 \pm 44.2$  W) separated by 2 weeks. Maximal voluntary isometric contraction strength of the knee extensors (MVC) and visual analogue scale (VAS) for muscle soreness were assessed before and 1-2 days post-exercise. An ultrasound probe was attached to the middle portion of the VL to record muscle movements during ECC cycling. Surface electromyogram (EMG) was recorded from the VL, and cycling torque and knee joint angle were measured during exercise. Three revolutions at 1 and 10 min of cycling were averaged for the fascicle behaviour, and 10 revolutions were averaged for peak EMG amplitude (EMGpeak). Fascicle length (Lf) and angle ( $\theta_{fas}$ ) were determined using the trigonometric method, and muscle-tendon unit (MTU) length and tendinous tissue (TT) length were estimated (2). Changes in these variables were compared between ECC1 and ECC2 by two-way repeated measures ANOVAs and paired t-tests. **Results** Peak VAS was greater ( $P = 0.000$ ) after ECC1 ( $32.3 \pm 23.5$  mm) than ECC2 ( $8.0 \pm 9.0$  mm), but decreases in MVC (e.g. 8% at 1 day post-exercise) were not significantly different between bouts. Peak torque was consistent for 10 min, and was not different between bouts. EMGpeak did not change significantly over time and was not different between bouts. The magnitude of fascicle elongation during ECC2 was  $19.2 \pm 30.1$  mm smaller than that of ECC1 at 1 min ( $P = 0.03$ ), but this was not the case at 10 min.  $\theta_{fas}$  did not change significantly over time and was not different between bouts. MTU length changes were not different between bouts, but the Lf changes were 3.2% smaller ( $P = 0.036$ ), and TT changes were 6.1% greater ( $P = 0.07$ ) relative to the MTU length changes during ECC2 compared with ECC1 at 1 min. **Discussion** These results indicate that fascicles were lengthened less during ECC2 than ECC1, and elongation of TT tended to be greater during ECC2 than ECC1 for the same MTU length changes. It seems that less fascicle strain was imposed during ECC2 than ECC1, which could be related to the less muscle soreness after ECC2 and one of the mechanisms of the protective effect. **References** 1) McHugh (2003) *Scand J Med Sci Sports* 13:88-97 2) Finni et al. (2003) *Acta Physiol Scand* 177:483-91

## ARCHITECTURAL AND MORPHOLOGICAL ADAPTATIONS TO ECCENTRIC VS. CONCENTRIC CONTRACTIONS: POSSIBLE UNDERLYING MECHANICAL AND BIOCHEMICAL MECHANISMS

Franchi, M.V., Atherton, P.J., Reeves, N.D., Flück, M., Mitchell, W.K., Selby, A., Beltran-Valls, M.R., Narici, M.V.

*University of Nottingham*

**Introduction** We investigated the architectural, functional, and molecular responses of human skeletal muscle to concentric (CON) or eccentric (ECC) training protocols, performed on a leg-press machine. **Methods** 12 male volunteers were randomly assigned to two different groups performing either a CON or ECC training regime (3xwk for 10-wk, 4x8-10 repetitions at 80% of CON and ECC 1-RM). MR imaging was used to evaluate muscle volume and anatomical cross-sectional area was measured in the proximal, mid and distal portions of the VL. Ultrasound was used to determine muscle architecture (fascicle length, Lf; pennation angle, PA). An additional fourteen male subjects performed a single bout of CON or ECC exercise for determining acute molecular signalling responses (in biopsies taken from VL 30 min after a bout of CON or ECC). This post-exercise biopsy time-point was chosen to gauge 'remodelling pathways' (i.e. MAP Kinases), inflammation (TNF-signaling), anabolism (mTORC1) and catabolism (MuRF-1/MAFBx). The MAPKs were of particular interest since previous works suggested that molecular programs of ECC vs. CON signaling and growth are distinct [1, 2]. Immuno-blotting was used to assess phosphorylation/ abundance of signaling targets. Results Changes in muscle Vol (+8 CON vs. +6% ECC) and maximal voluntary contraction (MVC) (+9 CON vs. +11 % ECC) were similar in both groups. Lf increased significantly after ECC but not CON (+12 vs. +5%) and PA increased markedly after CON (+30 vs. +5%). Hypertrophy in the distal and mid part of the VL was different between the groups (CON +2 vs. ECC +8%; ECC +7 vs. CON +11%, respectively). **Discussion** In terms of whole-muscle hypertrophy, despite the ~1.2 fold greater training load of the ECC group, similar increases in VOL and MVC in were found after training. However, distinct architectural changes were found between the two loading regimes: increases in Lf were greater after ECC than CON while in contrast, PA increased more in CON vs. ECC. These adaptations (in accordance with [3]) reflected differences in fascicle behaviour in the two contraction modes, (i.e., lengthening in ECC vs. shortening CON). When examining regional hypertrophy, the changes in architecture induced by the two regimes induced preferential growth in the distal region of VL for ECC while for CON, VL growth occurred mainly at mid-belly. In terms of signaling, while MAPK activation (i.e., p38MAPK, ERK1/2, p90RSK) was exclusive to ECC, neither mode affected AKT-mTOR or inflammatory signaling. To conclude, hypertrophy in response to CON vs. ECC yields distinct architectural and regional adaptations, rather than in whole-muscle growth (despite the greater loading intensity of ECC protocol). These morphologic and architectural changes to ECC vs. CON were associated with discrete acute fascicle behaviour, which we speculate to underlie the preferential activation of MAPK signaling, and perhaps the ensuing distinct muscle adaptations. **References** 1- Kehat et al. *Circ Res*, 2011 2- Wretman et al. *J Physiol*, 2001 3- Reeves et al. *Exp Physiol*, 2009

## THERMOREGULATORY RESPONSES OF ATHLETES WITH A SPINAL CORD INJURY DURING INTERMITTENT WHEELCHAIR EXERCISE IN COOL CONDITIONS

Griggs, K., Leicht, C., Price, M., Goosey-Tolfrey, V.

*Loughborough University*

**Introduction:** Individuals with a spinal cord injury (SCI) have impaired thermoregulatory control, resulting in a loss or reduction in sweating capacity and an inability to make effective vasomotor adjustments. Individuals with high level cervical lesions (tetraplegia, TP) possess a greater impairment in thermoregulatory control than individuals with lower level lesions (paraplegia, PA). Although the thermoregulatory responses of athletes with SCI have been reported, no data has compared the responses of athletes with TP and PA during an intermittent sprint protocol (ISP). The purpose of this study was to investigate the thermoregulatory responses of athletes with TP and PA during intermittent wheelchair exercise and recovery. **Methods:** Eight wheelchair rugby players with TP (lesion level C4/5-C6/7, body mass  $65.2 \pm 4.4$  kg,  $VO_{2peak}$   $1.55 \pm 0.37$  L.min<sup>-1</sup>) and eight wheelchair basketball players with PA (lesion level T4-S1, body mass  $68.1 \pm 12.3$  kg,  $VO_{2peak}$   $1.92 \pm 0.47$  L.min<sup>-1</sup>) completed a 60 min ISP at maximal effort on a wheelchair ergometer, followed by 15 min of passive recovery in cool ambient conditions ( $20.6 \pm 0.1^{\circ}\text{C}$  and  $39.6 \pm 0.8\%$  relative humidity). Core temperature (T<sub>core</sub>, telemetry pill), mean (T<sub>sk</sub>) and individual skin temperatures were measured throughout. Heat storage (HS) was calculated every 15 mins. **Results:** Sprint speed ( $3.16 \pm 0.59$  m/s and  $3.51 \pm 0.44$  m/s for athletes with TP and PA, respectively) was similar between groups. There were larger increases in T<sub>core</sub> and T<sub>sk</sub> for athletes with TP compared to athletes with PA during exercise and recovery ( $p < 0.05$ ). Back, chest, lower arm and forehead skin temperatures all increased during recovery in athletes with TP compared to a decrease in athletes with PA ( $p < 0.05$ ). Heat storage was higher in athletes in TP ( $p < 0.05$ ), with end of recovery values of  $3.42 \pm 1.42$  J.g<sup>-1</sup> and  $-0.51 \pm 1.30$  J.g<sup>-1</sup> for athletes with TP and PA, respectively. **Discussion:** The results of this study show that athletes with TP experienced a greater increase in T<sub>core</sub> and T<sub>sk</sub> in comparison to athletes with PA. Although only exercising in cool conditions, this suggests athletes with TP have a greater inability to dissipate heat than athletes with PA during intermittent sprint exercise and recovery, possibly due to the greater loss of sweating capacity. This is also reflected by the gain in HS for athletes with TP and the net loss for athletes with PA by the end of the recovery period.

## THE ROLE OF THERMAL AND TOUCH SENSE IN THE PERCEPTION OF SKIN WETNESS AT REST AND DURING EXERCISE IN DIFFERENT ENVIRONMENTS

Filingeri, D.1, Redortier, B.2, Hodder, S.1, Havenith, G.1

1: *Loughborough University (Loughborough, UK)*, 2: *Oxylane Research, (Villeneuve d'Ascq, France)*

**Introduction** The type and amount of physical activity an individual performs is influenced by the level of comfort achievable with the surrounding environment (Vanos et al., 2012). Skin wetness has been shown to be a critical determinant of thermal and clothing comfort (Fukazawa et al., 2009). Clarifying the neurophysiological bases of wetness perception (WP) is critical to improve sporting garments' design and thus comfort. WP seems to result from the integration of temperature (cold) and mechanical (pressure) inputs. The aim of this study was to investigate the role of thermal and touch sense in the WP. **Methods** Six cold-dry stimuli [3 temperatures (4, 8, 15°C lower than local skin temperature) X 2 pressures (7 and 10 kPa)] were applied (10 sec) on the bare, upper and lower back of 11 (8F/3M) participants using a thermal probe (contact surface: 25cm<sup>2</sup>), during 5 experimental conditions: rest 22°C; rest 33°C; low intensity cycling (30W) 22°C; moderate intensity cycling (60W) 22°C; moderate intensity cycling 33°C. No information about the stimuli was given to participants. Mean and local skin temperature, thermal, wetness and pleasantness sensations (perceptual scales) were recorded. **Results** Different cold-dry stimuli produced significantly different ( $P < 0.05$ ) levels of local skin cooling (range: -0.7 to -4°C). Cold-dry stimuli were reported as wet at least once by 9 out of 11 participants. Stimuli applied with a mechanical pressure of 7 kPa, producing a skin cooling rate of 0.36°C/s, induced the most frequent (59.7% of times) cold-wet sensations. When applied with a pressure of 10 kPa, they were less often

(45.8% of times) perceived as cold-wet ( $P=0.09$ ). No effect of conditions was observed on WP. Same cold-dry stimuli produced displeasure during resting at 22°C and pleasure during exercise at 33°C. Discussion Cold sensations play a primary role in characterizing the WP. The touch sense interacts in the perception of cold-dryness/wetness, with greater pressures decreasing WP. Daanen (2009) proposes 0.05°C/s to 0.2°C/s as the cooling rate evoking WP when water evaporates from the skin. We observed a greater cooling rate (0.36°C/s) for WP resulting from contact with a cold-dry surface. Thus, sensory integration seems to vary according to the type of cooling (evaporative vs. direct contact). No effect of conditions was observed, suggesting the level of skin cooling and mechanical pressure as critical determinants of WP. References Daanen, H. (2009). EP Patent 2,110,108 - [http://www.tno.nl/content.cfm?context=kennis&content=IP\\_patent&laag1=35&item\\_id=35&taal=2](http://www.tno.nl/content.cfm?context=kennis&content=IP_patent&laag1=35&item_id=35&taal=2) Fukazawa, T., Havenith, G. (2009). Eur J Appl Phys, 106(1), 15-24 Vanos, J., Warland, J., Gillespie, T., & Kenny, N. (2012). Int J Biometeorol, 56(1), 21-32

## 15:00 - 16:30

### Invited symposia

#### IS-BN05 Specificity in strength training in elite sport \*

##### SPECIFICITY IN STRENGTH TRAINING NEEDS TO FOLLOW THE PRINCIPLE OF COORDINATIVE AFFINITY

Müller, E.

*University of Salzburg*

In elite sports the quality of conditioning training can be improved, above all, by using special technique-specific exercises. Numerous studies prove that the training of general conditioning leads to considerable improvements of particular physical parameters. However, training of this kind hardly succeeds in increasing competitive capacity. On the other hand, it could be shown in many cases that the use of technique-specific means of training - parallel to general conditioning training - leads to considerable improvements of performance also among athletes with many years of training experience (Manolopoulos et al., 2006; Manuel et al., 2010; C. Hrysomallis 2012; Mueller et al. 2000). Consequently, it is important to direct one's attention to the development of highly specific means of training. This applies chiefly to so-called seasonal sports such as alpine ski racing. For the development of specific training exercises the principle of kinematic and kinetic correspondence has to be taken into consideration. This principle states that the special exercises must be in harmony with those parameters of movement which characterise the structure of competition technique. A coordinative affinity between training and competition exercises has the advantage that it results in favourable training stimuli in the musculature relevant to the specific movement. It has the further advantage that the specific neuronal mechanisms are developed, which improve the strength usability in concrete execution of movement, as defined by the technique-specific muscle innervation schema. Sport biomechanics deals with the development of sport specific training devices and exercises. The necessity of using highly specific means of training mainly applies to what are called seasonal sports such as alpine ski racing. Ski racing is one of those sports which makes high demands on technical and physical abilities. This is made even more difficult by the fact that technique-specific training can only be performed on snow which is difficult to execute during the summer season. Therefore the use of exercises which imitate the racing technique on snow is very important during the preparation period in summer. In various studies we were able to develop training devices which make the performance of skiing specific exercises possible. Using biomechanical methods we were able to prove that these exercises come very close to the kinetic and kinematic structure of the racing techniques on snow.

##### DANGEROUS LIAISONS OF STRENGTH AND ENDURANCE TRAINING. CAN BE MINIMIZED?

Izquierdo, M.

*Public University of Navarra*

Different studies have found compromised adaptation of strength, especially muscle power, when both strength and endurance were trained at the same time. Several strategies or mechanisms have proven effective in reducing the interference phenomenon of concurrent strength and endurance training as follows (1-4):

- Short training phases (5 weeks) using highly concentrated training loads (>50% of the total training volume) and which focus on the development of only two target fitness components in each training phase (i.e. one for strength and another for endurance), result in a more effective training stimulus for the improvement of performance in highly trained athletes when compared with a more traditional training periodization approach (2).
- Avoidance of the simultaneous development of muscle hypertrophy (8–10 RM) and aerobic power can reduce the interference phenomenon due to both training intensities inducing opposite adaptations on the same peripheral components. In contrast, due to the compatible training-induced adaptations associated with strength and power and aerobic power, as well as the compatible effects of development of maximal aerobic power, muscle hypertrophy and strength and power stimulus, no interference effects should be expected during the concurrent development of these fitness components (4).
- The residual fatigue caused by a previous endurance session could reduce and/or impair the quantity and quality of subsequent strength training sessions. For highly trained athletes, the strength training sessions should be placed before the endurance sessions, or at least separating both types of training sessions by more than 8 hours. Performing extra endurance training sessions at submaximal intensities that involve mainly non-specific muscle groups, may allow high-level athletes to achieve muscle peripheral adaptations, while the specific muscle groups recover for subsequent sessions of greater intensity (1,3).
- The training to repetition failure approach should be avoided in athletes at any performance level. A concurrent strength and endurance training program using a moderate number of repetitions for not to repetition failure training provides a favorable environment for achieving greater enhancements in strength, muscle power and specific performance when compared with higher training volumes of repetition to failure. The training for the not to repetition failure approach speeds up recovery from strength training, allowing rowers and paddlers to perform subsequent endurance training sessions of higher quality (3).

References 1. García-Pallarés J and Izquierdo M (2011). Sports Medicine. 1,41(4):329-343. 2. García-Pallarés J et al. Eur J Appl Physiol. 110(1):99-107 3. Izquierdo-Gabarrén M, et al. Med Sci Sports Exerc (2011) 42(6):1191-9. 4. García-Pallarés J et al. (2010). Med Sci Sports Exerc 42(6):1209-14.

**IS IT GOOD TO TRAIN TO FAILURE IN ELITE SPORTS?**

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The high-intensity dynamic resistance training method in which subjects perform repetitions to muscle failure is very popular among professionals who prescribe exercise and is recommended as the main method for optimal strength gains by several scientific associations. However, the question of which of the two training stimuli (failure vs. non-failure) is the most effective for exercise prescription and optimal strength and power gains has not yet been resolved. We have found that 5 sets of 10 repetitions to failure of bilateral leg press exercise interspersed by 2 min resting pauses demanded a maximal effort and caused a disruption of cellular homeostasis, as reflected by a marked decrease in power output, a state of energy deficiency and a decline in skeletal muscle phosphate potential. However, when the number of repetitions in each set was reduced by 50%, a much lower decrease in muscle PCr content (~15% vs. 80% decline) was observed, with only modest increases in muscle lactate and no measurable changes in muscle levels of ATP and IMP. This was associated with no changes in peak power output throughout the exercise sets while ATP synthesis matched ATP utilization and energy balance and cellular homeostasis were maintained. In the last 15 years several studies have found contradictory results comparing training that leads to repetition failure vs non-failure in untrained and trained subjects performing isometric or dynamic contractions with the upper or lower extremities. Some studies have compared the effects of 8 to 16 weeks of dynamic high resistance training to failure vs. non-failure in the knee extensor movement in untrained recreational weight trainers and top level male subjects. Their results indicate that high-intensity resistance training not to failure enables a favorable environment for achieving greater enhancements in maximal strength or power and muscle power output of the knee extensors when compared to a training to failure approach. The lower degree of fatigue incurred and the higher average movement velocities developed may explain the superior adaptations in strength and power gains observed in the non-failure compared to the training to failure group. These results suggest that in order to improve performance in the majority of activities with great demands of muscle strength and power of the lower extremities, a program of dynamic resistance exercise which minimizes fatigue and discomfort and is characterized by not training to repetition failure, low metabolite accumulation and excellent energy balance and cellular homeostasis, may be a more effective, efficient and safe option compared with training designed to maximize fatigue or metabolite accumulation.

**15:00 - 16:30****Oral presentations****OP-PM30 Physiology [PH] 7****HEAVY-INTENSITY INTERVAL TRAINING INCREASES CIRCULATING PROGENITOR CELL MOBILISATION BUT REDUCES FLOW-MEDIATED DILATION IN OVERWEIGHT/OBESE WOMEN**

Harris, E., Weeks, A., Birk, G., Khalil, A., Ferguson, C., Lawton, C., Dye, L., Birch, K.M.

*University of Leeds*

Introduction Interval exercise training (INT) is reported to exert greater benefits to cardiovascular (CV) health than continuous exercise training (CON; 1,2). However, in previous studies the exercise intensity domain of INT and CON have not been confirmed. Thus, it is unknown whether these benefits would occur if both groups exercised in the same intensity domain. Therefore, we compared the effects of intensity and work matched INT and CON in a population at risk of CV disease on endothelial function and circulating progenitor cells (CPCs; markers of endothelial repair). Methods 20 sedentary overweight/obese women (age 42±3 yrs, BMI 31.9±3.6 kg/m<sup>2</sup>) completed 12 weeks of either INT (n=10) or CON (n=10) on a cycle ergometer, twice/week. Exercise sessions were performed in the heavy-intensity domain and both groups were matched for work by adjusting the CON session duration. Brachial artery flow-mediated dilation (FMD), shear rate area under the curve for 60s from cuff release (AUC60) and double positive (CD45dimCD34+) and triple positive (CD45dimCD34+KDR+) CPCs were assessed pre and post-training. Results Following INT, FMD significantly reduced (pre 0.28±0.09mm, post 0.21±0.07mm) whereas CON had little effect (pre 0.25±0.1mm, post 0.24±0.1mm; group x time interaction p=0.05). Although not significant (p>0.05), resting brachial artery diameter increased with INT (pre 3.40±0.7mm, post 3.49±0.63mm) but did not change with CON (pre 3.43±0.49mm, post 3.44±0.56mm). Shear rate AUC60 reduced with INT (pre 40698±14395a.u, post 29709±11103a.u) whereas CON had little effect (pre 35921±12231a.u, post 35636±15245a.u; group x time interaction p=0.05). CD45dimCD34+ CPCs increased post INT (pre 6±3 /100000 leukocytes, post 11±6 /100000 leukocytes) with no change post CON (pre 12±6 /100000 leukocytes, post 10±3 /100000 leukocytes; group x time interaction p=0.03). Training had no effect on triple positive CPCs (p>0.05). Discussion INT was a potent stimulus for initiating change in vascular health in overweight/obese women, whereas CON had little effect. The reduction in FMD following INT may be explained by the reduction in post cuff release shear rate or remodelling of the brachial artery. The increase in double positive CPCs suggests an increase in the capacity for vascular repair following INT. Since training groups were matched for work and exercise intensity, the mechanisms involved in the potential superior benefits of INT are yet to be elucidated, but may involve the repeated increments in shear stress brought about by the work-rate oscillations. References 1. Tjønnå et al. (2008) *Circ* 118, 346-354 2. Wisløff et al. (2007) *Circ* 115, 3086-3094

**EFFECT OF 60 MINUTES INTERMITTENT HYPOXIC EXPOSURE SESSION ON OXYGEN UPTAKE KINETICS IN HEAVY INTENSITY CYCLING EXERCISE**

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INTRODUCTION Passive exposures to hypoxia interspersed with training bouts in normoxia is a model known as intermittent hypoxic exposure (IHE). However the effects of normobaric hypoxic exposure in subsequent exercise remain unclear. The aim of this study was to test the hypothesis that a previous IHE would be associated with an increase in the slow component of oxygen uptake kinetics (VO<sub>2</sub>K) while performing heavy intensity cycling. METHODS Eight triathletes (37+7,8 yrs, 71,5+5,5Kg, 179+5,3cm) performed a pre-post controlled

trial in two different conditions, the first condition implies the realization of a hypoxic treatment corresponding to a 11.7% FIO<sub>2</sub> (i.e. 4500m) and the second condition a placebo treatment in normoxia. The subjects perform four square wave transitions at 40%Δ (heavy domain) determined after a maximal incremental test, two before the IHE and two after the IHE, with 45 minutes of passive rest, according to Burnley et al. 2006. VO<sub>2</sub>K was estimated using a double exponential regression mathematical model. Amplitudes for exponential terms (A1 and A2), time delays (td1 and td2), and time constants (T1 and T2) were assessed, each one representing the fast(1) and slow(2) components of VO<sub>2</sub>K. Significance was set at p≤0.05. RESULTS A2 and T2 increased in exercise after IHE exposure, by 3 ml/m and 180s, respectively, when compared to pre exposure values. In this condition there was no significant effect on the A1, td1 and the T1 of the first component. In contrast, in the exercise after normoxic exposure, the A1 decreased 2,7ml and T1 also decreased by 3s with no change in the second component parameters. DISCUSSION The reduction in VO<sub>2</sub> cost expressed by a lower A1, concomitant with the decrease in the slow component, after normoxic exposure, may be due to the priming exercise effect (Burnley et al. 2006). However in post-hypoxic heavy exercise conditions, this effect seems to be overridden by factors yet to identify, These results indicate that there must be an additional effort to monitor and control the influence of acute hypoxic exposure on immediate subsequent tolerance to exercise and performance. REFERENCES Bailey, S. J., A. Vanhatalo, et al. (2009). *J Appl Physiol* 107(6): 1743-1756. Burnley, M., J. H. Doust, et al. (2006). *J Appl Physiol* 101(5): 1320-1327. Engelen, M., J. Porszasz, et al. (1996). *J Appl Physiol* 81(6): 2500-2508.

### EFFECT OF SPRINT TRAINING: TRAINING ONCE A DAY VS. TWICE A DAY UNDER CONDITION WITH SAME TRAINING VOLUME

Ijichi, T., Hasegawa, Y., Morishima, T., Sasaki, H., Kageta, T., Mori, A., Goto, T.

*Ritsumeikan University*

Introduction Endurance training twice every second day demonstrated greater increases in endurance capacity and muscle glycogen level when compared with equivalent training once daily (Hansen et al., 2005). The authors suggested that lower muscle glycogen level during second bout of training session in a same day would be involved with augmented muscle adaptation. However no information is available whether similar adaptation will occur in high-intensity sprint training program. Therefore, the present study compared effects of sprint training between "training once a day" and "training twice a day" under condition with equivalent total number of training session. Method Twenty healthy men were assigned to either training once a day group (SINGLE) or training twice a day group (REPEATED). The SINGLE conducted sprint training session once a day (5 days / wk). The REPEATED conducted two bouts of training session in a same day, separated with rest period of 1 hour (2-3 days / wk). Each training session consisted of three consecutive 30s maximal pedaling with 10 minute rest between sets. The training was maintained for 4 wk, and the total number of training session (20 sessions) was equivalent between the groups. Before and after training period, two bouts of 30s maximal pedaling test, VO<sub>2</sub>max and blood lactate kinetic test were performed. Result Both groups showed significant increases in peak and mean power output during repeated two bouts of 30s maximal pedaling (P < 0.05). In particular, mean power output during second bout was improved dramatically in both groups, but the effect was significantly greater in the REPEATED than in the SINGLE (P < 0.05). The result from VO<sub>2</sub>max test showed similar increases in VO<sub>2</sub>max and time to exhaustion in both groups (P < 0.05). However, the REPEATED increased significantly onset of blood lactate accumulation (OBLA) whereas no change was observed in the SINGLE. Discussion In the present study, peak and mean power output during two bouts of 30s maximal pedaling increased in both groups. Greater improvement of attenuated power output during second bout of pedaling was found in the REPEATED. Also, the REPEATED showed a significant increase in OBLA after the training period. A possible reason for augmented training adaptation in the REPEATED may be enhanced lactate metabolism capacity during the repeated two bouts of maximal pedaling. Conclusion These results indicate that sprint training "twice a day" enhances consecutive 30s maximal pedaling performance and lactate metabolism when compared with "training once a day" consisting of equivalent number of training session and training period. References A. K. Hansen, C. P. Fischer, P. Plomgaard, J. L. Andersen, B. Saltin and B. K. Pedersen. (2005). *J Appl Physiol*, 98, 93-9

### SHORT DURATION HIGH INTENSITY/LOW VOLUME RESISTANCE TRAINING HAS A SUPERIMPOSABLE EFFECT ON AKT, 4EBP1 AND S6 COMPARED TO A MORE TIME COMMITMENT LOW INTENSITY/HIGH VOLUME RESISTANCE

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*1:Dept. Biomedical Sciences (University of Padova, Italy) 2: Human Movement Sciences School (University of Padova, Italy)*

Introduction Resistance training (RT) affects anabolic signalling molecule phosphorylation but, considering the numerous variables of RT, the differences between training modalities has been yet poorly investigated. We aimed to determine if any differences exist between an high-intensity resistance training (HIRT) technique and a traditional resistance training (TRT) on Akt, 4EBP1 and S6 signalling pathway. Methods 12 healthy and physically active subjects (ages 21,92±1.16 yrs, BMI 22,85±2,24) performed in two different moments and with different legs HIRT and TRT. HIRT consisted in 2 sets at the leg extension performed with the following technique: 6 repetitions, 20 seconds rest, 2/3 repetitions, 20 secs rest, 2/3 repetitions with 2 min 30secs rest between the sets. TRT consisted of 4 sets of 15 repetitions with 1 min 15 secs of rests between the sets. Biopsies from the vastus lateralis were taken one week before training (T<sub>0</sub>) sessions, immediately after training (T<sub>0</sub>), 6 hours after (T<sub>6</sub>) and 24 hours after (T<sub>24</sub>). Western blot analysis to examine anabolic signalling molecule phosphorylation was performed on Akt, 4EBP1 and S6. Results No significant differences was not found at any of time points after exercise in AKT and 4EBP1 phosphorylation. There was a significant increase in S6 phosphorylation at T<sub>6</sub> both in HIRT and TRT. S6-P remained at higher level even at T<sub>24</sub>. Discussion Our findings suggest that a less time commitment resistance training technique is, at least, equally effective to induce an increase in S6-P. The increase of the phosphorylated form of S6 without a concomitant increase of AKT-P could be explained with the different biopsies timing (after 6 hours in our experiment, after 1, 2 hours in other researches)3,4 or with an AKT-independent S6 phosphorylation5,6. References 1 Paoli A. *Am J Physiol Endocrinol Metab.* 2012 Feb 1;302(3):E387 2 Paoli A. *J Transl Med.* 2012 Nov 24;10:237 3 Dreyer HC. *J Physiol* 576: 613-624 4 Mascher H. *Acta Physiol.* 2007;191:67-75 5 Eliasson J. *Am J Physiol Endocrinol Metab.* 2006 Dec;291(6):E1197-205. 6 Miyazaki M. *J Physiol.* 2011, 589:1831-46

**NONINVASIVE EVALUATION OF MUSCLE OXYGEN SATURATION DURING HIGH-INTENSITY CONSTANT LOAD CYCLING.**

Van Beekvelt, M., Rasdal, V., Skovereng, K.

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Introduction Near-infrared spectroscopy (NIRS) is a noninvasive optical method that enables us to measure changes in oxygenation and hemodynamics in a continuous manner directly within the muscle. More recently, the development of the equipment has enabled us to measure a quantitative measure for (muscle) tissue oxygen saturation. In this study, NIRS was used to investigate the relationship between the individual maximum desaturation level that can be obtained by a vascular occlusion during rest and the desaturation levels that occur during prolonged high intensity work. Methods Eight healthy subjects performed a maximum desaturation test followed by a 30-min constant load cycling test. Cycling was done on an electro-magnetically braked cycle ergometer at 75% of maximum aerobic power (MAP). Near-infrared spectroscopy (NIRS) was used to define the maximum desaturation level of the vastus lateralis muscle (VM) for each individual, by application of a vascular occlusion (280 mmHg; 10 min) while seated in a comfortable semi-supine position. During cycling, NIRS, oxygen consumption (VO<sub>2</sub>) and heart rate (HR) were measured continuously, while blood lactate levels ([La-]b) were measured every 5 minutes. Results Preliminary results show baseline VL muscle saturation levels of  $69.9 \pm 6.8$  % (range: 61.3-80.2%). Maximum desaturation after 10 minutes of occlusion was  $19.5 \pm 13.7$  % (range: 2.9-41.7%). Delta desaturation was  $50.5 \pm 15.6$  % (range: 27.1-73.4%). At the start of exercise, tissue saturation levels were back to baseline values ( $69.3 \pm 7.3$  %, range: 55.8-79.6%), while at the end of 30 minutes high intensity cycling, tissue saturation reached a minimum of  $41.8 \pm 14.5$  % (range: 16.2-59.1%), though values decreased to  $19.2 \pm 5.6$  % (range: 13.5-27.4%) during 20 s of occlusion 1 min prior to the end of cycling. Discussion/Conclusion Although prolonged fatiguing high intensity exercise did not fully deplete muscle oxygen stores, short-duration occlusion (10 s) seemed to deplete muscle O<sub>2</sub> levels to a functional minimum, equal to the maximum desaturation attained under resting conditions. Variability in the response to both 10 min of occlusion and 30 min of high intensity cycling exercise seemed primarily due to inter-subject differences. Further analysis of the data might reveal a relationship between tissue saturation response and systemic changes in pulmonary O<sub>2</sub> uptake, heart rate and/or lactate levels.

**ARE THE MOOD CHANGES DURING HIGH-INTENSITY INTERVAL TRAINING RELATED TO CHANGES IN AEROBIC CAPACITY?**

Saarijoki, T.1, Hannukainen, J.1, Eskelinen, J.J.1, Savolainen, A.1, Heinonen, I.1, Virtanen, K.1, Kemppainen, J.1, Kapanen, J.1, Knutti, J.1, Nummenmaa, L.2, Kalliokoski, K.K.1

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Introduction High-intensity interval training (HIT) is a time-efficient strategy for promotion of health by physical exercise. This type of training is mentally rather demanding and may cause changes in mood which may be related to the outcome of the training. Accordingly, we investigated the effects of two weeks of high-intensity interval training on different mood parameters and their relation into the changes in aerobic fitness. Methods Twenty six sedentary middle-aged men (age:  $47 \pm 5$  years, BMI:  $26.0 \pm 2.6$ , VO<sub>2</sub>max:  $33.9 \pm 4.2$  mL/kg/min) were recruited into the study. They were randomly divided to train six sessions within two weeks in HIT group (n=13, training: 4-6 x 30 s / 4 min) and aerobic exercise training (AET) group (n=13, 40-60 min at 60 % VO<sub>2</sub>max). During the exercise subjective exertion was assessed using the Borg's Rating of Perceived Exertion (RPE) scale and perceived pleasure and arousal were assessed using The Self-Assessment Manikin (SAM) rating scale. Participants' mood ratings were recorded on the Finnish version of the Perceived Stress Questionnaire and the Positive and Negative Affect Schedule (PANAS) and a visual analog scale (VAS) prior to and immediately after each training session. One subject from both groups abandoned the study due to personal reasons. Results VO<sub>2</sub>max increased significantly and similarly between the groups (HIT: 6.2 % and AET: 4.1 %). Subjective exertion and agitation during training sessions increased significantly more in HIT than in AET group (P<0.05), but subjective pleasantness changed similarly in both groups. Relative to the AET group, the HIT group reported after the training sessions higher levels of perceived stress, decreased positive affect, significantly more depression, exhaustion, uptightness, and irritation (all P<0.01) and less motivation (P<0.05). However, both groups were similarly more satisfied after the training sessions (P<0.05) and satisfaction even improved during the training period (P<0.05). In the HIT group the changes in VO<sub>2</sub>max correlated negatively with the changes in exhaustion (r=-0.78, p=0.002) and uptightness (r=-0.81, p=0.001) and positively with the changes in satisfaction (r=0.62, p=0.03). Discussion These findings show that HIT is emotionally much more demanding than AET. Interestingly, despite of that, subjects in HIT group were similarly more satisfied after the training sessions than subjects in AET and both groups become more satisfied during the whole training period. Relatively strong correlation findings suggest that training success may be more related to mood changes than previously anticipated.

**15:00 - 16:30****Invited symposia****IS-SH01 Understanding sport participation in Europe \*****SPORT PARTICIPATION IN FINLAND – SOCIOLOGICAL INTERPRETATIONS**

Vehmas, H.

*University of Jyväskylä*

Sport participation is an important part of today's societies for various reasons. Firstly, sport participation is inseparably linked with contemporary citizens' health conditions. Secondly, participation functions as an important tool for socialization at various forms and levels. Thirdly, as one of the most frequently practiced leisure activities worldwide sport participation has several economic implications for creating employment and other forms of economic opportunities, both locally and globally. Sport participation varies from country to country, and even within one nation there are sometimes clear differences in the frequencies, intensities and forms of participation. For example Finland has had among the highest levels of participation in Europe over the years, whereas in South-East Europe participation

rates have generally been lower. At the same time some countries, for example Switzerland, show great regional differences in participation. The aim of this presentation is to outline a theoretical basis for sociological explanations that would contribute to understanding more precisely what factors and reasons seem to explain high participation levels in Finland. It is suggested that this way both national and comparative data could be used more effectively for sport participation and wellbeing promotion purposes in different countries. For this purpose Bourdieu's construction of habitus serves as an applicable theoretical basis. Sport participation is a construction of the individual action, structural determinants, cultural meanings and societal functions. For the sporting habitus formation data collection needs to be made about the definitions, perceptions and motives of sport participation; the roles of public, commercial and non-profit sectors in creating preconditions for participation; and about the historical, cultural and societal characteristics of sporting nations in question.

### **SPORT PARTICIPATION AND CULTURAL CHANGE. A COMPARATIVE ANALYSIS FOR SOME EUROPEAN COUNTRIES**

Llopis-Goig, R.

*University of Valencia*

**Introduction** Although in recent decades there has been a general increase in sports practice and a growing expansion of different sport facilities, the sport participation rates of the European population still differ considerably between countries, as several surveys have shown, specially the 2004 Eurobarometer 62.0 and the 2009 Eurobarometer 72.3. While Northern and Western Europeans generally have higher participation rates, in Southern and Eastern Europe sport participation has remained at lower levels. Given that since the ratification of the European Sport for All Charter (Council of Europe, 1975) policymakers have striven to provide wide access to sport for everyone across Europe, the persistence of these differences is a challenge to Social Sciences. Why do these differences between countries remain? Why are there such large differences in the sport participation rates of certain social groups? Following the framework of Inglehart and Welzel (2005), this communication suggests that the persistence of these differences cannot solely be explained by economic or sport policy related factors, and it provides some hypotheses about cultural influences that could be involved. **Methods** The analysis is based on data from the 'Leisure Time and Sport' module, collected within the International Social Survey Programme (ISSP) in 2007. This module was developed between 2003 and 2006 and fielded in 36 countries, of which 22 are European countries. This ISSP-survey is the first systematic world-wide comparative survey on the topic, and it contains questions on leisure time and sport activities, the gratification individuals get from them, and related personal items such as weight, subjective health and happiness. **Results** The results are presented in three steps. First, differences among countries on the main sport participation indicator are analysed. Second, further analyses of differences are carried out for certain groups (women, elderly people...). Third, all of these differences are analysed in relation to the socioeconomic development level of each country (level of industrialization, share of workforce in the industry...) and some cultural factors (cultural tradition, religion, individualism orientations). To do this, several bivariable and multivariable statistical analyses are performed. Analyses are conducted country by country and also through clustering in homogeneous groups. **Discussion** The analysis showed large differences between European countries, with these differences being greater in the case of some specific social groups. On the other hand, the regression analysis confirmed the importance of cultural variables in differences in sport participation among European countries. The communication will provide some theoretical reflections on the importance of these findings. **References** Council of Europe (1975): The European Sport for All Charter. Brussels: Council of Europe. Inglehart, R. and Welzel, Ch. (2005): *Modernization, Cultural Change and Democracy*. New York, Cambridge University Press.

### **UNDERSTANDING DIFFERENCES IN SPORT PARTICIPATION AND PHYSICAL ACTIVITY IN EUROPE**

Breedveld, K.

*Mulier Institute*

Over the years, in most Western countries, participation in sports and physical activity has grown considerably. Yet, policy makers all over the world continue to struggle with the same issues. Despite a general growth in participation levels, low SES-groups continue to lack behind when it comes to participation in either sports, PA or indeed many other social fields (like e.g. culture). This paper goes into the determinants of that social-inequality, particularly in sports and in PA, but also looking at other fields like culture, politics and volunteering. From these, we look for factors, motivations and barriers that occur in all the fields, pointing to a common overarching theme. From this, the paper aims at shedding light on the question on how to combat social-inequality in sports and PA, or perhaps on whether we can even expect this gap to be closed. In so doing we will explore the concept of life-style, both as a means for changing behaviour and as a factor explaining why behaviours are often very reluctant to change, and very likely to remain different between social groups.

**15:00 - 16:30**

## **Invited symposia**

### **IS-SH05 A Critical Pedagogy for Physical Education Futures: Prospects for Change**

#### **A CRITICAL PEDAGOGY FOR SCHOOL PHYSICAL EDUCATION: PROSPECTS FOR CHANGE**

MacPhail, A.

*University of Limerick*

This presentation focuses on the related aspects of (1) an equitable, culturally-relevant education for all students, (2) the ways in which teachers can build a consensus among their students of the necessary behaviors for building and maintaining a productive class environment, and (3) the consideration of prejudices and bias. These aspects, related to a caring pedagogy (Noddings, 1992), equity pedagogy (McGee-Banks & Banks, 1995) and critical pedagogy (Giroux, 1988), are essential before a teacher can effectively encourage pupils to consider involvement in a learning community that share similar values and are committed to each other's learning, growth and welfare. Caring and culturally relevant pedagogies are discussed with respect to providing culturally-relevant and equitable curriculum in

school physical education. Building and sustaining (student) learning communities (Brophy, 2012) in school physical education is explored as a way in which to encourage school physical education changes in practices informed by students.

### **A CRITICAL PEDAGOGY FOR PETE: PROSPECTS FOR CHANGE**

Martínez Alvarez, L.  
*University of Valladolid*

Critical Pedagogy (CP) and Sociocritical research have a visible, although minority, presence in schools and Teacher Education (for a recent review, see Devis, 2012). Despite it is difficult to deny the contemporarity of several of its analysis and foundations, starting with the necessity to tackle unjust and inequitable practices, Critical Pedagogy (or critical pedagogies), is often seen as an out-of-date approach to education. It is not that teachers, teacher educators or prospective teachers are insensitive to injustice, but they quite frequently take for granted that schooling provides equal opportunities for all, so they consider that many of the principles stated by CP are already part of the core of (in our case) Physical Education. That is to say: the mere fact that Physical Education is on the curriculum implies that emancipation, inclusiveness, equal opportunities, and so on are on its way; its a matter of time exerting its effect. In a sense, the triumph of the discourse warn us about the necessity of rethinking the meaning of these words, since the real impact of CP is reached not just assuming its principles, but rethinking them critically to work for emancipation. Rethinking implies a personal search in our own thoughts and the contexts in which they take its significance. As Kirk says, "this is a multi-level process that only becomes authentic when it is realized in the practical daily activities of individuals." (Kirk, 2006, p. 257) In this symposium, I'll argue that Critical Pedagogy is still relevant for PETE and for school Physical Education. Even more, it can be a path to avoid Physical Education risk of extinction due to its irrelevance (Kirk, 2010). CP is relevant for PETE because it can provide an approach to revisit the embodied ideologies that construct us as teachers. CP is relevant for Physical Education because it offers a more complex framework to understand education and the way educators can take part on the emancipation process. I will present an example of how teacher educators, physical education teachers and prospective physical education teachers can work collaboratively within the CP approach, linking knowledge production, professional development and social intervention. This action took place in a school attended mainly by students of the gypsy minority. The resistences offered by these students shocked the physical education teacher (new in the school) and the pre-service students that were doing their practicum with her. Along with a teacher educator, they explored critically how they embodied a hegemonic PE, and became aware of how their values and acts was made from this perspective. In doing so, they tried to learned how physical education can be relevant for the present of these gypsy students and for their future(s) and tried to detect ways of alienation that inadvertently Physical Education and school inflict to these children.

### **A CRITICAL PEDAGOGY FOR PHYSICAL EDUCATION FUTURES: PROSPECTS FOR CHANGE**

Kirk, D.  
*University of Bedfordshire*

As societies are increasingly disfigured by growing inequality, the presenters in this symposium argue for a critical pedagogy to secure a future that will enable physical educators to contribute to a reduction in inequality, to social justice and to the empowerment of all students. In his book *Physical Education Futures* (Routledge, 2010), David Kirk argues that without radical reform physical education is unlikely to survive in a form that can promote education for social justice. He proposed that reform must happen synergistically on three fronts: school physical education, PETE, and the school as an institution. Informed by a view of critical pedagogy outlined briefly by the Chair, this symposium examines the prospects for change in each of these areas. Each presentation considers the current situation, threats and opportunities, and in light of this analysis weighs the prospects for change in terms of the three futures scenarios outlined in Kirk's book: 'more of the same', 'radical reform', and 'extinction'. The speakers will present a coordinated symposium in which they will explore the interrelationships between their topic and the other two topics, thereby revealing the complexity of change and the need for coordinated struggle across each front. They will consider the prospects for teachers of physical education, teacher educators and student teachers, and members of school communities to engage in struggles to bring about change from the bottom-up.

**15:00 - 16:30**

## **Invited symposia**

### **IS-PM01 JSPFSM Exchange Symposium: Confronting super aging society -**

Japanese and European \*

#### **THE ROLE OF PHYSICAL ACTIVITY IN THE LIGHT OF AN AGEING EUROPEAN WORKFORCE**

Van Mechelen, W.  
*VU University Medical Center*

Prevalence rates of physical inactivity are high worldwide, as are associated non-communicable chronic diseases. Physical inactivity has been identified as the fourth leading independent risk factor for global mortality (6% of deaths globally). In the WHO European Region physical inactivity: is estimated to account for nearly one million deaths per year, i.e. 10% of the total and accounts for 8.3 million disability-adjusted life-years (DALYs - about 5% of the total). These epidemiological trends not only have impact on morbidity and mortality, but by consequence also on the associated direct and indirect cost. The latter primarily due to lost productivity costs. In addition we are in the western world confronted with an ageing society and a need for delayed retirement age. From both these perspectives it is important to keep the European workforce fit, vital and healthy. A way to do this is by worksite health promotion programmes, also stimulating physical activity and reducing sedentariness. Purpose of this talk is to present an overview of cost-effective worksite physical activity promotion programs, in the light of an ageing European workforce.

**EVALUATING THE IMPACT OF BLOOD FLOW RESTRICTION TRAINING ON VASCULAR FUNCTION**

Horiuchi, M., Sato, T., Takada, S., Kadoguchi, T., Okita, K.

*Yamanashi Institute of Environmental Sciences*

Introduction As low intensity training with blood flow restriction (BFR) leads to muscle hypertrophy despite with lower mechanical stress, BFR training may be a novel means for aged people to prevent sarcopenia. However, there is insufficient evidence regarding the impact of BFR training on vascular function. Thus, to clarify the potential safety of BFR training for vascular function as well as the advantages of this training is needed. Methods Study 1: Fourteen young males participated in this study. For training, unilateral plantar flexion exercise at 20% of 1-RM with BFR and a pressure of 1.3 times systolic blood pressure (SBP) was used. Training was conducted 3 days/wk for 4 wk. Muscle cross sectional area (MCA), 1-RM, and systemic vascular function assessed by beta-stiffness were measured pre and post training. Study 2: Sixteen young males were divided into either a jump training with BFR group (n = 8) or without BFR group (n = 8). A bilateral squat jump with a pressure of 200 mmHg was used. Training occurred 4 days/wk, for 4 wk. Muscle strength and beta-stiffness were measured pre and post training. Results Study 1: Although MCA and 1-RM increased significantly (5.0% and 13.7% vs. pre training,  $p < 0.05$ ), beta-stiffness remained unaltered. Study 2: Muscle strength in both groups remained unchanged. However, jump training with BFR significantly improved beta-stiffness (6.3 to 5.5 a.u.,  $p < 0.05$ ) without changes in arm SBP. Discussion Accumulation of metabolites contributes to muscle strength (Scott et al., 1995) and our results reveal that a greater amount of muscle metabolites was induced by BFR (Suga et al., 2009). These alterations in metabolites increased MCA and 1-RM in study 1. Only whole body BFR training improved beta-stiffness. However, low intensity and local muscle training with BFR was insufficient as a stimulus to improve beta-stiffness. One explanation is the different recruited muscle mass. A previous study indicated that arterial remodeling via blood flow changes is endothelium dependent (Rudic et al., 1998), suggesting that greater hyperemic blood flow after cuff deflation may be related to the improvement beta-stiffness caused by exercise-induced increases in systemic blood flow (Green et al., 2004). Collectively, these results suggest that BFR training might be useful for aged people who cannot perform recommended high-intensity resistance exercises. Because obvious increases in muscle mass and strength without degeneration of vascular function could be obtained by BFR training, even if an extremely low-intensity load was applied. References Schott J et al. (1995) *Eur J Appl Physiol* 71: 337-341. Suga T et al. (2009) *J Appl Physiol* 106: 1119-1124. Green DJ et al. (2004) *J Physiol* 561:1-25. Rudic R et al. (1998) *J Clin Invest* 101:731-736.

**ACUTE EFFECT OF INCREASED PARTICIPATION IN ACTIVITIES OF DAILY LIVING ON POSTPRANDIAL LIPAEMIA IN POSTMENOPAUSAL WOMEN**

Miyashita, M., Takahashi, M.

*Tokyo Gakugei University*

Introduction A "super-aging society" is one of the major issues being faced by Japan with 40 percent of the population expected to be over 65 years old by 2050 or so. Preventing elderly people from becoming limited in performing activities of daily living is an important health objective for maintaining their quality of life. Thus, it is important to consider lifestyle modifications which may be effective in reducing repeated daily episodes of exaggerated postprandial lipaemia, a risk factor for cardiovascular disease (Cohn, 1998), since there is an increased incidence of cardiovascular disease in middle-aged and older populations, particularly postmenopausal women. Thus, the aim of our study was to examine the acute effect of increased participation in activities of daily living on postprandial lipaemia in postmenopausal women. Methods Ten postmenopausal women, aged  $63 \pm 4$  years (mean  $\pm$  SD), completed two trials in a randomised order: 1) control trial and 2) active trial. On Saturday and Sunday of the control trial, participants maintained their usual lifestyle. On Saturday and Sunday of the active trial, participants were asked to increase their activities of daily living above their usual lifestyle levels (i.e. activity time did not fix). For the determination of physical activity levels, participants were asked to wear a uniaxial accelerometer for 4 consecutive weeks. On Monday of each trial, participants rested and consumed test meals for breakfast and lunch. Capillary blood samples were collected in the fasted state (0 h) and at 2, 4 and 6 h postprandially on day 2. Results The frequencies of performing moderate to vigorous physical activity (i.e.  $\geq 3$  metabolic equivalents) determined by the accelerometer were higher in the active trial than in the control trial ( $27.9 \pm 3.8$  vs.  $12.2 \pm 2.1$  min/weekend for the active and control trials respectively, paired t-test,  $P = 0.009$ ). Area under the capillary triacylglycerol concentration vs. time curve was 13% lower in the active trial than in the control trial ( $8.8 \pm 3.8$  vs.  $10.1 \pm 3.9$  mmol $\cdot$ 6h/L for the active and control trials respectively, paired t-test,  $P = 0.024$ ). Discussion Increased participation in activities of daily living was effective in attenuating postprandial lipaemia in postmenopausal women. Future studies should examine whether chronic changes in total daily activity time and/or sitting time over several weeks/months under free-living conditions have beneficial effects on activities of daily living and quality of life in older populations. References Cohn JS. (1998). *Can J Cardiol*, 14 (Suppl B), 18B-27B.

**15:00 - 16:30****Oral presentations****OP-SH05 Psychology [PS] 1****THE RELATIONSHIP BETWEEN THE OBJECTIVELY RATED COACH-CREATED MOTIVATIONAL CLIMATE, AND ATHLETES' BASIC PSYCHOLOGICAL NEEDS AND SPORT ENJOYMENT.**

Smith, N.1, Tessier, D.2, Tzioumakis, Y.3, Appleton, P.1, Quested, E.1, Duda, J.L.1

1: *University of Birmingham (UK)*, 2: *University of Grenoble, (France)*, 3: *University of Thessaly (Greece)*

Introduction Self-determination theory (SDT) predicts the extent to which the coach-created climate is autonomy supportive and/or controlling will contribute towards the degree to which athletes experience satisfaction of the basic needs of autonomy, competence and relatedness, and in turn, positive emotional responses. The relationship between athletes' self-reported perceptions of the coach-created motivational climate (as conceptualised in SDT) and athletes' basic need satisfaction (BNS) and associated outcomes is well understood. However, little is known about the implications of the objectively-measured features of the motivational climate for athletes' motivation related processes and associated outcomes. Thus, this research examined the relationship between objectively rated coach autonomy

support and controlling features of the environment, and athletes' self-reported BNS and sport enjoyment. Method 53 grassroots football coaches (Mage = 37.74 years) and 672 players (Mage = 11.32 years) took part in the study. During the first 10 weeks of the season, the coach was filmed during a training session and athletes completed a questionnaire assessing their autonomy, competence and relatedness need satisfaction and enjoyment in football. Recordings were split into four equal time periods and trained observers coded the potency of the autonomy supportive and controlling features of the climate using the Multi-dimensional Motivational Climate Observation System (MMCOS). Results Analyses suggest that observed autonomy support was positively related to players' autonomy need satisfaction ( $\beta=.36$ ,  $p=.008$ ), and observed controlling features of the coaching environment emerged as a significant negative predictor of players' sense of relatedness ( $\beta=-.34$ ,  $p=.013$ ) and enjoyment ( $\beta=-.31$ ,  $p=.025$ ). Relatedness was a significant positive predictor of enjoyment ( $\beta=.56$ ,  $p<.01$ ). Mediation analysis demonstrated relatedness partially mediated the relationship between observed controlling behaviour and player enjoyment ( $p=.029$ ). Discussion Findings demonstrate when coaches are observed to coerce behaviour by being controlling, players report lower levels of relatedness and consequently enjoy their sport less. Given that players' enjoyment in sport has been associated with important health-related outcomes, it seems important that coaches try and avoid emphasising a controlling motivational environment. In future, SDT-based coach education programmes that focus on encouraging more adaptive motivational environments may also wish to educate coaches about how to reduce the negative implications of emphasising maladaptive, controlling coaching practices.

### LONGITUDINAL EXAMINATION OF THE RELATIONSHIPS BETWEEN COACH INTERPERSONAL STYLE, PSYCHOLOGICAL NEED SATISFACTION AND MOTIVATIONAL REGULATIONS IN YOUNG FOOTBALLERS

González, L., Castillo, I., Tomás, I., Fabra, P., Balaguer, I.

*Universitat de València*

Self-determination theory (SDT; Deci & Ryan, 2000) holds that the understanding of human motivation requires consideration of the degree to which basic psychological needs for competence, autonomy, and relatedness are satisfied. Autonomy supportive contexts foster satisfaction of these needs and, in turn, will facilitate intrinsically motivated behaviours. Previous research has examined the interplay between these variables through cross-sectional studies using composite measures of need satisfaction and self-determined motivation. Extending the literature, the purpose of this study was: (1) to examine the relationship between changes in coach autonomy support to changes in the 3 needs satisfaction and in each motivation regulation over a football season, and (2) analyse the mediational effect of need satisfaction between coach autonomy support and motivation regulations. 597 male footballers ( $M = 12.58 \pm 0.54$  years) completed a questionnaire pack tapping the variables of interest at two time points (beginning and end of the season). Results of structural equation model revealed that changes in autonomy support predicted positive and significant changes in the satisfaction of the needs for competence ( $\beta=.13$ ), autonomy ( $\beta=.48$ ) and relatedness ( $\beta=.55$ ). Moreover, changes in the need for competence positively related to changes in intrinsic motivation ( $\beta=.17$ ) and identified regulation ( $\beta=.11$ ) and negatively predicted amotivation ( $\beta=-.13$ ). Unexpectedly, changes in competence need satisfaction were positively associated with changes in extrinsic regulation ( $\beta=.10$ ). Changes in the need for autonomy were a positive predictor of changes in intrinsic motivation ( $\beta=.23$ ) and identified regulations ( $\beta=.25$ ). Changes in autonomy need satisfaction were positively linked to changes in introjected ( $\beta=.24$ ) and external regulations ( $\beta=.16$ ), and changes in the need for relatedness were a positive predictor of changes in intrinsic motivation ( $\beta=.18$ ). Results also provided support for the full mediational role of the three psychological needs in the relationship between autonomy support and motivational regulations. According to SDT, results show the importance of promoting autonomy supportive atmospheres to facilitate satisfaction of young footballers basic psychological needs and intrinsic motivation. Future studies could further analyse the positive relation of satisfaction of the needs for competence and autonomy with more controlled forms of motivation. Research funded by Ministerio de Ciencia e Innovación (DEP2009-12748) Spain. References Deci, E. L., & Ryan, R. M. (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behaviour. *Psychological Inquiry*, 11, 227–268.

### THE ROLE OF COACHES IN FACILITATING MENTAL TOUGHNESS IN ADOLESCENT ENDURANCE ATHLETES.

Mahoney, J.W.1,2, Ntoumanis, N.2, Mallett, C.J.1, Gucciardi, D.F.3

1: UQ (Brisbane, Australia), 2: UoB (Birmingham, United Kingdom), 3: CUT (Perth, Australia)

Introduction Employing qualitative methodologies, researchers have indicated that coaching environments that support athlete autonomy and avoid controlling sanctions underscore mental toughness development (Gucciardi et al., 2009). These types of environments can be understood more broadly in light of self-determination theory (SDT). The aim of our study was to substantiate previous findings by quantitatively investigating the relationship between different coaching environments on mental toughness and associated outcomes in adolescent athletes. We hypothesised that autonomy-supportive coaching environments would positively correlate with mental toughness through the satisfaction of psychological needs. Further, we hypothesised that mental toughness would correlate positively with well-being and performance and negatively with ill-being. Method Two hundred and fifty-six adolescent endurance runners (139 male, 117 female; Mage =14.43 years of age, SD = 1.96) recruited from schools and clubs throughout Australia (N = 175) and the UK (N = 81) completed a battery of questionnaires: the Sport Climate Questionnaire, the Basic Psychological Needs Satisfaction in Sport Scale, the Mental Toughness Index, the Depression, Anxiety and Stress Scale, and the Mental Health Continuum Short Form. Performance data, in the form of competition times, were also obtained. Results Structural equation modelling revealed that autonomy-supportive coaching environments correlated positively with needs satisfaction. Needs satisfaction related with mental toughness in the expected fashion. Further, mental toughness significantly correlated with well-being and ill-being as expected, but not performance. Interestingly, performance and well-being were significantly correlated. Discussion Mental toughness in adolescent athletes could be fostered through the provision of autonomy-supportive coaching environments that satisfy athletes' psychological needs. Researchers could extend our findings by employing experimental methodologies to investigating how encouraging coaches to create autonomy-supportive environments affects mental toughness in adolescent athletes over time. References Gucciardi, D.F., Gordon, S., Dimmock, J., Mallett, C.J. (2009). *J Sport Sci*, 27, 1483-1496.

## THE EFFECT OF A SELF-DETERMINATION THEORY BASED EXERCISE INTERVENTION ON PHYSICAL ACTIVITY LEVELS IN RHEUMATOID ARTHRITIS PATIENTS

Yu, C.1, Rouse, P.1,2, Veldhuijzen Van Zanten, J.1,2, Metsios, G.2,3, Ntoumanis, N.1, Kitas, K.3, Duda, J.L.1

*University of Birmingham1 Dudley Group of Hospitals NHS Trust2 University of Wolverhampton3*

Introduction Exercise has been shown to reduce cardiovascular disease risk in patients with Rheumatoid Arthritis (RA) . Little is known about the effect of a prescribed gym-based exercise intervention on levels of physical activity (PA) in patients with RA, particularly leisure time PA. Self-determination Theory<sup>2</sup> holds that individuals are more likely to adopt and maintain PA when their autonomous motivation for engagement is enhanced. The present study examined the effects on objective and self-reported PA between an exercise programme supplemented with SDT-based PA promotion consultations and a standard exercise programme. Method To date, 88 RA patients (27 male, 61 Female, Mage= 54± 13 years) were recruited to participate in a structured 3-month exercise programme. The participants were randomly assigned to either: (1) an intervention arm (N=46)entailing a structured exercise programme customised for RA patients plus autonomy supportive consultations to promote PA engagement within/outside of the programme, or (2) a control arm(N=42)comprised of the structured exercise programme only. Valid objective PA data were obtained from 21 patients. Given the current sample size, changes in objective and subjective PA were investigated via dependent t-tests. Results Analyses revealed self-reported leisure time PA to decrease over the course of the exercise programme in the control arm (t=2.57, p=.014). Objective sedentary behaviour was significantly reduced (t=2.13, p<.05) and there were trends for PA at a light level (t=-1.94, p=.066) to increase T1 to T2. No significant changes in objective MVPA or step counts were observed in either arm. Conclusion Analyses of preliminary data revealed that there was a reduction in objective sedentary behaviour in RA patients and increase in subjective leisure time PA when autonomy supportive consultations were combined with 3 months of gym-based exercise. This ongoing RCT will further explore the sustainability of these changes in PA as a result of the exercise + SDT-grounded psychological intervention, and the impact of any changes in patients' autonomous motivation on PA. Stavropoulos-Kalinoglou, A., Metsios, G. S., Veldhuijzen van Zanten, J. J., Nightingale, P., Kitas, G. D., & Koutedakis, Y. (2012). Individualised aerobic and resistance exercise training improves cardiorespiratory fitness and reduces cardiovascular risk in patients with rheumatoid arthritis. *Annals of the Rheumatic Diseases*. 2Deci, E. L., & Ryan, R. M. (2000). The 'What' and 'Why' of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry*, 11(4), 42.

## PHYSICAL EDUCATION TEACHERS SELF-DETERMINED MOTIVATION TOWARDS THEIR CLASSES

Coelho, L.1, Matos, R.1, Cubo Delgado, S.2

*1: IPL (Leiria, Portugal), 2: UNEX (Badajoz, Espanha)*

Introduction This study analyses Physical Education (PE) teachers' self-determined motivation towards their classes in Leiria, Portugal. Given the fact that there has been growing concern in recent years about the low level of young peoples' participation in physical activity (PA), we would like to know if teachers' motivation level shows to be a contributing factor. Methods Forty one PE teachers with qualification certificate from high institution (21 males and 20 females) from eight Leiria (Portugal) district schools volunteered to participate in the study. They were recruited from government-run basic and high schools. They all taught students from 10 to 18 years of age. Self-determined motivation was assessed through the application of a previous validated questionnaire (SIMS; Guay, Vallerand, & Blanchard, 2000). A four item dimension was added to reflect introjected regulation, following Taylor and Ntoumanis (2007) example. Results On a scale from 1 to 7, teachers reported average intrinsic motivation of 6,1 ± 0,8. Identified regulation was 5,6 ± 0,96. Introjected regulation was 3,7 ± 1,4. External regulation was 2,9 ± 1,4. Amotivation was 2,0 ± 1,0. Intrinsic motivation and identified regulation were the two most significant factors indicated to justify this teaching activity, while the rest have a distinctive lower influence. Discussion Results clearly indicate high levels of PE teachers' self-determination towards their classes. When comparing data between genders, no significant statistical differences were found on any type of regulating factor, whether intrinsic, extrinsic and amotivation. This allows us to conclude that teachers' gender has no impact on teachers' overall self-determination towards their classes. When comparing data between schools, no significant statistical differences were found on any type of regulating factor, allowing us to conclude that schools characteristics has no influence on teachers' overall self-determination towards their classes. This was equally found for teachers' chorological age. Point out that the more intrinsic the motivation regulating factor is, higher the values presented. Based on this results, we can exclude this variable (teachers self-determined motivation towards their classes) as having any relation with concerning low level of young peoples' participation in PA by PE influence. References Guay, F., Vallerand, R.J. & Blanchard, C. (2000). On the assessment of state intrinsic and extrinsic motivation: The situational motivation scale (SIMS). *Motivation and Emotion*, 24, 175-213. Taylor, I. M. & Ntoumanis, N. (2007). Teacher Motivational Strategies and Student Self-Determination in Physical Education. *Journal of Educational Psychology*, 4, 747-760.

## PERFECTIONISM SUB-BELIEFS AND PSYCHOLOGICAL WELL- AND ILL-BEING IN ATHLETES WITH AND WITHOUT HEARING IMPAIRMENTS

Ho, M.S.H., Appleton, P.R., Duda, J.L., Cumming, J.

*University of Birmingham*

Introduction Past literature (Stoeber & Childs, 2010) has considered whether the sub-beliefs of self-oriented perfectionism (SOP) and socially-prescribed perfectionism (SPP) are adaptive or maladaptive. To provide further insight into this issue in sport, we examined the relations between perfectionism sub-beliefs (perfectionistic striving [PS], importance of being perfect [IBP], conditional acceptance [CA] and others' high standards [OHS]) to indices of well- and ill-being. As there is limited sport psychology research on disabled athletes, particularly deaf athletes, the second aim was to determine whether these relations vary across hearing and deaf athletes. Methods Participants were 205 hearing (Mage = 18.8, SD = 3.9) and 212 deaf (Mage = 27.3, SD = 9.3) athletes. Athletes were asked to complete a questionnaire including validated scales assessing well-being (positive affect [PA], subjective vitality [SV], and global esteem [GE]) and ill-being (perceived emotional and physical exhaustion [PEPE] and negative affect [NA]). Results As hypothesised, PS was negatively correlated with ill-being indicators and positively correlated with well-being indices in both groups. IBP was positively associated with all indicators of ill-being in deaf athletes and with all indicators of well-being in hearing athletes. PS had higher positive correlations with the markers of well-being and higher negative correlations with ill-being indicators than IBP. For the SPP sub-beliefs, CA was negatively associated with all indicators of well-being and positively associated with NA in hearing athletes. In the deaf sample, CA was negatively associated with GE. No significant correlations were found for OHS in the hearing sample, but PA and SV were positively associated with OHS in the deaf sample. Furthermore, CA had higher positive correlations with ill-being and higher negative correlations with well-being indices than OHS. Discussion Our findings indicate that PS could promote well-being and CA could induce ill-being in hearing and deaf

athletes. This supports recent arguments by Gotwals et al. (2012) on the adaptive nature of PS and Hall et al.'s (2012) proposals regarding the maladaptive nature of CA in sport. Our findings also show that IBP and OHS can be positive or negative, depending on whether the athlete has a hearing impairment. The sub-belief of IBP may be maladaptive for deaf athletes compared to their hearing counterparts. It is speculated that deaf athletes may be less satisfied with their goal progress and thus the importance placed on achieving perfection leads to greater ill-being. Regarding OHS, previous research by Campbell and Di Paula (2002) also revealed that OHS was uncorrelated with well- and ill-being indices in hearing students, supporting our findings concerning hearing athletes. Little is known about the correlates of OHS in deaf people, but it is speculated that deaf athletes consider others' expectations as a form of social support which fosters psychological health in deaf athletes.

**17:00 - 18:15**

## Plenary sessions

### PS-PL01 Does Pain Produce Gain? \*

#### UNCERTAINTIES REGARDING SOME OF THE EXPECTED BENEFITS OF REGULAR EXERCISE

Bouchard, C.

*Pennington Biomedical Research Center*

From a public health perspective, regular exercise is beneficial for everyone. This view is based on cross-sectional and longitudinal epidemiological studies and on observed average responses in exercise intervention studies. However, this notion needs to be critically evaluated considering the body of data on human variation in response to regular exercise. The concept of individual differences in the response to exercise was first defined three decades ago in a series of experiments with monozygotic twins and nuclear families. A powerful way to investigate the biological basis of human variation in the response to regular exercise is to use transcriptomic and genomic technologies. Whole-genome transcriptomics from skeletal muscle samples yielded a panel of 29 transcripts whose abundance profile accounted for 58% of the variance in VO<sub>2</sub>max gains among 24 sedentary men trained for 6 weeks, and these findings were replicated in a second study. A genome-wide association study was undertaken in the HERITAGE Family Study based on 324,611 single nucleotide polymorphisms (SNPs). Multivariate regression analyses showed that the top 21 SNPs explained 49% of the variance in VO<sub>2</sub>max trainability. A predictor score was constructed based on allelic composition at these SNPs, with a theoretical range from 0 (no beneficial alleles) to 42 (two copies of the beneficial alleles at all 21 loci). The difference in VO<sub>2</sub>max trainability between those carrying 9 or less of these alleles and those carrying 19 or more was threefold. Similar observations have been made for the training-induced changes in exercise hemodynamic, insulin and glucose, and lipid and lipoprotein traits. These results suggest that it may eventually be possible to predict who will benefit the least or the most from regular exercise for common cardiometabolic risk factors or physical performance. An examination of the response distribution for risk factor traits to regular exercise in HERITAGE yielded suggestive evidence that there were adverse responders. Further exploration in five other exercise intervention cohorts revealed that the prevalence of adverse responders reaches about 10% for a given risk factor while about 7% among almost 1,700 adults experienced multiple adverse responses. It is critical to be able to identify molecular predictors of the ability to respond to regular exercise not only for our understanding of the underlying biology, but also to screen individuals at risk of developing potentially harmful response patterns and to define realistic expectations at the individual level. It is simply not true that adverse responders, nonresponders, and low responders have failed to exercise hard enough. It is time to move away from the "no pain, no gain" model and to embrace the personalized exercise medicine paradigm.

#### UNIFICATION OF CONCEPTS AND MEASURES FOR CAPTURING THE MOND CONTROL OVER THE MOTION SYSTEM

Tenenbaum, G.

*Florida State University*

Of great concern is how well one may perform tasks under conditions of intense pressure or high cognitive workload, and how decision-making skills may be influenced when emotions and time-based pressures call for immediate actions to be taken. Under such conditions without properly integrated emotional responses, cognitive processes and subsequent behaviors could potentially make a dangerous or even fatal decision. This presentation examines how relationships between emotions, cognitive processes, and motor behaviors change under stress and lay out a framework that details how linkages may alter under specific conditions of perceived pressure. Is it the case that stronger emotional control can mediate the cognitive-motor relationship and result in better performance? What are the underlying mechanisms that enable or prevent efficient courses of action from occurring? Though sound theories have been put forth and extensive research has been devoted to investigate these questions, most of those initiatives have not taken an integrative approach to examine how the emotional, cognitive, and motor systems interact. More specifically, the structural components of human performance, such as emotional processes (i.e., feelings, mood), cognitive processes and structures (e.g., knowledge architecture, long-term working memory), motor processes (coordination, endurance), and the neurophysiological basis of these structural components (i.e., activation of cortical areas) have been studied independently. This presentation provides a conceptual framework to address the integration across these systems, and proposes a unified theoretical framework that offers an improved understanding of human performance as well as helping to generate scientifically valid applications.

# Thursday, June 27th, 2013

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**08:30 - 10:00**

## Oral presentations

### OP-PM22 Nutrition [NU] 3

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#### **EVALUATION OF FOOD PROVISION AND NUTRITION SUPPORT AT THE LONDON 2012 OLYMPIC AND PARALYMPIC GAMES.**

Pelly, F.1, Meyer, N.2, Pearce, J.2, Burke, L.4, Burkhart, S.1

*1:USC (Queensland Australia), 2:University of Colorado (Colorado USA) and United States Olympic Committee, 3:High Performance Sports NZ (Auckland New Zealand), 4:AIS (Canberra Australia).*

**Introduction** Over the past thirty years there has been an increasing emphasis on the food provision and nutrition support for athletes at major competition events such as the Olympic Games. While evaluation of this service has been conducted at previous events (Pelly et al., 2009; Burkhart and Pelly, 2013), expert opinion of this process has not been investigated. Therefore, the aim of this study was to evaluate the food provision and nutrition support at the London 2012 Olympic (OG) and Paralympic Games (PG) from the perspective of nutrition experts attending the event. **Methods** Experienced nutrition professionals who attended the London 2012 OG's and PG's were invited to complete an online survey and rate on a Likert scale of 1 'very poor' to 5 'very good', the dining hall menu, food for specific situations, cultural requirements, dietary regimens, and nutrition support. Open-ended questions were included to explore responses in more depth and allow suggestions for improvement. **Results** While factors such as variety, freshness, cultural and religious representation and temperature rated highly ('average' to 'good'), specific items (in particular, gluten free items, sports bars, meal replacement/high energy drinks, and snack bars) were rated as poorly represented on the menu. Mean low ratings were also received for provision of recovery items ( $M=2.1$ ,  $SD=0.78$ ), food for travelling to ( $M=2.7$ ,  $SD=1.00$ ) and at venues ( $M=2.8$ ,  $SD=1.17$ ), and ability to take snacks out of the dining hall ( $M=2.7$ ,  $SD=0.95$ ). While nutrition labelling of individual items was supported, the use of websites and applications for accessing information about the menu was suggested as a better service for athletes. **Discussion** While the general consensus of experts was that the menu met the needs of most athletes, several areas of improvement were noted. These included refining food provision to better cater for athlete recovery (dairy and snack items, and food provided outside of the village), weight management (modification of recipes to low fat) and catering for therapeutic needs (gluten free). These results are supported by previous studies on athletes' opinion of food provision at past events (Pelly et al., 2011; Burkhart and Pelly, 2013), are in line with current evidence for competition and recovery, and therefore should be a focus for future events. **References** Burkhart S, Pelly F.(2013). *Int J Sport Nutr Ex Metab*,23,11-23. Pelly F, O'Connor H, Denyer G, Caterson I.(2009). *Int J Sport Nutr Ex Metab*, 19, 340-354. Pelly F, O'Connor H, Denyer G, and Caterson I.(2011). *Nutr Rev*, 69, 321-332.

#### **WEIGHT STATUS IN PRIMARY SCHOOL CHILDREN: THE ACTUAL VERSUS THE PERCEIVED BY PARENTS**

Leitão, R.1,2, Lopes, A.1, Freitas, H.1, Pereira, S.1

*1: School of Education at Polytechnic Institute of Viana do Castelo. 2: Research Centre on Child Studies at University of Minho.*

**Introduction** Parental perception of their child's overweight is considered to be a crucial factor for its management. In Portugal, the most recent data revealed that childhood overweight has reached an alarming dimension. Therefore, we aimed to examine the parental perception of their children's weight status. Given the limitations of body mass index (BMI) as an index of adiposity, we further used a measure of excess central adiposity. **Methods** This study involved a convenience sample of 110 parent-child dyads from two public primary schools in Viana do Castelo (Northern Portugal). The mean age (SD) of children and parents was 8.7(0.6) and 38.2 (4.7) years, respectively. Anthropometric assessment (weight, height and waist circumference) was performed during physical activity sessions at school setting. Parent self-reported perception data was obtained through administered questionnaires. Children's actual weight status (BMI-based) was defined by the International Obesity Task Force standards (Cole et al., 2000; 2007). A waist-to-height ratio (WHtR)  $\geq 0.5$  was used as cut-off for excess central adiposity (McCarthy and Ashwell, 2006). **Results** There was a poor agreement between the actual children's weight status and the one perceived by parents, as indicated by a Kappa of 0.37 ( $P<0.001$ ). The combined prevalence of overweight and obesity (BMI-based) was 33.6%, whereas only 12.7% of parents perceived their children as overweight. None of the participants objectively classified as obese (3.6%) was recognized as so by their respective parents, but all thin children (3.6%) were. Excess central adiposity was found in 42.7% of the total sample, with no significant differences between boys (20.0%) and girls (22.7%,  $P=0.8$ ). Misconception of excess central adiposity is of great concern, since 69.6% of parents of children with a WHtR $\geq 0.5$  perceived their children as having normal weight. **Conclusion** The misclassification observed shows that parents tend to underestimate overweight and obesity. Lack of recognition of excess central adiposity seems to be even more problematic. **References** Cole T, Bellizzi M, Flegal K, Dietz W (2000). Establishing a standard definition for overweight and obesity worldwide: international survey. *BMJ* 320:1240-1243. Cole T, Flegal K, Nicholls D, Jackson A (2007). Body mass index cut-offs to define thinness in children and adolescents: international survey. *BMJ* 335:194-197. McCarthy HD and Ashwell M (2006). A study of central fatness using waist-to-height ratios in UK children and adolescents over two decades supports the simple message - 'keep your waist circumference to less than half your height'. *Int J Obes (Lond)* 30: 988-992.

#### **NUTRITIONAL ASSESSMENT OF HIGH INTENSITY TRAINING COLLECTIVE: STATUS OF VITAMINS**

García Hortal, M., Molina-López, J., Ortiz, M., Sáez-Pérez, L., Planells del Pozo, M.E.

*Faculty of Pharmacy, University of Granada*

**Introduction** Vitamin deficiencies and nutritional excess alter performance and the optimization of results. Unbalanced diets and bad eating habits cause adverse effects, so nutrition is important to control high intensity athletes because their increased energy expenditure

requires a huge intake. The aim of this study was to evaluate the nutritional status focused on vitamins in a young male adult collective trained with high intensity tests. For that, we made an assessment of the nutritional evaluation, intake habits, anthropometric measures and physical tests. Methods This is a cross-sectional study. Twelve men, aged  $25.8 \pm 4.2$  years, participated in the study voluntarily. Real kcal intake was measured with NUTRIBER software, the anthropometry with TANITA and specific methodology, and the physical condition was tested with practical exercises (2000m run, high jump, a circuit and pull-ups). SPSS 7.0 program was used to determine the bivariate Pearson's correlation between vitamins and other parameters. Probability level for statistical significance was set at  $\alpha=0.05$ . Results The Recommended Dietary Allowance (RDA) of Energy, Protein, Lipids, Carbohydrates, Vitamin B2, Vitamin B6 and Vitamin C were 76.1, 219.9, 80.8, 63.1, 116.4, 140.4 and 194.2, respectively. Vitamins B2 ( $r=0.771$ ;  $p=0.005$ ) and B6 ( $r=0.727$ ;  $p=0.011$ ) were directly correlated with pull-ups. Significant associations ( $r=0.617$ ;  $p=0.033$ ) were found between lipids and carbohydrates intake. Also, significant correlations were found between the intake of Calcium, Proteins and Carbohydrates, and the latter with Selenium ( $r=0.609$ ;  $p=0.036$ ). Energy intake was directly correlated with the intake of macronutrients and the intake of Selenium ( $r=0.591$ ;  $p=0.043$ ). The intake of protein was correlated with Vitamin C ( $r=0.655$ ;  $p=0.021$ ). There was also a high correlation between the intake of Protein and Vitamin B2 ( $r=0.895$ ;  $p<0.001$ ) and Vitamin B6 ( $r=0.915$ ;  $p<0.001$ ). Protein intake was also directly correlated with the intake of Vitamin E ( $r=0.756$ ;  $p=0.004$ ) and pull ups ( $r=0.784$ ;  $p=0.004$ ). Discussion According to the results, the group studied shows imbalances in nutrient intake that given the association can alter the availability of other macro and micro nutrients, affecting the results on training. For that reason, nutritional counseling and the nutritional optimization are necessary as well as monitoring these types of collectives. References Lim JH, Kim EN, Kim MY, Chung S, Shin SJ, Kim HW, Yang CW, Kim YS, Chang YS, Park CW, Choi BS. (2012) *Oxid Med Cell Longev*. 2012;171383. doi: 10.1155/2012/171383. Morteza Jourkesh, Iraj Sadri, Amineh Sahranavard, Ali Ojagi, Mohammad Dehganpoori (2012) *Journal of American Science*, 2011;7(6):852-858 Michalis G. Nikolaidis, Chad M. Kerkick, Manfred Lamprecht, and Steven R. McNulty (2012) *Oxid Med and Cell Longev* Volume 2012, Article ID 707941, 11

## PROTEIN DISTRIBUTION AND QUANTITY AMONGST ELITE RUGBY PLAYERS

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1. Queensland University of Technology 2. University of the Sunshine Coast

Introduction: Optimising protein intake to promote gains in skeletal muscle mass (SMM) is considered important by many athletes (Phillips et al, 2007). Research has suggested that muscle protein synthesis may be optimised by a single 20g protein dose (approximately  $0.3\text{g}\cdot\text{kg}^{-1}$  body mass) with no further stimulation at higher doses (Moore et al, 2007). One acute study reported enhanced muscle protein synthesis when protein was consumed after resistance training as several small 20g doses, rather than larger, less frequent doses (Areta et al, 2012). This study aimed to examine self-reported protein distribution and dose in elite development rugby union athletes. A secondary aim was to assess the relationship between protein distribution and changes in fat-free mass (FFM) over a rugby pre-season. Methods: 25 athletes ( $20.5 \pm 2.3$  yrs;  $100.2 \pm 13.3$  kg) completed a 7d food diary. Food portion guides and Foodworks v.6.0.2562 (2009) were used to quantify food intake. Protein distribution scores were calculated as the number of times an eating occasion (>15 minutes apart) achieved a target amount of protein (20g or individually calculated target based on  $0.3\text{g}\cdot\text{kg}^{-1}$  i.e.  $30.0 \pm 4.0$ g) averaged per day. FFM was measured by dual energy x-ray absorptiometry. Results: The mean number of eating occasions was  $5.6 \pm 1.0$ . The protein distribution scores for 20g and calculated protein target were  $3.8 \pm 1.0$  ( $68 \pm 18\%$  of eating occasions) and  $2.8 \pm 1.1$  ( $50 \pm 20\%$  of eating occasions) respectively.  $2.0 \pm 0.9$  ( $36 \pm 16\%$ ) of all eating occasions exceeded the calculated protein target by more than 50%. The effect of 20g protein distribution score on changes in FFM was not significant ( $p=0.15$ ); regression analysis was impacted by statistical power and multicollinearity. Discussion: This study provides evidence that rugby players select a meal plan that includes larger, less frequent doses of protein. However, it is unclear whether protein distribution impacts on chronic changes in FFM. Chronic studies monitoring associations between dietary intake and protein distribution on changes in FFM or SMM pose several methodological and analytical challenges. Acute studies may assist by clarifying the optimal protein distribution and protein doses for changes in indicators of SMM synthesis. Further research is warranted to assess the impact of protein dose and distribution, with consideration of other dietary intake variables, on chronic changes in body composition amongst rugby union athletes. References: 1. Phillips, SM, Moore, D.R, Tang, J.E. (2007). *USNEM*, 17,558-576. 2. Moore, D.R. et al. (2009). *Am J Clin Nutr*. 89(1),161-168. 3. Areta, J.L et al. (2012) Timing and quantity of protein ingestion during prolonged recovery from resistance exercise alters myofibrillar protein synthesis. *Am J Clin Nutr*, ahead of print.

## GLYCAEMIC INDEX BREAKFASTS AFFECT CONGITION BUT NOT LUNCH INTAKE IN ATHLETIC MALES

Wu, D.M.Y., Bowtell, J.L., Williams, C.A.

University of Exeter

Introduction Low blood glucose concentration [Glu] is associated with impaired cognition and hunger whilst elevated [Glu] improves cognitive response time. Attention and memory are better in adolescent (Cooper et al. 2012) and older adults (Nilsson et al. 2009) after low vs high glycaemic index (GI) foods, but the effects of breakfast GI on cognitive function and appetite in active male adults have not been explored. Methods Sixteen athletic males (mean  $\pm$  SD; age  $24.4 \pm 3.6$  y, BMI  $22.9 \pm 3.3$  kg/m<sup>2</sup>) participated in a randomised cross-over study providing a low GI (LGI) (42.2) and a high GI (HGI) (72.4) breakfast. The breakfast contained 1 g carbohydrate per kg body mass matching contents of protein, fat and fibre; and caloric density. Participants started the 25-min rapid information process task (RIPT) and Stroop Colour Word Task (SCWT) 15 min post-meal. Three rounds were completed with a 15-min break in between. Appetite score (AS) using visual analogue scales and capillary [Glu] were monitored regularly. An ad libitum HGI lunch was provided 3 hours post-breakfast. Results The area under the curve of the HGI [Glu] was higher than that of the LGI [Glu] until 90 min post-breakfast ( $585 \pm 61$  vs  $627 \pm 64$  mmol/L min,  $p = 0.029$ ). Peak [Glu] were observed prior to task 1 (LGI vs HGI:  $6.9 \pm 1.1$  vs  $8.1 \pm 1.2$  mmol/L,  $p = 0.003$ ). The LGI and the HGI [Glu] returned to the baselines at 90 min and 105 min respectively. The number of correct-wrong response of HGI task 1 RIPT was negatively associated with its pre-task 1 [Glu] ( $r = -0.68$ ,  $p = 0.003$ ). The HGI task 2 and the LGI task 3 SCWT interference scores were negatively associated with the HGI pre-task 2 [Glu] (90 min) ( $r = -0.56$ ,  $p = 0.025$ ) and the LGI pre-task 3 [Glu] (105 min) ( $r = -0.53$ ,  $p = 0.036$ ) respectively. The HGI pre-lunch [Glu] was lower than its baseline ( $4.0 \pm 0.17$  vs  $4.3 \pm 0.13$  mmol/L,  $p < 0.001$ ). Although there was no difference in AS between trials, both pre-lunch AS were positively associated with the LGI ( $r = 0.51$ ,  $p = 0.045$ ) and the HGI ( $r = 0.66$ ,  $p = 0.005$ ) lunch intakes per kg fat free mass. Discussion A HGI breakfast is not advised if a demanding cognitive task shortly follows the meal. High post HGI breakfast [Glu] reduced the number of correct response whilst the decline in attention was delayed after LGI vs HGI breakfast. The difference in the GI in breakfasts did not affect the lunch energy intake. Hence, as for adolescent and older adults, a LGI breakfast appears to support better cognitive function in athletic adult males. References Cooper, S. B., Bandelow, S., Nute, M. L., Morris, J. G., & Nevill, M. E. (2012). *Br J Nutr*, 107(12), 1823-1832. Nilsson, A., Radeborg, K., & Bjorck, I. (2009). *Eur J Clin Nutr*, 63(1), 113-120.

**THE ANALYSIS OF BODY COMPOSITION AND NUTRITIONAL STATUS IN ROWERS**

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1: Volga Region State Academy of Physical Culture, Sport and Tourism (Kazan, Russia) 2: Kazan State Medical University (Kazan, Russia) 1: Volga Region State Academy of Physical Culture, Sport and Tou

**Introduction** The improvement of athletic performance and the level of adaptation to physical performance are provided with the control of the body weight and composition and range of biochemical parameters (Banfi G, 2012). This study aimed to analyze the nutritional status, body composition, as well as the hormonal and lipid profiles of Russian rowers. **Methods** Twenty Russian sub-elite rowers (15 males and 5 females; aged 20.8±2.0) were examined with professional body composition analyzer Tanita MC-980 (Japan), blood tests and questionnaire survey. **Results** Analysis of the questionnaires revealed that 65% of athletes had balanced and complete diet, 35% of athletes have pointed to the lack of dietary fiber and protein products. Seventy percent of the athletes took food 3-4 times a day, 10% - only 2 times a day. Thirty five percent of respondents completely avoided fizzy drinks, 35% of athletes consumed them about once a week, 20% - once a month, and 10% - 1-2 times a year. It was established that 20% of the athletes had chronic gastritis, and 5% - gastric ulcer in their past medical history. Lean body mass in males and females was 67.09±7.5% and 52.95±3.11%, respectively; proportion of body fat in males and females was 10.65±4.55% and 23.18±4.24%, respectively. Furthermore, basal metabolism rate (2063±270.2 vs. 1637±59.31 kcal) and total body water (64.5±2.71 vs. 55.35±2.53%) was larger in males than in female athletes. Analysis of lipid profile of rowers: the average concentration of the total cholesterol was 4.13±0.64 mmol/l, low-density lipoproteins - 2.49±0.47 mmol/l. The average value of the high-density lipoproteins was 1.27±0.23 mmol/l, indicating that rowers had reduced levels of the HDL in comparison with the reference ranges (normal range > 1.55 mmol/l). Analysis of the hormonal profile of female athletes showed appropriate levels of all hormones with reference ranges (cortisol 360.8±68.75 nmol/l, total testosterone 1.54±0.44 nmol/L and free testosterone 0.99 (0.41-3.92) pg/ml). had The mean values of cortisol, total testosterone and free testosterone in males was 458.8±151.4 nmol/L, 19.56±5.98 nmol/l, and 13.5 (5.04 -57.85) pg/ml, respectively. **Discussion** In conclusion, our study revealed that rowers had significant nutritional deficiencies. A reduction in the level of high-density lipoproteins in the blood serum of the majority of athletes was determined. It is important to emphasize that the changes in lipid and hormonal profiles were primarily found in male athletes. **References** Banfi G, Colombini A, Lombardi G, Lubkowska A. Metabolic markers in sports medicine. *Adv Clin Chem*. 2012

**08:30 - 10:00****Oral presentations****OP-PM40 Sports Medicine [SM] 1****FATIGUE EFFECTS ON SENSORIMOTOR CONTROL IN ATHLETES WITH AND WITHOUT FUNCTIONAL ANKLE INSTABILITY**

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1: University of Erlangen-Nuremberg (Erlangen, Germany), 2: University of Hamburg (Hamburg, Germany)

**Introduction** Sensorimotor control is acutely affected by fatiguing exercise (Paillard, 2012). Further, deficits exist in individuals with functional ankle instability (FAI) (Hertel, 2008). It is unclear whether the presence of ankle instability increases the magnitude of fatigue-induced sensorimotor control alterations. **Methods** 57 athletes, 19 individuals with FAI, 19 ankle sprain copers and 19 non-injured controls participated in this study. Center of pressure sway velocity in single-leg-stance (vCOP), time to stabilization (TTS) in a unilateral jump-landing task, maximum reach distance in the star excursion balance test (SEBT) and passive ankle joint position sense (JPS) were assessed in a randomized, counterbalanced order before and immediately after a fatiguing treadmill running exercise. A three factorial linear mixed model was specified for each of the main outcomes to evaluate the effects of a previous ankle sprain ('FAI', 'coper'), exhausting exercise ('fatigue') and their interactions ('fatigue' x 'FAI', 'fatigue' x 'coper'). Effect sizes (ES) were calculated as Cohen's d. **Results** In unfatigued condition, the FAI group demonstrated lower SEBT scores in anterior (p=.004; ES=-0.38) and lateral direction (p=.026; ES=-0.30) compared to controls. No pre-fatigue differences existed between copers and controls for any outcome measure. TTS, SEBT and vCOP, but not JPS, were negatively affected by fatigue in all groups. Copers suffered significantly larger pre-fatigue to post-fatigue reductions in anterior reach direction compared to the FAI (p=0.007; ES=-0.36) and control group (p=0.052; ES=-0.26). No other significant group by fatigue interactions existed. However, the FAI group demonstrated the largest fatigue effects in medial SEBT (p=0.002; ES= -0.42) and medial-lateral TTS (p≤0.001; ES= 0.63). **Discussion** Physical fatigue caused sensorimotor control impairments in athletes with a history of an ankle sprain. Although effects were small, the presence of ankle instability appeared to increase fatigue-induced alterations of postural control. **References** Paillard T. (2012). *Neurosci Biobehav Rev*, 36(1), 162-176. Hertel J. (2008). *Clin Sports Med*, 27(3), 353-370.

**RELATIONSHIP BETWEEN NEUROPSYCHOLOGICAL PERFORMANCE AND OCCURRENCE OF KNEE INJURIES IN TEAM SPORTS**

Dallinga, J., Does, H.T.D., van der Benjaminse, A., Lemmink, K.A.P.M.

University Medical Center Groningen and University of Applied Sciences (Groningen, Netherlands)

**Introduction** Determining risk factors is crucial for the prevention of injuries (Van Mechelen et al., 1992). Recently, attention has been paid to neuropsychological screening for knee injuries. Reaction time in anterior cruciate ligament (ACL) injured players was slower compared to uninjured players (Swanik et al., 2007). The aim of this study was to compare neuropsychological performance at baseline between elite team players with and without a knee injury during the subsequent season. **Methods** Fifty male (age=22.9 ± 3.9 y, height=193.5 ± 7.9 cm, mass=87.1 ± 10.6 kg) and 19 female (age=21.5 ± 2.9 y, height=175.9 ± 7.3 cm, mass=69.0 ± 11.7 kg) elite team players participated in this study. At baseline, the determination test (DT) and peripheral perception test (PP) of the Vienna Test System (Schuhfried, Moedling, Austria) were used to calculate reaction time and accuracy of reactions. In the consecutive season injuries were reported by team physical therapists (Fuller et al., 2006). Student t-tests were used to analyze differences between injured and uninjured players. **Results** Seven acute (10.1% of players) and 11 overuse knee injuries (17.4% of players) were reported. A slower reaction time was found in

athletes that sustained an overuse knee injury compared to uninjured athletes ( $645.45 \pm 63.46$  ms vs  $614.56 \pm 54.55$  ms,  $p < 0.05$ ). Players that sustained an overuse knee injury showed fewer reactions in total ( $237.67 \pm 11.33$  vs  $244.56 \pm 13.22$ ,  $p < 0.05$ ) and fewer reactions on time ( $189.67 \pm 21.15$  vs  $200.91 \pm 17.77$ ,  $p = 0.03$ ) compared to uninjured players. Finally, fewer reactions in total were found in players that sustained an acute knee injury compared to uninjured players ( $235.14 \pm 8.47$  vs  $244.29 \pm 13.25$ ,  $p = 0.04$ ). Conclusion A slower reaction time and lower accuracy of reactions were shown in players that sustained an overuse injury compared to uninjured players. No speed-accuracy trade-off was seen (Pachella, 1974), since a slower reaction time to stimuli was accompanied by fewer reactions. A lower accuracy was reported in players that sustained an acute knee injury compared to uninjured players. Reaction time and accuracy of reactions seem potential screening tools for knee injuries. The mechanism behind the relation between neuropsychological performance and knee injury needs further examination. References Fuller CW, Ekstrand J, Junge A, et al. (2006) *Scand J Med Sci Sports*;16:83-92. Pachella RG. (1974) In B.H. Kantowitz (Ed.), Hillsdale, NJ: Erlbaum Swank CB, Covassin T, Stearne DJ, et al. (2007). *Am J Sports Med*;35:943-948 Van Mechelen W, Hlobil H, Kemper H. (1992). *Sports Med*;14:82

### **MODERATE ENDURANCE EXERCISE IN SICKLE CELL DISEASE PATIENTS: EFFECTS ON OXIDATIVE STRESS, NITRIC OXIDE BIOAVAILABILITY AND ENDOTHELIAL ACTIVATION**

Faes, C.1, Martin, C.1, Connes, P.2,3, Balayssac-Siransy, E.4, Hivert, L.1, Bogui, P.4, Pialoux, V.1

1 University of Lyon 1, France; 2 University of French West Indies, Pointe à Pitre, France; 3 PRES Sorbonne, Paris Cité, France; 4 University of Felix Houphouët Boigny, Abidjan, Ivory Coast

**Introduction** Sickle cell disease (SCD) is a genetic disease leading to the synthesis of abnormal hemoglobin (HbS). When deoxygenated, HbS polymerizes causing the sickling of red blood cells (RBCs). The recurrent painful vaso-occlusive crisis caused by the rigid and sticky sickle RBCs leads to severe organ damages. Intense exercise is often contra-indicated by health care professionals in SCD patients because the metabolic changes could promote RBC sickling. Nevertheless, few studies investigated the effects of exercise in SCD. The aim of this study was to test the effects of a mild-moderate endurance exercise on oxidative stress, nitric oxide bioavailability and endothelial activation biomarkers in SCD patients and non-SCD controls. **Methods** Twelve SCD patients and 15 healthy subjects (CONT) were enrolled in the study. They completed a 20 minutes duration submaximal cycling exercise at the same absolute intensity (50W). Before (Trest) and after the exercise (Tex), blood was sampled and plasma markers of oxidative stress (AOPP, MDA, nitrotyrosine), antioxidant activity (SOD, GPx, catalase, FRAP), endothelial activation (sVCAM-1, sICAM-1, sP-selectin, sE-selectin, sL-selectin) and NO bioavailability (NOx) were investigated. Results Plasma levels of sVCAM-1 and nitrotyrosine were significantly higher ( $P < 0.001$ ) and NOx, AOPP were significantly lower ( $P < 0.05$ ) in SCD compared to CONT subjects. While SOD and catalase did not differ between the two groups, GPx and FRAP concentrations were higher in SCD than CONT subjects at any time ( $P < 0.05$ ). sVCAM-1, sICAM-1 and MDA concentrations increased similarly in the two groups with exercise ( $P < 0.05$ ). The exercise did not induce significant changes for the other plasma markers. **Discussion** Although the exercise intensity was considered mild-moderate, plasma vascular adhesion molecules and MDA concentrations increased in both groups between Trest and Tex. In SCD patients, such increase may further increase the risks for vaso-occlusive complications. Concurrently, we however observed lower plasma AOPP in SCD patients that could be accounted for higher plasma total antioxidant capacity. Overall, this study is the first to report that mild-moderate exercise increases oxidative stress and endothelial activation in SCD patients. Based on the present data, care should be taken by SCD patients to practice safety moderate effort.

### **FOREARM DEOXYGENATION USING A HANDGRIP TEST IN SEVERE MITOCHONDRIAL MYOPATHY AND MCARDLE DISEASE**

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1Department of Movement and Sports Sciences, Ghent University, Ghent, Belgium 2Department of Pediatrics, Division of Pediatric Neurology and Metabolism, Ghent University Hospital, Ghent, Belgium 3Department of Neurology, Ghent University Hospital, Ghent, Belgium **Introduction** Mitochondrial myopathy (MM) describes mitochondrial diseases predominantly affecting skeletal muscle. The glycogen storage disease type V or McArdle describes a metabolic disorder, caused by a myophosphorylase deficiency. The validity and reliability of near infrared spectroscopy (NIRS) in skeletal muscle at rest and during exercise was reported earlier in literature. Therefore we propose a handgrip exercise protocol using NIRS for evaluation of microvascular oxygen extraction in patients with MM and McArdle disease. The reliability of this protocol has been established in a previous study (Celie et al., 2012). **Methods** Three groups of subjects were studied: 6 patients with McArdle disease, 11 patients with severe MM and 11 age- and gender-matched untrained healthy controls. The protocol started with arterial occlusion of the forearm by external compression until a steady state for deoxy[Hb+Mb] (100%-value) was reached. Deoxy[Hb+Mb] is the amount of unloaded hemoglobin and myoglobin (in  $\mu\text{M}$ ) and is considered as an index of oxygen extraction. Thereafter, a dynamic handgrip exercise protocol was used until exhaustion. The changes in deoxy[Hb+Mb] during each work step (i.e., the mean of the maximum 10-s) were expressed in percent. A Repeated Measures ANOVA was used to compare the increase in deoxy[Hb+Mb] between McArdle- and MM patients and healthy control subjects. Results A significant main effect ( $p < 0.001$ ) was found for groups indicating that the increase in deoxy[Hb+Mb] showed a significant different pattern for all populations. In the post hoc analysis significant deoxy[Hb+Mb] differences were found between MM patients and healthy controls ( $p < 0.001$ ) and between McArdle patients and healthy controls ( $p = 0.034$ ). No significant deoxy[Hb+Mb] difference was found between MM and McArdle patients ( $p = 0.112$ ). **Discussion** In accordance with the incremental cycle ergometric protocol in Grassi et al. (2007) we found an impaired oxygen extraction in McArdle and MM patients. NIRS can be confirmed as a valuable tool to detect impaired oxygen extraction, which can be useful in screening and follow up of patients. Important advantages of this handgrip exercise protocol are the small cost and low cardiovascular load, as some patients suffer from cardiomyopathy. References Celie B, Boone J, Van Coster R, Bourgois J. *Eur J Appl Physiol*. 2012 Jun;112(6):2369-74 Grassi B, Marzorati M, Lanfranconi F, Ferri A, Longaretti M, Stucchi A, Vago P, Marconi C, Morandi L. *Muscle Nerve*. 2007. 35(4):510–520. Do not insert authors here

## RELATIONSHIP BETWEEN CARDIORESPIRATORY FITNESS AND QUALITY OF LIFE IN RESPONSE TO A LIFESTYLE INTERVENTION STUDY IN BREAST CANCER SURVIVORS

Travier, N.1, Guillaumo, E.2, Agudo, A.1, Oviedo, G.R.3, Fonseca, A.1, Javierre, C.2

1-Catalan Institute of Oncology (ICO-IDIBELL), Barcelona, Spain; 2-University of Barcelona, Barcelona, Spain; 3-University Ramon Llull, Barcelona, Spain

**Introduction** Physical activity (PA) in breast cancer (BC) survivors may improve quality of life (QoL). Nevertheless, it is unclear whether PA interventions of moderate-to-high intensity could promote significant changes in cardiorespiratory fitness (CRF) and whether changes in CRF and QoL could be related<sup>2</sup>. The aim of the present study was to assess changes in QoL and CRF during a diet and PA intervention in BC survivors and to investigate the possible relation between these changes. **Methods** The intervention of this 12-week single-arm pre-post pilot study involved group-based sessions: one-hour weekly diet sessions delivered by a nutritionist and 75-minute bi-weekly PA sessions of moderate-to-high intensity led by experienced PA monitors. This intervention, conducted in 2012 at the Catalan Institute of Oncology (Barcelona, Spain), was designed to promote weight loss, and therefore targeted at overweight/obese women, aged 18 to 75, who had recently (up to 6 months previously) completed chemotherapy and/or radiotherapy for a non-metastatic BC. CRF and QoL were assessed before and after the intervention and compared using paired t-tests. Stepwise linear regression models, including CRF variables, weight change and participants' characteristics, were used to assess the independent association between changes in CRF and changes in QoL. **Results** Among the 37 BC survivors (out of 42) who completed the intervention, significant changes in CRF and QoL were observed. Peak O<sub>2</sub> uptake respect to body weight (mL.kg<sup>-1</sup>.min<sup>-1</sup>) increased from 19.0±2.8 to 24.0±4.1 (p<0.001) while workload respect to body weight (watts.kg<sup>-1</sup>) increased from 1.30±0.28 to 1.72±0.34 (p<0.001). The increase in workload respect to body weight was independently associated with increases in physical, mental and general health as well as with a decrease in fatigue. **Discussion** This lifestyle intervention in BC survivors improved participants' QoL and CRF and suggested possible relationships between CRF and QoL. Future research is needed to confirm these associations and design and promote lifestyle interventions that will improve BC survivors' QoL. **References** 1. Bicego D, Brown K, Ruddick M, et al. Effects of exercise on quality of life in women living with breast cancer: a systematic review. *Breast J* 2009;15:45-51. 2. Taylor DL, Nichols JF, Pakiz B, et al. Relationships between cardiorespiratory fitness, physical activity, and psychosocial variables in overweight and obese breast cancer survivors. *Int.J.Behav.Med.* 2010;17:264-70.

## COMPARISON BETWEEN THREE COMMON AND EFFECTIVE ENDURANCE TRAINING PROTOCOLS ON EXERCISE CAPACITY IN CORONARY ARTERY DISEASE

Tschantcher, M., Eichinger, J., Egger, A., Dröse, S., Haller, U., Niebauer, J.

Paracelsus Medical University, Salzburg

**Introduction** Endurance training is a key component of cardiac rehabilitation and recommended in treatment guidelines of all major professional societies [Heran 2011, Piepoli 2012]. During the past decades different endurance training protocols have been studied [Rognmo 2004, Helgerud 2011], however, a head-to-head comparison between the most effective modes, i.e. continuous endurance training (CET), high-intensity interval training (HIIT), and pyramid training (PYR), has not yet been performed in patients with coronary artery disease (CAD). **Methods** In this prospective, randomized study three isocaloric training protocols were compared: 1) CET (n=18): 31min at 65-75% HRpeak according to the European Guidelines of Cardiac Rehabilitation; 2) HIIT (n=17): 4x4min intervals at 85-95% HRpeak, each followed by 3min of active recovery at 60-70% HRpeak (25min total); and 3) PYR (n=19): three repetitions (each 8min) of gradual load increase and subsequent decrease from 65-95-65% HRpeak, supplemented by 2min recovery in between pyramids at 65% HRpeak (28min total). All protocols included 5min of warm-up and cool-down at 60-70% HRpeak. Supervised training was performed 3x/week for 6 weeks on cycle ergometers. Primary endpoint was physical work capacity during maximal ergometry. **Results** All protocols led to highly significant increases (p<0.001) of exercise capacity (begin vs. end: CET: 132W vs. 160W (21,2% increase); HIT: 148W vs. 180W (21,6%); PYR: 130W vs. 160W (23,1%)), without statistically significant differences between protocols. **Discussion** Our data clearly show that 6 weeks of exercise training leads to significant improvement in exercise capacity by >20%, regardless of the mode of endurance training. Therefore exercise training can be even more individualized and thus tailored to the specific preferences and needs of patients, which might have a positive impact on patients' compliance. **References** Heran, B.S., et al., *Cochrane Database Syst Rev*, 2011(7):CD001800 Piepoli, M.F., et al., *Eur J Prev Cardiol*, 2012 Rognmo, O., et al., *Eur J Cardiovasc Prev Rehabil*, 2004. 11(3): p. 216-222 Helgerud, J., et al., *Int J Sports Med*, 2011. 32(1): p. 54-9

08:30 - 10:00

## Oral presentations

### OP-PM47 Training and Testing [TT] 1

#### NON-INVASIVE DETECTION OF VENTILATORY BREAKPOINTS DURING FIELD TESTING IN RUNNING

Heyde, C.1, Leutheuser, H.2, Röcker, K.3, Gollhofer, A.1

1: DSSS (Freiburg, Germany), 2: DSG-PRL (Erlangen, Germany), 3: APH (Furtwangen, Germany)

**Introduction** Determination of the Ventilatory Threshold (VT) is one of the key parameter in cardiopulmonary fitness testing and individual training guidance (Gaskell et al. 2001). However, mainly due to methodological problems, neither the detection of VT nor Respiratory Compensation Point (RCP) is established in the field. Therefore, the aims of this study were to validate an available Respiratory Inductance Plethysmography (RIP) device (LifeShirt™ Garment, Wilhelm et al. 2003) during running exercise as well as to establish a novel statistical method for computerized detection of significant breakpoints in ventilation during a graded ramp test (RT) in the field. **Methods** During an incremental test (IT) on treadmill until voluntary exhaustion, breath-by-breath data recorded by RIP were compared to flow measurements at the orifice in 186 healthy subjects. VT, RCP and Lactate Threshold (LT) were determined as described by Beaver et al., 1986 and Roecker et al., 1998. Within 3 weeks around the IT two additional RT on track were performed, while subjects worn a RIP garment and speed was controlled. During RT slope changes in ventilation were determined as significant breakpoints (BP1 and BP2). Validity of RIP in

measuring breathing rate (fR) and tidal volume (Vt) was examined by means of  $R^2$  and equivalence statistics (Jones et al. 1996). Speed at LT and RCP were compared respectively to speed values at BP1 and BP2 in RT by examining Pearson's  $r$ . Test-Retest reliability of individual determined BP1 and BP2 between both RT was examined by equivalence statistics. Results Means of  $R^2$  ( $\pm$ SD) in fR and Vt respectively were  $0.96\pm 0.04$  and  $0.91\pm 0.05$  ( $p < .01$ ) whereat 99% and 96% of all breaths were measured within  $\pm 20\%$  limits of equivalence. After analyzing a random sample of 28 subjects, individual speed at LT and RCP correlated significantly to speed at BP1 ( $r=0.79$ ,  $p < .05$ ) and BP2 ( $r=0.72$ ,  $p < .05$ ), respectively. Speed values at BP1 and BP2 between both RT were equivalent within  $\pm 10\%$ . Discussion RIP is able to determine ventilatory timing and volume nearly equivalent to flow meter under conditions of various running speeds. Novel statistical methods applied on RIP data may enable detection of ventilatory breakpoints in field supportive for cardiopulmonary fitness testing and individual training guidance outside the lab. References Beaver, WL, Wasserman, K, Whipp, BJ (1986). *J Appl Physiol*, 60(6), 2020–2027. Gaskell, SE, Walker, AJ, Serfass, RA, Bouchard, AS et al. (2001). *Int J Sports Med*, 22(8), 586–592. Jones, B, Jarvis, P, Lewis, JA, Ebbutt, AF (1996). *BMJ*, 313(7048), 36–39. Roecker, K, Schotte, O, Niess, A, Horstmann, T, Dickhuth, H (1998). *Med Sci Sports Exer*, 30(10), 1552–1557. Wilhelm, F, Roth, W, Sackner, M (2003). *Behav Modif*, 27(5), 671–691.

## A RANDOMIZED CONTROLLED TRIAL TO INVESTIGATE THE EFFECTS OF TRAINING IN THE FUNCTIONAL MOVEMENT CIRCLE FOR ELDERLY ON FALL-RELATED RISK FACTORS

Morat, T., Mechling, H.

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**Introduction** Guidelines of fall prevention recommend in particular balance and resistance training to positively influence risk factors for falls (Sherrington et al., 2008). To facilitate the transfer of exercises to movements in daily life, functional tasks of daily living (=FT; for example stair climbing) were embedded in the Functional Movement Circle for Elderly (FuMoC-E) – in addition to systematic balance and resistance training exercises. The aim of this study was to analyse the effects of training in the FuMoC-E (IG1) in comparison to resistance and balance training without FT (IG2) and a control group (CG). **Methods** In this randomized controlled trial, 35 community-dwelling older adults aged 60 years and older were recruited. Participants were randomized into one of the three groups: IG1 (n=12), IG2 (n=11) trained over six months (twice a week) and the control group (n=12) maintained their usual activities. The primary outcomes were 1-repetition maximum test (= 1RM test) in leg and chest press, modified Timed Up and Go Test (modTUG: a: normal; with an additional b: cognitive and c: motor task), Maximal Step Length Test (MSLT), Chair Rise Test (CRT) and Multisurface Obstacle Test for Older Adults (MSOT; Morat et al., 2013). These parameters were measured at baseline, after three and six months. **Results** Six months after baseline, IG1 (+9%; +20%) and IG2 (+16%; +23%) improved in the 1RM test (in leg press; chest press (significantly)) in comparison with the control group (-4%; -4%) ( $p=.06/p=.01$ ). Concerning measures of functional mobility, modTUG showed changes in IG1 (a: +8%; b: +9%; c: +4%), IG2 (a: +5%; b: 0%; c: +2%) and CG (a: -2%; b: -6%; c: -3%) with significant improvements of IG1 (a:  $p=.003$ ; b:  $p=.004$ ) and IG2 (a:  $p=.034$ ). Results of MSLT displayed significant differences of IG1: +12% ( $p=.001$ ) and IG2: +8% ( $p=.021$ ) in comparison to CG: 0% ( $p=.022$ ). In MSOT, IG1 (+11%,  $p < .001$ ) enhanced performance with significant group differences at T3 in opposition to IG2 ( $p=.014$ ) and CG ( $p < .02$ ). **Discussion** The findings demonstrate that training in the FuMoC-E was an effective training program for the tested older adults to improve strength and functional performance after six months of training. The additional component of functional movements of daily life showed significant improvements in variables of functional performance than a sole resistance and balance training. Training in the FuMoC-E could address both strength and functional performance. **References** Morat T, Kroeger D, Mechling H. (2013). *Eur Rev Aging Phys Act*. DOI 10.1007/s11556-013-0121-0. Sherrington C, Whitney JC, Lord SR, Herbert RD, Cumming RG, Close JCT. (2008). *J Am Geriatr Soc*, 56(12), 2234–2243.

## A NEW MODEL FOR ESTIMATING PEAK OXYGEN UPTAKE BASED ON POST-EXERCISE MEASUREMENTS AND HEART RATE KINETICS IN SWIMMING

Schuller, T., Rodríguez, F.A., Iglesias, X., Barrero, A., Chaverri, D., Hoffmann, U.

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**Introduction** We aimed to assess the validity of a mathematical model based on heart rate (HR) and post-exercise  $\dot{V}O_2$  measurements for estimating peak  $\dot{V}O_2$  at the end of a swimming exercise. Its physiological rationale relies on the assumption that during the immediate recovery the systolic volume and the arterio-venous  $O_2$  difference remain practically constant for a certain period. According to Fick's principle, this leaves HR as the main parameter for changes in  $\dot{V}O_2$  (Drescher et al., 2010). **Methods** 34 elite swimmers performed 3x200 m at increasing submaximal speeds, followed by a maximal 200-m swim.  $\dot{V}O_2$  was measured breath-by-breath using a portable gas analyser (K4 b2, Cosmed, Italy) connected to the swimmer by a respiratory snorkel. HR was measured from RR intervals (CardioSwim, Freelap, Switzerland). Data were time aligned and 1-s interpolated.  $\dot{V}O_2$  at the end of exercise [ $\dot{V}O_2(\text{end})$ ] was the average of the last 20 s during the swim, and recovery  $\dot{V}O_2$  was the post-exercise 20-s average [ $\dot{V}O_2(0-20)$ ]. The model calculates a virtual  $\dot{V}O_2$  at time (t) of recovery [ $\dot{V}O_2(t)$ ], using the quotient between the peak HR during the last 10 s of the swim [HR(0)] and the 1-s interpolated value at (t) [HR(t)], multiplied by the 1-s interpolated  $\dot{V}O_2$  value at (t) [ $\dot{V}O_2(t)$ ], resulting in:  $\dot{V}O_2(t) = \text{HR}(0) / \text{HR}(t) \cdot \dot{V}O_2(t)$ . Different  $\dot{V}O_2$  average values were calculated for different recovery intervals (0-20, 5-20, 10-20, 15-20, and 10-15 s). **Results**  $\dot{V}O_2(\text{end})$  (mean  $3547 \pm$  SD  $692$  ml/min) was different from  $\dot{V}O_2(0-20)$  ( $3431 \pm 685$ ) (mean diff.  $-116$ , 3.3%,  $p=0.001$ ). All virtual  $\dot{V}O_2$  values were highly correlated with ( $R^2=0.86$  to  $0.96$ ,  $p < 0.001$ ), and not different from  $\dot{V}O_2(\text{end})$ . Best estimates (mean diff.  $< 0.5\%$ ) were delivered by  $\dot{V}O_2(0-20)$  ( $3564 \pm 698$ ,  $R^2=0.96$ ,  $\text{SEE}=120$ ) and  $\dot{V}O_2(5-20)$  ( $3559 \pm 705$ ,  $R^2=0.94$ ,  $\text{SEE}=121$ ). **Discussion** The difference between peak  $\dot{V}O_2$  at the end of the exercise and during recovery supports the need for the model, while the lack of differences and high correlation between peak  $\dot{V}O_2$  and the estimated post-exercise  $\dot{V}O_2$  support its basic physiological assumption, avoiding the uncertainty of the backward extrapolation method (Rodríguez, 1999). In conclusion, the proposed mathematical model for peak  $\dot{V}O_2$  estimation based on post-exercise measurements, which takes into account both HR and  $\dot{V}O_2$  off-kinetics, provides valid results when observing some limitations. **References** Drescher U, Essfeld D, Hoffmann U. (2010) 15th ECSS Annual Congress, Antalya. Rodríguez FA. (1999). *Biomechanics and Medicine in Swimming VIII*. Jyväskylä, Gummerus Printing.

**VALIDITY OF SUB-MAXIMAL ERGOMETER TESTS FOR ESTIMATING MAXIMAL AEROBIC CAPACITY IN CHILDREN**

Ekblom, Ö.

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The aerobic capacity in children is a central factor in youth sports due to its close relation to performance. Poor aerobic capacity has also been linked to increased prevalence of cardio-metabolic risk factors, increased risk for depression in adulthood and cognitive function and development. However, assessment of aerobic capacity using maximal tests poses a great challenge in unaccustomed children, and therefore different forms of sub maximal tests are frequently used. The aim was to compare validity between different cycle ergometer based methods for aerobic fitness testing in 11-12 yrs old children. Subjects (n=62) performed a bout of sub-maximal work on a mechanically braked cycle ergometer (893E; Monark Exercise, Vansbro, Sweden). Work rate was set to elicit a heart rate between 140 and 170 bpm. Åstrand-Rhyming (Å-R) nomogram-based values (unadjusted, age-adjusted and maximal heart rate adjusted) and values obtained using the Woynarowska and the Olgyn- Binyildiz methods were compared. Direct measurement was used as criterion method, using computerized metabolic system with mixing chamber (Oxycon Pro, Erich Jaeger GmbH, Germany). Correlation coefficients between measured values and the different Å-R based estimates varied between 0.734 and 0.753, with SEEs varying between 386 mL x min<sup>-1</sup> and 398 mL x min<sup>-1</sup> and CVs between 16.9 % and 19.8%. Unadjusted and maximal heart rate Å-R data gave a mean underestimation of 346 mL x min<sup>-1</sup> (19.0%) and 396 mL x min<sup>-1</sup>, respectively. Using similar method as Åstrand to correct for age related error, a proposed factor for age adjusting in 12 years-olds is 1.19. Multiplying unadjusted Å-R data by 1.19 gave a mean overestimation of 23 mL x min<sup>-1</sup>. The Olgyn Binyildiz-method correlated stronger with measured values (r=0.865) and gave a relatively small SEE (298 mL x min<sup>-1</sup>) and CV (14.7%), but resulted in a large underestimation by 660 mL x min<sup>-1</sup> or 27.8 %. Using the method proposed by Woynarowska to adjust obtained Å-R data increased correlation to 0.865, slightly decreased SEE (340 mL x min<sup>-1</sup>) and CV (17.2%) and generated a mean difference of 14 mL x min<sup>-1</sup>, thus smaller than the other methods. In studies with a test-retest design the use of the Olgyn Binyildiz-method is justified due to its low random error. On the other hand, in studies aiming at comparing data with those obtained with direct measurements or absolute values in larger groups, the Woynarowska or possibly the age adjusted Å-R method may be the primary choice due to their limited systematic error. Depending on the aim of a study, researchers must carefully make a decision on which method to select. Astrand PO, Ryhming I. (1954) Journal of applied physiology. 7:218-21 Binyildiz PO (1980) Eur J Appl Phys 43:213-9 Woynarowska B (1980) Eur J Appl Phys 43:19-23

**LIPID MOBILISATION AND RESPIRATORY QUOTIENT DURING REST AND EXERCISE IN YOUNG AND ELDERLY AFTER 2 WEEKS OF UNILATERAL IMMOBILISATION**

Vigelsoe, A., Gram, M., Noerregaard, J., Wiuff, C., Kuhlman, A.B., Dela, F., Helge, J.W.

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Background: During exercise lipids are a major fuel for skeletal muscle. Here we study lipid mobilisation and respiratory quotient (RQ) across the leg during rest and at moderate intensity exercise after 14 days of one leg immobilisation (IM) using the other leg as control (CON). Methods: Healthy young (Y) (n=14; age 23±1 yr (mean±SEM); 24±0.4 kg/m<sup>2</sup>; 45±1 ml O<sub>2</sub>/min/kg; bodyfat (BF%): 20±2%) and elderly (E) (n=12; age 68±1.2 yr; 27±0.2 kg/m<sup>2</sup>; 32±2 ml O<sub>2</sub>/min/kg; BF%: 29±2%) males were included. The subjects had one leg immobilised for 2 weeks with a DONJOY® cast. After immobilisation arterio(A)-venous(V) catheters were inserted in the brachial artery and femoral veins. A-V differences across the leg were measured at rest (-15 and 0 min) and during dynamic knee-extensor exercise in two independent one-leg kicking-ergometers (30 and 45 min). There was no difference in the absolute, (20±1 and 19±1 Watt for Y and E, respectively) or relative workload between YIM/YCON and EIM/ECON (55±3/49±3% and 50±3/47±5% of Wattmax, respectively). Blood flow was measured by ultrasound Doppler. VO<sub>2</sub>, FFA -uptake, VCO<sub>2</sub> and glycerol -release were calculated by Fick's principle. RQ was calculated from the ratio of V-A VCO<sub>2</sub> and A-V VO<sub>2</sub> -difference. Results: Y had lower BMI and BF% but higher VO<sub>2</sub>max compared to E (P<0.05). After 2 weeks of immobilisation leg lean mass (LLM) was higher (P<0.05) in YCON (10.5±0.3 kg) compared to YIM, ECON and EIM (10.1±0.3kg, 9.4±0.4kg and 9.4±0.3kg), respectively. At rest the RQ was higher (P<0.05) in YIM/YCON compared to EIM/ECON (0.93±0.04/0.92±0.04 and 0.84±0.02/0.84±0.02, respectively). However, during exercise the RQ for EIM/ECON increased to the level of YIM/YCON (0.92±0.02/0.92±0.02 and 0.92±0.02/0.91±0.02, respectively). At rest free fatty acid (FFA) uptake and glycerol release did not differ between YIM/YCON and EIM/ECON (FFA: -1.01±0.32/-1.04±0.38 and 0.20±0.70/0.60±0.80 μM/min/kg LLM; glycerol: 0.6±0.1/0.5±0.1 and 0.4±0.1/0.4±0.1 μM/min/kg LLM, respectively). During exercise FFA uptake increased (P<0.05) for both groups, with a larger increase (P<0.05) in the EIM/ECON compared to YIM/YCON (7.30±1.40/6.30±1.50 compared to 2.01±0.99/2.69±0.83 μM/min/kg LLM, respectively), whereas leg glycerol release only increased (P<0.05) from rest to exercise in YIM/YCON, but not in EIM/ECON (1.6±0.3/1.3±0.2 and 0.4±0.2/0.4±0.2 μM/min/kg LLM, respectively). Conclusion: Intriguingly, 2 weeks of complete leg immobilisation was not sufficient to induce changes in RQ across the leg during rest and exercise. Further, our findings imply that during exercise elderly utilize relatively more exogenously derived fatty acids per lean mass compared to young subjects.

**EFFECT OF PHYSICAL EXERCISE ON POSTURAL CONTROL IN PATIENTS WITH HIP OSTEOARTHRITIS**

Miller, R., Steinhilber, B., Haupt, G., Janssen, P., Grau, S., Krauss, I.

*University Hospital Tuebingen*

Introduction Numerous studies have identified Osteoarthritis (OA) induced changes as a factor that impairs postural stability (i.e. Hinman et al., 2002). Resulting balance deficits are associated with higher risk of falls (Lord et al., 2007), consequently leading to loss of independence and mobility. Physical exercise has been shown to improve postural stability in patients with OA. However, no study focuses on exercises in relation to static balance of patients with hip OA (hOA). Hence, this prospective, randomised, and placebo-controlled study aims to determine whether an exercise program specifically designed for patients with hOA can improve static postural control. Methods 218 patients with hOA (aged 59±10 years, BMI 27±4, 129 males) were randomly assigned to an exercise group (EG, n=71), a control group (CG, n=69), and a sham-ultrasound placebo group (PG, n=70). During a 12 week period, EG completed a home work-out (2/week) in addition to a weekly supervised group training. Sham-ultrasound was applied once a week, 15'. CG received no treatment. Postural control was assessed by quantifying centre of pressure (COP) velocity during single leg (SLS) and tandem stance (TS) on a plantar pressure measurement platform (Zebri Medical GmbH, Isny) before (M1) and after (M2) the intervention period. The Wilcoxon signed-rank tests were used to compare differences (M2-M1) between each of the groups (p<.05). Results There were no differences in TS (p=.90) or SLS (p=.71) of COP velocity between groups at baseline assessment. After the intervention period, participants of the EG showed significant improvement in TS compared to CG (p=.008) and to PG (p=.04). However, no significant differences were found in SLS between EG and

CG or EG and PG. Discussion This study shows that a specific exercise program designed for patients with hOA can improve static balance performance in a tandem stance position. The findings are consistent with results that have also shown improvements in postural stability measures of patients with hOA. Thus, Rasch et al. (2010) reported effects on balance in bilateral but not in unilateral standing conditions after total hip replacement. An explanatory approach for the improvements in TS but not in SLS may be the greater number of failed attempts in SLS compared to TS. This assumption agrees with an observation of Fox et al. (1996), who determined that SLS is not feasible for patients with hip fracture due to the great number of failed attempts. References Fox K, Felsenthal G, et al. (1996). Arch Phys Med Rehabil, 77, 171-176. Hinman R, Bennell K, et al. (2002). Rheumatology (Oxford), 41(12), 1388-94. Lord S, Sherrington C, et al. (2007). Falls in Older People, 163. Cambridge Univ Pr, London. Rasch A, Dalén N, Berg H (2010). Acta Orthopaedica, 81 (2), 183-88.

**08:30 - 10:00**

## Oral presentations

### OP-PM14 Neuromuscular Physiology [NP] 1

#### RESPONSE INHIBITION ALTERS PERCEPTION OF EFFORT INDEPENDENTLY OF NEUROMUSCULAR ALTERATIONS

Pageaux, B.1, Lepers, R.2, Rozand, V.2, Marcora, S.1

*University of Kent*

1: Endurance Research Group (SSES, University of Kent, UK); 2: INSERM U1093 (Université de Bourgogne, FR) Introduction Perception of effort (PE), defined as "the conscious sensation of how hard, heavy, and strenuous exercise is", is known to be a determinant of endurance performance (Marcora, 2009a). Recent studies demonstrated the negative effect of cognitive tasks involving response inhibition (RI) on PE during subsequent physical tasks (Marcora et al., 2009b; Pageaux et al., 2012). RI is a component of cognitive control, and it refers to the inhibition of inappropriate motor or emotional responses. These studies found higher PE independently of any alteration of the cardiorespiratory and metabolic responses to exercise. However, higher PE may be due to a negative effect of RI on neuromuscular fatigue. The aim of this study was to investigate this hypothesis. Methods Neuromuscular function was assessed in two different conditions: 1) pre and post a cognitive task involving RI (incongruent Stroop Task) to exacerbate PE; 2) pre and post a control cognitive task with no RI (congruent Stroop task). Both cognitive tasks lasted 30 min followed by 6 min of submaximal cycling at 80% of peak power output, and a third assessment of neuromuscular function. Rate of perceived exertion was measured during cycling. Results are presented as means  $\pm$  SEM, and analyzed by two-way repeated-measure ANOVAs. Results Neither cognitive tasks induced any central or peripheral fatigue ( $P > 0.05$ ). During cycling, subjects rated PE higher after the cognitive task involving IP (IP  $13.9 \pm 0.3$ , control  $13.3 \pm 0.4$ ). Cycling induced a similar decrease in maximal voluntary contraction (IP  $-13.4 \pm 4.3$  %, control  $-11.9 \pm 3.2$  %), voluntary activation level (IP  $-6.4 \pm 3.2$  %, control  $-6.3 \pm 2.4$  %) and resting twitch (IP  $-34.1 \pm 3.8$  %, control  $-34.7 \pm 3.3$  %) in both conditions. Discussion These results confirm the link between RI and PE. Moreover this study provides the first experimental evidence that the negative effect of RI on PE is independent of any neuromuscular alteration. Indeed, RI did not induce any central fatigue, and neuromuscular fatigue induced by cycling was similar in both conditions. These results suggest that RI and PE share some common neurobiological mechanisms, and that activities involving RI should be avoided before endurance competitions. References Marcora SM (2009a). Encyclopedia of Perception, 380-382. Marcora SM, Staiano W & Manning V (2009b). J Appl Physiol 106, 857-864. Pageaux B, Marcora SM & Lepers R (2012). The Biomedical Basis of Elite Performance, 53. London.

#### IMPACT OF NEUROMUSCULAR ELECTRICAL STIMULATION CURRENT CHARACTERISTICS ON NEUROMUSCULAR FATIGUE

Neyroud, D., Dodd, D., Gondin, J., Maffiuletti, N.A., Kayser, B., Place, N.

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Introduction Neuromuscular electrical stimulation (NMES) for rehabilitation and strength training purposes usually involves short pulses (50-400  $\mu$ s) at low-to-moderate tetanic frequencies (20-50 Hz), hereafter referred to as conventional (CONV) NMES (1). With CONV NMES motor units are recruited in a random, non selective and spatially fixed way, and a common problem is exaggerated muscle fatigue in comparison to voluntary contractions (2). NMES with larger pulse width ( $\sim$ 1 ms) at a higher frequency ( $\sim$ 100 Hz) (wide pulse high frequency, WPHF) may in part recruit motor units according to the size principle via a spinal reflex pathway, which could potentially minimize muscle fatigue (1). The aim of the present study was to test the hypothesis that muscle fatigue would be lower following WPHF compared to CONV NMES. Methods Fourteen healthy subjects (11 men and 3 women, aged  $27 \pm 4$  yrs) participated to two experimental sessions performed in a random order (WPHF and CONV NMES). WPHF (100 Hz-1 ms) and CONV (25 Hz-50  $\mu$ s) NMES was delivered to the triceps surae (20 repetitions with an on:off ratio of 20:40 s, at an initial target force of 10% of maximal voluntary contraction force (MVC)). The pre-post NMES decline in MVC force was considered as index of muscle fatigue. Voluntary activation level (VAL, twitch interpolation technique) and potentiated doublet force were used as indexes of central fatigue and peripheral fatigue, respectively. Results The reduction in MVC force (WPHF:  $-7.0 \pm 2.7$ %; CONV:  $-6.2 \pm 2.5$ %;  $p < 0.01$ ) and in doublet force (WPHF:  $-8.0 \pm 4.0$ %; CONV:  $-7.4 \pm 6.1$ %;  $p < 0.001$ ) were similar between conditions, whereas no change was observed for VAL ( $p > 0.05$ ). The 20 evoked contraction force-time integral was lower for WPHF than for CONV (WPHF:  $1086 \pm 834$  N.s vs. CONV:  $1898 \pm 559$  N.s,  $p < 0.001$ ). Further, force-time integral was reduced by contraction 2 in WPHF ( $p < 0.001$ ), whereas no reduction was observed in CONV ( $p > 0.05$ ). Conclusion Contrary to our hypothesis, we found a similar level of muscle fatigue, which can be mainly attributed to peripheral impairment, following both CONV and WPHF NMES despite differences in force-time integral induced by WPHF in comparison to CONV. These findings therefore suggest a random motor unit recruitment in both conditions. 1. Collins DF, Burke D, and Gandevia SC. J Physiol 538: 289-301, 2002. 2. Maffiuletti NA. Eur J Appl Physiol 110: 223-234, 2010.

**DOES TRUNK STRENGTH CORRELATE WITH THE ONSET TIMING OF ANTICIPATORY POSTURAL ADAPTATIONS?**

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**Introduction** Upright posture in human is an ongoing process of sensory-motor control. Stability is defined as ability to maintain the position or to continue intended movement, when perturbation occurs. Some perturbations are predictable and in such cases central nervous system induces anticipatory postural adaptations (APAs) which precede the perturbation. Fast voluntary arm rise represent expected perturbation, often used in protocols for APAs assessment (Bouisset and Do, 2008). The purpose of this study was to investigate if the strength of the trunk muscles and the onset timing of the trunk APAs are correlated. We hypothesized that there will be less delay between the trunk muscle activation and the beginning of the hand movement in subjects with stronger trunk muscles. **Methods** Seventeen healthy volunteers (5 female and 12 male; age  $29.6 \pm 6.4$  years; height  $173.6 \pm 7.8$  cm; weight  $73.4 \pm 9.8$  kg), without spinal or neurological disorder, participated in the study. Each subject performed 30 repetitions of fast voluntary arm raises in simple reaction time conditions to visual clue. Activation of 4 back and 4 abdominal muscles was recorded by means of surface electromyography. On the separate session, isometric strength of trunk flexors and extensors were measured in standing position with pelvis fixated. Results In all subjects trunk extensors were activated before the initiation of the hand movement and before the activation of the flexors ( $p < 0.001$ ). Pearson's correlation coefficient showed moderate negative correlation between the APAs of extensors and strength of the extensors ( $r = -0.619$ ,  $p = 0.011$ ) and the flexors ( $r = -0.498$ ,  $p = 0.049$ ). Onset timing of the trunk flexors activation was not statistically significantly correlated with the strength of the extensors ( $r = -0.439$ ,  $p = 0.089$ ) or flexors ( $r = -0.273$ ,  $p = 0.306$ ). **Discussion** Results supported the hypothesis and showed that there is about 38% of the common variance between the strength of trunk extensors and latency between activation of the trunk extensors and the beginning of hand movement. These findings are in agreement with the similar impulse hypothesis which suggests that in a fatigued muscle the reduced force capacity is compensated by increased latency of APAs (Strang and Berg, 2007). The candidate mechanism may be functional adaptation by the central nervous system to preserve postural stability. Although some mutual influence can be expected, both entities should be trained complementarily in terms of rehabilitation, prevention and performance. **References** Bouisset, S., and Do, M. C. (2008). *Neurophysiol Clin.* Dec;38(6):345-62. Strang, A. J., and Berg, W. P. (2007). *Exp Brain Res*, 178(1), 49-61.

**NEUROMUSCULAR CONTROL OF LEG STIFFNESS FOLLOWING SOCCER-SPECIFIC EXERCISE**

Oliver, J.L., De Ste Croix, M.B.A., Lloyd, R.S., Williams C.A.

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**INTRODUCTION** Little is known about potential changes in the control of rapid SSC actions following soccer-specific exercise. As strong associations have been demonstrated between neural feedforward and feedback mechanisms and leg stiffness in a non fatigued state (Oliver and Smith, 2010), it was hypothesised that changes to these mechanisms would influence leg stiffness following exercise. **METHODS** Ten youths aged  $15.8 \pm 0.4$  years participated in the study, completing 10 s of two-legged hopping at their preferred frequency pre and post 42 min of soccer-specific exercise. Leg stiffness was calculated via double-integration of vertical force-time data. Surface EMG was recorded from the Vastus Lateralis (VL) and Soleus (SOL) of the dominant leg. EMG data was smoothed using a linear envelope employing Butterworth fourth order zero lag filters (20 Hz high pass, 50 Hz low pass). EMG activity was normalized by integrating data during ground contact and calculating the contribution during specific phases; feedforward background activity (0-30 ms, BGA) and short (31-60 ms), medium (61-90 ms) and long (91-120 ms) latency reflexes, as well as during braking and push-off phases. **RESULTS** There was no significant change in stiffness following the soccer exercise ( $26.6 \pm 10.6$  versus  $23.9 \pm 7.0$  kN,  $p > 0.05$ ), with half the group showing an increase and half a decrease in stiffness (range  $-16.5$  to  $6.6$  kN change). Mechanically, changes in stiffness were primarily explained by altered centre of mass displacement ( $r = 0.90$ ,  $p < 0.01$ ) as opposed to changes in peak GRF ( $r = 0.58$ ,  $p > 0.05$ ). Changes in stiffness following exercise were strongly related to the change in BGA contribution in both the SOL ( $r = 0.94$ ,  $p < 0.05$ ) and the VL ( $r = 0.90$ ,  $p < 0.05$ ) and changes in SOL activity during braking ( $r = 0.88$ ,  $p < 0.05$ ), while relationships with changes to reflex contribution were mostly moderate in strength. **DISCUSSION** Forty-two minutes of soccer-specific exercise lead to individualised responses in alterations to leg stiffness. These changes appear driven by feedforward mechanisms given the strong association between the change in stiffness and the change in BGA. Changes in BGA may also modulate the total amount of muscle activity during the eccentric braking phase and consequently influence leg stiffness by altering centre of mass displacement. This may be both a performance and injury concern for those individuals who experienced a lowering of leg stiffness during exercise; with reduced feedforward activity potentially leading to some yielding upon ground contact. **REFERENCES** Oliver, J.L. & Smith, P. (2010). *Neuromuscular control of hopping in boys and men. Journal of Electromyography and Kinesiology*, 20:973-979

**CENTRAL AND PERIPHERAL CONTRIBUTIONS TO FATIGUE AFTER 4-KM, 20-KM AND 40-KM CYCLING TIME TRIALS**

Thomas, K., Goodall, S.G., Stone, M.R., Howatson, G., St Clair Gibson, A., Ansley, L.

*Northumbria University*

**Introduction** Fatigue is defined as an exercise-induced decrease in maximum voluntary force, or an inability to sustain exercise at a required force (Gandevia, 2001). The contribution of central and peripheral mechanisms to fatigue is largely task-dependent. Few studies have estimated these contributions to the fatigue observed during self-paced locomotor exercise. Moreover, none have assessed the degree of supraspinal fatigue. The aim of this study was to assess the aetiology of fatigue during self-paced cycling exercise of different durations. **Methods** Thirteen well-trained male cyclists ( $VO_{2max}$ ,  $4.26 \pm 0.38$  L min<sup>-1</sup>) completed 4-km, 20-km and 40-km simulated time trials (TT) in a randomised, counterbalanced order. Neuromuscular function was assessed pre- and post- each TT. Participants completed isometric maximum voluntary contractions (MVC) of the knee extensors with femoral nerve stimulation delivered during and 2 s post to assess voluntary activation (VA) and potentiated quadriceps twitch force (Q<sub>tw</sub>.pot). Transcranial magnetic stimulation (TMS) was delivered to the motor cortex at rest and during contractions at 100%, 75% and 50% MVC to measure corticospinal excitability and cortical voluntary activation, respectively (Goodall et al., 2009). **Results** Mean time to complete 4-km, 20-km and 40-km was  $5.96 \pm 0.20$  mins,  $31.84 \pm 1.04$  mins and  $65.76 \pm 2.18$  mins, respectively. Exercise resulted in significant global fatigue in all TTs, with no difference in the drop in MVC between trials. The 4-km was characterised by a greater degree of peripheral fatigue (40% reduction in Q<sub>tw</sub>.pot) compared to the 20-km and 40-km (31 & 29% reductions, respectively). In contrast, the longer TTs were characterised by a greater degree of central fatigue, evidenced by a greater reduction in VA (-12% and -10% for 20-km and 40-km vs. -6% for 4-km). Supraspinal fatigue contributed ~50% to the observed fatigue in the 20-km and 40-km and 32% in the 4-km. Corticospinal excitability was reduced post-trial in the 20-km and 40-

km but not in the 4-km. Discussion These data demonstrate the aetiology of fatigue during self-paced exercise is task-dependent, with a greater degree of peripheral fatigue evident in short (<6 mins) TTs and an increased contribution of central fatigue in longer TTs (>30 mins). The increased central fatigue in longer time trials is accompanied by an increased contribution of supraspinal fatigue, and a decrement in the integrity of the brain to muscle pathway. These findings provide novel insight in to the regulation of exercise intensity during self-paced locomotor exercise. References Gandevia SC. (2001). *Phys Reviews*, 81, 1725-1789. Goodall S, Romer L, Ross E. (2009). *Exp Phys*, 94, 995-1004.

### PERCEIVED EXERTION, TIME OF IMMERSION, AND PHYSIOLOGICAL CORRELATES IN ELITE SYNCHRONIZED SWIMMING DURING COMPETITION

Rodríguez-Zamora, L., Iglesias, X., Iruñia, A., Barrero, A., Chaverri, D., Rodríguez, F.A.

*INEFC-Barcelona Sports Sciences Research Group, Institut Nacional d'Educació Física de Catalunya, Universitat de Barcelona (Barcelona, Spain)*

Introduction The physiological response during competition in elite synchronized swimmers has been recently described (Rodríguez-Zamora et al., 2012). The rating of perceived exertion (RPE) appeared to be a fair indicator of internal load and discriminated between elite junior and senior swimmers. Here we aimed to examine the relationship between RPE, heart rate (HR) response, blood lactate, and immersion (IM) time in elite synchronized swimmers during competition. Method 17 elite synchronized swimmers (17.9±3.5 years) performed a total of 30 routines during an official national championship in the free (FS) and technical solo (TS) and free (FD) and technical duet (TD). HR was measured from RR intervals (CardioSwim, Freelap, Switzerland). Peak blood lactate (La) was measured during recovery (min 3, 5, 7, and 10). RPE was assessed using the Borg's category-ratio CR-10 scale after each performance. All routines were recorded using a digital video camera at a rate of 50 Hz and a time resolution of 0.02 s. A recording instrument was used to identify and time IM intervals. Differences between routines were assessed using one-way ANOVA. Pearson correlation coefficients (R) were calculated, and multiple regression models (MRM, Rm) were used to predict RPE from physiological parameters. Results Mean (±SD) RPE scores were 7.7±1.1 and did not differ among routines, as did not any of the HR parameters. A significant relationship (R, P<0.05) was found between RPE and La (0.50), pre- (0.37), minimum (-0.53), range (0.45), and 3- (0.44) and 5-min (0.45) post-exercise HR, number of IM (0.33), total time immersed (0.58), and number (0.50) and total IM time over 10 s. MRM revealed that minimum pre- and 5-min post-exercise HR, total time immersed over 10 s, and La accounted for 62% of the variance in RPE (Rm= 0.79; P< 0.001; SEE= 0.72). Discussion This is the first study to reveal a clear association between RPE and the frequency and duration of immersions during competitive SS. This is likely due to central factors which are thought to be linked to RPE, such as are the sensations primarily associated with the cardiorespiratory system resulting from tachycardia, tachypnea, and dyspnoea (Pandolf, 1978). RPE appears also related to the magnitude of bradycardic events and post-exercise blood lactate and HR, thus reflecting the psycho-physical stress imposed both by the intensity of dynamic exercise and the repeated prolonged breath-holding intervals during competition. References Pandolf K (1978). *Percept Mot Skills* 46(3), 683-698. Rodríguez-Zamora L, Iglesias X, Barrero A, Chaverri D, Erola P, Rodríguez, FA. (2012). *PLoS One* 7(11), e49098.

**08:30 - 10:00**

## Oral presentations

### OP-BN10 Motor Learning [ML] 1

#### THE CONTEXTUAL INTERFERENCE EFFECT IN PERCEPTUAL-COGNITIVE TRAINING

Broadbent, D.1, Causer, J.1, Ford, P.R.1, Williams, A.M.2

*1: LJMU, 2: Brunel University*

Introduction When multiple motor skills are practiced in a blocked manner it creates less contextual interference (low CI) compared to when multiple skills are practiced in a random order (high CI). Practice with low CI results in better performance during practice, whereas high CI leads to better retention and transfer of skill, referred to as the CI effect (Shea and Morgan, 1979). However, in contrast to the large body of work exploring the CI effect in motor skill learning, its effect on the training of perceptual-cognitive skills, such as anticipation, has not been explored, despite their key role during expert performance in sport. The aim of this study was to examine the relative effectiveness of low and high CI practice schedules when attempting to acquire anticipation skill in tennis using video-based simulation training. Methods Participants were required to anticipate shot direction when viewing life size video filmed from a first person perspective of opponents playing tennis shots occluded at ball-racket contact. Response accuracy scores were recorded at a pre-test, during acquisition, and at two delayed retention tests (7-days, 2-months). An on-court test was used to measure transfer of learning. During acquisition, one group practiced under low CI (n=9) in which the three types of tennis shot were practiced in separate blocks, whereas the other group practiced under high CI (n=9) in which the three shot types were practiced in a quasi-random order. Data were submitted to analysis of covariance, with pre-test scores as a covariate. Results There were no between-group differences on the pre-test or during acquisition. However, the high CI group had significantly (P<.01) higher response accuracy scores compared to the low CI group at the retention tests (7-days = 72% vs. 64%; 2-months = 62% vs. 56%) highlighting the benefits of random compared to blocked practice schedules for acquiring perceptual-cognitive skills. Moreover, decision times were significantly (P<.01) faster in the high CI group (94 ms) compared to the low CI group (248 ms) on the 7-day field transfer test, although this advantage disappeared on the 2-month field transfer test. Discussion This study is the first to examine the relative effectiveness of low and high CI practice schedules in perceptual-cognitive training. The CI effect was found to extend beyond motor skill learning to the training of anticipation. A high CI practice schedule led to improved retention and transfer of learning when compared to a low CI schedule, providing support for the findings of Shea and Morgan (1979). Findings suggest that perceptual-cognitive training programs should consider a high as opposed to low CI practice schedule. References Shea, J. B. and Morgan, R. L. (1979). *Jou of Exp Psych: Hum Learn and Mem*, 5, 179-187.

## THE COUPLING BETWEEN GAZE BEHAVIOUR AND OPPONENT KINEMATICS DURING SUCCESSFUL ANTICIPATION OF BADMINTON SERVES

Alder, D.I, Ford, P.R.I, Causer, J.I, Williams, A.M.2

1 *Liverpool John Moores (Liverpool, UK)*, 2 *Brunel (London, UK)*

**Introduction** Past research examining gaze behaviours has identified areas of an opponent's body that experts fixate vision upon during anticipation in sport (e.g., Williams and Elliott, 1999). However, scientists have devoted less effort to identifying when this postural information becomes available across the phases of an opponent's movement, how participants use it, and how it changes across different types of opponent actions. The aim of this study was to investigate the kinematic differences between two types of badminton shots (long and short serves) and then to examine whether players fixate vision upon that discriminating kinematic information during successful anticipation. **Methods** A full body kinematic analysis of four expert badminton players was undertaken as they completed long and short serves. Movement distance and peak acceleration of each marker were analysed in paired t-tests. Video of these players serving was used to create a life-size, first person perspective film containing 72 trials occluded at racket-shuttle contact. Expert (n = 8) and novice (n = 8) badminton players viewed the film whilst wearing an eye movement registration system and anticipating serve direction. Anticipation accuracy was analysed in an independent t-test. Visual fixation locations were analysed in a 2 Group x 2 Response Success x 4 Location ANOVA. **Results** Kinematic analysis revealed the movement contained two phases: the preparation and execution phase. During the execution phase, there were between-shot differences in movement distance and peak acceleration for the wrist, elbow, racket and shoulder (all P's < .05), but not at other body locations or in the preparation phase. Anticipation accuracy was higher (P<.01) in the expert (55 out of 72 trials) compared to the novice group (38 out of 72 trials). During the execution phase, the experts fixated upon the racket or wrist in more trials (68 out of 72 trials) than the novices (53 out of 72 trials) (P < .05), whereas for the other locations and in the preparation phase there were no differences. Moreover, during the execution phase, these two locations were fixated upon significantly more (P < .05) in successful (41 out of 72 trials) versus unsuccessful trials (19 out of 72 trials), whereas the other locations were not. **Discussion** This study was the first to show that expert performers fixate their gaze more frequently during the execution phase of movement on areas that had been identified in the kinematic analysis as discriminating shot types. Our data support and extend previous research (e.g., Williams and Elliott, 1999) by showing when postural information becomes available across the phases of a movement and how participants use it. Findings may be used as an intervention in training to change visual search and improve anticipation. **References** Williams, A.M., Elliott, D. (1999), *J Sport & Ex Psych*, 21, 362-375

## MUSCLE COORDINATION DURING BENCH PRESS IN UNTRAINED AND EXPERT POWER LIFTERS

Kristiansen, M., Madeleine, P., Hansen, E.A., Samani, A.

*Aalborg University*

**Introduction** Neural and muscular adaptations to resistance training result in increased strength. Part of these adaptations is thought to be related to improvements of the muscle coordination. The aim of the present study was to elucidate the role of expertise level on muscle synergies involved in bench press. We hypothesized that expert power lifters (EXP) would display less inter-individual variability in muscle synergies compared to untrained individuals (UNT). **Methods** Nine male UNT and 10 male EXP completed three sets of eight repetitions at 60% of 3 repetition maximum in bench press. Muscle synergies were extracted from surface EMG data from 8 muscles in 21 bench press cycles using a non-negative matrix factorization algorithm. A muscle synergy can be characterized by a synergy activation coefficient and a muscle synergy vector. The synergy activation coefficient reflects the strength of a muscle synergy within the entire movement while the muscle synergy vector reflects the activity of single muscles within a muscle synergy. A cross-correlation function was computed for the muscle synergy vector and the synergy activation coefficient for all participants in each group. The maximum of the cross-correlation function (rmax) was calculated as an index of similarity. **Results** Two muscle synergies accounted for more than 90% of the overall data variability. Muscle synergy 1 represented the concentric phase of the bench press, while muscle synergy 2 represented the eccentric phase. Cross correlations for synergy activation coefficient 2 were 0.82 (0.64;0.89) and 0.59 (0.46;0.81) (Median rmax (25th;75th percentile)) (P=0.001) in UNT and EXP, respectively. Median rmax for muscle synergy vector 2 was 0.58 (0.21;0.81) and 0.24 (0.02;0.60) (P=0.008) in UNT and EXP, respectively. **Discussion** Contradictory to our hypothesis, EXP showed larger inter-individual variability in muscle synergies than UNT as reflected by the lower rmax values of the synergy activation coefficient and the muscle synergy vector during the eccentric phase of the bench press. This is in line with a growing part of motor control literature reporting an increase in variability with experience, allowing participants to benefit from the motor redundancy (Latash et al 2002; Van Emmerik et al 2002). In this sense a large variability can be viewed as the possibility of changing muscle coordination while still satisfying the constraints of the task. Thus, EXP were more capable of utilizing the motor redundancy in the eccentric phase than UNT. **References** Latash ML, Scholz JP, Schöner G. Motor control strategies revealed in the structure of motor variability. *Exerc Sport Sci Rev.* 2002; 30:26-31 Van Emmerik REA, Van Wegen EEH. On the functional aspects of variability in postural control. *Exerc Sport Sci Rev.* 2002; 30:177-83

## THE EFFECT OF EXPERTISE ON COORDINATION VARIABILITY DURING A DISCRETE MULTI-ARTICULAR ACTION

Stannard, R., Robins, M.

*Nottingham Trent University*

**Introduction** When investigating the relationship between task expertise and movement variability, contrasting findings have been reported in scientific literature (e.g. Darling and Cooke, 1987; Wilson, et al., 2008; Robins, et al., 2008). These equivocal reports could be due, to task constraints influencing variability magnitudes. Whilst some research has used static accuracy-based tasks (Darling and Cooke, 1987), more complex, dynamic multi-articular movements tasks have also been used (Wilson, et al., 2008; Robins, et al., 2008). Currently there is a lack of research examining task expertise-movement variability during such dynamic movement tasks, and ultimately how movement variability can be used functionally to satisfy the specific constraints on action. Therefore, the purpose of this study was to examine the interaction of expertise and coordination variability during a dynamic basketball shooting task. **Methods** Male university basketball players (n=8) with varying basketball experience (scoring between 35-80% of pre-test shots) performed 20 shots from a distance of 4.25 metres after a dribbling movement of 6.5 metres. Kinematic data was collected from a seven-camera motion capture system sampling at 200Hz. 14mm reflective markers attached to upper limb anatomical landmarks allowed calculation of shoulder, elbow and wrist angular displacements. Coordination variability for the wrist-elbow, elbow-shoulder, and wrist-shoulder joint couplings were produced using the normalised root mean squared difference (NoRMS) approach. Providing a metric by which the degree of consistency may be assessed, as such, one measure of stability of the underlying coordination. Quadratic regression analysis was used to identify the poten-

tial relationship between joint coupling coordination variability and shooting score. Results The quadratic regression values for the wrist-elbow joint coupling was 0.1609 ( $p=0.48$ ), elbow-shoulder, 0.1109 ( $p=0.66$ ), and wrist-shoulder, 0.6467 ( $p=0.02$ ) with respect to shooting performance score. Discussion Similar to previous research, task performance and coordination variability demonstrated an U-shaped relationship (Wilson, et al., 2008). Intermediate skilled participants displayed the lowest coordination variability; whilst higher skilled participants demonstrated higher functional variability owing to adapting to perturbations (Hamill, 1999). Least skilled participants revealed variability that is less functional and evident of less stable movement patterns. Additional research is needed, to further understand the task expertise-movement variability relationship for different task constraints. References Darling W.G, Cooke J.D. (1987). *Journal of Motor Behavior*, 3, 291-309. Hamill J, van Emmerik, R.E.A, Heiderscheit B.C, Li L. (1999). *Clinical Biomechanics*, 14, 297-308. Robins M, Davids K, Bartlett R, Wheat J (2008). ISBS Conference 2008, Seoul, Korea, 408-411. Wilson C, Simpson SE, Van Emmerik REA, Hamill J. (2008). *Sports Biom*, 7, 2-9.

## INFLUENCE OF THE AMOUNT OF PRACTICE ON THE CONSOLIDATION OF MOTOR MEMORY IN FORCE FIELD ADAPTATION TASKS

Stockinger, C., Focke, A., Diepold, C., Stein, T.

*Karlsruhe Institute of Technology*

Introduction Force field adaptation experiments are a common tool to investigate the consolidation of motor memories (Shadmehr and Brashers-Krug, 1997). Several studies showed that catch trials, on which the disturbing forces are suddenly turned off, have a positive effect on consolidation when learning two opposing force fields one day apart (Shadmehr and Brashers-Krug, 1997; Overduin et al., 2006). In contrast, consolidation was not observed for more complex force field tasks (viscosity of 35 Ns/m instead of 10-13Ns/m), not even in combination with catch trials (Focke et al., 2012). However, for different motor tasks, an increase of learning trials showed positive effects on consolidation (Krakauer et al., 2005). Therefore, we investigated whether the amount of practice influences the consolidation of motor memories in force field adaptation tasks with a comparatively high complexity. Methods Subjects (N=42) performed 2d center-out reaching movements at a robotic manipulandum in a force field A (day 1) followed by an interfering force field B=-A (day 2) and retest in force field A (day 3). The velocity-dependent viscous curl force field (35 Ns/m) was directed clockwise (A) or counterclockwise (B). Subjects were randomly assigned to four groups, performing either 256 movements (L0, L1) or 640 movements (M0, M1) per block. The groups L1 and M1 pseudo-randomly received catch-trials (~19%) whereas groups L0 and M0 performed all trials in the force field. We quantified performance by the enclosed area between hand trajectory and straight line joining start and target point. Results Neither for the groups L0 and M0 (no catch trials) nor for the groups L1 and M1 (catch trials) a significant effect of the amount of practice was found. None of the groups showed consolidation of force field A when learning the interfering force field B. Discussion Our results indicate that the amount of practice in complex force field adaptation tasks does not influence consolidation processes. An increase of learning trials appears not to be sufficient to compensate a more complex task in order to achieve resistance to interference and therefore to observe consolidation. Potentially, anterograde interference effects avoid detection of consolidation processes. Therefore, further studies should concentrate on controlling possible effects of anterograde interference through the use of washout trials. References Focke A, Stockinger C, Diepold C, Taubert M, Stein T (submitted). *Int J Comp Sci Sport*. Krakauer JW, Ghez C, Ghilardi MF (2005). *J Neurosci*, 25(2), 473-478. Overduin SA, Richardson AG, Lane CE, Bizzi E, Press DZ (2006). *J Neurosci*, 26(46), 11888-11892. Shadmehr R, Brashers-Krug T (1997). *J Neurosci*, 17(1), 409-419.

## COGNITIVE TRAINING DURING 14-DAY PHYSICAL INACTIVITY IMPROVES DUAL-TASK WALKING

Marusic, U.1,2, Kavcic, V.3, Gerzevic, M.1, Piacentini, M.F.4,2, Meeusen, R.2, Pisot, R.1

*University of Primorska*

1: Institute for Kinesiology Research, SRC, UP, (Koper, Slovenia), 2: VUB (Brussels, Belgium), 3: Institute of Gerontology, WSU (Detroit, USA), 4: IUSM (Rome, Italy) Introduction: Prolonged immobilization or inactivity which follows sports injuries and surgery could lead to serious motor dysfunction preventing a quick recovery and causing elevated costs for a national health care system. Recent studies show that sustained spatial navigation training modifies hippocampal volumes in humans and protects it from age-related decline (Lovden et al. 2012). Therefore, it is important to develop interventions to reduce the deterioration of the motor output during immobilization or inactivity. This study tested a cognitive based intervention during 14-days bed rest (BR) on walking performance with and without a dual-task. To the best of our knowledge this was the first BR study with a cognitive training intervention. Methods: Fourteen older male adults (59.7±3.5 years) volunteered for a controlled longitudinal interventional BR study. To study the effect of cognitive training, we randomly split the subjects into 2 groups: a cognitive training group (CTG; N=6) that trained virtual maze navigation for 50 minutes a day and a control group (CG; N=8) that watched documentaries. Gait parameters were measured with the OptoGait system (Microgate, Italy). To measure the effect of cognitive training on gait we used percent of change in gait speed between normal walking (self-selected speed) with and without dual task [(dual-norm)/norm\*100] (Montero-Odasso et al. 2012). Between-groups (CTG vs. CG group) and within-groups (pre- vs. post-BR) differences were tested with the 2x2 mixed ANOVA. Results: There were no significant differences ( $p=0.44$ ) between the CTG and CG before the BR. However, after the BR the CTG showed significantly higher ( $p=0.02$ ) change of walking speed as compared to the CG (+8.6±7.0% and -1.1±5.8%, respectively). Further, within-group analysis showed for CTG, but not for CG, significantly increased change of walking speed ( $p<0.001$ ) from pre-BR to post-BR (-13.4±5.7% and +8.6±7.0%, respectively). In other words, the results showed that after BR in CG there was a decrease (1.29±0.23 vs. 1.25±0.15 m/s) while in CTG there was an increase (1.08±0.18 vs. 1.17±0.14 m/s) in walking speed with dual-task. Discussion: The results of this study demonstrate that cognitive training during 14-days BR significantly prevents a decrease of gait performance in dual-task walking. Our findings suggest a possible link between cognitive training intervention and motor output and represent new perspectives of basic research regarding novel methods for preventing declines in gait performance due to prolonged immobilization or inactivity. References Lovden, M., et al. (2012). *NEUROBIOL AGING*, 33(3). Montero-Odasso, M., et al. (2012). *J AM GERIATR SOC*, 60(11): 2127-2136.

**08:30 - 10:00****Oral presentations****OP-BN09 Coaching [CO] 1 Coaching****RELATIVE AGE EFFECTS IN ELITE JAPANESE SWIMMER: A LONGITUDINAL STUDY OF SEX, AGE AND PERFORMANCE**

Yoshimi, J.1, Nomura, T.2, Takagi, H.1

*University of Tsukuba*

Introduction Relative age effects (RAEs) occur in annual age-groups and are widely observed phenomenon not only in education fields but also in athletic fields as a difference of educational achievement and imbalance distribution on birth month (Kawaguchi., 2006, Cobley et al., 2009). From the point of player development, not only personal adolescence (early or late mature) but also the birth month effects as relative different growth in same annual age-groups and effect as advantage or disadvantage to performance, competitive experience and training environment. In Japan, swimming is one of popular sports so that children start learning on their early age, thus competitive swimming could make the RAEs phenomenon stronger in competitive swimming. Therefore, the aim of this study was to analyze longitudinal effect of RAEs on sex, age and performance in elite Japanese swimmers. Methods All data (swimmer's personal information and their race records) of JAPAN SWIM championships (2004 to 2008) were provided by the JAPAN SWIMMING FEDERATION SCIENCE COMMITTEE. Swimmers were divided into 4 categories of age (12-14, 15-17, 18-21, over 22years old) and date of months (Jan. to Mar., Apr. to Jun., Jul. to Sep., Oct. to Dec.). Who born at April 1st was operate as born in March (April 2nd is the first date of birth for enter school). Rate of change on records were calculated by same swimmer, same event, consecutive competitions and best record in a competition. Kruskal-Wallis test was used to compare between groups. Statistical significance was set at  $P < .05$ . Results Distribution of birth month in swimmers (737 male, 711 female) were not equal (male Apr.-Jun. 31.1%, Jan.-Mar. 17.6%, female Apr.-Jun. 29.6%, Jan.-Mar. 18.2%). There was a negative relation between the age and the ratio of breaking records (12-14y 254.6%, 16-17y 180.1%, 18-21y 151.0%, 22-y 105.3%), but no significant differences were found in rate of change on records with sex, age and date of months. Discussion Strong RAEs was found in a distribution of swimmers of Japanese elite swimmers, but not in performance with sex, age and birth month. A limitation of this study was that we could not compare the biological age of each swimmer. But in Japan, many swimming competitions which developing level participate are held through the year and it doesn't have particular cut-off date because the first day of each competitions are the cut-off date. The particular cut-off date is one of reason to cause RAEs (Musch et al., 2001), so the result indicating the indirect effect of school system. References Daiji Kawaguchi(2006). ESRI Discussion Paper Series No.162(June), Stephen Cobley, Joseph Baker, Nick Wattie, Jim McKenna(2009). Sports Med, 39(3), 235-256. Jochen Musch, Simon Grondin(2001). Developmental Review, 21,147-167.

**VALIDITY ISSUES IN SELECTIONS OF TOP LEVEL SPORT TEAMS**

Johansson, A.

*Umeå university*

VALIDITY ISSUES IN SELECTIONS OF TOP LEVEL SPORT TEAMS Introduction The purpose of the study was to increase the knowledge of selections of athletes to top-level sport teams and analyse them from a validity perspective. Selections to top level sport teams are highly important for the persons involved in them as well as for the sport organizations and the credibility of the sports. Methods 14 semi-structured interviews were performed with top-level coaches (selectors) highly involved in the selection processes in the individual sport alpine skiing (n=6) and in the team sport soccer (n=8). The theoretical frame work was the evolved validity concept including content and criterion evidence as well as reliability (Kane, 2006). Key issues concerned the goals and the criteria involved in the selection processes, how the processes were performed and the coaches perceptions about the outcomes and consequences of the selections. Results The results demonstrate large differences in the explicitness of the selection criteria and in coaches' beliefs about the importance of having and communicating criteria. This has implications for the validity of the selections with regard to both what is really used as the grounds for the selections and how stable those grounds are. All coaches emphasised the importance of the selection criteria being formulated in such a way that they gave the coaches opportunities to influence the judgements themselves and stated that their eyes and their feelings were their most valuable selection tool. Ranking lists, physical test results and statistics were said not to give enough information about the athletes, as numbers could never give a complete picture of a person or a performance. Still quite some of the team's selections were based mostly on ranking lists. If the system allowed, quite a few coaches would choose an athlete with good behaviour and a favourable personality over an athlete with better sports skills. This could be discussed in relation to previous studies indicating that only psychological factors seem to be able to explain maintained success (Abbott & Collins, 2004). Discussion The results display validity issues that might affect the outcome of the selection processes and raises questions for more research concerning research-based guidelines to help coaches and sport organisations develop valid selection processes. None of the coaches had any education concerning selections and many of them regarded the selection processes as difficult, which further points to a need for continued research about selection processes. References Abbott, A., & Collins, D. (2004). Eliminating the dichotomy between theory and practice in talent identification and development: considering the role of psychology. Journal of Sports Sciences, 22, (5), 395-408. Kane M. T. (2006). Validation. In R.L. Brennan (Ed.), Educational Measurement (4th ed., pp. 17-64). Westport, CT: ACE/Praeger.

**COACHES INFLUENCE SUCCESS BY MENTAL ROTATION IN BASKETBALL**

Schul, K.1, Memmert, D.1, Jansen, P.2,1

*German Sports University Cologne - 1. GSUC (Cologne, Germany), 2. UR (Regensburg, Germany)*

Introduction Many team sports incorporate timeouts during a game. To date no research exists evaluating the costs of mental rotation on tactical behavior in team sports notably related to timeouts. According to the alignment effect in spatial cognition research extra cognitive costs are needed to encode information by mental rotation (Levine, Jankovic, & Palij, 1982). The present research attempts to investigate if the alignment of the tactic board in timeouts influences the performance of basketball players. Methods We designed two studies that offered a computer based timeout simulation. After watching a videoclip of a timeout the participants had to recall the corresponding

pattern from five different options. In our first study we examined if experts differ from novices and in our second study we investigated if experts could recall the stimuli better when they were shown in the players point of view instead of upside down. Results The observation of 22 international basketball matches showed that information given by coaches on a tactic board is usually presented from the coaches point of view resulting that players have to mentally rotate timeout instructions. Our first study showed that basketball experts (59%) were significantly better than novices (43%) in recalling specific basketball patterns ( $t(19) = 2,57, p < 0.021$ ). Results of the second study revealed that basketball experts achieved significantly better results in recalling patterns when they were shown in the players' perspective (84%) instead of a mirror inverted coaches' perspective (76%) ( $x^2(2, N = 16) = -2.68, p < .01$ ). Discussion One context in team sports that has seen relatively little empirical research is that of timeouts although this aspect of the game arouses increasing interest in the field of sport psychology. Research in the past concerned with the coaching process itself rather than with the inputs and outputs of coaching (Gómez et al 2011). The main finding of our studies is that coaches should give their tactical instructions most suitable by drawing instructions in the players' perspective. Although this might be too difficult or circumstantial at least they should turn the tactic board towards the players before they finish the timeout. This would give the players a last opportunity to review the tactical orders. Our findings also strongly recommend to be utilized in future coaches education. References Gómez, M. A., Jiménez, S., Navarro, R., Lago-Penas, C., Sampaio, J. (2011). Effects of coaches' timeouts on basketball teams' offensive and defensive performances according to momentary differences in score and game period. *European Journal of Sport Science*, 11, 303-308. Levine, M., Jankovic, I., & Palij, M. (1982). Principles of spatial problem solving. *Journal of Experimental Psychology: General*, 111, 157-175.

### THE EFFECTS OF 6-WEEKS TRAINING PROGRAMME ON PHYSICA FITNESS IN SEMI-PROFESSIONAL FEMALE HANDBALL: CASE STUDY

Skarbalius, A.

*Lithuanian Sports University*

Introduction Due to increasing the competitive period in modern handball it is highly important to prepare players' performance potential to appropriate level (Gorostiaga et al., 2006). The question is what duration and what kind of training programme would be suitable in semi-professional female handball in order to adapt physical capacity in a simple and effective manner for match demands. Methods The duration of 6-weeks of training programme in preparatory period was applied for 12 semi-professional female field handball players (age  $21.4 \pm 2,7$ ; height  $176.4 \pm 5.6$ cm; body mass  $69.5 \pm 5,5$ ; sporting experience  $9.3 \pm 2.1$ ). VO<sub>2</sub>max, Yo-Yo intermittent endurance level I & level II (IE1, IE2) and Yo-Yo intermittent recovery level I & level II (IR1, IR2) (Bangsbo et al., 2008) tests were measured pre and post preparatory period. Results VO<sub>2</sub>max increased by 10.5% ( $p < 0.001$ ), Yo-Yo IE1 by 13.5% ( $p < 0.001$ ); Yo-Yo IE2 by 9.7% ( $p < 0.001$ ), Yo-Yo IR1 by 7.7% ( $p < 0.01$ ), Yo-Yo IR2 by 8.9 ( $p < 0.001$ ). Discussion In order to solve multiple training goals related to team sports (Gamble, 2010) like handball the content of training programme was applied: specificity (integral) 19.8%, physical 16.4%, technical and tactical 19.7%, theoretical 10.2%, warming-up 17.8%, and recovery 16.1%. The loads were applied in such a way: 33 training days, 47 training sessions, 6 matches, total 4887 minutes. We can conclude that such kind of duration, applied training loads, content, allowed to solve multiple training goals (Zatsiorsky, Kraemer, 2006) in semi-professional female handball. At the same time we have to emphasize that alteration of volume and intensity of training sessions and sequence of microcycles are highly important. References Bangsbo J., Iain, FM., Krstrup P. (2008). *Sports Med.* 38 (1): 37–51. Gamble P. (2010). *Strength and Conditioning for Team Sports*. London & New York, Routledge. Gorostiaga E. M., Granados C., Ibanez J., Gonzalez-Badillo J. J., & Izquierdo M. (2006). *Med. Sci Sports and Exc*, 38, 357–366. Zatsiorsky VW, Kraemer WJ. (2006). Champaign, IL: Human Kinetics, pp. 89–108.

### THE ANALYSIS OF SPORT EXPERIENCE BY AGE AND GROUP ON THE DEVELOPMENT OF BALANCE CONTROL: A STUDY BY ACCELEROMETRY

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*Universidade Estadual de Londrina*

Introduction The purpose of this study was to determine the relationship between a motor skill postural and focal components (Frank & Earl, 1990) and moving balance. Increased motion and reduced smoothness of head and trunk in the medial-lateral plane might be related to decreased balance skills for children, especially after 7 years of age, a period where it is expected that they demonstrate an adult pattern of balance control strategies (Yack et al., 1992). The study investigated the influence of sport experience on the development of balance control. Methods The sample involved sixty female subjects (6-, 12-, and 19-years old). In each age group there were 10 gymnasts and 10 non-gymnasts. There were 10 subjects in each age x experience group. Younger gymnasts would stabilize their head in space in a manner similar to the older subject but with increases in complexity the young gymnasts would respond similarly to their age group peers. The instruments were a scale with stadiometer, three tri-axial accelerometers (ADXL150/EM-3, 5g, Analog Devices, Norwood, MA) placed on head, hip and ankle, a footswitch, a line on the floor, a balance beam, and an AD computer. The tasks were: walk on a line on the floor (3.68 m long, 10.0 cm wide), over a white obstacle, walk across a balance beam, and over an obstacle. The dependent variables were Root Mean Square and Index of Smoothness for acceleration harmonics of the head and trunk in three planes of movement: vertical, anterior-posterior, and medial-lateral,  $p < 0.05$ . Results The ANOVA table values for the RMS indicated that when the factor age was analyzed there were differences in the trunk in the AP 5.25 (.01) and VT 10.95 (.01) planes; for group (gymnasts x non-gymnasts) the differences were on the head in the AP 5.57 (.02) and VT 10.25 (.01) planes. No differences were observed when analyzed group x age. The ANOVA table values for the IS indicated no differences for age, group and group x age for head and trunk in the ML, AP and VT planes of movement. Discussion Age differences existed for the non-gymnasts but not the gymnastic group. The gymnasts changed their trunk and ankle motion in preparation to walk over an object whereas the non-gymnasts did not. When walking over the object the gymnasts stabilized their heads. Thus there was support for experience influencing the development of a stabilization of the head in space strategy. Experience influenced balance control across age and task in the experiment. References Assaiante C, Amblard B. (1995). An ontogenetic model for the sensorimotor organization of balance control in humans. *Human Movement Science*, 14, 13-43. Frank JS, Earl M. (1990). Coordination of posture and movement. *Physical Therapy*, 70 (12), 855-863. Sponsor: CNPq and CAPES

## RELIABILITY ANALYSIS OF THE SCORING JUDGES SYSTEM IN SNOWBOARDING HALPIPE: WORLD CHAMPIONSHIP AND OLYMPIC GAMES.

Perez Ruiz, J., Muñoz Jimenez, J.

*Universidad de Extremadura*

**INTRODUCTION** Snowboarding is a Olympic Sport included in the Olympic program since 1998, in Nagano Games, through the International Olympic Committee and the International Ski Federation (Popovic & Morrow, 2008). It's a massively practiced winter sport, which moving important economical resources, with a significant scientific and technological development. The Olympic Snowboard competition has three disciplines; Slalom, Boardercross and Halfpipe (FIS, 2008). The last one, Halfpipe, athletes have to perform a series of aerial acrobatic maneuvers above a special track in the snow, while five judges subjectively assess the performance of different technical elements of the sport, assigning a final score exercise (Harding & James, 2010). The exercises are evaluated following basic rule set, in section 6 of the "Judges' Manual" (FIS, 2009). These rules are designed to ensure the objectivity of the judges in their scoring. One important aspect of the scoring system is the elimination of highest and lowest of the five evaluations of judges, adding the remaining three. Despite these indications, we find that "Judges manual" is less detailed about the description of the exercises and their difficulty as can happen in other sports where the final performance result is also subject to the valuation of judges. The main aim of this study is to make a first approach to this sporting context, analyzing the reliability of Snowboard Halfpipe scoring system. **METHOD** The data used are in the FIS database ([www.fis.com](http://www.fis.com)). We record the score for all Olympics Games and World Championship, from 2003 through 2011 (N=1423). The statistical analysis is made with IBM-SPSS Statistics 19 software. The reliability was measured with Cronbach's alpha (AC) and ICC (Interclass Correlation Index) **RESULTS** Results show high levels of reliability regardless of the selected variables (Competition: Olympic Games A.C = ,979 ; ICC= ,9,05. World Championship A.C= ,974 ; ICC= ,882 / Gender: women A.C= ,977; ICC= ,896 / men A.C= ,974; ICC= ,881 / level of qualification: qualification A.C= ,974; ICC= ,882. semifinal A.C= ,990; ICC= ,954. Final A.C= ,973; ICC= ,878 / Round: 1ª A.C= ,977; ICC= ,897. 2ª A.C= ,974 ; ICC= ,882) **CONCLUSIÓN** Results show high levels of reliability in spite of a less concision of judge manual, compared with other sport judge manuals. **REFERENCES** Harding, J. W. & James, D. A. (2010). Analysis of Snowboarding Performance At The Burton Open Australian Half-Pipe Championships. IJPAS, Volume 10, no1, 66-81 Popovic, M. & Morrow, D. (2008) Stomping the Shadow: The Elevation of Snowboarding to the Olympic Pedestal from a Jungian Perspective. Sport History Review, 39, 170-191. Muñoz, J. y León, K. (2010). Performance indicators in Snowboard - Halfpipe in Vancouver 2010 Olympic Games. Preliminary study. IX C.I.E.F.I. Mercado laboral y competencias asociadas. San Javier, Murcia. Federation Internationale de Ski – FIS (2008), International Snowboard Rules. Ed. 2008. Federation Internationale de Ski – FIS (2009), Fis Snowboard Judges Manual 2009/2010.

**08:30 - 10:00**

### Oral presentations

#### OP-PM12 Molecular Biology [MB] 2

##### TIME-COURSE OF TRANSCRIPTOMIC CHANGES IN SKELETAL MUSCLE DURING RECOVERY FROM ENDURANCE EXERCISE

Neubauer, O.1,2, Sabapathy, S.2, Lazarus, R.3,6, Desbrow, B.2, Ashton, K.4, Wessner, B.1, Peake, J.5, Cameron-Smith, D.7, Wagner, K.H.1,2, Haseler, L.2, Bulmer, A.2

1: Univ. Vienna, AUT; 2: Griffith Health Institute/Univ.; 3: Baker IDI Heart&Diabetes Inst.; 4: Bond Univ.; 5: QLD Univ. of Technology; 2-5: AUS; 6: Harvard Medical School, USA; 7: Univ. Auckland, NZ

**Introduction** Re-programming of gene expression is fundamental for skeletal muscle adaptations in response to endurance exercise (1, 2). However, no data is available on systemic gene expression changes beyond 48 hours post-exercise. This study aimed to investigate the changes in the muscle transcriptome throughout recovery and beyond 48 hours after an exercise trial (EXTRI; two hours of continuous cycling and running). We hypothesised that the time-course of transcriptomic changes in skeletal muscle would reflect the cross-talk with accumulating leukocytes (3), and the signalling pathways involved in acute stress, recovery, and adaptive responses to endurance exercise. **Methods** Eight healthy, endurance-trained, male subjects participated. Skeletal muscle and blood samples were taken one week before the EXTRI, 3, 48, and 96 hours post-EXTRI under standardized conditions. RNA was extracted from skeletal muscle. Differential gene expression was evaluated using Illumina microarrays, and validated with qPCR. Gene set enrichment analysis identified enriched molecular signatures chosen from the Molecular Signatures Database. **Results** At 3 hours post-EXTRI, 102 gene sets were up-regulated (FWER p-value<0.05) including groups of genes related with leukocyte migration, immune and chaperone activation, the activation of transcription factors and the striated muscle activator of Rho signalling (STARS) pathway. At 48 hours post-EXTRI, 19 gene sets were enriched, and two gene sets related to actin cytoskeleton remodelling were up-regulated (FWER p-value<0.05). The pre- to 48 hour post-EXTRI gene expression fold-change of the macrophage-specific CD68 gene in the muscle correlated with plasma myoglobin changes ( $r=0.85$ ;  $P<0.01$ ). At 96 hours post-EXTRI, 83 gene sets were enriched (FWER p-value<0.05), 80 of which were up-regulated including groups of genes related with chemokine signalling, proteolysis, and interactions with the extracellular matrix (ECM). **Discussion** This study provides novel insights into the muscular transcriptomic responses to endurance exercise, indicating a biphasic recovery pattern, potentially related to the accumulation of leukocytes (3). The 96 hours post-exercise transcriptome indicates sustained inflammatory processes and extensive remodelling of the muscular ECM. **References** 1. Coffey V, Hawley J (2007). Sports Med 37. 2. Coffey V, Shield A, Canny B, Carey K, Cameron-Smith D, Hawley J (2006). Am J Physiol Endocrinol Metab 290. 3. Paulsen G, Mikkelsen U, Raastad T, Peake J (2012). Exerc Immunol Rev 18.

### THE ACUTE ANGIOGENIC TRANSCRIPTIONAL RESPONSE TO LOW LOAD RESISTANCE EXERCISE WITH BLOOD FLOW RESTRICTION

Hunt, J.E.1,2, Taylor, C.1, Martin, N.1, Player, D.1, Lewis, M.P.1, Ferguson, R.A.1

1 Loughborough University, 2 University of Gloucestershire

**Introduction** Physiological angiogenesis is a graded response mediated by ischemic, metabolic, shear and/or mechanical stress (Egginton, 2011). Distortion to these stimuli during low load resistance exercise with blood flow restriction (BFR) may affect the magnitude and phenotype of angiogenesis. Measuring gene expression of VEGF and other growth/transcription factors will verify the presents of an angiogenic response and provide information of potential mediating stimuli. **Methods** In a repeated measures cross over design, six healthy moles (age; 26±2 yrs, height; 184±6 cm, body mass; 83±11 kg) performed 4 sets of bilateral knee extension exercise at 20% 1RM [set 1: 30 reps, set 2: 15 reps, set 3: 15 reps, set 4: continued to fatigue] with (BFR) and without (CON) blood flow restriction (110mmHg). Muscle biopsies were obtained from the vastus lateralis before, 2 and 4 hours post-exercise. Angiogenic gene expression for VEGF, VEGF-R2, HIF-1α, PGC-1α, eNOS and MMP-9 was determined using real-time RT-PCR and expressed relative to GAPDH mRNA. Omnibus tests and targeted pairwise comparisons were used to assess differences within and between conditions. Data are presented as fold-change from rest (mean ± SD). **Results** BFR exercise enhanced mRNA expression of VEGF at 2 h ( $5.2 \pm 2.8$  vs  $1.7 \pm 1.1$ ,  $P = 0.02$ ) and 4 h ( $6.8 \pm 4.9$  vs.  $2.5 \pm 2.7$ ,  $P = 0.012$ ) compared to CON. Despite an increase in mRNA expression following BFR exercise (Friedman's ANOVA,  $P < 0.05$ ), peak changes in VEGF-R2 ( $5.0 \pm 4.9$  vs.  $1.5 \pm 0.8$ ), HIF-1α ( $2.6 \pm 1.1$  vs.  $1.8 \pm 1.8$ ), PGC-1α ( $5.9 \pm 2.8$  vs.  $2.1 \pm 1.7$ ) and eNOS ( $4.9 \pm 4.5$  vs.  $1.8 \pm 2.7$ ) mRNA were not significantly different to CON. Only PGC-1α ( $3.2 \pm 1.7$  vs.  $1.5 \pm 0.9$ ) mRNA was enhanced at 4 h relative to CON ( $P = 0.046$ ). MMP-9 mRNA was not altered in response to BFR or CON exercise. **Discussion** In support of previous investigations (Larkin et al. 2012) our study finds that BFR potentiates the VEGF mRNA response to low load resistance exercise. The up-regulation of VEGFR-2, PGC-1α, HIF-1α and eNOS mRNA expression following BFR exercise demonstrates a targeted angiogenic response potentially mediated through enhanced metabolic, ischemic and shear stress stimuli. In contrast, MMP-9 mRNA expression was unchanged reflecting the limited development of muscular tension/stretch during low load and volume resistance protocols. **References** Egginton, S. (2011). *Acta Physiologica*, 202 (3), 225–239. Larkin, K.A, Macneil, R. G., Dirain, M., Sandesara, B., Manini, T. M., Buford, T. W. (2012). *Med Sci Sport Exerc*, 44 (11), 2077–2083.

### AGING IMPAIRS MYOGENIC PRECURSOR CELL EXPANSION AND MUSCLE RECOVERY AFTER IMMOBILITY-INDUCED ATROPHY IN HUMAN SKELETAL MUSCLE

Suetta, C., Frandsen, U., Mackey, A.L., Jensen, L., Hvid, L.G., Beyer, M.L., Petersson, S.J., Schrøder, H.D., Andersen, J.L., Aagaard, P., Schjerling, P., Kjaer, M.

Glostrup Hospital, University of Copenhagen, Bispebjerg Hospital and Center of Healthy Aging, University of Southern Denmark, Odense Hospital

**Introduction** Recovery of skeletal muscle mass from immobilisation-induced atrophy is faster in young than older individuals [1], yet the cellular mechanisms remain unknown. We examined the cellular and molecular regulation of muscle recovery in young and old human subjects subsequent to 2 weeks of immobilisation-induced muscle atrophy. **Methods** Re-training consisted of 4 weeks of supervised resistive exercise in 9 older (OM: 67.3yrs, range 61-74) and 11 young (YM: 24.4yrs, range 21-30) males. Measures of myofiber area (MFA), Pax7-positive satellite cells (SC) associated with type I and type II muscle fibres, as well as gene expression analysis of key growth and transcription factors associated with local skeletal muscle milieu were performed after 2 weeks immobilisation (Imm) and following 3 days (+3d) and 4 weeks (+4wks) of re-training. **Results** OM demonstrated no detectable gains in MFA (VL muscle) and no increases in number of Pax7-positive SCs following 4 wks re-training, whereas YM increased their MFA ( $p < 0.05$ ), number of Pax7-positive cells, and had more Pax7-positive cells per type II fibre than OM at +3d and +4wks ( $p < 0.05$ ). No age-related differences were observed in mRNA expression of IGF-Ea, MGF, MyoD1 and HGF with re-training, whereas myostatin expression levels were more down-regulated in YM compared to OM at +3d ( $p < 0.05$ ). **Discussion** In conclusion, the diminished muscle re-growth after immobilisation in elderly humans was associated with lesser response in satellite cell proliferation in combination with an age-specific regulation of myostatin. In contrast, expression of local growth factors did not seem to explain the age related difference in muscle mass recovery. [1] Suetta C, Hvid LG, Justesen L, Christensen U, Neergaard K, Simonsen L, Ortenblad N, Magnusson SP, Kjaer M, Aagaard P. Effects of aging on human skeletal muscle after immobilization and retraining. *J Appl Physiol* 107(4),1172–1180,2009.

### DYNAMIC CHANGES IN DNA METHYLATION STATUS IN PBMCs FOLLOWING AN ACUTE BOUT OF EXERCISE: POTENTIAL IMPACT OF TEMPORAL ELEVATION IN IL-6 CONCENTRATIONS

Robson-Ansley, P., Saini, A., Toms, C., Ansley, L., Walshe, I., Nimmo, M., Curtin, J.

Northumbria University

The aim of our study was to examine the relationship between interleukin-6 (IL-6) concentrations and DNA methylation in the peripheral blood mononuclear cells (PBMCs) of trained runners after a bout of prolonged, strenuous exercise. Eight healthy trained males completed a treadmill run at 60%  $\dot{V}O_{2\max}$  for 120 min followed by a 5 km time trial in a fasted condition. Whole blood samples were taken prior to, immediately and 24 h following exercise. From these samples, PBMCs were isolated for analysis and plasma IL-6 concentrations were measured. DNA methylation from extracted DNA was analysed using the Illumina 27k methylation beadchip platform. Global DNA methylation status was unaltered immediately and up to 24 hours following a bout of prolonged exercise in comparison to pre-exercise. Despite no change in global DNA methylation, we found that plasma IL-6 concentrations were significantly related to the DNA methylation status of 11 individual genes. Our study provides novel data suggesting that exercise-induced increases in IL-6 can alter the DNA methylation status of certain genes although the physiological relevance of these preliminary findings requires further study.

## THE ASSOCIATION OF GENES INVOLVED IN THE ANGIOGENESIS-ASSOCIATED CELL SIGNALLING PATHWAY WITH RISK OF ANTERIOR CRUCIATE LIGAMENT RUPTURE

Rahim, M.1, Gibbon, A.1,2, Hobbs, H.3, O'Cuinneagain, D.3, van der Merwe, W.1,3, Dandara, C.2, Posthumus, M.1, Collins, M.1,4, September, A.V.1

1ESSM, UCT (Cape Town, South Africa); 2Division of Human Genetics, UCT, (Cape Town, South Africa); 3Sports Science Orthopaedic Clinic (Cape Town, South Africa); 4ESSM, MRC (Cape Town, South Africa)

**INTRODUCTION:** Genetic factors have been implicated with risk of anterior cruciate ligament (ACL) ruptures. Angiogenesis plays an important part in the pathogenesis of several human diseases and is regulated by several growth factors. Increased levels of angiogenic cytokines and growth factors have been observed in degenerative ligaments. The aim was to investigate if genes encoding proteins involved in angiogenesis-associated cell signalling are associated with ACL injury risk. **METHODS:** A genetic-association study was conducted on 234 control participants (CON) and 188 participants with ACL ruptures (ACL). All participants were genotyped for the NGFB rs6678788, VEGFA rs699947, VEGFA rs1570360, VEGFA rs2010963, KDR rs2071559, KDR rs1870377 & HIF1A rs11459465 polymorphisms. Statistical analyses were conducted to determine any significant differences ( $p < 0.05$ ) in genotype and allele frequency distributions between the CON and ACL groups as well as CON and NON subgroup (participants with a noncontact mechanism of injury). **RESULTS:** VEGFA rs1570360 genotype frequency distributions were significantly different between the CON and ACL groups ( $p = 0.046$ ) with the GA genotype significantly over-represented in the CON group ( $p = 0.015$ , OR: 1.66; 95% CI: 1.11-2.48). VEGFA rs2010963 C allele was significantly higher in the CON group compared to the ACL group ( $p = 0.002$ ; OR: 1.69; 95% CI: 1.28 to 2.23) and compared to NON subgroup ( $p < 0.001$ ; OR: 2.19; 95% CI: 1.58 to 3.02). Furthermore, the VEGFA rs699947 A allele was significantly over-represented in the CON group in comparison to the NON subgroup ( $p = 0.036$ ; OR: 1.39; 95% CI: 1.03 to 1.89). KDR rs2071559 G allele was significantly lower in the CON group compared to the ACL group ( $p = 0.002$ ; OR: 1.70; 95% CI: 1.28 to 2.25) and in comparison to the NON subgroup ( $p = 0.007$ ; OR: 1.73; 95% CI: 1.27 to 2.37). No significant associations were noted for the remainder of the polymorphisms either between CON vs. ACL or CON vs. NON groups. **CONCLUSION:** These novel findings provide preliminary evidence suggesting that variants within the VEGFA and KDR genes may be implicated in the pathophysiology of ACL ruptures; therefore highlighting the potential biological significance of the angiogenesis-associated cell signalling pathway in the aetiology of ACL ruptures.

08:30 - 10:00

## Oral presentations

### OP-SH01 Misc. topics [CS][EC][HI][PE]

#### SPORT CONSUMPTION IN GERMANY

Alfs, C.

Johannes Gutenberg University Mainz

**Sport Consumption in Germany Introduction** No reliable data on the sport outside of sport clubs in Germany is available. Therefore, this research, based on the study of Preuss, Alfs & Ahlert (2012), focuses on the consumption of sport by German private households in the years 2009 and 2010. The invested time and related expenditures for sport participation and the interest in sport are analysed. This provides representative data about the whole of sport in Germany, including the number of people participating and/or being interested in the different forms of sport, how much they spend and in what categories, socio-demographics and related consumption patterns. Further, determinants of sport participation, sport interest and the expenditures related to both are identified and analysed. **Methods** Using a combination of CATI and CAWI surveys, a total of  $n = 17,455$  residents of Germany were interviewed from Oct 2009 to Mar 2011. The sample was representative for Germany in the dimensions age, gender and state of residence. 71 forms of sport, characteristics of participation, 32 (participation) and 18 (interest) categories of expenditures were surveyed. Results 52.8% of the German population participates in sport, 33.5% do so on a weekly basis. Participation does not decline with age, but moves to different forms of sport. Males are more active at younger age, women from age 35 up. The most popular sports are bicycling, running, swimming, fitness and hiking. Football, as the first team sport, is the sixth most practised form of sport. Participation-related expenditures amounted to 112.6 bn. in 2010. 30% of these expenditures were for transportation, 20% for sport-related vacations, 13.3% for equipment and 10% for (entrance) fees. Apparel accounted for 9% and shoes for 5.6% of the expenditures. 35% of males and 21% of females in Germany spend money on their interest in sports, predominantly for Football, followed by Handball, motorsport and ice hockey. Overall, 26 bn. was spent in 2010 on the interest in sports, with 40% being spent on tickets, 20% for catering and accommodation, 15.5% on media and another 10% on transportation. The analysis of the determinants of participation, interest and expenditures is still being done at this early point, but results will be available for the conference in June. **Discussion** Almost 75% of all sport activities take place in self-organized ways outside of sport clubs. The data from this research is finally able to provide reliable evidence of this large part of sport that was not well researched before. The data will be used by German sport politics to plan and build infrastructure for sport and promote a physically active population. The attested economic dimension of sport-related expenditures can support the whole sport sector. **References** Preuß, H. Alfs, C. & Ahlert, G. (2012). Sport als Wirtschaftsbranche - Der Sportkonsum privater Haushalte in Deutschland. Wiesbaden: Gabler Verlag

#### COSTS AND BENEFITS OF DECEPTION: THE CASE OF PROFESSIONAL BASKETBALL PLAYERS AND REFEREES

Morgulev, E., Azar, O., Lidor, R., Sabag, E., Bar-Eli, M.

Ben-Gurion University of the Negev

Numerous investigations demonstrated how even extremely experienced performers in sport can be influenced by various environmental factors, hence perform non-optimally. We selected five hundred incidents of collisions between attacker and stationary defender (offensive foul situations) from games of the Israeli Super League. The incidents were analyzed by three independent groups of three experts (elite basketball referees). The first group decided whether the defender was able to remain standing (i.e., chose voluntarily to fall); the second group was requested to make a referee's judgment (e.g., offensive foul, defensive foul, technical foul for intentionally

falling defender – “flop”); and the third group focused on collisions where the defender remained on his feet, and decided for each incident if an offensive foul was committed. Real game decisions were compared to the expert answers. Environmental information for each incident was assessed. Our findings indicate that players usually tried to deceive the referees by exaggerating the collision and falling on purpose; this resulted in slightly higher percentage for offensive fouls awarded, but overall reduced the effectiveness of the defense. The referees were able to some extent to distinguish between deceptive and non deceptive falls. Based on the sufficient differences between laboratory and game decisions we concluded that certain “environmentally dangerous” calls were avoided by referees.

## THE EVOLUTION OF THE ATHLETIC DEPARTMENT IN CATALAN UNIVERSITIES DURING THE PERIOD 2003-2007

Requesens, A.

*9equip*

**INTRODUCTION** The Athletic department of the universities offers a fundamental service to the sport system in Catalonia. The study details the economic reality of the Athletic department throughout the evolution of the income and expenditures of the users during the period 2003-2007. **METHODS** The income of all the Catalan universities during the studied period have been valued and compared according to their users, after developing a unique model to collect the economic data of all the athletic departments of these universities. Through the simple statistical, we have extracted the regression lines and the correlation coefficients of the income and the expenses versus the users in both cases. **RESULTS** The slope of the linear regression line in income is  $m = 214.94x$  and the slope of the linear regression line in expenditure is  $m = 260.41x$ . Whether the relationship between income and users and between expenditure and users shows a linear trend, the correlation coefficient between income and users is 0.96 and the coefficient of correlation between expenditure and users is 0.98. **DISCUSSION** Although both parameters show a linear trend in the studied period, the expenditure line shows a greater slope, unlike income, and so a higher expense ratio. During the studied period, there was an increase in the users' expenditure in terms of their income. Despite these differences are minimal, the correlation coefficient is balanced in both relationships and therefore, in the overall evolution among the different parameters, this has been balanced. Our proposal is cost containment and finding new avenues of revenue for the athletic department to achieve balanced accounts. **REFERENCES** ALVAREZ-SANTULLO PLANAS, L.; MARTÍNEZ ORGA, V. El modelo deportivo universitario en España. *Civitas. Revista Española de Derecho Deportivo*, 1999, vol. 12. p. 165-184. ISSN 1132-9688. BOSCH, J., [et al.]. Avaluació del pes econòmic de l'esport a Catalunya 2006 i 2007. *Ien líneal Institut d'Estudis Territorials; Consell Català de l'Esport ed.*, 2010. [Consulta: gener 2010]. Disponible a: <http://www.ietcat.org/index.php/ca/proyectos-econ-realitzats/pes-economic-de-lesport>. SIMON CANO, A.; UNISPORT ANDALUCÍA. Financiación del deporte en la Universidad. Málaga: Unisport, 1989. ISBN 8486826241.

## CONTEXTUAL AND AGE GROUP EFFECTS IN POSITIVE DEVELOPMENT OF YOUTH SOCCER PLAYERS

Santos, A.J., Gonçalves, C.E.

*University of Coimbra*

**Introduction** During the sport participation the youth athlete establish relations that could influence his development. The specificity of the contexts, such as demographic and organizational culture, could exert different influences. The development assets framework pretend to promote successful adults, promoting resilience and inhibiting risk-behaviors (Benson, 2002). The adhesion and maintenance in sport is due to the enjoyment that the athletes experience in these activities (Vlachopoulos, Karageorghis, & Terry, 2000). The values express through the sport attitudes are important due to the possibility of transference for daily life actions (Shields & Bredemeier, 2009). We pretend to verify the contextual and age effects on sources of enjoyment, development assets and sport attitudes of youth soccer athletes. **Methodology** The sample was selected by convenience being composed by 135 subjects with ages between 12 and 18 years ( $M=15.29$ ,  $SD=1.64$ ) from the clubs analyzed by Santos and Gonçalves (2011). They responded to the Sources of Enjoyment in Youth Sport Questionnaire, Developmental Assets Profile and Sport Attitudes Questionnaire. Results It was verified age effects in Convention and in Positive Identity. There are contextual effects in Self-referenced competencies, Effort expenditure, Affiliation with peers, Convention and Commitment. The combined model context and age group present differences in Unsportsmanship. **Discussion** The age differences could be due to the time involved in sport which can lead to a development of athlete-identity mixed with self-identity. The athletes from rural amateur club are in a disadvantage educational context. **Conclusion** Coaches, managers and politicians should take in attention the specific differences of the contexts to improve the youth development. Benson, P. (2002). Adolescent development in social and community context: a program of research. *New directions for youth development*, 95, 123–47. Santos, A. & Gonçalves, C. (2011). Analysing sport delivery entities with youth teams. In C. Marian, M. Ion, B. Victor, M. Adriana, C. Florin, & R. Larisa (Eds.), *4th Annual International Conference: Physical Education, Sport and Health* (pp. 109–111). Pitești, Romania. Shields, D. & Bredemeier, B. (2009). *True Competition: A guide to pursuing excellence in sport and society*. (D. L. Shields & B. L. Bredemeier, Eds.). Champaign, Ill.: Human Kinetics. Vlachopoulos, S., Karageorghis, C., & Terry, P. (2000). Motivation Profiles in Sport: A Self-determination theory perspective. *Research quarterly for exercise and sport*, 71(4), 387–397. **Acknowledgments:** This study was support by the Portuguese Foundation for Science and Technology (FCT) through the grant SFRH/BD/71534/2010.

## WINNING WITHOUT CONSEQUENCES: TENDENCIES OF DOPING AND ENHANCEMENT

Knechtl, S.

*Centre of Sport Science; University of Vienna*

**Introduction** The prevalence of doping in public society, especially in recreational sports like for example fitness centre and running events, is an emerging problem with serious impacts on people's health. These days, if you are keen to be better, work harder and/or train longer, the drugs available are much more effective and easier to get than they have ever been – and are less likely to make someone feel bad after taking them, no matter what side-effects they may cause. Besides the typical doping-drugs, also nutritional supplements and evermore medicine to boost individual physical and cognitive performance, are gaining on broad interest and permanent use. If taken by the civil society, this practices are often called „enhancement“. **Methods** The paper aims to review the latest publications on the field of doping (and enhancement). A hermeneutic approach offers the possibility of comparing different views and review current discussions. **Results** There is still the fatal problem of defining what doping explicitly is and where to draw a line between doping and „pushing“ his-/herself performance, respectively enhancement. Neither the sanctions for doping are well-regulated, nor is the current prevention system satisfyingly developed. The danger which emanates from using those substances as a healthy person is not really embraced by the broad public mass. Scientific research and results about the long-term effects are still missing. The current situa-

tion of doping and enhancement as well as their influencing factors from an ethical and sociological view as well as the risks and dangers of misuse should be shown. As a result, a future prospect could be developed and further actions could be considered. Discussion It becomes clear that a separation of doping and enhancement is not reasonable or even possible. The ethical, social and juridical aspects of doping shown in the paper could not be differentiated from the same aspects of enhancement. Nevertheless, the use of the terms doping and enhancement for a further dispute seems to be suggestive. References Bostrom, N. & Roache, R. (2008). Ethical Issues in Human Enhancement. In Ryber, J., Petersen, Th. & Wolf, C. (Hrsg), *New Waves in Applied Ethics* (S. 120-152). Hoberman, J. (2002). Sports Physicians and the Doping Crisis in Elite Sport [Abstract]. In *Clinical Journal of Sport Medicine*, 12(4), 203-208. Kayser, B., Mauron, A., Miah, A. (2005). Viewpoint: Legalisation of performance-enhancing drugs. In *The Lancet*, 366, S21. Lev, O. (2001). Will biomedical enhancements undermine solidarity, responsibility, equality and autonomy? *Journal of Bioethics*, 25(4), 177-184. doi: 10.1111/j.1467-8519.01799.x Savulescu, J., Foddy, B., Clayton, M. (2004). Why We Should Allow Performance Enhancing Drugs in Sport. *British Journal of Sports Medicine*, 38, 666-670. doi:10.1136/bjism.2003.005249

## DEVELOPMENT, VALIDATION AND APPLICATION OF A QUESTIONNAIRE ABOUT THE ISSUE OF INTERSEXUALITY IN SPORT COMPETITION

Scarpa, S.

*University of Padua*

**Introduction** An event that occurred during the Athletics World Championships held in Berlin in 2009 raised serious questions about traditional categories of sports competition, based on gender differences. The condition of Caster Semenya, winner of the women's 800 metres gold medal, and a suspected hermaphrodite, raises anthropological and ethical issues which cannot be easily solved. The 'paralysis' of IAAF - who were unable to decide whether the athlete should be allowed to keep the gold medal or not (until medical examinations gave an answer) - is completely understandable. It is not an easy decision - taking away the medal would be viewed as insulting the dignity of hermaphrodites, whereas allowing the athlete to keep the medal would destroy traditional categories (hermaphrodites would be able to choose which category they wish to compete in and therefore their condition would be considered as nature's gift). Are there any criteria to establish a person's sexual identity? Can there be cases in which male and female polarities coexist in a single individual? In which category should hermaphrodites compete? After an interdisciplinary approach supported by a multi-level analysis which permitted to examine all the possible solutions, the aims of this study were to develop, to validate and to apply a Questionnaire about the issue of Intersexuality in Sport Competition (Q-ISC). **Methods** The Q-ISC was developed as a multidimensional instrument after a review of the literature and discussion with specialists of the field. The questionnaire is composed by 35 items (Likert scale) in order to assess the following 5 factors: Free Choice, Third Category, The Most Difficult, Standard, No Solutions. The questionnaire was administered to 524 university students (382 female, 142 male) aged 19-30 (M=22.24). **Results** Statistical analysis (Cronbach's Alpha: from .78 to .93; Exploratory Factor Analysis, Confirmatory Factor Analysis, factor analysis on the single factors: from .441 to .894; indexes assessing data fit to the model: RMSEA=.0593, NFI=.928, NNFI=CFI=.955, GFI=.884, AGFI=.861, PGFI=.740) showed a good validity and reliability of the instrument, confirming the factor structure, and invariance across gender and age. Interesting data emerged also from descriptive statistics, analysis of variance, differences of gender, sexual orientation, sports participation, university education. **Discussion** Our results indicate that the Q-ISC has good measurement properties of the five factors. The fifth factor (No Solutions) obtained the highest mean scores, while the second (Third Category) and the third (The Most Difficult) obtained the worse scores. Participants appear to consider possible three of the five perspectives, giving credit to the complexity of the problem. **References** Butler J. (2009). *Wise Distinctions*. The London Review of Books. Scarpa S. (2010). *Gender ways of knowing?*, Trento, p. 64. Scarpa S, Gobbi E, Carraro A. (2010). *BPSA Congress*, Cardiff, p. 39.

**08:30 - 10:00**

## Oral presentations

### OP-SH07 Psychology [PS] 3

#### DECISION MAKING AND GAZE BEHAVIOUR IN BEACH VOLLEYBALL DEFENSIVE ACTIONS: MOVING JUST IN TIME!

Kredel, R., Lienhard, O., Klostermann, A., Koedijker, J., Hossner, E.J.

*University of Bern*

**Introduction** In recent years several studies highlighted the importance of visual perception in decision-making in sports (for an overview, see Mann et al., 2007). The current study investigated decision making and gaze behaviour in beach volleyball defensive actions with an automated gaze and behaviour analysis, allowing for measuring a high number of participants with a high number of trials in a relatively natural and dynamic setting. It is hypothesized that perceptual and behavioural expertise in beach volleyball defensive actions is characterized by a „Moving-just-in-time“-Strategy, allowing for maximization of information pick-up before action initiation. **Methods** 16 female and 16 male Swiss Elite players, as well as 16 female and 16 male Swiss Near-elite players were subjected to 12 videos with 20 attacking scenes each (10 diagonal smashes, 5 cut shots, 5 line shots; randomized) shown from the perspective of a defensive player on a 3x4m projection screen. In half of the videos participants were required to react as they would do on the field (Action condition). The other half of the videos were under temporal occlusion (occlusions: -40 ms, -120 ms, -200 ms, -280 ms before ball hand contact) in which participants were instructed to call the specific attack variation (Occlusion condition). In both conditions decision accuracy as well as gaze (EyeSeeCam, Vicon-integrated) was recorded. Further, in the action condition decision time was calculated on the basis of participants' kinematics (using Vicon). **Results and Discussion** Elite-players demonstrated a higher decision accuracy in the Occlusion condition,  $F(1, 59) = 7.87, p < .01, \eta^2 = 0.33$ , as well as in the Action condition,  $F(1, 59) = 5.22, p < .01, \eta^2 = 0.21$ , compared to Near-elite players. Thus, Elite players were better able to anticipate the attack variation. Despite their superior anticipation skills, data from the Action condition show that Elite players actually initiate their defensive movements later compared to Near-elite players,  $F(1, 59) = 18.53, p < .01, \eta^2 = 0.24$ . Combined, the data suggest a "Moving-just-in-time- strategy", in which Expert players start their defensive movements at the optimal intersection between the maximization of information pick-up from the opponent's movement in relation to their own physical capabilities and simultaneously minimizing chances for opponents to adapt their attack variation. This hypothesis is further supported by the gaze

data, which show that Elite players have a higher fixation probability right before movement initiation when compared to Near-elite players. Reference Mann, D. T. Y., Williams, A. M, Ward, P., & Janelle, C. M. (2007). Perceptual-cognitive expertise in sport: A meta-analysis. *J Sport Exerc Psychol*, 29, 457-478.

### **EMOTION IN DECISION MAKING: THE CASE OF SPORT REFEREEING**

Rix-Lièvre, G., Récopé, M., Boyer, S., Grimonprez, M.

*Clermont University - Blaise Pascal University*

**Introduction:** Many researches have focused on referee decision making; few have taken their emotions into account. When emotions are studied, they are usually assessed through questionnaires filled out before or after the game. Results only provide information on how the referees relate to their emotions. Our aim is to study how emotions contribute, during the match, to referees' judgment acts. Referees' judgment acts show and impose on the players what is possible (Rix, 2005). We seek to determine whether 1) a negative affect arises from the referees' relationship to the unfolding game; 2) judgment acts are able to end this unsatisfactory situation. **Method:** We have investigated 4 games in a professional rugby championship. Each game was filmed from the stands, the referee was equipped with a head-mounted camera, and a self-confrontation interview was realized. The head-mounted video was used during the interview in order to foster an experiential immersion. **Results:** We analyzed the interview excerpts in which the referee reported affective dissatisfaction. It revealed two distinct cases. In the first case, affective dissatisfaction was related to an abnormal situation. The referee showed what was abnormal and overcame his dissatisfaction through a judgment act. In the second case, affective dissatisfaction was related to a paradoxical situation. The return to a satisfactory state occurred when a norm became predominant to determine the normality/abnormality of the situation within its unfolding. **Discussion:** Dosseville et al. (2011) suggested that the perception of players' action provokes an emotion that will guide the decision. Our results support partially this proposal. Negative affect was the basis for the referees' judgment acts: what was perceived as abnormal in the moment or in the dynamics of the situation led the referee to whistle. But it is not the perception of action that causes an emotion; affect is at the heart of referees' perceptions of player activity. Every perception is an assessment of what is happening in terms of personal well-being (Lazarus, 2001). This appraisal is not the result of deliberation; it is instantaneous and results from a mostly unconscious and embodied process. These proposals might lead some authors to denounce bias in refereeing judgments and to find an affective explanation of biases in perception and/or categorization. Instead we emphasize the implacable logic of emotion and its rationality (Lazarus, 2001); we claim the necessity to investigate this rationality to better understand referee naturalistic decision making. **References:** Dosseville F., Laborde S., Tractlet A. & Koffi P.E. (2011) *STAPS* 93(3), 51-60. Lazarus R.S. (2001) in Scherer, Schorr & Johnstone, *Appraisal processes in emotion*, Oxford University Press. Rix G. (2005) *Sc. & Mot.* 56(3), 109-124.

### **SELF-GENERATED EMOTIONS AND THEIR INFLUENCE ON SPRINTING ABILITY: AN INVESTIGATION OF HAPPINESS AND ANXIETY**

Rathschlag, M., Memmert, D.

*German Sport University Cologne*

**Self-generated Emotions and Their Influence on Sprinting Ability: An Investigation of Happiness and Anxiety** **Introduction:** Emotions and their regulation appear to be a fruitful area for improving performance and for this reason have more recently become a focus of extensive research in sports (Hanin, 2000). In sprint competitions only a few hundredths of a second can decide on whether athletes get a medal or not. Regardless of a good physical preparation for competition situations, athletes are often searching for further possibilities to improve their performance. This paper will help to answer the question if sprinters can benefit from the regulation of their emotions directly before the competition and if this regulation can help to improve sprinters' performance. The main purpose of the study was to examine the effects of self-generated emotions on sprinting times within Lazarus' (2000) cognitive-motivational-relational (CMR) theory framework. **Method:** Using self-generated emotions as emotion induction method, 26 sport students were asked to recall personal emotional episodes before the sprints. We used a within-subject design and therefore, all participants took part in three emotion induction conditions (happiness, anxiety, and an emotion-neutral state) and we measured their sprinting times over a distance of 40 meters under the respective emotion induction conditions. **Results:** We found a main effect for emotion induction ( $F(2, 50) = 3.42, p < .041, \eta^2 = .12, \text{power} = .61$ ). Follow-up Bonferroni corrected pairwise comparisons indicated a significant difference between the happiness condition and the emotion-neutral condition ( $p < .012$ ), indicating that participants in the happiness condition ran significantly faster when compared with the emotion-neutral condition. The emotion-neutral and the anxiety condition did not differ significantly ( $p = 1.000$ ). The happiness and the anxiety condition did also not differ significantly ( $p = .214$ ). **Discussion:** From a practical sport perspective it seems to be helpful for athletes to self-generate the emotion happiness before the sprint to enhance physical performance. Further research is needed to replicate and extend study findings. **References:** Hanin, Y. L. (Ed.). (2000). *Emotions in sport*. Champaign, IL: Human Kinetics. Lazarus, R. S. (2000). How emotions influence performance in competitive sports. *The Sport Psychologist*, 14, 229-252.

### **GOAL PERSPECTIVE AND PHYSICAL FITNESS**

Mehus, I.

*Norwegian University of Science and Technology*

**Introduction.** Researchers have found that task orientation is positively related to intentions towards physical activity and exerted effort, (Duda & Hall, 2001). Furthermore, Tzetis et al. (2002), found that children high in task orientation participated more in vigorous physical activity (VPA), regardless of their ego orientation. However, authors hypothesize that results could have been different in a highly competitive environment. Tests of physical fitness are extensively used in sport and physical education, and are regarded highly competitive. The present study investigates the effect of goal orientation on physical fitness when controlling for age, gender and objectively measured VPA. **Methods.** Participants (N=107) were students taking part in an introductory course in Sport Science. The mean age of the participants was 21 years (SD=1.9), and 50.5% were female. To measure aerobic fitness, participants were required to run around a volleyball court for three minutes, demanding two full stops for each lap. Total distance served as a measure of aerobic fitness. VPA was measured using an Actigraph GT1M accelerometer (Actigraph LLC, Pensacola, FL, USA). Students were instructed to wear the monitor for 6 consecutive days. Dispositional goal orientations were measured using the Perception of Success Questionnaire (POSQ; Roberts, Treasure & Balague, 1998). **Results.** Participants wore the accelerometer for a mean of 4.8 days (SD=1.3). Time in VPA reached a mean of 8.9 minutes pr. day (SD=8.9). The regression model explained 46.1% of the variance in physical fitness (adjusted R<sup>2</sup>), and turned out statistically significant ( $F(5, 106)=19.13, p<.001$ ). Gender, ego orientation, and time spent in VPA were statistically significant predictors ( $p<.05$ ), whereas age

and task orientation were not. Discussion. In this study physical fitness could also be regarded as a measure of exerted effort in a highly competitive situation. Contrary to some other studies, the level of task orientation has no impact on fitness/effort. However, together with gender and time in VPA, ego orientation is a significant predictor of fitness. Results indicate that high ego orientation predicts a high level of physical fitness and exerted effort. Results are further discussed within the theoretical framework of AGT. References Duda, J. L., & Hall, H. (2001). Achievement goal theory in sport: Recent extensions and future directions. In R. Singer, H. Hausenblas, & C. Janelle (Eds.), *Handbook of sport psychology*, (2nd ed.) (pp. 417–443). New York: Wiley. Roberts, G. C., Treasure, D. C., & Balague, G. (1998). Achievement goals in sport: The development and validation of the perception of success questionnaire. *Journal of Sports Sciences*, 16, 337-347. Tzetzis, G., Goudas, M., Kourtessis, T., & Zisi, V. (2002). The relation of goal orientations to physical activity in physical education. *European Physical Education Review*, 8, 177-188

## GOAL ORIENTATION IN SPORT AND PREFERRED COACHING STYLES AMONG YOUNG ATHLETES

Mohd Rasyid, N., Tengah, R., Abdul Aziz, S.

*Sultan Idris Education University*

**Introduction** The objective of this research was to identify goal orientation and preferred coaching styles of the young athletes from Malaysian Sports Schools. This study also examined goal orientation and preferred coaching styles among young athletes based on gender differences, age, and type of sport participated. **Methods** Instruments used in this study were Task and Ego Orientation in Sport Questionnaire (TEOSQ) and the athlete's preferred version of the Leadership Scale for Sport (LSS). Subject were young athletes from Malaysian Sport School age 13 to 18 years old (N = 854). **Results** The findings showed that young athletes were more inclined toward Task orientation rather than Ego. t-test and ANOVA analyses revealed significant differences for goal orientation based on gender, age and types of sports. Boys were found to be high in both Task and Ego orientation than girls. Younger athletes (under 15 years) are more task-oriented as compared to senior athletes (under 18 years). Individual sport athletes were found to be more Ego oriented than team sport athletes. The most preferred coaching styles were Training and Instruction, followed by Democratic, Social Support, and Positive Feedback. Autocratic behaviour was the least preferred coaching style. The result also indicated that there was a significant different ( $p < .05$ ) in coaching style based on gender and age group. Male athletes preferred more Autocratic and Positive Feedback as compared to female athletes. Senior athletes ( $\geq 21$  years old) preferred Training and Instruction and Social Support, while the young athletes ( $\geq 18$  and 15 years old) preferred Autocratic coaching style. **Discussions** Young athletes from Malaysian Sport School were found to be more task-oriented than ego. This augur well for the future of sport in Malaysia as task-oriented athletes are often associated with positive self-image (Biddle, Wang, Kavussanu & Spray, 2003). The findings of this study was in agreement with the previous studies that training and instruction coaching style is the style of coaching that often preferred by athletes meanwhile Autocratic style was the least popular (Sullivan, & Kent, 2003). In conclusion, to improve the commitment and achievement of the young athletes in sports the authorities involved in the development and planning of the sport programme should know and understand the athletes goal and their preferred coaching styles. **References** Biddle, S.J.H., Wang, C.K.J., Kavussanu, M., & Spray, C.M. (2003). Correlates of achievement goal orientations in physical activity: A systematic review of research. *European Journal of Sport Science*, 3, 1–20. Sullivan, P.J., & Kent, A. (2003). Coaching efficacy as a predictor of leadership style in intercollegiate athletics. *Journal of Applied Sport Psychology*, 15, 1-11. Do not insert authors here

**08:30 - 10:00**

## Oral presentations

### OP-PM31 Physiology [PH] 8

#### THE EFFECT OF EXERCISE TRAINING INTENSITY ON FAT OXIDATION, NEAT, AND APPETITE IN OVERWEIGHT/OBESE MEN

Alahmadi, M.A.1, Hills, A.P.2, King, N.A.3, Byrne, N.M.3

*1King Saud University, 2Griffith University, 3Queensland University of Technology*

**Introduction** It is important to ensure exercise intensity is appropriately prescribed, and to identify and monitor potential compensatory behavioural responses to exercise training. Therefore, the aim was to compare the impact of two different intensities of 4 weeks of exercise training on fat oxidation, non-exercise activity thermogenesis (NEAT), and appetite in overweight and obese men. **Methods** Using a cross-over design, 11 participants (BMI =  $29 \pm 4$  kg/m<sup>2</sup>; age =  $27 \pm 4$  y) were randomly assigned initially to: [1] a low-intensity (45% O<sub>2</sub>max) exercise training (LIT) or [2] a high-intensity interval (alternate 30 s at 90% O<sub>2</sub>max followed by 30 s rest) training (HIIT) 40-min duration, three times a week. Participants completed four weeks of supervised training for each training period, with a two week washout period in between. At baseline and the end of each exercise period, O<sub>2</sub>max, fat oxidation, and NEAT were measured. Fat oxidation was measured by indirect calorimetry during a standard 30-min continuous exercise bout at 45% O<sub>2</sub>max. NEAT was measured for 7 consecutive days using an accelerometer (RT3) the week before, at week 3 and the week after training. Subjective appetite sensations and food preferences were measured using visual analogue scales, immediately before and after the first exercise session every week for four weeks. **Results** The mean fat oxidation rate at baseline for both LIT and HIIT was  $0.14 \pm 0.08$  g.min<sup>-1</sup>, increasing to  $0.178 \pm 0.04$  g.min<sup>-1</sup> after four weeks of LIT and  $0.183 \pm 0.04$  g.min<sup>-1</sup> after HIIT. There was no significant difference in fat oxidation between LIT and HIIT, but there was a trend for fat oxidation to increase during exercise after HIT ( $P = 0.08$ ). The mean NEAT (counts.min<sup>-1</sup>) was  $45 \pm 18$  at baseline,  $55 \pm 22$  and  $44 \pm 16$  during training, and  $51 \pm 14$  and  $50 \pm 21$  after training for LIT and HIIT, respectively. Although not statistically significant ( $P = 0.08$ ), NEAT was 20% lower during week 3 of exercise training in HIIT compared with LIT. There were no statistically significant differences between LIT and HIIT in appetite ratings or preferences for high-fat sweet foods. **Conclusion** The results suggest that after 4 weeks of training there was no differential effect of exercise intensity on appetite or food preferences. However, there was some suggestion that compared with LIT, HIIT may lead to greater improvements in fat oxidation during a constant load exercise, but may also reduce non-exercise physical activity during the training program.

### MUSCLE WATER DEFICIT DOES NOT INCREASE GLYCOGENOLYSIS DURING INTENSE EXERCISE

Fernández-Elías, V.E., Hamouti, N., Ortega, J.F., Mora-Rodríguez, R.

*Universidad de Castilla-La Mancha*

Exercise that results in increases in body temperature accelerate muscle glycogen use. Several factors could be responsible for the increased anaerobic glycolysis; i) increased muscle temperature (T<sub>m</sub>), ii) stimulation of glycogen phosphorylase (PHOS) by epinephrine, iii) hypovolemia reducing cardiac output and allosterically activating PHOS. Purpose: To determine if muscle water deficit is an additional factor stimulating glycogen use during prolonged exercise in the heat. Methods: Seven endurance-trained males (VO<sub>2</sub>max = 55±3 mL • kg<sup>-1</sup> • min<sup>-1</sup>) dehydrated by 4.6±0.3% after 150 min of cycle-ergometer exercise in a hot-dry environment (33±1 °C) followed by a 4 hours recovery period. During recovery, in one occasion subjects ingested 400 g of a carbohydrate syrup (HYPO trial) and in another two occasions the 400 g of carbohydrates were accompanied by a fluid load to recover all fluid losses (i.e., 3.1 L; EU trials). Finally, subjects exercised intensely (75% VO<sub>2</sub>max) for 40 min in three different conditions: a) hypohydrated-thermoneutral (25±1 °C) environment (HYPO); b) euhydrated-thermoneutral environment (EUNEUTRAL) and c) euhydrated-hot (36±1 °C) environment (EUHOT). Muscle biopsies from vastus lateralis were collected prior and at the end of intense exercise and heart rate (HR) and intestinal temperature (T<sub>INT</sub>) were continuously monitored during the trials. Results: Before the high intensity exercise bout, muscle glycogen content was similar in the three trials (~434±22 mmol/kg dm) but muscle water content was lower in the HYPO trial (i.e., 357±5 mL/100g dm) than in the EU trials (389±9 and 386±10 mL/100g dm for EUNEUTRAL and EUHOT, respectively; P<0.05). After the 40 min of intense exercise, T<sub>INT</sub> increased similarly in HYPO and EUHOT (39.2±0.15 and 39.2±0.19°C respectively). Glycogen use was also similar during HYPO vs. EUHOT (172±32 and 185±37 mmol/kg dm, respectively) despite large differences in muscle water content. In contrast, during EUNEUTRAL, HR (161±4 beats/min), T<sub>INT</sub> (38.5±0.18°C) and glycogen use (117±20; P<0.05) were significantly lower than both during HYPO and EUHOT. Conclusion: These data suggest that thermal and cardiovascular stress stimulates glycogenolysis rate during exercise while muscle water deficit has a minor role. References: 1. Febbraio M.A. et al. (1994). Effect of heat stress on muscle energy metabolism during exercise. *JAP*; 77(6):2827-31.

### EXERCISE-INDUCED DEHYDRATION, INDEPENDENT OF HYPERTHERMIA, DOES NOT INFLUENCE PERFORMANCE OR NEUROMUSCULAR DRIVE DURING A MAXIMAL EFFORT, 5KM CYCLE TIME TRIAL

Cannon, J.I., Stewart, C.I., Wickham, J.I., Whyte, D.2, Marino, F.E.2,1

*Charles Sturt University CSU (Bathurst, Australia), ACU (Melbourne, Australia)*

**INTRODUCTION** Exercise in hot conditions can result in hyperthermia, which may reduce neuromuscular drive and exercise performance. However, exercise-induced dehydration may also contribute to reduced neuromuscular drive and exercise performance independent of elevated core temperature (T<sub>c</sub>). Despite this, the effect of exercise-induced dehydration on neuromuscular drive and exercise performance independent of thermal strain is not known. This study examined the effect of exercise-induced dehydration independent of hyperthermia on time to completion and neuromuscular drive during a maximal effort 5km, self-paced cycle time trial. **METHODS** In a counterbalanced design, seven (7) males (age 23.0 ± 4.3 years and peak power output 371 ± 57 W) completed two trials one week apart. Both trials involved initial assessments for maximum voluntary torque (MVT) and the level of voluntary activation (VA) of the right knee extensors followed by a 2-2.5 hour dehydration exercise protocol that reduced body mass by 3.8 ± 0.5 kg. Participants then had a 2 hour recovery period where they rested and either consumed water equivalent to 115% of the fluid lost or remained dehydrated. Following this, the MVT and VA assessments were repeated after which participants completed a maximal effort 5km, self-paced cycle time trial (TT). Performance data, T<sub>c</sub> and heart rate (HR) were monitored throughout each TT. EMG were also sampled from the vastus lateralis, vastus medialis, and biceps femoris of the right limb throughout each TT and were analysed for root-mean-square (RMS) and spectral compression ratio (SCR). **RESULTS** After the recovery period and prior to the TT, pre-dehydration values for MVT, VA, T<sub>c</sub> and HR were re-established and these were not different between trials (p> 0.05). No differences in the time to complete the TT were observed between trials (p> 0.05). HR and the rating of perceived exertion during the TT increased with time in both trials (p< 0.05) and the changes observed were comparable between trials (p> 0.05). In both trials, power output at 2km, 3km and 4km was lower than immediately after the start of exercise (p< 0.05); but at 5km returned to the level seen immediately after the start of exercise (p> 0.05). RMS and SCR were unchanged across all intervals for all muscles in both trials (p> 0.05). T<sub>c</sub> was higher at 4km and 5km in both trials (p< 0.05); however, T<sub>c</sub> did not exceed 37.9 ± 0.2°C in either trial. **CONCLUSION** These findings demonstrate that exercise-induced dehydration independent of hyperthermia may not influence exercise performance or neuromuscular drive during maximal effort, self-paced tasks of moderate duration. Such data demonstrate resilience of the neuromuscular system to imbalances in internal fluid homeostasis.

### A-GALACTO-OLIGOSACCHARIDES <A-GOS> PREVENTS SKELETAL MUSCLE ATROPHY IN STREPTOZOTOCIN-DIABETIC RATS THROUGH A REDOX-SENSITIVE MECHANISM.

Ferrando, B.I.2, Derbre, F.I, Vincent, S.I, Groussard, C.I, Lefevre-Orfila, L.I, Gómez-Cabrera, M.C.2, Viña, J.2, Gratas-Delamarche, A.I

*1Laboratory "Movement, Sport and health Sciences" (M2S). University Rennes 2-ENS Cachan. France. 2Department of Physiology. University of Valencia. Spain.*

**Introduction:** Skeletal muscle atrophy is a debilitating consequence of multiple chronic diseases such as type 1 diabetes mellitus (T1DM). It reduces treatment options and positive clinical outcomes as well as compromising quality of life and increasing morbidity and mortality. Oxidative-inflammatory cascade is recognized to play a key role in the pathogenesis of diabetes, and also in skeletal muscle atrophy. Interestingly, α-galacto-oligosaccharides (α-GOS) are prebiotics that selectively alter the composition of gut microbiota and exhibit strong antioxidant and anti-inflammatory effects in vitro (Efstathiou and Fathi 2010). Because T1DM is characterized by a pro-oxidant and pro-inflammatory state (Tran, Oliver et al. 2012), we designed the present study to test the hypothesis that α-GOS can limit skeletal muscle atrophy, oxidative stress and inflammation in a model of streptozotocin-induced type 1 diabetes. **Methods:** Twenty-seven male Wistar rats were divided into control placebo, streptozotocin-diabetic rat groups (STZ) supplemented or not with α-GOS. They received water (placebo groups) or water diluted α-GOS (20 mg/kg/day) daily for a period of 8 weeks. At the end of the protocol, blood was obtained by venous puncture into heparin-containing tubes. Tibial anterior muscle was removed, weighted and analyzed to determine oxidative stress and inflammatory parameters. **Results:** Relative to the control group, STZ rats exhibits skeletal muscle atrophy (-56%), hyperglycemia, insulin deficiency and a trend to higher plasma fructosamine levels, a marker of glycated proteins. α-GOS treatment partially prevents the loss of muscle mass, reduces plasma fructosamine levels compared to STZ rats. In skeletal muscle, STZ treatment down-regulates MnSOD protein content, increases p38 MAPK activation and inflammatory markers (i.e. NF-κB and TNF-α). Interestingly, α-GOS partially

prevents MnSOD down-regulation and p38 MAPK activation, but fails to influence inflammatory marker levels. Discussion: Our results suggest that oxidative stress, but not through inflammation pathway, play a role in diabetes-induced skeletal muscle atrophy.  $\alpha$ -GOS supplementation partially prevents the loss of muscle mass due to T1DM, probably by limiting oxidative stress and p38 pathway activation. References Efstathiou, T. and D. Fathi (2010). Sojasun Technologies. Tran, B., S. Oliver, et al. (2012). *Exp Diabetes Res* 2012: 683-680.

### ACUTE EFFECT OF AEROBIC EXERCISE ON POSTPRANDIAL LIPAEMIA IN OBESE ADULTS ACCORDING TO THE POLYMORPHISM -3826 A/G IN THE GENE FOR UNCOUPLING PROTEIN 1

Reischak-Oliveira, A., Pezzi, F., Bijoldo, J.M., Moreira, D.C.

*Universidade Federal do Rio Grande do Sul*

**Introduction** Hypertriglyceridaemia is a common feature in obesity and can be characterized by elevated triglycerides in fasting state or postprandial. There are evidences the polymorphism -3826 A/G gene UCPI affect the lipid profile (OH et al., 2004). Furthermore, exercise improves the postprandial lipaemia (Stensel et al. 2006; Katsanos et al., 2004). The purpose of this study was to identify the effects of an acute bout of aerobic exercise on postprandial lipaemia in obese adults according to. **Methods** Thirty-six young adults of both sexes were split into groups: Eutrophic A/A (EAA, n = 10), Eutrophic A/G (EAGs, n = 8), Obese A/A (OAA, n = 8) and obese A/G (OAG, n = 10). Study volunteers attended the laboratory on four sessions. In the first session, a blood sample was collected to DNA extraction and genotyping, through PCR. In the second session the aerobic power (VO<sub>2</sub>peak) was evaluated and in the third and fourth session the volunteers performed the tests in a randomized sequence (exercise or control test) with an interval of seven days. In both trials a standard hyperlipidic breakfast (41.3%) was offered. The exercise protocol consisted of cycling at an intensity equivalent to 60% of VO<sub>2</sub> peak for 45 minutes with a pedalling cadence between 60 and 80 rpm. Blood samples were collected after 12 hours fasting, and two, three, four and six hours after the standard breakfast for triglycerides, total cholesterol and LDL-c analysis. Data were analysed using SPSS version 19.0 for Windows. Two-way ANOVA was used to determine differences between groups. The Statistical significance was determined as p < 0.05. **Results** Biochemical parameters of fasting indicated significant differences between both groups Eutrophic (Total cholesterol and LDL-c) and for the Obese (Triglycerides and Total Cholesterol) when the G allele was present in the genotype. All groups showed a time effect (p = 0.000) compared with baseline. It was also evident a treatment effect (control vs. exercise). Aerobic exercise was able to decrease the postprandial triglyceridaemia in the EAA groups (p = 0.01), EAG (p = 0.03) and OAA (p = 0.000). However, surprisingly, the exercise had no effect for the OAG group (p = 0.15). **Discussion** The main contribution of this study was to show that acute aerobic exercise performed for 45 minutes at 60% of VO<sub>2</sub>peak was able to modify the triglyceridaemia in Eutrophic A/A, Eutrophic A/G and Obese A/A groups. However, the exercise had no effect on the postprandial lipaemia in the Obese A/G group. In conclusion, the exercise was not able of promoting effect in subjects with excess body fat associated with the presence of the G allele in the genotype of the -3826 polymorphism in the UCPI gene. References KATSANOS C.S; GRANDJEAN P.W; MOFFATT R.J. *J Appl Physiol*, 96: 181-188, 2004. OH, H. H; KIM, K. S; CHOI, S. M; YANG, H. S; YOON, Y. *Metabolism*. 53:8, 1054-1059, 2004 STENSEL, J.D; BARRETT, A.L; MORRIS, G.J; NEVILL, E.M. *Med Sci Sports Ex*. 39:1, 116 – 122, 2006.

**08:30 - 10:00**

## Oral presentations

### OP-SH16 Sport Statistics and Analyses [SA] 2

#### THE EFFECTS OF ADDITIONAL LINES ON A FOOTBALL FIELD ON ASSISTANT REFEREES' POSITIONING AND OFFSIDE JUDGMENTS

Barte, J.C.M., Oudejans, R.R.D.

*VU University Amsterdam*

**Introduction:** Judging offside in association football is a complex task and a popular topic for discussion by coaches, players, media and football fans because the consequences of errors in judging offside can be significant. The observation point of assistant referees relative to the offside line, and the corresponding viewing angle, is an important determining factor in incorrect decisions in judging offside. For that reason, information provided by extra lines across the width of a football field (comparable to an American football field) could help assistant referees to correctly judge offside. Therefore, we investigated whether extra lines across the width of a football field influence the positioning of assistant referees and their offside judgments. **Method:** Eight expert assistant referees each judged potential offside situations played by several attackers and defenders on two different fields, one field with and one field without extra lines. The data were collected by video recording and analyzed using an interactive digital video analysis system. Relative positions of the players and the assistant referee to the offside line at the moment of passing and correctness of the assistant referee's decision were determined. The relative position of the assistant referee to the offside line and the number of erroneous decisions on the field with and without extra lines were compared using chi-square tests. **Results:** 555 (282 situations with extra lines and 273 without extra lines) potential offside situations were played. Assistant referees were positioned more often on line (p=.01) and less often far trailing (p<.001) on the field with lines compared to the field without lines. No significant differences in incorrect decisions between the fields with and without lines were found (7.6% vs. 7.9%, p=0.88). In total, the assistant referee made more incorrect decisions when leading the offside line (16.1%) rather than trailing (6.5%, p=.02) or on line (5.1%, p<.01). **Conclusion:** The extra lines resulted in better positioning of the assistant referees but not in less incorrect decisions. A possible explanation for not finding better performance results in the number of incorrect decisions is that the assistant referees first have to learn to use the information provided by the additional lines for judging offside.

**MEASURING ACCELERATIONS AND DECELERATIONS IN SOCCER-SPECIFIC MOVEMENTS**

Stevens, T.G.A., de Ruijter, C.J., van Niel, C., van de Rhee, R., Beek, P.J., Savelsbergh, G.J.P.

*VU University Amsterdam*

**Introduction** Computerized time-motion analysis has become the standard for measuring work load during training and match in team sports, particularly in soccer. Information such as total distance covered and number of sprints is used to quantify the physical load on players. Local Position Measurement (LPM) systems provide more accurate data compared to GPS. Ogris et al. (2012) reported error values of the Inmotio LPM system and found an underestimation of 1% for mean speed and an overestimation of 7% for maximum speed for straight running executed on maximal intensity. Currently, no data is available about accuracy of LPM systems regarding acceleration and deceleration characteristics of whole body movements. The main purpose of this study was to investigate the accuracy of LPM on mean and peak accelerations for accelerated and decelerated runs executed at different intensities. **Methods** Twelve male amateur soccer players (22±3 yrs; 183±8 cm; 76±7 kg) performed two kinds of straight runs: acceleration from standstill and deceleration from running to standstill, executed at three intensities: jog (~10 km/h), sub max (~17 km/h) and max (~29 km/h). LPM (Inmotio Object Tracking BV, Amsterdam, The Netherlands) sampled at 45Hz (settings as recommended by manufacturer) was compared to a golden standard: VICON sampled at 100Hz. VICON signals from markers placed upon LPM sensors on top of both shoulders were combined, low-pass filtered (1Hz Butterworth) and analyzed in XY-direction. Absolute thresholds of 0.2 m/s<sup>2</sup> (VICON) were used to define begin and end of movements. Mean and peak values were computed for acceleration and deceleration. **Results** With respect to distance and mean speed, differences between systems were small (<1% for all mean values) and mostly insignificant. No significant interaction effects were found for execution intensity. In the accelerated run, LPM overestimated ( $p < 0.05$ ) peak acceleration with 28±27% (grand mean ± SD), whereas mean acceleration was not different (0±11%). In the decelerated run, mean deceleration (0±5%) and peak deceleration (3±14%) were not different. **Conclusion and discussion** For runs from or to standstill, the LPM system provides reasonable accurate values for mean acceleration and mean and peak deceleration, but for peak acceleration LPM accuracy is limited and the variation relatively large. Nevertheless, the system may be useful in practice for quantifying mean accelerations and parameters such as summed accelerations or time spent in acceleration zones when the above error margins are kept in mind. **References** Ogris G, Leser R, Horsak B, Kornfeind P, Heller M, Baca A. (2012). Accuracy of the LPM tracking system considering dynamic position changes. *J Sports Sci.* 30(14): 1503-1511.

**SOCCER ANALYSIS OF FAST ATTACK SEQUENCES THAT END IN GOAL. COMPARING REAL MADRID AND INTER MILAN**

Barbosa, A.1, Sarmiento, H.2, Anzano, A.1, Campaniço, J.3

*1INEF (Catalunya, Espanha); 2 ISMAI (Maia, Portugal) 3 UTAD, (Vila Real, Portugal)*

**Introduction** This study aims to identify the significant repeated and regular behaviors, emerging from the diversity of game actions regarding the fast attack sequences that end in goal scored. The selected teams are Real Madrid (2010/2011) and International Milan (2009/2010), two top level teams, that share the same coach and technical team were analyzed. **Methods** To collect data, we used the instrument developed and validated by Sarmiento et al. (2010). Several offensive sequences were coded through the observation of 24 games (12 per each team) of Inter Milan and Real Madrid. The collected data were analyzed through in the SDIS-GSEQ (5.1). The determination of the motivational value of transitions between the different behaviors considered as criteria categories and object, occurred considering the pattern sequence up to the transition limit of 5, retrospectively, in other words delays of -5, since after this number, "the sequence awareness is greatly reduced" (Castellano Paulis, 2000). The analysis of data reliability was calculated by intra and inter observer agreement, and values above 0.90 for all criteria were achieved. **Results and Discussion** We verified that both teams don't activate any conduct object along delay -5 to delay -2, and didn't activated any conduct related to field zones along all delays. In retrospective terms, on IM we identified that the max-lag is on the -1 delay corresponding to the conduct object, diagonal pass to the back. In our opinion, the conduct that was activated is connected with the pass directed to player facing the opponent's goal. Relatively to RM, it evidences a short pattern. We verified that the max-lag is on the -1 delay corresponding to development by intervention from the goalkeeper of the opposing team. We think that the behavior that precedes the goal achievement is similar and consist on winning a second ball. **Conclusion** We think that the result reflect the importance of training exercise, related to the end of the offensive processes, in different field zones on the various corridors. Unpredictability is the key factor in achieving goal. However the pass towards behind and winning a second ball allows the teams to score goals. **References** Sarmiento, H., Anguera, T.; Campaniço, J. & Leitão, J. (2010). Development and Validation of a Notational System to Study the Offensive Process in Football. *Medicina (Kaunas)*, 46(6), 401-407. Castellano Paulis, J. (2000) Observacion y analisis de la acción de juego en fútbol. Tesis doctoral. Departamento de Historia y Teoría de la Educación de la Universidad del País Vasco. *Lecturas Educación Física y Deportes. Revista Digital*, Nao 5, 22, junho de 2000 (em linha) [http:// www.efdeportes.com/](http://www.efdeportes.com/). Do not insert authors here

**CLASSIFICATION POWER OF SPATIAL METRICS IN INVASION TEAM SPORTS**

Fonseca, S.1, Lopes, A.1,2, Leser, R.3, Baca, A.3, Hadjileontiadis, L.4

*Universidade Lusofona, 2: CIDESD (Portugal), 3: Centre for Sport Science and University Sports, University of Vienna, 4: Aristotle University of Thessaloniki*

**Introduction:** Team sports can be studied as a multi-agent action system (Saltzman & Kelso, 1987) when described by the interactions of team-players. This interpersonal coordination is specific to task constraints (Araújo, Davids, Bennett, Button, & Chapman, 2004) and self-organised structures, like offensive and defensive patterns that describe the system's/team's behaviour, that can emerge from these complex interpersonal interactions of performers (McGarry et al., 2002). Tactical behaviour includes both individual and team tactics, and the position of every player is influenced by the tactical concept of the team (Jäger, Perl, & Schöhlhorn, 2007). A proper method of assessing tactical team performance in game sports is the observation of spatial organization (Garganta, 2009), in particular the space in the field covered by a team (Bartlett et al., 2012). Spatial metrics such as the convex hull's area, bounding rectangle's area, voronoi cells' area have been considered (Fujimura & Sugihara, 2005; Bourbousson, Sève, & McGarry, 2010; Fonseca, et al., 2012), as well as measures derived from the teams' centroid (Bourbousson, Sève, & McGarry, 2010). The purpose of this work is to measure the power of these spatial metrics to discriminate between attack and defense phases of a game. **Methods:** Four trials of an indoor small sided amateur soccer game (5vs5) played in a 33m×18m field were considered. Players and ball trajectories were collected across the duration of each trial by means of Ubisense Location System (Leser, Baca, & Ogris, 2011). The spatial metrics defined above were calculated for each team across the duration of each trial and their classification power was tested sole and in pairs. **Discussion:** Results suggest that it is possible to identify attack and defense phases of a game in invasive team sports using some of the spatial metrics considered in this study. Further research is needed to verify the current findings. **References:** Bartlett, R., Button, C., Robins, M., & Dutt-mazumder, A. (2012).

Analysing Team Coordination Patterns from Player Movement Trajectories in Soccer: Methodological Considerations, 398–424. Bourbosson, J., Sève, C. and McGarry, T. (2010). Space-time coordination dynamics in basketball: Part 2. The interaction between the two teams. *JSS*, 28, 349–358. Fonseca, S., Milho, J., Travassos, B., and Araújo, D. (2012). Spatial dynamics of team sports exposed by Voronoi diagrams. *HMS*, 30(6), 1652–1659. Garganta, J. (2009). Trends of tactical performance analysis in team sports: bridging the gap between research, training and competition. *Rev. Port. Cien. Desp.*, 9(1), 81–89. Jäger, J. M., Perl, J., and Schöllhorn, W. I. (2007). Analysis of players' configurations by means of artificial neural networks. *Int J Perform Anal Sport.*, 7(3), 90–105. Leser, R., Baca, A., and Ogris, G. (2011). Local Positioning Systems in (Game) Sports. *Sensors*, 11, 9778–9797. McGarry, T., Anderson, D.I., Wallace, S.A., Hughes, M.D., & Franks, I.M. (2002). Sport competition as a dynamical self-organizing system. *JSS*, 20:10, 771–781.

## RELATION BETWEEN DISTANCE FROM THE LEAST ADVANCED OUTFIELD DEFENDER TO HIS GOAL LINE ON ZONE OF THE PITCH WHERE THE BALL IS GAINED IN SOCCER.

Añón Gómez, A.1, Ruiz-Ruiz, C.2, Zubillaga, A.3, Fradua, L.1, Nardi, A.1, Gómez-Pérez, P.T.2

1 University of Granada, 2 University of Seville, 3 University of the Basque Country.

**INTRODUCTION** In Football it has been demonstrated that the closer to the opposing goal teams gain the ball the higher probability of scoring a goal and the lower of conceding it (Bate, 1988). However, until the present there is a lack of studies focused on ascertain in what manner teams should play to gain the ball in those zones. When defending pieces of play initiated in the opposing half, pushing up the back four line might help teams to win the ball back in advanced parts of the pitch. The aim of this study was to examine differences on distance from the least advanced outfield defender to his goal line according to the zone of the pitch where the ball is gained. **METHODS** 4 matches played by a team during the 2010/11 Liga BBVA (Spanish first football division) were monitored using the AMISCO PRO® system. The matches analysed (3 home and 1 away matches) resulted in 2 wins, 1 draw, and 1 loss. 217 defensive pieces of play initiated in the opposing half were analysed. A defensive piece of play initiated in the opposing half starts when the attacking team initiates a possession of the ball in his own half of the pitch and ends when the analysed team gains possession of the ball. Data was normally distributed and had equal variance. A one-way ANOVA test was run. The dependant variable was distance from the least advanced outfield defender to his goal line when the analysed team gained the ball. The factor was zone of the pitch where the ball was gained (1, 2, 3, 4, 5, 6). **RESULTS** LSD post hoc analysis revealed that distance from the least advanced outfield defender to his goal line was significantly higher as the ball was gained in more advanced zones of the pitch,  $F(5,211) = 182.86$ ,  $P < 0.001$ ,  $\eta^2=0.81$ . When the ball was gained in zones 1, 2, 3, 4, 5, and 6 the distance from the least advanced outfield defender to his goal line was  $11.21 \pm 5.69$ ,  $22.45 \pm 5.69$ ,  $35.38 \pm 6.32$ ,  $43.93 \pm 4.68$ ,  $48.02 \pm 7.93$ , and  $55.23 \pm 7.47$  metres respectively. **DISCUSSION** Results showed that pushing up the back four line helped teams to gain the ball in advanced zones of the pitch. This finding supports Suzuki and Nishijima (2007) notions about the benefits of pushing up the back four line when defending in order to keep the team compact and restrict the spatial temporal demands of the opposition. **REFERENCES** Bate, R. (1988). Football chance: Tactics and strategy. In T. Reilly, A. Lees, K. Davids, & W. J. Murphy (Eds.), *Science and football* (pp. 293–301). London: E & FN Spon. Suzuki, K., & Nishijima, T. (2007). Sensitivity of the Soccer Defending Skill Scale: A comparison between teams. *European Journal of Sport Science*, 7, 35–45.

## 10:20 - 11:50

### Invited symposia

#### IS-PM06 Sports nutrition: from science to recommendations sponsored by GSSI \*

##### CARBOHYDRATE: CARBOHYDRATE INTAKE GUIDELINES AND LOW VERSUS HIGH DEBATE

Jeukendrup, A.

University of Birmingham

It has been known for a long time that carbohydrate is the main fuel for athletes in the vast majority of events. There is much discussion about training with low carbohydrate and training with high carbohydrate availability. Carbohydrate availability is increased by consuming carbohydrate in the hours or days prior to the session, intake during exercise, and refueling during recovery between sessions. This is important for the competition setting or for high-intensity training where optimal performance is desired. Carbohydrate intake during exercise should be scaled according to the characteristics of the event. During sustained high-intensity sports lasting ~1 h, small amounts of carbohydrate, including even mouth-rinsing, enhance performance via central nervous system effects. While 30–60 g/h is an appropriate target for sports of longer duration, events >2.5 h may benefit from higher intakes of up to 90 g/h. Products containing special blends of different carbohydrates may maximize absorption of carbohydrate at such high rates. In real life, athletes undertake training sessions with varying carbohydrate availability. Whether implementing additional 'train-low' strategies to increase the training adaptation leads to enhanced performance in well-trained individuals is unclear. It is clear that both training low and training high approaches seem to have some advantages and disadvantages. But how do you decide how to approach training? In this presentation the following topics will be addressed in particular: 1. Current carbohydrate intake guidelines 2. A brief summary of the evidence supporting these guidelines 3. A discussion of the train high versus train low debate 4. A recommendation on how to incorporate train high/train low into a training program

##### THE ROLES OF EXERCISE AND NUTRITION IN MAXIMIZING ANABOLISM

Phillips, S.

McMaster University

Muscle proteins are constantly and simultaneously being synthesized and degraded. This 'turnover' provides for a mechanism of constant maintenance and greater potential for changes in protein pool size. The two most potent stimuli for enhancing muscle protein synthesis (MPS) are exercise and provision of protein. While protein feeding and exercise are independent stimulators of MPS they are additive in their effect and when combined over longer periods of time sum to result in expansion of a protein pool, the most obvious

example of which is muscle fibre hypertrophy with resistive exercise (Phillips et al., 2005). The traditional dichotomy for the phenotypic adaptation induced by exercise is that endurance exercise does not lead to hypertrophy but instead results in expansion of the mitochondrial protein pool. On the other hand resistance exercise leads to muscle fibre hypertrophy (i.e., expansion of the myofibrillar protein pool) and does not change mitochondrial content. Our work has shown that in the untrained state the response to exercise is, however, rather generic and that both protein pools expand, at least acutely (Wilkinson et al., 2008). With increased specificity and time spent training with one particular exercise mode the response is 'honed' and the protein pools that are synthesized become specific (Wilkinson et al., 2008). With a focus on resistive exercise, since it is a potent countermeasure to atrophy even in small doses and an effective countermeasure to sarcopenic muscle loss, we have shown that various paradigms of resistance exercise that are non-traditional are actually effective in stimulating MPS (Burd et al., 2010; Burd et al., 2012a) and also in promoting hypertrophy (Mitchell et al., 2012). In combination with our work on optimal sources of protein to promote MPS (Tang et al., 2009; Burd et al., 2012b) we are now beginning to understand that rapidly digested high-leucine content proteins such as whey protein are remarkably effective in stimulating MPS (Tang et al., 2009; Burd et al., 2012b); we propose that this phenomenon is explained by the 'leucine trigger' hypothesis. According to this thesis the rise in intramuscular free leucine, likely through mTOR signalling, stimulates MPS. Noteworthy is the fact that slowly digested or low leucine-containing proteins are ineffective in stimulating MPS. Recent data in conditions of extreme hypertrophy, weight loss, and specific meal composition will be discussed.

**10:20 - 11:50**

## Oral presentations

### OP-PM48 Training and Testing [TT] 2

#### THE RELIABILITY OF POWER OUTPUT AND PERFORMANCE TIME DURING SIMULATED DYNAMIC GRADIENT CYCLING TIME TRIALS

Clark, B.1, Paton, C.D.2, O'Brien, B.J.1

*1 University of Ballarat (Ballarat, Australia) 2 EIT (Hawkes Bay, New Zealand)*

THE RELIABILITY OF POWER OUTPUT AND PERFORMANCE TIME DURING SIMULATED DYNAMIC GRADIENT CYCLING TIME TRIALS Introduction Laboratory assessment of physiology and performance forms an integral part of athlete preparation for competition. Establishing the physiological capacity and performance standard of cyclists, allows sports scientists and coaches to formulate and implement structured training programs and subsequently assess the effectiveness of those programs. Cycling performance assessment is generally characterised by simulated time trials of various duration generally completed under controlled conditions in a laboratory. The purpose of this investigation was to establish the reliability of simulated cycling time trials completed on a course of varying gradient. Methods Twenty competitive cyclists (Age:  $32 \pm 12$  years, weight  $73 \pm 11$  kg, height  $178 \pm 5$  cm) completed four simulated cycling time trials over a 20km course with numerous and un-regimented changes in gradient (both ascents and descents). The time trials were completed over a 5 week period to establish short and long term reliability. Results Performance time was highly reliable across all trials (TT1-TT2 CV=  $1 \pm 0.5\%$ , TT2-TT3 CV=  $1.4 \pm 0.7\%$ , TT3-TT4 CV=  $1.5 \pm 0.8\%$ ). Similarly, average power output highly reliable across all trials although somewhat less so than performance time (TT1-TT2 CV=  $1.9 \pm 1.0\%$ , TT2-TT3 CV=  $2.5 \pm 1.3\%$ , TT3-TT4 CV=  $2.2 \pm 1.2\%$ ). Discussion The major finding of the present study is a new laboratory based simulated cycling time trial performed on a course of varying gradient is a highly reliable test of the performance standard of competitive cyclists. In the present study, a course was designed to closely mimic the natural changes in gradient faced by cyclists in competitive situations thus improving the ecological validity of laboratory performance assessment. The average CV for performance time (1.3%) from the new protocol investigated by this study was found to be similar to, if not lower than the average CV reported for the same measure from previous investigations on constant gradient protocols (Sporer, 2007; Zavorsky, 2007; Smith, 2001; Nooreen, 2010). Correspondingly the average CV for average power output (2.2%) was also found to be similar to or better than the average CV reported from studies on constant gradient (Sporer, 2007; Zavorsky, 2007; Smith, 2001; Nooreen, 2010) and constant gradient dynamic protocols (Abiss, 2008). References Sporer, B. C., & McKenzie, D. C. (2007). *Int J Sports Med*, 28(11), 940-944. Zavorsky, G. S., Murias, J. M., Gow, J., Kim, D. J., Poulin-Harnois, C., Kubow, S., & Lands, L. C. (2007). *Int J Sports Med*, 28(9), 743-748. Smith, M. F., Davison, R. C. R., Balmer, J., & Bird, S. R. (2001). *Int J Sports Med*, 22(04), 270,274. Nooreen, E., Yamamoto, K., & Clair, K. (2010). *European Journal Of Applied Physiology*, 110(3), 499-506. Abbiss, C. R., Levin, G., McGuigan, M. R., & Laursen, P. B. (2008). *Int J Sports Med*, 29(7), 574-578.

#### COMPARISON OF TWO DIFFERENT TRAINING LOADS IN SPANISH ELITE FREEDIVERS.

Fernández, F.A., González-Ravé, J.M., Juárez Santos-García, D.

*University of Castilla -la Mancha*

Introduction Numerous studies conclude that training is the main reason for developing the diving response and thus increase apnea time in divers (Schagatay, 2000; Lemaitre, 2010), but there are few studies that had compared different periodized training with elite freedivers. The aim of this study was to evaluate and compare the impact of two different training loads by means body composition, lung function and of static apnea time. Methods. Ten Spanish elite freedivers ( $36 \pm 5.07$  years, BMI  $22.8 \pm 1.43$ ). The sample includes the Spanish recordman in free immersion (117 m.), the Spanish ex-recordman in static apnea (7'05") or the Spanish ex-recordwoman in dynamic apnea (144 m.). The divers were divided in two groups: Group A received a training program with Specific loads of Deep apnea (SLDA) and group B conducted a training program with Specific loads of Static apnea (SLSA). Both groups performed a program of preparation of 4 weeks with 6 weekly sessions for the training of apnea. Testing were carried out before and after to perform the training programs. We used a segmental bioimpedance analyzer (InBody 230, Biospace) to assess body composition. On the other hand we performed a spirometry test, determining the Forced Vital Capacity (FVC) and maximum expiratory volume in first second (FEV) by Spirometry (Datospir-70, Sibelmed). Static apnea test is performed after a free warm-up of ten minutes. The freediver remains in "jellyfish position" and is calculated the time that remains in apnea by two different timers. Results Body composition; Muscle mass decreased by 0.23% in A group and was increased by 2.66% in B group. Fat percentage was decreased by 5.21% in A group and decreased by 6.67% in B group. Respiratory flows; FVC was decreased by 4.78% in A group and was increased by 1% in B group. VEMS was decreased by

0.85% in A group and was increased by 2.55% in B group. Static apnea; was decreased by 20.8 seconds in A group and was increased by 2.2 seconds in B group. No significant differences were found between two groups on the dependent variables. Discussion Training in SLSA performs better but not significantly in Static Apnea, although no significant differences, the effect size can be considered large ( $\eta^2$  0.102). These differences may be relevant in competition, so it is a more determining training in delaying the rupture of apnea in this discipline. This is consistent with that seen in other studies such as Gamble (2006) which speaks of the principle of specificity in the training of apnea, and concludes that improvement in the specific training content that is trained. The general concept of specificity also appears in the study of Schagatay (2000) which compares physical training in apnea, where the results show that training effects are specific to the training conducted. References Schagatay, Van Kampen, M., & Holm, B. (2000). *EJAP*, 82(3), 161-169. Lemaître, F., Joulia, F., & Chollet, D. (2010). *Medical Hypotheses*, 74(3), 413-415. Gamble, P. (2006). *Strength & Conditioning Journal*, 28(3), 54-58.

### HALF TIME SOCCER PERFORMANCE CAN BE IMPROVED FOLLOWING SPECIFIC RE WARM UP ACTIVITIES

Zois, J., Bishop, D., Fairweather, I., Aughey, R.

*Victoria University*

**Introduction** Half-time periods provide soccer players with an opportunity to physically prepare for subsequent competitive tasks. High-intensity, short duration warm-up (WU) activities can improve subsequent physical performance when completed during the pre-game WU routine (Zois et al., 2011). However, the beneficial physical and skilled effects of similar WUs conducted during half-time rest intervals in soccer are unknown. **Methods** Eight male amateur soccer players participated with a mean age, height, body mass and maximal HR of 23.6±4.1 y, 1.73±0.5 m, 75.5±7 kg and 187±4 bpm respectively. They performed two 26-min periods of intermittent activity on a non-motorised treadmill, interspersed by 15 min of passive recovery. During the 15 min recovery period, participants performed either a 3 min small-sided game (SSG) re-WU; a 5RM leg-press re-WU, or no re-WU. Measures included counter-movement jump (CMJ), repeated-sprint ability (8x4 s sprints embedded in each intermittent activity protocol), the Loughborough Soccer Passing Test (LSPT), core temperature, blood lactate concentration, HR, and perceptual measures. Data were analysed using the effect size statistic with 90% confidence intervals, and percentage change, to determine magnitude of effects. **Results** Repeated-sprint ability in the second period improved only in the 5RM re-WU condition; on average, peak velocity, mean velocity and acceleration was 4, 3 and 18% greater. Compared to pre-intervention, only the SSG re-WU improved performance on the LSPT, 6.4% (0.6±0.8) post intervention and 6.2% (0.6±0.6) following the second activity period. Flight-time to contraction-time measured in the CMJ, improved following the 5RM re-WU compared to the SSG re-WU (9.8%, 0.5±0.3) and no re-WU (9.4%, 0.7±0.5), and remained higher post the second activity period (8.8%, 0.5±0.3 and 10.2%, 0.6±0.6, respectively). Relative maximum rate of force development measured in the CMJ, was greater in the 5RM condition following the second activity period compared to the small-sided game (29.3%, 0.7±0.5) and no re-WU (16.2%, 0.6±0.6). **Discussion** Results suggest that a 5RM leg-press re-WU completed following standardised intermittent exercise improved subsequent physical performance. In contrast, skilled based re-WUs which included SSG activity, enhanced skill execution following the standardised intermittent exercise. **References** Zois J, Bishop D, Ball K, Aughey R (2011) *J Sci Med Sport*, 14(6): 522-8

### THE DUTCH TALENT IDENTIFICATION ASSESSMENT FOR TABLE TENNIS; A REPRODUCIBILITY AND VALIDITY STUDY

Faber, I.R., Nijhuis-van der Sanden, M.W.G., Oosterveld, F.G.J.

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**Introduction** Talent identification programs in sports can provide an optimal connection between sports, talents and personal preferences. As a result, both elite sports and sports on amateur level benefit from these programs. Assessing essential fundamental motor skills could be helpful in talent identification to estimate the potential of young athletes (Gagné, 2004; Vandorpe et al., 2012). In this context, valid and reliable tests are essential to obtain trustworthy results (Faber et al., 2011). This study aimed to investigate the reproducibility on test-item level, internal consistency, underlying dimensions, and concurrent validity of the talent identification assessment (TIDA) of the Netherlands Table Tennis Association. **Methods** In total, 113 youngsters (6-10 years) were tested using the TIDA. The TIDA consists of eight test-items measuring specific skills for table tennis: sprint, agility, vertical jump, speed while dribbling, aiming at target, ball skills, throwing a ball and eye-hand coordination. A retest was taken to test reproducibility. The initial assessments were used for estimating internal consistency and searching for possible underlying dimensions. National ranking was used to test concurrent validity. **Results** Reproducibility analyses exposed that the ICC's of six of the eight test items (sprint, agility, vertical jump, speed while dribbling, throwing a ball and eye-hand coordination) met the criteria of 0.7 for reliability and had coefficients of variation between 9.9-22.0% as agreement parameters. Chronbach's alpha valued 0.853. Principal components analysis distinguished two conceptually meaningful factors; 'ball control' and 'gross motor function'. Concurrent validity analyses demonstrated moderate but significant association between the results of the TIDA and national ranking; boys  $r=-0.53$  ( $p<0.001$ ) and girls  $r=-0.45$  ( $p=0.015$ ). **Discussion** Evaluation of the Dutch TIDA demonstrated six reproducible test items, good internal consistency and good prospects for validity. Two test-items, aiming at target and ball skills, need to be revised. Longitudinal validity studies are necessary to learn more about the discriminative ability and the predictive value of the TIDA (Vaeyens et al., 2008; Faber et al., 2011). **References** Faber IR, Nijhuis-Van der Sanden MWG, Oosterveld FGJ. A first step to an evidence-based talent identification program in the Netherlands; a research proposal. *International Journal of Table Tennis Sciences* 2011; 7: 15-8. Gagné F. Transforming gifts into talents; the DMGT as a developmental theory. *High Abil Stud* 2004; 15(2): 119-147. Vaeyens R, Lenoir M, Williams AM et al. Talent Identification and Development Programmes in Sport. *Current Models and Future Directions*. *Sports Med* 2008; 38(9): 703-714. Vandorpe B, Vandendriessche JB, Vaeyens R et al. The value of a non-sport-specific motor test battery in predicting performance in young female gymnasts. *J Sports Sci* 2012; 30(5): 497-505.

### DETRAINING OF ELITE JUNIOR TENNIS PLAYERS DURING INTERNATIONAL TOURS AND THE EFFECT OF TRAINING AND TOURNAMENT LOAD

Murphy, A.

*Charles Sturt University*

**Introduction** The competitive demands of professional tennis require players to regularly engage in extended overseas tours, making adequate physical training difficult. Accordingly, the purpose of this study was to examine the effects of a four-week international junior representative tour on physical training status. Specifically, to assess changes in fitness before and after tours, in relation to training load performed overseas. Incorporated in this analysis was training and tournament load based on match win-loss ratio and with and without a physical preparation coach present. **Methods** 30 national-level junior athletes representing Australia in a four-week international

tour were assessed within two days of departure and within two days of return. Measures involved mass, speed (5,10,20m), agility (modified 5-0-5), speed endurance (10 x 20m repeat sprint), power (vertical jump double/left/right), and endurance (20-m shuttle-run test). Training loads (duration x sRPE) were also collected in the four weeks prior to departure and for the duration of each tour. Results Analysis showed no significant change ( $p>0.05$ ) in any measures for pre compared to post tour, though effect size analysis demonstrated a moderate effect for decreased 5m and 10m speed ( $d>0.6$ ). Comparison of load prior to and during the tour showed significantly greater load completed on tour for total load and tennis only load ( $p<0.01$ ,  $d>1.4$ ). Pearson's correlations indicated significant ( $p<0.05$ ) moderate positive correlation between total tennis load and 10m, 20m sprints ( $r=0.45$ , and  $0.52$  respectively), whilst a moderate negative correlation was shown with shuttle-run test ( $r=-0.44$ ). Finally, total load ( $p<0.00$ ,  $d=1.6$ ), tennis load ( $p<0.00$ ,  $d=1.3$ ) and strength and conditioning ( $p<0.00$ ,  $d=2.0$ ) loads were all significantly greater when a physical preparation coach was present. Discussion These data suggest that junior international tennis tours of four weeks result in minimal detraining effects if total training load (match and training) are maintained; though trends for reduced speed characteristics and endurance should be noted. Whilst training load on tour may not relate to match performance, sufficient loads throughout tournaments (match or training) may alleviate fitness decrement. Furthermore, these findings also highlight greater training volume in the presence of a physical preparation coach. These outcomes assist tennis federations to make informed decisions as to the training loads and support staff required to prevent player detraining on prolonged international tours.

**10:20 - 11:50**

## Invited symposia

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**IS-SH11 In Pursuit of Active Aging - Achieving Sustained Physical Activity and Function in Older Adults \***

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**OPAL-PLUS: A 3-YEAR FOLLOW-UP ASSESSING CHANGES IN PHYSICAL FUNCTION, PHYSICAL ACTIVITY AND MENTAL WELL-BEING IN ADULTS 70+ YEARS.**

Fox, K.R.

*University of Bristol*

Do not insert authors here OPAL-PLUS is a recently completed follow-up study of Project OPAL (Older People and Active Living). The aim of OPAL was to provide a comprehensive objective documentation of the nature of physical activity and function in older people in the UK, and possible determinants and consequences for health and well-being. OPAL participants were a diverse sample of 240 men and women aged 70 and over (mean age 78 years) living in a neighbourhood of low, medium or high deprivation. Follow-up (mean 38 months) resulted in 190 participants revisited (24 had died). Objective measures at both time points included 7-day accelerometry, the Short Physical Performance Battery, and body mass index. Questionnaires were used to assess frequency, mode of travel, and purpose of daily trips from home, falls confidence, food choices, and measures of health and well-being. In addition, health service usage for a period of 48 months following baseline measures was extracted from patient primary care records. This data set provides a unique opportunity to investigate patterns and levels of change in physical activity and physical function and their consequences. It also allows an estimation of the potential for maintenance of physical activity and physical function to influence subsequent aspects of health and life quality into later adult years. Prospective associations between baseline physical activity and function data will be calculated for levels of 'getting out and about', levels of well-being, morbidity, dietary habits, and their usage of primary and secondary health services at follow-up. A summary of results will be provided with particular attention paid to the relative predictive power of physical activity parameters and aspects of physical function on indicators of mental well-being.

**DEVELOPMENT AND PILOTING OF A MODEL OF NEIGHBOURHOOD SUPPORT FOR PROMOTION OF ACTIVE AGEING – PROJECT ACE**

Stathi, A.1, Withall, J.1, Fox, K.R.2, Davis, M.2, Thompson, J.L.3, Gray, S.4, Lloyd, L.2, Parkhurst, G.4

*1: University of Bath (UK), 2: University of Bristol (UK), 3: University of Birmingham (UK), 4: University of West of England (UK).*

Introduction The contribution of regular physical activity to the maintenance of older people's physical and mental health is well-established. However, older people remain the least active of all age groups. Strategies are needed to motivate older people to adopt more active lifestyles in order to sustain their capacity to undertake activities of daily living, retain good physical function, maintain social networks and enjoy later life to the full (Stathi et al., 2010). Project ACE (Active, Connected and Engaged communities) developed a low cost, pragmatic, and sustainable intervention programme in which retired volunteers promote physical activity in older adults. This paper presents the ACE intervention protocol focussing on the recruitment rate and methods. Methods Recruitment rate, study completion rate, intervention concordance and intervention fidelity are the main outcomes of Project ACE. To pilot the trial measures, physical activity (by accelerometry), well-being, neighbourhood quality of life, perceptions of competence, autonomy, relatedness, and resilience, for both intervention participants and activators are assessed. Post intervention, focus groups will explore topics related to recruitment, training and delivery of the ACE programme. Results Project ACE is a two phase, 24-month pilot study involving sedentary older adults (ACE participants), two paid coordinators (ACE coordinators) and 20 activity promotion volunteers (ACE activators). In Phase 1, the ACE intervention protocol, the activator training manual and the role of the ACE coordinators were further developed and refined. In Phase 2, sedentary older adults aged 65–85 years are recruited in two neighbourhoods in Bristol and randomised to the intervention and control groups. Recruitment methods included presentations in community events, targeted mail, leaflets and adverts in local media and organisations working with older adults. As recruitment is still in progress, the results of the effectiveness of the recruitment strategies are not available yet but they will be presented in the 18th Annual Congress of the ECSS. Discussion Project ACE has developed a well-informed and grounded intervention that has potential for generalisation throughout the UK. The results will establish whether it is possible to evaluate the ACE intervention in a definitive effectiveness and cost effectiveness trial. Sharing information about recruitment challenges in community-based physical activity interventions and choosing effective recruitment strategies will benefit researchers, funders and, ultimately, older people. References Stathi, A., et al. (2010). *J Health Psychol.* 15, 6,838-847.

**NEW EVIDENCE FOR THE POSITIVE RELATIONSHIP BETWEEN SPORTS, HEALTH AND AGEING**

Hopman-Rock, M.1,2, van Meeteren, N.2,3

*1, BodyatWork Research Center TNO VU university medical center Amsterdam; 2, TNO (Netherlands Organisation of Applied Scientific Research) Leiden; 3, Center for Care Technology Research, Maastricht*

Background. In clinical practice the use of the knowledge about the effects of sports and physical activity (PA) on health and risk of mortality, onset of co-morbidity, and delay of the onset of dependency and frailty in older adults could be enlarged. Objectives. To present the scientific evidence for the relationship of sports and PA with successful ageing using several position statements of leading organizations and other sources. Methods. Position stands of the American College of Sports Medicine (ACSM; Chodzko-Zajko et al, 2009) and the European College of Sports and Science (ECSS; Biddle et al, 2012) are used to present the latest state of the art. Other emerging literature is presented in the areas of epidemiology and PA, PA and disability, perioperative physical therapy and behavioural change (counselling and interventions). Evidence levels: A. Overwhelming evidence from RCTs and/or observational studies. B. Strong evidence from a combination of RCT and/or observational studies. C. Generally positive or suggestive evidence from a smaller number of observational studies and/or uncontrolled or nonrandomized trials. D. Panel consensus judgment. Results. In most areas of sports/PA and ageing A/B level of evidence is found. The outcome of treatment of people with several diseases and geriatric syndromes is more effective with higher-intensity exercise (e.g., type 2 diabetes, clinical depression, osteopenia, sarcopenia, muscle weakness). PA amounts in persons older than 75 years are far below what is recommended. Figures in residential care settings are even worse. Perioperative physical therapy is promising to reduce costs and patients burden. Counselling in the short term has level A evidence, but barriers to change habitual PA do exist (perceived fall risks, ageism, and the difficulties to design and implement helpful intervention programmes). European initiatives towards implementation of new insights have been undertaken ([www.eunaapa.org](http://www.eunaapa.org) ; [www.paseo.net](http://www.paseo.net)) Conclusion. More sports and PA (counselling and interventions) in older adults could be effective if barriers for implementation in clinical practice could be overcome. References. Chodzko-Zajko WJ et al.(2009) American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Med. Sci. Sports Exerc.* 41, 1510-1530. Biddle S J H, Brehm W, Hopman-Rock M, Verheijden M W. (2012) Population physical activity behaviour change: a statement of the European College of Sport Science. *Eur J Sport Sciences* 12 (4), 367-383.

**10:20 - 11:50****Oral presentations****OP-PM24 Physiology [PH] 1****FOUR WEEKS OF REPEATED-SPRINT EXERCISE TRAINING UP-REGULATES THE NA<sup>+</sup>-K<sup>+</sup>-ATPASE B1 ISOFORM IN BOTH FAST AND SLOW TWITCH SINGLE FIBRES IN HUMAN SKELETAL MUSCLE**

Wyckelsma, V.L.1, Murphy, R.M.2, Serpiello, F.R.1, Lamboley, C.R.1, McKenna, M.J.1

*Victoria University; La Trobe University*

Introduction The Na<sup>+</sup>, K<sup>+</sup>-ATPase (NKA) is a key protein regulating membrane excitability in skeletal muscle and is upregulated after endurance, sprint or resistance training interventions. Repeated-sprint exercise (RSE) is a high-intensity short duration training modality specific to team sport activity but the effects of RSE training on molecular NKA adaptations are unknown. As human skeletal muscle is heterogeneous with respect to fibre type, it is important to ascertain whether specific fibre type adaptations occur with RSE training. This study therefore investigated four weeks RSE training on NKA isoform abundance in single skeletal muscle fibres. Methods Eight healthy participants trained three times per week for 4 weeks, each session comprising three sets of five, 4-s maximal sprints. Vastus lateralis biopsies were taken before and after training and single fibres were separated. Fibre type (myosin heavy chain Type I and IIa) and NKA isoform protein abundance ( $\alpha$ 1-3,  $\beta$ 1-3) were determined by western blotting. Results Training had no effect on the abundance of the  $\alpha$ 1- $\alpha$ 3 isoforms in Type I fibres;  $\beta$ 1 was upregulated after training ( $P=0.035$ ) with no change in the  $\beta$ 2 or  $\beta$ 3 isoforms. In Type IIa fibres, training did not effect the abundance of the  $\alpha$ 1- $\alpha$ 3 isoforms, however a tendency was detected for an increase in  $\alpha$ 1 (moderate Effect Size,  $ES=0.6$ ). The  $\beta$ 1 isoform was upregulated following training ( $P=0.05$ ); no change was found for  $\beta$ 2 or  $\beta$ 3, but there was a tendency for increased  $\beta$ 2 ( $ES$  0.4) and  $\beta$ 3 ( $ES$  0.5) in Type IIa fibres after training. Discussion Interestingly 4 weeks of RSE training did not increase the NKA  $\alpha$  isoform abundance in either Type I or IIa fibres, but did upregulate the  $\beta$ 1 isoform in both fibre types. The lack of training adaptation in NKA  $\alpha$  isoforms with RSE may reflect insufficient physiological stress induced by 4-s sprints. In contrast the upregulation of  $\beta$ 1 occurred in both fibre types and this may have implications for increasing NKA activity

**EFFECTS OF HIGH-INTENSITY INTERVAL TRAINING ON MYOCARDIAL VASCULAR FUNCTION**

Eskelinen, J.J., Hannukainen, J.C., Savolainen, A., Heinonen, I., Virtanen, K.A., Kempainen, J., Koivumäki, M., Kapanen, J., Knuuti, J., Kalliokoski, K.K.

*University of Turku*

Introduction High-intensity interval training (HIT) has recently gained popularity among recreational exercisers and it has indeed been shown that it is beneficial for health in many aspects and with much less time commitment. However, it is poorly known how this type of training effects on myocardial vascular function and we studied that. Methods Twenty-six healthy sedentary middle-aged men (age  $47 \pm 5$  years and BMI  $26.0 \pm 2.6$ ) were recruited into the study and randomly divided into the HIT ( $n=13$ ) and aerobic exercise training (AET) ( $n=13$ ) groups. Both groups trained six sessions within two weeks. A session of HIT group consisted of 4 -6 x 30 s maximal sprints (Win-gate protocol) with 4 min rest between the sprints and a session of aerobic group consisted of 40-60 min of cycling at an intensity of 60 % of  $VO_{2max}$ . Both groups increased the amount of training after every second session (4->5->6 sprints / 40->50->60 min aerobic). Myocardial blood flow was measured at baseline and during standard adenosine infusion using Positron Emission Tomography before and about 48 hours after the last training session. One subject from the both groups stopped the training prematurely due to personal reasons and for two others in the HIT group and four others in AET group blood flow measurements could not be done due to technical reasons. Thus, those measurements were successfully performed in 10 subjects in the HIT and 8 subjects in the aerobic group. Results

Both training modes increased VO<sub>2</sub>max similarly (HIT: from 34.0 ± 3.7 to 36.2 ± 4.5 ml/kg/min, AET: from 33.6 ± 4.6 to 34.9 ± 4.8 ml/kg/min, p=0.0003 for the training effect, p=0.32 for interaction). Myocardial blood flow at baseline was not different between the groups and training had no effect on it. However, training induced significantly different response between the groups in myocardial blood flow during adenosine infusion. While it increased by on average 9 % in the AET group, it decreased by 17 % in the HIT group (p=0.038 for the interaction). On the other hand, myocardial blood flow reserve - derived as the fold increase in blood flow from baseline to adenosine - did not differ between the groups and training had no significant effect on that (HIT: from 4.2 to 3.8 and AET: from 3.8 to 3.9, all p=NS). Discussion This data shows that myocardial blood flow response to a standard dose of adenosine decreases acutely after a short very intense training period in previously sedentary subjects. Probably this is a transient finding, but still it warrants further study on this issue. This finding also suggests that we should be somewhat cautious when prescribing really high-intensity exercise for the beginners who are not used to cope with that.

### MECHANICAL EFFICIENCY DURING SPRINT EXERCISE IN MAN

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1 Univ of Las Palmas de Gran Canaria, Spain ; 2 Univ of Zürich, Switzerland

Introduction The mechanical efficiency (ME) is the ratio between the work performed and the energy expended to produce this work. The assessment of mechanical efficiency during high intensity exercise, when a substantial part of the energy is provided by anaerobic metabolism, is a challenge. Consequently it remains unknown with what mechanical efficiencies humans perform sprint exercise. To determine the total enthalpy during a 30 s all-out sprint exercise on the cycle ergometer (Wingate test) and the impact of acidosis on ME two experiments were carried out in nineteen men. Methods The total enthalpy and the leg and whole body MEs were calculated by combining the determination of muscle mass with the assessment of muscle metabolites, leg VO<sub>2</sub> and exchange of metabolites (direct Fick method with assessment of femoral blood flow by thermodilution and arteriovenous O<sub>2</sub> and lactate differences) during isokinetic Wingate tests performed in normoxia (PIO<sub>2</sub>=142 mmHg) and hypoxia (PIO<sub>2</sub>=75 mmHg). Results Compared to normoxia, mean power output and accumulated VO<sub>2</sub> were reduced in hypoxia by 5.5% and 33%, respectively (P<0.05). Almost 50% greater muscle lactate accumulation was observed immediately after the sprint in hypoxia (P<0.05) and consequently the muscle pH was 0.2 units lower in hypoxia than in normoxia (P<0.05). In normoxia, 19.8, 49.4, and 30.8 % of ATP was provided by ATP+PCr, the glycolysis and the aerobic metabolism. The corresponding figures for hypoxia were: 15.6, 60.2, 24.2%, respectively. The legs' mechanical efficiency was reduced by 16% in hypoxia, from 22.7± 3.4 (range: 17.2 - 27.8%) in normoxia to 19.1±4.0 (range: 14.0 - 25.1%) in hypoxia (P<0.05). The whole body ME tended to be reduced by 14% from 21.3±3.0 (range: 16.6 - 26.4%) in normoxia to 18.3±3.7 (range: 13.7 - 23.7%) in hypoxia (P=0.06). Consequently, the total energy cost of exercise per watt (total enthalpy/mean power output) was 18% higher in hypoxia than in normoxia (169.7±34.4 and 143.5±21.2 J.w<sup>-1</sup>, respectively P<0.05). In normoxia there was a linear relationship between the percentage of MHC IIA with mechanical and ATP use efficiencies, at the leg (r=0.66 and 0.76, respectively, both P<0.05) and whole body levels (r=0.73 and 0.78, respectively, both P<0.05) (Fig. 5). ME was higher during sprint than during submaximal exercise. Discussion and conclusions. In agreement with previous studies using leg extension exercise producing exhaustion in ~ 3 min (~110-130% of VO<sub>2</sub>max), the ME during sprint exercise was greater than during submaximal exercise, due to the higher energy efficiency of the anaerobic pathways. In summary, the mechanical efficiency of sprint exercise in man was determined to lie between 14 and 28%. In severe acute hypoxia the mechanical efficiency of sprint exercise is reduced likely due to the greater level of acidosis caused by a higher glycolytic rate in hypoxia than in normoxia. Grant-ed by DEP2009-11638

### HIGH INTENSITY INTERVAL TRAINING IMPROVES INSULIN MEDIATED GLUCOSE CLEARANCE IN SKELETAL MUSCLE IN PATIENTS WITH TYPE 2 DIABETES

Skaaby, S., Pedersen, H.P., Andersen, N.B., Nielsen, M.B., Petersen, H.H.H., Helge, J.W., Dela, F.

University of Copenhagen

Objective The effect of high intensity interval training (HIIT) on skeletal muscle and insulin sensitivity is not fully established. The aims are to investigate the efficacy of HIIT for improving insulin mediated glucose clearance in skeletal muscle in patients with type 2 diabetes (T2DM) and matched healthy controls. Methods Six patients with T2DM and four healthy, age, BMI and VO<sub>2</sub> max matched controls were included (age: 58.2±2.8 and 52.5±1.8 yrs (mean ± SE); BMI: 31.3±0.8 and 28.5±0.6 kg/m<sup>2</sup>; VO<sub>2</sub>max: 26.9±1.3 and 31.3±2.6 ml/min/kg). One-legged HIIT training was performed every other day for 16 days. The protocol comprised 10 x 1 minute of exercise at a workload > 60% of one-legged VO<sub>2</sub>-peak, and heart rate > 80 % of maximal heart rate. 1 minute of exercise was followed by 1 minute of recovery. Body composition and lean leg mass before and after the training period were assessed using dual-energy X-ray absorptiometry. 40 hours after the last training session, a two-step isoglycemic, hyperinsulinemic (80 and 400 mU/min/m<sup>2</sup>) clamp was performed in combination with catheterization of the femoral veins, a brachial artery and a cubital vein. Blood flow in the femoral arteries was measured with Doppler ultrasonography. Whole body insulin stimulated glucose clearance rates were expressed per kg body weight. Metabolically speaking, the leg predominantly consists of skeletal muscle, and rates were expressed per kg lean leg mass. Differences were tested by two-way repeated measures ANOVA. Results Whole body insulin stimulated glucose clearance rates were lower (p<0.05) in T2DM vs. controls (step 1: 3.5±0.6 vs. 6.0±0.3 and step 2: 7.7±0.5 vs. 10.3±0.8 ml/min/kg). Insulin stimulated glucose clearance rates were significantly higher in trained compared with untrained legs in both subjects with type 2 diabetes (step 1: 4.4±0.6 vs. 3.6±0.5 and step 2: 9.3±1.1 vs. 7.5±0.9 ml/kg/min, both P< 0.005) and controls (step 1: 5.9±0.4 vs. 4.2±0.3, step 2: 10.2±0.7 vs. 8.2±0.6 ml/kg/min, both P< 0.005). The relative improvement was similar in the two groups. Conclusion HIIT induced 29 % and 25 % (step 1 and 2) improvement in insulin stimulated glucose clearance in skeletal muscle in T2DM and 39 % and 22 % (step 1 and 2) increase in controls after only 80 minutes of effective exercise. This time-effective training modality may be attractive in the treatment of insulin resistance and type 2 diabetes.

## ACUTE INTERVAL AND CONTINUOUS SPRINT CYCLING INCREASES ANGIOGENIC GENE EXPRESSION IN TRAINED SKELETAL MUSCLE

Taylor, C.W., Ingham, S.A., Hunt, J.E., Martin, N.R., Lewis, M.P., Pringle, J.S., Fudge, B.W., Ferguson, R.A.

*Loughborough University*

**Introduction** Low-volume sprint interval training promotes mitochondrial biogenesis as evidenced by increases in the gene and protein expression of mitochondrial enzymes (Little et al. 2010). However, it is currently unknown whether this type of exercise results in an acute angiogenic adaptive response. Thus, the primary aim of the present study was to examine the changes in gene expression for pro-angiogenic growth factors to acute low-volume sprint cycling. A secondary aim was to determine whether the magnitude of gene expression differs in response to interval versus continuous sprint cycling. **Methods** In a repeated measures cross-over design, 8 trained males (age,  $29 \pm 5$  yr; height,  $180 \pm 9$  cm; body mass,  $79.2 \pm 10.5$  kg;  $VO_{2max}$ ,  $4.5 \pm 0.5$  L·min<sup>-1</sup>) performed two cycling protocols on an isokinetic cycle ergometer (at an identically fixed pedal cadence) consisting of  $4 \times 30$  s sprint efforts interspersed by 4 min of passive recovery (INT) or a 2 min continuous sprint effort (CON). Muscle biopsies were obtained from the vastus lateralis before and 3 hours post-exercise. Angiogenic gene expression for VEGF, HIF-1 $\alpha$ , eNOS, PGC-1 $\alpha$  and MMP-9 were determined using real-time RT-PCR and expressed relative to RP-18 $\beta$ . Data were analysed using a two way repeated measures ANOVA. Data are presented as fold-change from rest (mean  $\pm$  SE). **Results** Total work was greater (53%,  $P < 0.05$ ) during INT compared to CON ( $71.16 \pm 7.28$  vs.  $46.27 \pm 2.73$  kJ, respectively). Both INT and CON increased the mRNA expression of PGC-1 $\alpha$  (7- vs. 5.5-fold,  $P < 0.05$ ), HIF-1 $\alpha$  (1- vs. 0.5-fold,  $P < 0.05$ ) and VEGF (3.5- vs. 4.5-fold,  $P < 0.05$ ), respectively, however the magnitude of fold change for either of these genes was not different between protocols. There was a trend ( $P = 0.06$ ) for greater mRNA expression for MMP-9 (0.5-fold) after both protocols, though the magnitude of expression was not different between trials. There was no difference in eNOS mRNA expression in response to either protocol. **Discussion** This study has demonstrated that an acute bout of sprint interval and continuous cycling provides a potent stimulus capable of inducing similar increases in skeletal muscle VEGF gene expression. Furthermore, our data suggest that the increases in VEGF gene expression in response to this type of exercise are potentially mediated via activation of PGC-1 $\alpha$  and HIF-1 $\alpha$  in response to increased metabolic perturbations. **References** Little, J. P., Safdar, A., Bishop, D., Tarnopolsky, M. A., Gibala, M. J. (2011). *Am J Physiol Regul Integr Comp Physiol*, 300, 1303-1310.

## HIGH INTENSITY INTERVAL AND TRADITIONAL ENDURANCE TRAINING BOTH INCREASE INSULIN SENSITIVITY, VO<sub>2</sub>PEAK AND SKELETAL MUSCLE PERILIPIN 2 AND PERILIPIN 5 CONTENT IN SEDENTARY OBESE MALES

Shepherd, S.1, Cocks, M.1, Ranasinghe, A.2, Barker, T.2, McClean, A.2, Wagenmakers, A.J.M.1, Shaw, C.S.3

1: *Liverpool John Moores University (Liverpool, UK)*, 2: *University of Birmingham (Birmingham, UK)*, 3: *Victoria University (Melbourne, Australia)*

**Introduction:** We have recently demonstrated that both sprint interval training (SIT) and traditional endurance-based training (ET) increase skeletal muscle oxidative capacity, intramuscular triglyceride (IMTG) concentration,  $VO_{2peak}$  and whole-body insulin sensitivity in previously sedentary lean men. We also provided evidence that increases in perilipin 2 (PLIN2) and perilipin 5 (PLIN5) observed after both training modes played a role in the increased net IMTG breakdown during 1 h of endurance exercise (Shepherd et al., 2013). However, SIT requires repeated 'all-out' efforts against a very high resistance (Wingate sprints), which may not be suitable or practical for obese individuals. **Aims:** To investigate the hypotheses that in sedentary obese males high intensity interval training (HIT) at a constant load of 200%  $W_{peak}$  and ET lead to 1) similar increases in  $VO_{2peak}$  and insulin sensitivity and a similar reduction in cardiovascular risk factors; and 2) similar increases in IMTG, PLIN2 and PLIN5 content. **Methods:** Sixteen sedentary obese males ( $25 \pm 2$  y, BMI  $34.8 \pm 1.3$  kg·m<sup>-2</sup>) performed 4 weeks of either HIT (4-7 30s bursts at a constant load of 200%  $W_{peak}$  interspersed with 2 min recovery, 3d.wk<sup>-1</sup>) or ET (40-60 min cycling at ~65%  $VO_{2peak}$ , 5d.wk<sup>-1</sup>). Values are given as means  $\pm$  SEM. For analytical methods, statistical methods and power calculation see Shepherd et al. (2013). Only the main effects of training were significant and are reported. **Results:** Training increased  $VO_{2peak}$  (HIT  $7 \pm 3\%$ , ET  $12 \pm 4\%$ ;  $P < 0.05$ ) and the Matsuda insulin sensitivity index (HIT  $14 \pm 3\%$ , ET  $17 \pm 9\%$ ;  $P < 0.05$ ). Training reduced fasting plasma cholesterol (HIT  $13 \pm 6\%$ , ET  $10 \pm 7\%$ ;  $P < 0.05$ ), and fasting plasma triglyceride concentration (HIT  $16 \pm 8\%$ , ET  $10 \pm 7\%$ ;  $P = 0.06$ ). Training increased both PLIN2 (HIT  $92 \pm 19\%$ , ET  $82 \pm 23\%$ ;  $P < 0.05$ ) and PLIN5 protein content (HIT  $54 \pm 15\%$ , ET  $36 \pm 10\%$ ;  $P < 0.05$ ) in type I muscle fibres, but a non-significant increase in IMTG concentration (HIT  $51 \pm 21\%$ , ET  $31 \pm 25\%$ ;  $P = 0.086$ ) was observed. **Conclusions:** This study demonstrates that 4 weeks of HIT at 200%  $W_{peak}$  provides an effective alternative to ET to increase  $VO_{2peak}$ , insulin sensitivity and skeletal muscle PLIN2 and PLIN5 protein content and reduce cardiovascular risk factors in sedentary obese males. HIT at this high workload appears to be a tolerable and effective alternative to SIT, which is likely too demanding for this target group. **References:** Shepherd SO, Cocks M, Tipton KD, Ranasinghe AM, Barker TD, Burniston JG, Wagenmakers AJM, Shaw CS. (2013). *J Physiol* 591(3):657-675.

10:20 - 11:50

### Invited symposia

#### IS-BN02 Feedback and feedforward interaction - the role of augmented feedback in performance (sponsored by Adidas)

##### PRACTICAL IMPLICATIONS IN LEARNING WITH FEEDBACK

Taube, W.

*University of Freiburg*

There is an ongoing debate of how augmented feedback (aF) should be used to optimize motor performance, learning, and training. Although the present talk can certainly not give conclusive advice about the "optimal provision of aF" for all disciplines, it sensitizes the audience with respect to certain essential questions of how to provide aF. The "guidance theory" (1) is most probably the best known theory in the field of motor learning dealing with the question of how aF should be applied. The theory states that "frequently provided aF is a two-edged sword" guiding the learner to optimal performance but at the same time making the learner dependent on aF. Therefore,

it is frequently suggested to provide aF with a relative frequency of less than 100%. It has to be highlighted, however, that there is increasing evidence suggesting that this theory cannot be applied without limitations to all settings. It has to be considered in this context that aF can serve different functions: it can provide information what has to be learnt (to identify the goal of the task) or it can provide information with respect to the performance (to evaluate the performance). One branch of motor learning research therefore proposed to differentiate movements into "simple" and more "complex tasks" as the guidance hypothesis may be applicable to simple but not necessarily to more complex tasks (2). Similarly, based on recent observations, the differentiation into "entirely new tasks" and "tasks that are already in the movement repertoire but have to be maximized" makes probably sense. In line with this way of argumentation, the beneficial effects of aF may – at least in certain settings – be increased when subject can self-control the provision of aF (3) or when the aF is provided in "good trials" only (4). Concerning the mode of functioning, the most wide spread assumption is that aF guides the learner to a better movement technique/strategy. Thus, aF is assumed to enable athletes to differentiate "better" from "less good trials" and consequently may allow making better interrelations of cause and action. However, alternative explanations have to be taken into consideration. There is for example good evidence that especially in tasks where performance has to be maximized aF does beneficially influence the motivational aspects of the participants. Furthermore, aF might change the focus of attention but empirical data supporting this idea are lacking. 1. Salmoni AW et al. *Psychol Bull* 95: 355-386, 1984. 2. Wulf G & Shea CH. *Psychon Bull Rev* 9: 185-211, 2002. 3. Fairbrother JT et al. *Front Psychol* 3: 323, 2012. 4. Badami R, et al. *Res Q Exerc Sport* 83: 196-203, 2012.

### BRAIN PLASTICITY IN FEEDBACK-MEDIATED LEARNING

Leukel, C., Schween, R., Lauber, B., Keller, M., Lundbye-Jensen, J., Gollhofer, A., Taube, W.

*University of Freiburg; University of Fribourg; University of Copenhagen*

In most motor learning settings sensory feedback is required to improve performance. Natural sensory feedback from different sensors of the human body (e.g. vision, proprioception) estimates the state of the body in relation to the surrounding world. In addition to natural sensory feedback a special type of feedback, called augmented or extrinsic feedback, can facilitate performance improvements. Augmented feedback refers to explicit information about the execution and/or result of a motor task, e.g. a basketball player may receive feedback about the jump height in cm after performing a lay-up. Motor learning is only possible because of the capacity of the central nervous system (CNS) to undergo plastic changes. In order to understand learning it is therefore essential to understand its underlying neural mechanisms. Particularly in learning with augmented feedback, it is consequently important to understand the learning-related mechanisms that are associated with this type of sensory feedback. This understanding may help to develop new motor learning strategies in practical settings but also to identify the underlying problems that are associated with pathology. The aim of the present talk is to identify and describe the function of CNS plasticity that is associated with motor learning with augmented feedback. A special focus is on learning-related plasticity of the primary motor cortex and the cerebellum, as these structures are important for many types of learning, including error-based skill learning and adaptation learning.

**10:20 - 11:50**

## Oral presentations

### OP-BN02 Biomechanics [BM] 2

#### UNSTEADY FLOW FIELD AROUND A HUMAN UNDULATORY SWIMMER: COMPARISON BETWEEN EXPERIMENTAL 2D-PIV-RESULTS AND NUMERICAL SIMULATIONS

Hochstein, S.1, Pacholak, S.2, Brücker, C.2, Blickhan, R.1

*1:Friedrich-Schiller-University Jena, Institute of Sport Science, Motion Science (Germany); 2:TU Bergakademie Freiberg, Institute of Mechanics and Fluid Dynamics (Germany)*

Introduction In fish locomotion low gliding drag values can be achieved during active propulsion. A carefully adjusted body wave travels along the body and pumps the fluid caudal. As a result the probability of flow separation is reduced. Swimmers try to successfully copy strategies like undulatory swimming from fish locomotion during the gliding period after start and turn to maximize their swimming speed. Therefore, the aim of this study was to analyse the unsteady flow field around a human undulatory swimmer using experimental analyses (Hochstein and Blickhan, 2011) and numerical simulation techniques (Hochstein et al., 2012). Methods Time resolved Particle Image Velocimetry (2D-TR-PIV) presented the experimental flow field around a human swimmer. The path of the levitating particles (illuminated by a green laser light sheet) was monitored at 250 fps with a high speed video camera (PHANTOM V12) and hence local flow velocities were calculated using a cross correlation algorithm. The experiments were applied to different swim situations (maximum swimming and swimming after push off from the wall). The numerical simulation analysis (CFD) consisted of the use of a 3D body scan, moving mesh, moving boundary conditions and swimmer's motion function realised by Open FOAM software. Results The experimental flow field presents vortex separation in the head and mainly in the leg region as soon as the undulatory pump. Swimmer's legs interacted with vortices generated cranially. The 3D flow field of the numerical simulation validates the experimental 2D results and shows vortex rings after the up- and down stroke similar to results of von Loebbecke et al. (2009). Discussion Cranially generated vortices could pedally reuse by swimmer's legs to enhance the propulsion ("vortex re-capturing"; Hochstein and Blickhan, 2011). The CFD simulation of swimming with symmetric amplitude distribution can indicate if the human anthropometric limitations results in worse swimming performance or the swimming with asymmetric amplitudes distribution may have advantages in underwater locomotion. References - Hochstein, S., Blickhan, R. (2011). Vortex re-capturing and kinematics in human underwater undulatory swimming. *Human Movement Science*, 30, 998-1007. - Hochstein, S., Pacholak, S., Brücker, C., Blickhan, R. (2012). Experimental and numerical investigation of the unsteady flow around a human underwater undulating swimmer. In: C. Tropea, H. Bleckmann (eds.), *Nature-Inspired Fluid Mechanics*, NNFM, 119, 263-278. - von Loebbecke, A., Mittal, R., Mark, R., Hahn, J. (2009). A computational method for analysis of underwater dolphin kick hydrodynamics in human swimming. *Sports Biomechanics*, 8, 60-77.

### TRUNK MUSCLE ACTIVITY DURING FRONT CRAWL SWIMMING

Martens, J., Pellegrims, W., Einarsson, I., Fernandes, R.J., Staes, F., Daly, D.

*KULeuven*

**Introduction** Core stability training is of increasing interest to both researchers and coaches. Sufficient core stability is needed to balance forces generated by the upper and lower extremities separately (Hibbs et al., 2008). In swimming the development of wireless EMG has created new possibilities to study underwater muscle activity with little hinder. The purpose here was to analyze lower trunk muscle activation during front crawl swimming and examine how trunk muscle activity is related to the arm movement, swimming velocity and arm and leg coordination. **Methods** Five male swimmers (personal record 100m freestyle :  $55 \pm 4$ s) swam 2x12.5m at maximal speed without breathing using a 6-beat leg kick and no kick with a 10min rest interval. EMG was obtained with 4 wireless units (Kine @, 1600Hz). Electrodes were placed on the left and right m. Obliquus Externus (OE) and on the left and right m. Erector Spinae (ES) following the guidelines of SENIAM. Four video cameras (Sony @ Handycam DCR-HC96: 50Hz) recorded the swims in synchronization with the EMG-signal. Dartfish Prosuite @ software was used to determine stroke phases, swimming velocity and arm and leg coordination. **Results** Activation of OE was seen in both leg-kick conditions in all 5 swimmers during the first propulsive phase of the ipsilateral arm. Activation of ES occurred when the collateral arm was at 135°-180° in all 5 swimmers in both conditions. **Discussion** Because of the ipsilateral activation of OE and the contralateral activation of ES in both test conditions, it can be assumed that the muscle activation pattern is linked to arm movements. During quadruped position core stability exercises on dry land contralateral activation of OE was also seen (Bergson et al., 2010). Further research (e.g. in the butterfly stroke with symmetric arm movement) is needed to clarify which arm actions are linked to abdominal muscle activation. ES is active in trunk extension and forward rotation of the pelvis (Kaneda et al., 2009), but may also act in rotational movements (Toren, 2001). It is possible that the contralateral activation of ES during front crawl swimming is needed to stabilize the lower trunk by countering forces generated at the start of arm recovery. **References** Bergson, C.Q., Cagliari, M.F., Amorim, C.F., Sacco, I.C. (2010). Archives of Physical Medicine and Rehabilitation, 91, 86-92. Hibbs, A.E., Thompson, K.G., French, D., Wrigley, A. & Spears I. (2008). Sports Medicine, 38, 995-1008. Kaneda K., Sato D., Wakabayashi H., Nomura T. (2009). J. of Electromyography and Kinesiology, 19, 1064-1070. Toren A. (2001). Applied Ergonomics, 32(6), 583-91.

### INFLUENCE OF SPORT SURFACES ON RUNNING PATTERN OF CHILDREN AND ADULTS. NATURAL GRASS AND ARTIFICIAL TURF COMPARISON

Sanchis, M., Alcantara, E.

*ASOC. INSTITUTO BIOMECANICA VALENCIA*

**Introduction** Last generation of artificial turf for football has been developed taking into account forces and velocities of adult football player skills. The behavior of the materials used in these kinds of surfaces (rubber infill) is different depending on forces and velocities of application. These forces are higher than forces applied by children and therefore the response of artificial turf is different. The objective of this work is to analyze the effect of this different behavior on running pattern of children and adults. **Methods** Biomechanical tests were carried out with children and adults on natural grass (as reference surface), artificial turf and concrete (as rigid surface). They ran a distance of 10 m at 4 m/s ( $\pm 15\%$ ). Accelerometers in forehead and right tibia were used and electrogoniometer was located in right knee. The information obtained from the accelerometers was the maximum acceleration in tibia and forehead during the heel impact. Maximum knee flexion angle during each step was obtained from the electrogoniometer. Finally, a statistical analysis of the information was carried out. First, outliers were identified, analysed and eliminated if necessary. Descriptive statistics were obtained for all variables and an ANOVA was done to assess whether statistically significant differences among pitches for children and adults existed. **Results** Tibia accelerations measured in adults did not show differences between natural grass and artificial turf; they were significantly higher when they ran on concrete. In the case of children, lesser tibia accelerations were measured running on natural grass than on artificial turf; however, significant differences were not found between artificial turf and concrete. Forehead accelerations did not show significant differences between surfaces for children and adults. Regarding knee angles measured in adults they were significantly higher running on concrete and differences were not found between natural grass and artificial turf. Knee angles measured on children were significantly lesser on natural grass than on artificial turf and concrete. The two latter did not show any significant difference. **Discussion** Adults did not modify their running pattern on natural grass and artificial turf. However, children increased their knee flexion angle running on artificial turf as a system of protective measure due to the increase of tibia acceleration (higher impacts). From the results of this work it is possible to conclude that artificial turf for football has been developed taking into account adult requirements with the aim of simulating natural grass behavior. However, the behavior of the materials of this kind of surfaces causes impacts on children's tibia similar to concrete.

### A NOVEL INSTRUMENTED BACKSTROKE START HANDGRIP

de Jesus, K.

*University of Porto*

**Introduction** FINA approved the use of a new starting block with two horizontal backstroke handgrips. Most of the Olympics have used the highest horizontal handgrips, probably to full remove themselves out of the water. Only de Jesus et al. (2011) adapted instrumented handgrips to perform backstroke start dynamometry, although based on the old handgrips configuration. This study aimed to develop a handgrip based on the new block to assess upper limbs dynamometry on the highest horizontal handgrip position. **Methods** Two identical triaxial force plates adapted from Roesler's (2003) and two independent handgrips were designed using SolidWorks 2011. A pair of independent tubes was designed at 566mm vertically from the water level (FINA, 2012). Static and modal analysis was carried out for the force plates and horizontal handgrips using Ansys 12.1. A force plate prototype was instrumented with 24 strain gages Kyowa to register the deformations under load. Force plates were fixed on the block and handgrips were fixed on the force plates. The deformations are presented as mean values. **Results** When 8000N horizontal load was applied on the force plate centre the strain gages responsible for the anterior-posterior deformations registered  $545\mu\epsilon$ . For 8000N vertical load the responsible strain gages registered  $290\mu\epsilon$ . First natural frequency of vibration was 328Hz. For 2000N horizontal load applied on the highest handgrips, the strain gages responsible for the anterior-posterior deformations registered  $107\mu\epsilon$  and  $106\mu\epsilon$ , for medial and lateral force application, respectively. For the simulated 2000N vertical load, deformations of  $179\mu\epsilon$  and  $186\mu\epsilon$  were observed for medial and lateral force application, respectively. **Discussion** The upper limbs role was considered only to drive the centre of mass over the water (de Jesus et al., 2011), although no other force components and handgrips position were analysed beyond the horizontal on the old starting block configuration. The developed system

allows assessing independently the right and left upper limbs triaxial forces and moments on different handgrips, and it is not dependent on the force application point. Handgrips were customized to assess upper limbs dynamometry from other different backstroke and ventral starts positioning. References de Jesus, K, de Jesus, K, Figueiredo, P., Gonçalves, P, Pereira, S., Vilas-Boas, JP, Fernandes, R (2011). *Int J Sports Med*, 32, 546-551. Hoesler, R. (2003). *BMS IX*. University of Saint Etienne; 243-248. FINA. (2012). *Federation Internationale de Natation*. <http://www.fina.org> 2010. Acknowledgements CAPES, BEX n°. 0761-12-5/2012-2013 and Santander Totta, PP-LJUP2011-123.

### FOOT STRIKE PATTERNS IN LONG-DISTANCE RUNNING: BIOMECHANICAL AND PHYSIOLOGICAL IMPLICATIONS

Ogueta-Alday, A., Rodríguez-Marroyo, J.A., García-López, J.

*University of León*

**Introduction** The possible relationships between foot strike pattern, running injuries and performance are some of the current topics of discussion (Hayes and Caplan, 2012; Kasmer et al., 2012). There is controversy about the influence of foot strike pattern on long-distance running performance (Kasmer et al., 2012). Various studies have only approached it from one point of view: performance, physiology or biomechanics (Ogueta-Alday et al., 2012; Perl et al., 2012). Therefore, the aim of the study was to analyse simultaneously the influence of the foot strike pattern on biomechanical and physiological characteristics in well-trained runners with a similar level of performance. **Methods** Twenty long-distance runners participated (range of 66:40-74:09 mm:ss in half-marathon), and were divided into two groups according to their foot strike pattern: rearfoot (RF, n=10) and midfoot/forefoot runners (MF, n=10). Anthropometric characteristics were measured (height, body mass, BMI, skinfolds, circumferences and lengths) without differences between RF and MF. Physiological (VO<sub>2</sub>max, anaerobic threshold and running economy) and biomechanical characteristics (contact and flight times, step rate and step length) were registered during both incremental and submaximal tests on a treadmill. Results No significant differences in VO<sub>2</sub>max and anaerobic threshold were obtained between both groups. However, RF were more economical than MF at submaximal speeds (57-81% of VO<sub>2</sub>max). Step rate and step length were not different between groups, but RF showed longer contact time ( $p < 0.01$ ) and shorter flight time ( $p < 0.01$ ) than MF at all speeds. Significant relationships ( $p < 0.05$ ) were found between step rate at submaximal speeds and VO<sub>2</sub>max ( $r = 0.47-0.66$ ). **Discussion** The differences in both contact and flight times are in consonance with previous studies (Hayes and Caplan, 2012; Ogueta-Alday et al., 2012), and could justify the differences in running economy. It was not clear the theoretical advantage of MF at low running speeds (<15 km/h), although further studies should analyse higher intensities. Runners with higher VO<sub>2</sub>max possibly tried to minimize the neuromuscular demands rather than the energetic expenditure by increasing step rate. Future studies about long-term effects of stride rate manipulation on running economy are necessary. References Hayes P, Caplan N. (2012). *J Sports Sci*, 30(12), 1275-1283. Kasmer ME, Liu XC, Roberts KG, Valadao JM. (2012). *Int J Sports Physiol Perform*, in press. Ogueta-Alday A, Morante JC, Rodríguez-Marroyo JA, García-López J. (2012). *J Strength Cond Res*, in press. Perl DP, Daoud AI, Lieberman DE. (2012). *Med Sci Sports Exerc*, 44(7), 1335-1343.

### BIOMECHANICAL PREDICTORS OF PERFORMANCE IN ALPINE SKI RACING

Spörri, J., Kröll, J., Schwameder, H., Müller, E.

*University of Salzburg*

**Introduction:** Two main categories of biomechanical performance predictors have been suggested in alpine ski racing: path-related and speed-related predictors (Hirano, 2006; Supej et al., 2010). Since between these predictors a permanent trade-off has to be made, it is not a priori clear whether reaching for shorter path or higher speed is more advantageous. Only a comprehensive concept including both aspects might be able to sufficiently predict performance (Spörri et al., 2012). One such concept could be found in the time loss per elevation difference ( $dt/dz$ ), which depends on both the distance travelled per elevation difference ( $ds/dz$ ), and speed (Federolf, 2012). Speed itself depends on the entrance speed ( $v_{in}$ ) and the rate of energy dissipation per elevation ( $demech/dz$ ) (Supej et al., 2010). By combining the aforementioned predictors ( $ds/dz$ ,  $v_{in}$ ,  $demech/dz$ ) in one model, the aim of the current study was to assess their relevance for performance within a giant slalom (GS) turn. **Methods:** During a video-based 3D kinematic field measurement using six panned, tilted and zoomed cameras (50Hz), six top level racers performed several runs on a GS course. A 22 point multi-body segment model was reconstructed in 3D and centre of mass kinematics were calculated. For each run, the analysed turn was divided into four functional turn phases (p1, p2, p3, p4), according to Spörri et al. (2012). For the prediction of  $dt/dz$  phase averages by  $ds/dz$ ,  $v_{in}$  and  $demech/dz$ , two runs per subject (n=12) were entered into multiple regression models. To assess the relevance of the performance predictors within the specific turn phases, beta weights were compared. **Results:** Using the stepwise method, highly significant models emerged for all turn phases ( $p < .001$ ; Adjusted R<sup>2</sup> > .980). In all turn phases,  $v_{in}$  was of the highest relevance for the prediction of  $dt/dz$  phase averages (beta weights: -.776 (p1); -.977 (p2); -.826 (p3); -.647 (p4)). While  $ds/dz$  had the second strongest weighting in the models for p1, p3 and p4 (.603 (p1); .301 (p2); .279 (p3); .426 (p4)), during p2,  $demech/dz$  was of higher relevance for  $dt/dz$  phase average (.108 (p1); .470 (p2); .123 (p3); .110 (p4)). **Discussion:** For coaching practice, these findings indicate that starting with a certain entrance speed, which depends on the performance in the previous section, a racer should primarily aim for reducing his rate of energy dissipation while steering into the fall line (p2). Then, while steering out of the fall line (p3) and during the turn transition (p4 and p1) he should instead strive for a shorter path in order to enhance his instantaneous performance. References: Hirano Y. (2006). *Sports Eng*, 9, 221-8. Federolf PA. (2012). *J Sports Sci*, 30(10), 1063-8. Spörri J, et al. (2012). *Int J Sports Sci Coach*, 7(4), 647-59. Supej M, et al. (2010). *Scand J Med Sci Sports*, 21(6), 72-81.

10:20 - 11:50

## Oral presentations

### OP-PM11 Molecular Biology [MB] 1

#### REACTIVE OXYGEN SPECIES REGULATES MUSCLE SIGNALLING AND POST EXERCISE INSULIN SENSITIVITY.

Stepito, N.K.1, Trewin, A.1, Vikhe Patil, K.2, Lundell, L.2, Perry, B.1, Chibalin, A.V.2, Shaw, C.S.1, Levinger, I.1

*Victoria University*

1- ISEAL and CSES VU Melbourne Australia 2- Karolinska Institute Stockholm Sweden Introduction: There currently exists a reactive oxygen species (ROS) paradox. Specifically, it is well known that many chronic diseases (including obesity and type 2 diabetes) and their progression are associated elevated ROS and oxidative stress. Yet exercise generates ROS and oxidative stress, while effectively preventing and/or managing these diseases. Furthermore, a single exercise bout can improve insulin sensitivity for up 48-h. It is now recognised that ROS is a vital molecule in normal tissue survival, adaptation and function including insulin action in skeletal muscle, however the exact role of exercise induced ROS in protein signalling and insulin action in humans has not been fully elucidated. We therefore aim to investigate the role of exercise induced ROS on post exercise and insulin stimulated muscle signalling by scavenging ROS during a bout of cycling with the antioxidant N-acetylcysteine (NAC). Methods: Seven, healthy, consenting adults volunteered for the study. They undertook 2 two 1-h cycle sessions of 55min at 65% VO<sub>2</sub>max and 5 min at 95%VO<sub>2</sub>max followed 3-h later by a 2-h hyperinsulinaemic euglycaemic clamp (40 mIU/min/m<sup>2</sup>). In a double blind randomised design the exercise sessions were undertaken either with a primed (35 min of 125mg/kg/min) infusion of NAC (25mg/kg/min) or without (Saline infusion). Muscle biopsies were taken before infusion and immediately after exercise, as well as before and after the clamp. Serial blood samples and expired gas samples were taken throughout these trials. Insulin sensitivity was determined as an M-Value (glucose infusion rate (mg/kg/min)/ plasma insulin pM/L). Exercise and insulin action on key signalling proteins was evaluated with immuno-blotting for total and phospho-proteins. Results: NAC infusion resulted in discordant muscle protein signalling in response to exercise and insulin stimulation, where phospho (p)-ERK (p=0.10), p-mTOR (p=0.01) and p-P70S6K (p=0.10) were reduced. In contrast, p-Akt/PKB thr308 (p=0.10) and p-S6 (p=0.09) trended to higher activation. These signalling responses were associated with a 6% (M-value; 13±2 vs. 10±2; p=0.02) reduction of the post exercise insulin stimulated glucose uptake. Discussion: These data demonstrate that ROS production during exercise has an important role in regulating exercise and insulin stimulated skeletal signalling and glucose uptake in humans. Exercise induced ROS had the greatest effect on mTOR signalling, demonstrating that ROS may mediate muscle insulin stimulated glucose uptake either via alternative protein modifications that do not effect phosphorylation or via non-canonical signalling proteins. This study was funded by the VURDGS Scheme

#### A C-TO-T POLYMORPHISM IN 3'-UNTRANSLATED REGION OF CNTFR IS ASSOCIATED WITH SPRINT/POWER PERFORMANCE

Mikami, E.1,2,3, Murakami, H.4, Miyachi, M.4, Higuchi, M.1, Tanaka, M.3, Kawahara, T.5, Fuku, N.3

1: Waseda University, 2: JSPS Research Fellow, 3: Tokyo Metropolitan Institute of Gerontology, 4: National Institute of Health and Nutrition, 5: Japan Institute of sports sciences

Introduction Ciliary neurotrophic factor (CNTF) was associated with muscle performance traits (Guillet et al., 1999), and can signal by binding to its receptor (CNTFR). Previous studies suggested that a G-to-A polymorphism (rs1800169) in the second exon of the CNTF gene and a C-to-T polymorphism (rs41274853) in the 3'-untranslated region (3'-UTR) of CNTFR gene were associated with trainability of muscle strength (Walsh et al., 2009) and fat-free mass (Roth et al., 2003), respectively. Thus, the purpose of the present study was to investigate whether CNTF (rs1800169) and CNTFR (rs41274853) polymorphisms are associated with elite sprint/power athlete (SPA) status. Methods 134 elite Japanese SPA (72 national and 62 international track and field athletes) and 649 Japanese controls were genotyped for rs1800169 and rs41274853 polymorphisms using TaqMan Genotyping Assay, and genotype frequencies were compared between groups by chi-square tests. Leg extension power in control subjects were also measured by using a dynamometer and multiple liner regression analyses were conducted to determine the independent effect of these polymorphisms on muscle power. Results CNTF (rs1800169) and CNTFR (rs41274853) genotype frequencies did not differ between elite SPA and controls. However, when elite SPA were limited to international athletes, the frequency of TT genotype in rs41274853 polymorphism was significantly higher in international SPA than in controls (P=0.007 under T-recessive model). In addition, TT genotype carriers of rs41274853 polymorphism exhibited greater leg extension power than CT+CC genotype carriers in male control subjects (P=0.013 after adjusted by age and physical activity). Discussion Our results are consistent with previous association between the T allele of rs41274853 polymorphism and high fat-free mass (Roth et al., 2003). These results suggest that C-to-T substitution in the CNTFR 3'-UTR is beneficial to sprint/power athletic performance. Micro RNAs are small non-coding RNAs and post-transcriptionally regulate protein expression by binding to the 3'-UTR of target mRNAs. TargetScan software predicted that miR-675-5p targets the polymorphic site within the CNTFR 3'-UTR. Therefore, it is possible that rs41274853 polymorphism affects sprint/power performance by interfering with miR-675-5p binding. References Guillet C et al. (1999) J Neurosci, 19(4), 1257-1262. Walsh S et al. (2009) J Appl Physiol, 107, 1235-1240. Roth SM et al. (2003) J Appl Physiol, 95, 1425-1430.

#### POLYMORPHIC VARIATION WITHIN THE ADAMTS2, ADAMTS14, ADAMTS5, ADAM12 AND TIMP2 GENES AND THE RISK OF ACHILLES TENDON PATHOLOGY; A GENETIC ASSOCIATION STUDY

El Khoury, L., Posthumus, M., Collins, M., Handley, C.J., Cook, J., Raleigh, S.M.

*The University of Cape Town*

Objective. Achilles tendon pathology (ATP) is a multifactorial condition for which genetic risk factors have been identified. The COL5A1 gene has been associated with the risk of ATP in two independent Caucasian populations. The ADAMTS, ADAM12 and TIMP2 genes encode enzymes that are important regulators of tendon homeostasis. ADAMTS2 and ADAMTS14 proteins are procollagen N-propeptidases for pro-collagen type I, type II, and type III. ADAMTS2, like COL5A1, has been linked to Ehlers-Danlos syndrome. Variants within ADAMTS5 and ADAM12 have been associated with osteoarthritis. TIMP2, a metalloprotease inhibitor, maintains homeostasis in the ECM by inhibiting ADAM, ADAMTS and MMP functions. We sought to determine whether single nucleotide polymorphisms (SNPs) within

the ADAMTS2, ADAMTS5, ADAMTS14, ADAM12 and TIMP2 genes were associated with the risk of ATP in two independent populations. Methods. 213 (115 ATP cases and 98 asymptomatic controls) South African Caucasian participants and 209 (60 ATP cases and 149 asymptomatic controls) Australian Caucasian participants were recruited for this case-control genetic association study. All participants were genotyped using TaqMan technology for the ADAMTS2 rs1054480, ADAMTS5 rs226794, ADAMTS14 rs4747096, ADAM12 rs3740199, and TIMP2 rs4789932 SNPs. Results. We report the detection of a significant ( $P=0.016$ ) genotypic association between ATP and TIMP2 rs4789932 in the combined South African and Australian cohorts. In contrast, we detected no significant association between any of the ADAMTS or ADAM SNPs with ATP in either cohort. Conclusion. Our data show for the first time that a common SNP within the TIMP2 gene is a risk factor for ATP in Caucasians.

### INVESTIGATION OF GENES INVOLVED IN THE CELL-SIGNALLING PATHWAY WITH RISK OF ANTERIOR CRUCIATE LIGAMENT RUPTURE

September, A.V.1, Rahim, M.1, Mannion, S.1,2, Hobbs, H.3, O'Cuinneagain, D.3, van der Merwe, W.1,3, Dandara, C.2, Collins, M.1,4

*1UCT/MRC ESSM, Human Biology,UCT; 2Human Genetics,UCT. 3SSOC;4MRC*

**INTRODUCTION:** Anterior cruciate ligament (ACL) injuries are multifactorial, for which a genetic component has been implicated. Genes encoding matrix remodelling proteins have been shown to be associated with risk of ACL ruptures. The aim of this study was therefore to investigate if additional genes coding for matrix remodelling proteins are associated with risk of ACL injury. **METHODS:** A pathway-based genetic-association study was conducted. Two hundred and thirty four control participants (CON group) and 188 participants with ACL ruptures (ACL group) were recruited. All participants were genotyped for the following polymorphisms: IL6 rs1800795, IL6R rs2228145, CASP8 rs3834129, CASP8 rs1045485, IL1B rs16944, PTGER4 rs4495224 and TGF $\beta$ 2 rs7550232. Statistical analyses were conducted to determine any significant differences ( $p<0.05$ ) in genotype and allele frequency distributions between the CON and ACL groups as well as the CON group and the NON subgroup (participants with a noncontact mechanism of injury). **RESULTS:** The IL6 rs1800795 genotype frequencies were significantly different between the CON group and the NON subgroup ( $p=0.002$ ). Specifically, the GG genotype was significantly under-represented ( $p=0.0008$ , OR: 2.299; 95% CI: 1.417 to 3.730) and the GC genotype significantly over-represented ( $p=0.005$ , OR: 2.043; 95% CI: 1.237 to 3.373) in the CON group in comparison to the NON subgroup. Furthermore, the frequency of the C allele was significantly higher in the CON group compared to the NON subgroup ( $p=0.005$ ; OR: 1.651, 95% CI: 1.161 to 2.348). No other significant differences in genotype or allele frequencies were noted between the CON and ACL groups or between the CON and NON groups for the remaining polymorphisms. **CONCLUSION:** This study provides preliminary evidence suggesting that polymorphisms in the IL6 gene may be implicated in the pathophysiology of ACL ruptures. Investigations into the interactions between genes involved in the cell-signalling pathway will provide greater insight into the biological importance of this cascade in the pathophysiology of ACL ruptures.

### THE ASSOCIATION OF A POLYMORPHISM WITHIN A FUNCTIONAL REGION OF THE COL5A1 GENE WITH ULTRA-ENDURANCE RUNNING PERFORMANCE AND JOINT RANGE OF MOTION

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**Introduction:** Endurance running performance and joint range of motion are both multifactorial phenotypes and were independently associated with a single nucleotide polymorphism, rs172722 (C/T), within the COL5A1 3'-untranslated region (UTR). Two major functional forms of the COL5A1 3'-UTR have been identified and differ by seven tightly linked polymorphisms including rs12722 and a short tandem repeat polymorphism (STRP rs71746744, -/AGGG) (Laguetta et al. 2011). It has been proposed that STRP rs71746744 plays a role in the predicted secondary structures and mRNA stability of the two major forms of the COL5A1 3'-UTR, implying a regulatory role (Abrahams et al. 2013). The aim of this study was therefore to determine whether STRP rs71746744 is also associated with running performance and pre-race sit and reach range of motion (SR ROM) within a cohort of 56 km ultra-marathon road runners. **Methods:** One hundred and six (74 males and 32 females; aged 22 – 67 years) Caucasian runners who participated in either the 2009 or 2011 Two Oceans 56 km ultra-marathon were included in this study. Their SR ROM measurements, COL5A1 rs71746744 genotype and overall race times were determined. **Results:** COL5A1 rs71746744 was independently associated with running performance ( $P = 0.024$ ) and pre-race SR ROM ( $P = 0.020$ ). Moreover, the AGGG/AGGG genotype was significantly over-represented in the fastest and inflexible athletes when compared to those with either the -/AGGG or -/- genotypes. **Discussion:** It has been proposed that STRP rs71746744 is functional and, partly, regulates type V collagen synthesis (Abrahams et al. 2013). Type V collagen is an important regulator of type I collagen fibrillogenesis (Birk et al. 1990). We have proposed that changes in the type V collagen content of musculoskeletal soft tissues affects collagen fibril diameter and packing density altering the mechanical properties of tissue (Collins and Posthumus 2011). Therefore, this functional region within COL5A1 3'-UTR plays a role in improving running performance and reducing SR ROM. However, further studies are needed to investigate the effect of the rs71746744 variant on the mechanical properties of connective tissue. **References:** Abrahams, Y., M.-J. Laguetta, S. Prince & M. Collins (2013) *Annals of Human Genetics*. Birk, D. E., J. M. Fitch, J. P. Babiarz, K. J. Doane & T. F. Linsenmayer (1990) *J Cell Sci*, 95 ( Pt 4), 649-57. Collins, M. & M. Posthumus (2011) *Exerc Sport Sci Rev*, 39, 191-8. Laguetta, M.-J., Y. Abrahams, S. Prince & M. Collins (2011) *J Int Soc Matrix Biol*, 30, 338-45.

### EFFECT OF CONTINUOUS COMPARED WITH ACCUMULATED EXERCISE ON INSULIN SENSITIVITY

Burns, S.F., Chan, Y.M., Balasekaran, G.

*Nanyang Technological University*

**Introduction** Expert guidelines recommend physical activity is accumulated in bouts with a minimum duration of 10 min, to achieve the 30 min per day necessary for good health (Haskell et al., 2007). Whilst the concept of accumulating exercise is attractive the evidence for its efficacy on health is limited (Murphy et al., 2009). The present study compared the effect of accumulating three 10 minute bouts of exercise with one 30 minute continuous bout of exercise on insulin sensitivity in young healthy males. **Methods** Following ethical approval, 12 healthy males (aged  $24.4 \pm 1.9$  y, BMI  $21.8 \pm 1.2$  kg/m<sup>2</sup>, maximum oxygen uptake  $43.8 \pm 6.7$  ml/kg/min, mean  $\pm$  SD) completed three 2-day trials at least 5 days apart in a randomised repeated measures design. On day 1 the participants rested (no exercise) or walked on a treadmill at 70% of maximum oxygen uptake in either three 10-min bouts (accumulated) of exercise with 20 min rest between each or one continuous 30-min bout (continuous) of exercise. On day 2, participants came to the laboratory at 0800 and consumed a 75 g oral glucose tolerance test (OGTT). Venous blood samples were obtained in the fasted state and at 15, 30, 60, 90 and 120 minutes after the

OGTT. Fasting insulin sensitivity was calculated using the homeostasis model assessment 2 index (HOMA2). Whole body insulin sensitivity was calculated from fasting and OGTT measures using the Matsuda index;  $10000 / \sqrt{(\text{fasting glucose} \times \text{fasting insulin}) \times (\text{mean OGTT glucose concentration} \times \text{mean OGTT insulin concentration})}$ . One-way ANOVA (repeated measures) with post-hoc Bonferroni comparisons were used to determine differences in fasting and whole body insulin sensitivity among trials. Data are mean  $\pm$  SD. Results Fasting insulin sensitivity (HOMA2) was significantly different among trials (no exercise,  $176 \pm 54$ ; accumulated,  $183 \pm 45$ ; continuous,  $239 \pm 103$ ) (main effect of trial,  $P=0.033$ ). Post-hoc tests were not significant but the most likely improvement in insulin sensitivity was on the continuous exercise trial compared with the no exercise trial ( $P=0.064$ ). Similarly, whole body insulin sensitivity (Matsuda) differed among trials (no exercise,  $176 \pm 54$ ; accumulated,  $183 \pm 45$ ; continuous,  $239 \pm 103$ ) (main effect of trial,  $P=0.048$ ) with post-hoc tests suggesting an improvement in insulin sensitivity on the continuous exercise trial compared with the no exercise trial ( $P=0.058$ ). Discussion These data suggest that continuous but not accumulated exercise in line with the minimal recommended duration of 30 minutes per day leads to improvements in insulin sensitivity. References Haskell WL, Lee I-M, Pate RR, Powell KE, Blair SN, Franklin BA, Macera CA, Heath GW, Thompson PD, Bauman A (2007). *Circulation*. 116:1081-1093. Murphy MH, Blair SN, Murtagh, EM (2009). *Sports Med*. 39:29-43.

## 10:20 - 11:50

### Invited symposia

#### IS-SH03 Transitions and strategies in top level sport

##### APPLYING THE DEVELOPMENTAL MODEL OF TRANSITIONS IN INVESTIGATING THE CAREER DEVELOPMENT OF ELITE ATHLETES

Wylleman, P., Rosier, N., Reints, A., Tekavc, J., De Brandt, K.

*Vrije Universiteit Brussel*

Introduction Throughout their lives, athletes are faced with transitions. According to Wylleman and Lavallee's holistic athletic career model, transitions take place at different spheres of athletes' lives. During as well as after their athletic career, athletes face challenges at athletic, psychological, psychosocial and academic or vocational level. After an athletic career, athletic retirement places demands upon the athlete. However, not all athletes make it to the top; many drop out on their road to excellence, or do not reach the level required at elite senior level. Especially the transition from junior to senior elite athlete seems a challenging turning point. This presentation will consider two studies, one concerning the athletic retirement and one concerning the junior-senior transition. Method Two interview guides were developed using the holistic athletic career model as framework. For study 1, interviews were conducted with 24 Flemish former elite athletes. For study 2, interviews were conducted with high performance director of the category I sports in Flanders. Interviews were transcribed and analyzed using QSR Nvivo. Results Study 1 confirmed the existence of the four levels within the holistic athletic career model and revealed the presence of several within-career transitions not included in the model. This study also led to the identification of two other developmental levels, the financial level and the physical level. Study 2 found that in most sports there are different phases in the transition from junior athlete to senior elite athlete. Moreover, the structure of the sport and competition (e.g. from 2-3 ages at junior level to at least 10 ages at senior level) makes it difficult for junior athletes to conquer their place in the elite senior ranks. Besides this, challenges at the four levels of the holistic athletic career model were recognized. Discussion Both studies confirm the idea that athletic careers must be approached by using a holistic and lifespan perspective. Moreover, they showed that different sports have aspects in common, but also have their specificities. As a consequence, sport-specific research is required (e.g. early versus late specialization sports). In practice, career support services should help athletes to acquire the skills needed for a specific transition. During and after the junior-senior transition, athletes may be empowered by assisting them to acquire goal-setting, time-management, transitions, media, and relationship skills. Athletes who are about to plan their career end may benefit more from financial management and networking skills, and role exploration.

##### ENTERING AN ELITE SPORT TRAINING CENTER: MODALITIES OF ADAPTATION

Ledon, A., Debois, N., Rosnet, E.

*INSEP*

ENTERING AN ELITE SPORT TRAINING CENTER: MODALITIES OF ADAPTATION Aurélie Ledon a, Nadine Debois a, Elisabeth Rosnet a  
aNational Institute of Sport, Expertise and Performance, Paris, France Introduction This communication is in connection with a previous research about decision-making for entering an elite sport training center (Ledon, Debois, & Rosnet, 2009). The present research is based on the transitional adaptation from Charner and Schlossberg (1986) which underscores three categories of factors interacting during a transition: (a) the characteristics of the individual, (b) his perception of the current transition and, (c) the characteristics of the environment, above and below the transition. The main aim of the present study was to identify factors facilitating versus those constraining the adaptation in the elite sport training center. Method 31 elite athletes, (13 male athletes and 18 female athletes) aged 16 to 25 ( $M = 18,39$ ,  $SD = 3,56$ ) voluntarily participated to the study. They were both training and living in a national sport training center. 16 belong to an individual sport (athletics, karate, taekwondo, dive, skating, modern pentathlon, dive, squash) and 17 to a team sport (basketball). Semi directive interviews were carried out with the support of an interview guide, and retranscribed verbatim. Results Three different categories were identified as influencing the quality of the integration of the elite athletes in elite training center: (a) the living environment, (b) the dual career conditions and, (c) the sporting context. For each category, two sub-categories were distinguished: (a) a sub-category gathering factors facilitating the adaptation and, (b) a sub-category gathering factors constraining the adaptation. Discussion Our results confirm the role of the environment represented in the transitional adaptation model from Charner and Schlossberg (1986). The living environment, the dual career conditions and the sporting context appear as determining factors of the adaptation. These results are in accordance with the developmental model put forward by Wylleman and Lavallee (2004), which emphasizes the importance to adopt an holistic approach (e.g., taking into account both athletic, educational and social development) in the support given to athletes living and training in elite sport training centers. References Charner, I., & Schlossberg, N.K. (1986). Variations by theme: The life transitions of clerical workers. *The vocational Guidance Quarterly*, 34, 213-224. Ledon, A., Debois, N., & Rosnet, E. (2009). Decision-making modalities bound to the integration in elite training center at the elite athletes. *International Congress of Sport Psychology*, Paris. Wylleman, P. & Lavallée, D.

(2004). A developmental perspective on transitions faced by athletes. In M.R. Weiss (Ed.), *Developmental Sport and Exercise Psychology: a lifespan perspective* (pp.503-523). Morgantown: Fitness Information Technology.

### **FOREIGN FOOTBALL PLAYERS ADAPTATION TO SPANISH LEAGUES: UNTANGLING NON-NORMATIVE TRANSITIONS**

Azócar, F., Pérez, A., Pallarès, S., Torregrosa, M.

*University Autònoma de Barcelona*

**Introduction** The studies in professional athlete's adaptation involve several situations to untangle (e.g., relocation changes, injuries). Among the models in career sport life, the holistic developmental perspective on transitions faced by players (e.g., Wylleman & Lavallee, 2004) shows an image of the athletes including different levels of their lives. Stambulova, Alferman, Statler & Côté (2009) explain non-normative transitions as important and unplanned situations lived during the sport career, this transitions are less predictable (than normative transitions) and can be caused by different factors like a new professional contract, who includes a migration to a new continent/culture. This study explores the experiences of professional football players using Shinke, Gauthier, Dubuc, & Crowder (2007) reflections about cultural adaptation process throw five core motives: belonging, understanding, controlling, self-enhancement and trusting. **Methods** The participants were ten Latin-American football players who played in first and second Spanish leagues. At the moment of interview their age range was between 19 and 27 years old. The interviews were transcribed (verbatim) and then analyzed using Atlas.ti 7.0 **Results & Discussion** Analyzing the experiences associated to this transition three general contexts emerged: personal, sporting and cultural. In personal context we can find character of the player and their relationships (e.g., wife, teammates); the participants highlight the sporting experiences playing in important teams before Spain and national teams calls; and, finally, cultural context emphasize several variables like language, food, or training style. According to Schlossberg (1984) this changes must be understood throw the meaning that transitions has in each case. In this way, untangling it we must defined type of transitions, the context, and the impact in their roles, routines or assumptions. In each general context football player must cope with different changes and adapt themselves to the new situation. **References** Schinke, R., Gauthier, A., Dubuc, N., & Crowder, T. (2007). Understanding athlete adaptation in the national hockey league through an archival data source. *The Sport Psychologist*, 21, 277-287 Schlossberg, N.K. (1984). *Counseling adults in transitions*. New York: Springer Publishing Company. Stambulova, N., Alfermann, D., Statler, T., & Côté, J. (2009). Career development and transitions of athletes: The ISSP Position Stand. *International Journal of Sport & Exercise Psychology*, 7, 359-412. Wylleman, P., & Lavallee, D. (2004). A developmental perspective on transitions faced by athletes. In M. Weiss (Ed.), *Developmental sport and exercise psychology: A lifespan perspective* (pp.503-524). Morgantown, WV.: Fitness Information Technology.

**10:20 - 11:50**

### **Invited symposia**

#### **IS-SH10 Implementation and impact of the Empowering Coaching programme in promoting children's active and healthy engagement in sport: Findings from the PAPA main trial**

##### **EMPOWERING AND DISEMPOWERING COACH BEHAVIOURS, PLAYERS' NEED SATISFACTION AND WELL-BEING IN THE CONTEXT OF SPANISH GRASSROOTS FOOTBALL: A MULTILEVEL ANALYSIS**

Balaguer, I.1, Castillo, I.1, Tomás, I.1, González, L.1, Fabra, P.1, Soler, M.J.P.1, Cruz, J.2

*University of Valencia, 1; Autonomous University of Barcelona, 2*

Drawing from Achievement Goal (Ames, 1992; Nicholls, 1989) and Self-determination (Deci & Ryan, 1985) theories, a hierarchical linear multilevel approach was used to examine the effects of the social environment created by the coach (i.e., its empowering and disempowering features) at the team level, and player need satisfaction at the individual level, on key indicators of indicators of young athletes well-being (subjective vitality and enjoyment). Cross-level interactions between individual and team level variables were analysed. 1612 Spanish football players (182 girls, 1427 boys and 3 gender unspecified) from different regions (Valencia, Castellón, Barcelona and Lerida) who were between 9 and 15 years old ( $M = 11.53$ ,  $SD = 1.19$ ) and represented 134 teams from 39 different clubs, completed a questionnaire assessing the variables of interest. Within-group inter-rater agreement indicated shared perceptions of the coach-created social environment among the team members, so team aggregated measures were estimated. Hierarchical linear modelling procedures revealed that at the individual level needs satisfaction of competence, autonomy and relatedness positively predicted subjective vitality, and that satisfaction of competence and relatedness were positive predictors of enjoyment. Results also showed that perceptions of an empowering climate exerted a positive cross-level influence on subjective vitality and enjoyment. Finally, a cross-level interaction effect of perceived empowering climate on the positive relationship between satisfaction of the need of competence and enjoyment was found. Interactional effects indicated that when athletes have low satisfaction of competence, they exhibited greater enjoyment in climates perceived as more highly empowering while athletes reporting high competence enjoyed playing football at similar levels whether they perceived a high or low empowering coach-created environment. This research was funded by the European Commission under the Seventh Framework Program - Health - 223600 - as part of the PAPA Project [www.projectpapa.org](http://www.projectpapa.org) **References** Ames, C. (1992). Achievement goals, motivational climate, and motivational processes. In G.C. Roberts (Ed.), *Motivation in sport and exercise* (pp. 161-176). Champaign, IL: Human Kinetics. Deci, E.L. & Ryan R.M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press. Nicholls J.G. (1989). *The competitive ethos and democratic education*. Cambridge, MA: Harvard University Press.

### GENERAL SELF-ESTEEM, VITALITY AND INTENSIVE PHYSICAL ACTIVITY: EVIDENCE FOR CROSS-CULTURAL INVARIANCE OF THEIR ASSOCIATION ACROSS 5 EUROPEAN COUNTRIES

Papaioannou, A., Appleton, P., Bosselut, G., Gonzalez, L., Haug, E., Torregrosa, M., Ertesvaag, V., Jowett, G., Zourbanos, N.

*University of Northumbria*

The study examined the association of general self-esteem and vitality with youngsters' intensive physical activity and the generalizability of these associations across different European populations. The original sample of this study included 7769 youngsters aged 10-14 who participated in football teams in five European countries. These athletes reported on measures of general self-esteem, vitality and intensive physical activity one month after the start of the football season. After listwise exclusion of missing cases and elimination of athletes who reported less than a week intensive physical activity, the sample of this analysis included 6796 athletes from France (N = 974), Greece (N = 1416), Norway (N = 1051), Spain (N = 2175) and UK (N = 1180). Results from multi-sample structural equation modeling analyses established invariance across countries for factor loadings and structural covariance. Across the five countries intensive physical activity corresponded positively to general self-esteem ( $r = .21$ ,  $P < .001$ ) and vitality ( $r = .17$ ). Self-esteem was strongly related to vitality ( $r = .73$ ,  $p < .001$ ). The results support the validity of these measures across the five countries and the generalizability of findings concerning the association of intensive physical activity with self-esteem and vitality across different European populations.

### CORRELATES OF THE OBJECTIVELY ASSESSED EMPOWERING AND DISEMPOWERING FEATURES OF THE MOTIVATIONAL CLIMATE IN GRASSROOTS FOOTBALL

Sarrazin, P.1, Smith, N.2, Tzioumakis, Y.3, Tessier, D.1, Quested, E.2, Papaioannou, A.3, Duda, J.2

*1. University Joseph Fourier Grenoble; 2. The University of Birmingham, UK; 3. University of Thessaly, Greece*

The coach created motivational climate is a key concept for understanding the determinants of athletes' welfare and optimal functioning when taking part in sport. Drawing from an integrated achievement goal theory (Nicholls, 1989) and self-determination theory (Deci & Ryan, 2002) perspective, an observational system has been developed in the PAPA project to provide an objective assessment of the coach-created motivational environment in sport. This Multidimensional Motivational Climate Observation System (MMCOS) allows to code the coach created motivational climate in terms of 6 first order dimensions (i.e., controlling, task-involving, ego-involving, relatedness supportive, relatedness thwarting, structure) and 2 higher order dimensions (i.e., Empowering vs. Disempowering). Fifty-seven coaches from England, Greece and France were selected to take part in the study. Each coach was videotaped during one complete training session using a digital camcorder and microphone. Using the MMCOS their motivation climate was then coded. Correlations between coaches' motivational climate and various players' motivational variables (e.g., need satisfaction) were examined. Results showed factorial and predictive validity of the tool. Moreover, coaches tended to emphasise a more need-supportive environment than need thwarting one (i.e., 69.9% and 30.1% of the whole behaviours coded, respectively), and although coaches' interpersonal styles varied significantly across countries, the general pattern of the coach-created environment observed in the three countries had a similar profile.

**10:20 - 11:50**

## Oral presentations

### OP-SH06 Psychology [PS] 2

#### THE WHY OF GOAL STRIVING MATTERS: THE IMPACT OF PRIMED GOAL MOTIVES ON PERSISTENCE

Healy, L.1, Ntoumanis, N.1, Stewart, B.1, Duda, J.L.1, Bond, J.2

*1: University of Birmingham (Birmingham, UK), 2: University of Rochester (Rochester, USA)*

Introduction Grounded in Self-Determination Theory, the self-concordance model (Sheldon & Elliot, 1999) posits that personal motives for goal pursuit can be autonomous or controlled. Individuals striving with autonomous motives engage in goal striving due to enjoyment or perceived importance of the goal, whereas those with controlled motives strive due to internal pressures, such as avoiding unpleasant emotions, or the expectations of important others. These diverse motives can lead to different outcomes for persistence and well-being (Sheldon & Elliot, 1999; Smith, et al.2011), with autonomous motives predicting more adaptive outcomes. Research has thus far only examined an individual's explicit personal goal motives; hence this study investigated the impact of implicit/primed goal motives on goal persistence and other important outcomes. Methods 90 athletes (47 female, M age = 19.63 years, SD = 1.14) were recruited to an incremental multi stage exercise trial on a cycle-ergometer. Prior to the trial, participants were exposed to an autonomous, controlled or neutral motivational prime. This comprised a filmed matched-gender actor describing their upcoming participation in an unrelated task. Persistence was defined as the total number of stages completed in the trial. Questionnaires assessed positive affect and interest in future engagement in a similar trial. Results Non-orthogonal contrast coding compared the controlled prime with the autonomous and neutral prime. Structural equation modelling supported a model in which, when compared to the controlled prime, autonomous ( $\beta = .38$ ,  $p = .01$ ) and neutral ( $\beta = .27$ ,  $p = .02$ ) primes predicted greater persistence. Consequently, persistence led to greater positive affect change from pre-trial ( $\beta = .42$ ,  $p < .01$ ), which in turn predicted interest in future engagement ( $\beta = .47$ ,  $p < .01$ ). Future interest was also directly predicted by the autonomous versus controlled contrast ( $\beta = .22$ ,  $p = .02$ ). Discussion The findings extend previous research by demonstrating that goal motives can be primed, and that primed autonomous goal motives can lead to greater persistence and better motivation-related outcomes, compared to primed controlled motives. Furthermore, the undermining effect of primed controlled motives was shown, as the neutral prime with no motivational content resulted in greater persistence than the controlled motives prime. Future research should investigate how primed goal motives might predict other self-regulatory responses, such as the ease of disengagement from an unattainable goal. References Sheldon KM Elliot AJ. (1999). *J Personality & Social Psychology*, 76, 482-497. Smith A Ntoumanis N Duda J Vansteenkiste M. (2011). *J Sport & Exercise Psychology*, 33, 124-145.

## HIGH INTENSITY INTERVAL AND TRADITIONAL ENDURANCE TRAINING LEAD TO COMPARABLE IMPROVEMENTS IN MOTIVATION AND WELL-BEING OUTCOMES

Kinnafick, F.E.1,2, Shepherd, S.O.1,3, Wilson, O.J.1, Shaw, C.S.1,2, Wagenmakers, A.J.M.1,3, Thøgersen-Ntoumani, C.1

1 University of Birmingham; 2 University of Northampton; 3 Liverpool John Moores University; 4 Victoria University, Melbourne Australia; 2,3,4 Current Affiliations

**Introduction** Lack of time is a salient barrier to exercise in physically inactive adults. High intensity interval training (HIT) is a time-efficient exercise approach that elicits similar beneficial metabolic and cardiovascular adaptations to traditional endurance training (ET). Given that psychological effects of exercise are key determinants of sustained behavioural engagement (Williams et al., 2008) and consequently long-term health, it is critical to measure the effect of HIT on motivation and psychological well-being. **Aim** To investigate whether an instructor-led group-based HIT intervention enhances psychological well-being to a similar extent as ET. **Methods** Using a randomised controlled design, 57 overweight, physically inactive employees of mixed gender (M age=40; SD=10; age range 25-60; BMI M=28.0; SD=0.6 kg.m<sup>-2</sup>) from a UK University and hospital were assigned to undertake HIT (n=30) or ET (n=27) exercise classes for 10 weeks. HIT consisted of repeated sprints (15-60 s duration) on a spin ergometer interspersed with periods of recovery cycling (≤25 min per session, 3x.wk<sup>-1</sup>). ET participants cycled at a constant workload (~65% VO<sub>2</sub>max) on a spin ergometer (30-45 min per session, 5x.wk<sup>-1</sup>). Attendance was recorded. Psychometrically validated scales measured well-being outcomes (positive and negative affect, subjective vitality, perceptions of health, and self-esteem) at baseline, post-intervention and at a three month follow-up. Motivational regulations for exercise were measured at baseline, week 5 and post-intervention. Using intention-to-treat principles, a series of mixed-design ANOVAs (within-subject factor = time, between-subject factor = condition), were used to analyse the data. **Results** Over time, well-being outcomes (subjective vitality:  $F(2,52)=14.269$ ,  $p<0.01$ ,  $\eta^2=.35$ ; positive affect:  $F(2,52)=15.33$ ,  $p<0.01$ ;  $\eta^2=.37$ ; negative affect:  $F(2,52)=7.13$ ,  $p<0.01$ ,  $\eta^2=.215$ ; perceptions of health:  $F(2,52)=32.22$ ,  $p<0.01$ ,  $\eta^2=.37$ ), intrinsic motivation ( $F(2,51)=7.83$ ,  $p<0.01$ ,  $\eta^2=.23$ ) and self reported total physical activity ( $F(2,49)=18.08$ ,  $p<0.01$ ,  $\eta^2=.42$ ) improved after training and remained above baseline at follow-up. Group analysis yielded no significant differences over time for any outcomes. Adherence was greater in the HIT group (HIT M=84.9% vs. ET M=70.3% sessions attended;  $p<0.05$ ). **Conclusions** Adding to known fitness and health benefits, HIT improves psychological well-being with effects similar to those experienced following ET. As superior adherence rates to HIT were observed, data suggests that HIT performed in an instructor-led group environment is an effective lifestyle intervention as it counteracts a salient barrier to exercise (lack of time), improves exercise engagement, and may consequently engender long-term health benefits. **References** Williams et al., (2008). *Psychol Sport Exerc*, 9, 231-245.

## COMPARISON BETWEEN THINK ALOUD PROTOCOL AND RETROSPECTIVE RECALL IN ASSESSING DECISION MAKING IN GOLF

Whitehead, A., Polman, R., Taylor, J.

University of Central Lancashire

The present study compares different methods of data collection and analysis for the investigation of decision making in sport. Ericsson and Simon (1993) recommend using a think aloud protocol to gauge the thought processes of performers in events. This method has rarely been used in sport research; instead retrospective reports of decisions are more common. This study examined the congruence between data collected via think aloud protocol and retrospective recall of decisions on a golfing task. Six high level male golfers performed six holes of golf whilst engaging in level 3 think aloud, this involved describing one's thoughts and explaining one's decisions during the task. After performance three semi-structured retrospective interviews were conducted, the first was immediately after performance, the second 24 hours after performance, and the third 48 hours after performance. Think aloud verbalisations and interviews were transcribed verbatim and coded. Content analysis was used to identify first and second order themes related to decision making on the golf task. A comparison of the themes identified indicated large discrepancies between the information reported during think aloud and at interview, with only 38-41% similarity in variables reported to influence decision making on each hole. These findings suggest retrospective recall of decision making is limited since relevant information is lost due to memory decay. Future research should record decision making processes in event, employing the think aloud protocol.

## WATCHING VIDEO'S AS DELIBERATE PRACTICE AMONG MOGUL SKIERS

Laurin-Landry, D.1,2, Merri, M.2, Recope, M.1

1: Clermont University; 2: University of Quebec in Montreal (Canada)

**Introduction** Deliberate practice is an activity designed to improve the current performance of an individual and has been correlated to high level of expertise (Ericsson, Krampe & Tesch-Römer, 1993). Watching videos is the only deliberate practice that differentiates expert athletes from novice athletes (Baker, Côté & Abernethy, 2003). This research investigates the development of mogul skiers' deliberate practice when observing oneself and others on video. **Methods** Retrospective and semi-directive in depth interviews were conducted with 17 mogul skiers competing nationally and internationally. Interviews focused on three thematic: how did they start mogul skiing? What was missing from their team training plan so they had to watch videos of themselves and of others? Which parameters (what, when, where, why and how) did they use to watch videos of themselves and of others at every stage of their mogul skiing participation (Côté, 1999)? **Results** Firstly, motives of deliberate observation of the best mogul skiers on video have varied along with skiers' development. During the Sampling years, observation was mostly oriented towards sport enjoyment. During the Specializing years, skiers looked at a technical and esthetic model they wanted to emulate. During the Investment Years, skiers were most likely to watch videos of others when they experienced difficulties in their training. Secondly, the information collected in looking at oneself has evolved. In the Sampling Years, skiers only noticed the errors and the aspects well executed. The Specializing Years are critical: skiers competing nationally were still watching videos the same way as in their Sampling Years whereas skiers competing internationally watched videos in order to understand the sequence of actions causing errors or success. During the Investment Years, skiers observed themselves on video to perfect the technical and esthetic skier they wanted to be. Finally, video practice varied according to their knowledge and was focused on the technique currently trained. **Discussion** The main implication of this research is that deliberate practice takes place at an early age and evolves along with athletic development. Videos are good tools for an athlete to improve his performance by allowing one to develop knowledge about his own practice and to observe the ideal technical model. **References** Côté, J. (1999). The influence of the family in the development of talent in sport. *The Sport Psychologist*, 13, 395 – 417 Ericsson, K. A., Krampe, R. Th., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, 100(3), 363-406 Baker, J., Côté, J., & Abernethy, B.

(2003). Learning from the experts: practice activities of expert decision makers in sport. *Research Quarterly for Exercise and Sport*, 74(3), 342-347

### **DANCERS' DAILY EXPERIENCES: A BASIC NEEDS THEORY APPROACH**

Norfield, J.E., Quedsted, E., Duda, J.L., Ntoumanis, N.

*University of Birmingham*

**Introduction** Previous research (e.g. Gagne, Ryan & Bargman, 2003) grounded in Basic Needs Theory (BNT; Deci & Ryan, 2000) has found daily experiences of autonomy support and basic psychological need satisfaction to have implications for the psychological health of athletes. Building on previous research grounded on BNT (Deci & Ryan, 2000) and pulling from Duda's (in press) conceptualisation of the social environment which integrates dimensions from Deci and Ryan's work as well as achievement goal theory (Nicholls, 1989), we had two aims; firstly to examine whether dancers' perceptions of empowering (i.e., autonomy supportive, task-involving and social supportive) and disempowering (i.e., controlling and ego-involving) climates in dance classes predict post-class basic need satisfaction and thwarting and in turn, changes in affective states during classes. Secondly we aimed to examine whether dancers' typical level of contingent self-worth and fear of failure moderate the relationships between dancers' perceptions of class climates and reported basic need satisfaction and thwarting, and changes in affective states during classes. **Methods** 135 full-time vocational dancers (Mage = 15.57 years, SD = 2.48) completed an initial questionnaire measuring contingent self-worth and fear of failure and a diary before and after daily technique classes, for 5 consecutive days. Diaries measured dancers' affective states before class and perceptions of the motivational climate, basic needs and affective states post-class. **Results** Hierarchical multiple regressions on data averaged across time showed perceptions of class climates and basic need satisfaction and thwarting post-class to significantly predict dancers changes in positive affect ( $F(4,1041) = 10.22, p < .01$ ) and negative affect ( $F(4,1046) = 8.21, p < .01$ ) during classes. Hierarchical moderated regression analyses revealed contingent self-worth to moderate the relationship between perceptions of empowering climates, basic need thwarting and changes in negative affect. Fear of failure moderated the relationship between empowering climates and basic needs satisfaction and thwarting. **Discussion** This study reveals that dancers with high levels of contingent self-worth and fear of failure were less likely to experience the positive effects empowering class climates have on post-class basic needs and affective states. This study highlights the importance of future studies and interventions grounded in SDT considering the interacting role of individual differences. **References** Deci, E.L. & Ryan, R.M. (2000). *Psych Inquiry*, 11, 227-268. Duda, J.L. (in press). *International Journal of Sport and Exercise Psych*. Gagne M. & Ryan R.M., & Bargman, K. (2003). *J of Applied Sport Psych*, 15(4), 372-390. Nicholls, J.G. (1989). London: Harvard University Press.

### **HOW INCREASE PUPILS MOTIVATION TOWARDS DANCE IN PHYSICAL EDUCATION?**

Amado, D., Sanchez-Miguel, P.A., Chamorro, J.L., Gonzalez-Ponce, I., Pulido, J.J.I, Garcia-Calvo, T.

*UNIVERSITY OF EXTREMADURA*

**Introduction** Pupils' motivation during Physical Education classes is positively associated with commitment and perception of positive experiences (Lonsdale et al., 2009). Thus, due to the dance and corporal expression contents in physical education are the ones which generated more resistance (Cuéllar and Rodríguez, 2009), and based on postulates from the Self-Determination Theory (Deci and Ryan, 2000) as a conceptual framework very used in the educative context, the aim of this study was to develop an intervention program with teachers using strategies to promote autonomy, competence and relatedness support, and therefore, trying to increase pupils motivation through these contents. **Method** In the study a physical education teacher and her 47 pupils (29 girls y 18 boys), ranging in age from 14 to 18 years old, participated in the research. Regarding the total amount of the sample, 20 pupils were included in the experimental group and 27 pupils composed the control group. To assess self-determination level, the Questionnaire of Motivation in Dance and Corporal Expression was used and to measure perception of basic psychological needs support from teacher, the Adaptation to the Corporal Expression of the Questionnaire of Basic Psychological Needs Support was used. The intervention program consists of 12 dance classes with each group, using a teaching program in the experimental group with the teacher to promote competence, autonomy and relatedness support. In both groups a questionnaire was administrated to pupils in three different times, coincidence with 4th, 8th and 12th classes. **Results** Results showed that there were not significant differences at multivariate level ( $F(5, 41) = .72, p = .73; n2 = .05$ ). Nevertheless, after examine the average of the different variables analyzed in the study, an increase of teacher perception of competence and autonomy support in the experimental group regarding control group were observed. **Discussion** Regarding the obtained results, and considering the main aim of the study, it is suggested that pupils who receive a dance teaching program including several teaching strategies to basic psychological needs support, perceive changes in their teacher along the time, and so, they are more interest to increase feeling of competence and autonomy in their pupils. Therefore, it is emphasized the utility of the intervention program to promote perception of pupils about positive changes in their teacher teaching's styles, which will be showed in pupils' behaviors. **References** Cuéllar, M. J. and Rodríguez, Y. (2009). Estrategias de enseñanza y organización de la clase en expresión corporal. *Habilidad Motriz*, 33, 5-14. Deci, E. L. and Ryan, R. M. (2000). The "what" and the "why" of goal pursuits: Human needs and the self-determination of behaviour. *Psychological Inquiry*, 11, 227-268. Lonsdale, C., et al. (2009). Self-determined motivation and students' physical activity during structured physical education lessons and free choice periods. *Preventive Medicine*, 48, 69-73.

10:20 - 11:50

## Oral presentations

### OP-SH14 Sport Management [SM] 2

#### SPONSORSHIP STRATEGIES BETWEEN LARGE AND SMALL SPORT ORGANIZATIONS IN THE USA

Stotlar, D.

*University of Northern Colorado*

**Introduction-** This research compares sponsorship acquisition strategies of large and small university sport organizations in the US. The literature shows of the transition of marketing theory from product-orientation to market-orientation. Current sponsorship practice shows that many sponsorship programs offer defined products (a.k.a. gold, silver & bronze packages) and then attempt to find sponsors interested in their offering. **Theoretical Framework-** Kotler (2006), indicates that too many organizations define themselves myopically around the products that they produce. As applied to sport, Mullin, Hardy and Sutton (2006) detail how sport marketers focus on producing and selling products rather than identifying and satisfying consumer needs. The presentation of static sponsorship programs and platforms is clearly rooted in myopic thinking. **Methods-** In this research, a content analysis and Chi Square test were conducted on a stratified sample of large and small sport organization sponsorship offerings. The sample of organizations (N = 109) was divided into two distinct groups. Large sport organizations (NCAA BSC institutions) (N= 68) and small organizations (NCAA Div. II, III or NAIA levels) (N= 41). Data were coded and analyzed. **Results-** The results indicated significant differences between the two classifications. The large organizations (55 of 68) were represented by one of the two dominant agencies in collegiate sport marketing (IMG College [ N= 34] and Learfield Sports [ N=21]). These agencies offer market-oriented sponsorships in line with current marketing strategy, they also used a "template" format across the properties. Of the remaining institutions, 3 managed their own opportunities through a "University of XX Properties" moniker with two utilizing a product-oriented approach and 1 offering a market-oriented program. Data for the small sport organizations indicated that sponsorship opportunities were presented through product-orientation (38/41). Only 3 institutions used the market-oriented approach. The Chi Square analysis (84.85 significant  $p > .001$ ) revealed significant difference between the two groups wherein large organizations were more likely to use market-orientation. Small sport organizations were more likely to be offered via antiquated product-oriented. **Discussion** Clearly the larger sport organizations have bigger budgets and are more sophisticated than the smaller organizations. The size of the marketing staff also varies greatly from large to small organizations and larger staffs would be more able to customize the offerings and be better able to service their sponsors. The smaller organizations also have much less capacity to drive ROI (return on investment), an objective typically demanded by larger sponsors. This researcher feels that a market-oriented approach fits best with current marketing theory. However, this approach demands more time and effort that might not be available at smaller organizations.

#### THE ORGANIZATION OF SWEDISH TALENT DEVELOPMENT IN SOCCER: IMPACT ON PERFORMANCE

Söderström, T.

*Umeå university*

Söderström, T, 1, Brusvik, P, 2., Lund, S, 3 1: Umeå university, Department of Education, 2: Swedish Football Association, 3: Linneus University, Department of Education, Psychology and Sport Science. **Introduction** This study reports empirical data from a project that investigates talent development in the 24 soccer districts in Sweden. The paper draws attention to the structural dimensions of specialization (roles and activities), standardization (rules, policies, procedures) and centralization (hierarchical positions and decision making) within the districts. The purpose is to explore whether the structural dimensions are related to and impact on soccer performance. **Methods** The material that the study is based on is an analysis of organizational form (Kikulis et al., 1989), data on the number of licensed players and elite teams in the district, the district's geographical location and a compilation of all 24 districts match results against other districts at 15 years age and at the age of 16. A total of 60 matches between 2001-2011 were registered for each district. The analysis of the district organizations was based on a content analysis of documents describing the structure and implementation of talent development. The documents were classified based on the structural dimensions of specialization, standardization and centralization. **Results** The results show that the specialization in the districts varies from explicit roles and responsibilities for different actions to a low degree of specialization. Similarly, the standardization varies from extensive rules to very low with few formal policies and that centralization differs from high to low. The analysis of performance between 2001 and 2011 shows that there are both successful districts (won many matches) and less successful districts and that successful boy teams are not always followed by successful women teams in the same district. The results show that there are no significant relationships between organizational dimensions and performance. The relationship that arises is that there is a correlation between performance at 15 and 16 years of age and the number of licensed football players and number of teams at the elite level in the district for the boys. For the girls this correlation is only visible at the age of 16. **Discussion** Although no significant differences between organization and performance were found, the data indicate that larger districts are more specialized and standardized. However, there is a need for more research, both quantitative and qualitative, to enable a wider understanding of the talent development system in Swedish soccer. **References** Kikulis, I. M., Slack, T., Hinings, B., & Zimmerman, A. (1989). A structural taxonomy of amateur sport organizations. *Journal of Sport Management*, 3, 129-150.

#### TALENT DEVELOPMENT IN SOCCER: A QUESTION OF TOP-LEVEL CLUBS BUDGET AND TABLE POSITION?

Sæther, S.

*Norwegian University of Science and Technology*

**Introduction** Developing young players is regarded as an important task for most European top-level clubs, both because of team performance and economic reasons. Young players are depending on playing time on the top-level to be able to develop into elite soccer players. This article focuses on the amount of playing time for players under 20 years in the seasons 2009, 2010, 2011 and 2012 in the Norwegian premier league Tippeligaen. The players playing time was analyzed in relation to the clubs table position, to be able to see if the playing time affected the clubs table position. Furthermore, the article discusses the effects between the clubs budget, seasonal table

position and playing time for under 20 players among clubs which has been in the Tippeligaen all four seasons. Methods Data regarding the U20 players playing time (minutes played) and the clubs table position was analyzed from the webpage [altomfotball.no](http://altomfotball.no), while data on the clubs budget was collected from webpage [nettavisen.no](http://nettavisen.no) (Norwegian newspaper). This article contains two analyses. The first analysis is a descriptive analysis of playing time dividing the clubs by league position into; top 5, middle 6 and bottom 5. The second analysis examine pearsons correlation between the clubs budget, final table position and playing time for under 20 players among clubs in the Tippeligaen all four seasons. Results The results of the first analysis show a positive increase in playing time with a lowering of table position during all seasons when the seasons are compared separately, except for the 2009 season. The results from the second analysis show a strong significant ( $p < .05$ ) correlation between budgets between all seasons (.675-.983), with the exception of the 2009 versus 2012 season. On the other hand there were found few significant correlation in term of playing time, budget and table position both within and between the four seasons. Two exceptions are a positive correlation between table position in 2009 and playing time in 2012, and a negative correlation between playing time in 2009 and table position in 2011. Discussion These results indicate that there is a connection between a low level of table position and playing time for U20 players. This could indicate that clubs on the lower part of the table has a disadvantage of letting the U20 players play. In a talent development perspective, young players would have an advantage of playing for clubs on the lower part of the table in terms of opportunity for playing time. Even so, since the results showed few correlations between the three factors playing time, budget and table position the connection between these factors seems indistinct.

### THE REGULATION OF CAREERS IN SPORT INDUSTRY.

Camps, A.1, Pappous, A.2, Segui, J.1, Nebot, R.3

*1 INEFC- (Lleida, Spain); 2 University of Kent (Canterbury, UK); 3 Escola Catalana Esport (Barcelona, Spain)*

Introduction In the current setting of deregulation of the professions in Europe as a whole, and specially in Spain, a regulation of the criteria which determine the minimum qualifications for a professional to work in the area of education, training, support and management of sport activities, remains necessary. The health of the sport users and students should be protected and guaranteed by legislation in order to avoid any risks that might damage their health. The Catalan model in Spain, where there is law which formally regulates the careers in Sport. There is a will on the rest of the Spanish state to regulate in the same/ or in similar way the sports careers and we believe that this model can also be very valid for many other European countries, mainly those which follow a more interventionist approach in sports, such as France, Italy, Portugal, Greece, etc. We are also convinced that this law can also serve as a model for several Latin-American countries. The law of Sport Careers in Catalonia is the FIRST EXAMPLE of the implementation of the Bologna model in the context of professional careers' regulation. Justification The primary objective of the law is to protect the health of citizens with special emphasis on those who may be at greater risk as children, the elderly, those with some kind of disease, those who work in sports activities that entail a clear risk, etc. The law is constitutional justification of the law eradicates on the obligation of the government to preserve and protect the health of its citizens. On one hand there is the right to the free market and the free exercise of professions, however on the other hand there is another constitutional right with even greater need to be guaranteed, and this the right to health and the protection of minors This new law eliminates the monopolistic practices of sports federations and the private sector of sport. Actually the limitations imposed by this law have a positive effect on the opening of the market. According to the law, the professional practice consists of the provision of paid services in the field of sport The law contains four professional careers: a- Physical Education Teacher. b- Animator or professional sports instructor. c- Professional Sports Coach. d- Sport Director. The system of access to professional careers is based on the European model of Bologna which grant access to employment according to professional skills and competences rather than exclusively on academic qualifications. A specific profession can be accessed by a variety of skills accreditation models and a single academic degree grants access to various career paths.

12:00 - 13:15

## Plenary sessions

### PS-PL02 Emerging Trends in Team Sports Science sponsored by Aspetar

#### USING TEAM SPORTS TO ENHANCE HEALTH AND WELL-BEING IN YOUNG PEOPLE

Duda, J.L.

*University of Birmingham*

Past research has indicated that participation in team sports facilitates the realising of recommended moderate-to-vigorous physical activity levels in young people. Engagement in team-based sports can also result in a number of psychological and physical benefits and contribute to children's overall psychosocial development. However, sustained engagement in such activities is often curtailed as dropout rates in youth sport tend to be high. As evidenced via heightened anxiety, diminished self esteem, and/or burnout, participation in team sports can also compromise the well-being of young athletes. Providing insight into the determinants of such discrepant consequences of team sport engagement, contemporary theoretical frameworks (such as Self Determination Theory; Deci & Ryan, 2000) and related research point to the implications of variability in the motivational climates created by significant others and the role of ensuing differential motivational processes in sport participants. Grounded in this literature, the European-wide 'PAPA' Project (Promoting Adolescent Physical Activity) centred on the delivery and evaluation of a theory-based coach education programme (Empowering Coaching™) in the context of youth football. This training programme aimed to work with coaches so that they could develop and implement strategies which would make the youth football environment more 'empowering' for young people (Duda, in press). In this presentation, preliminary findings emanating from the PAPA project will be highlighted. Suggestions will be provided for how we can create team sport settings that are more health-conducive for children. Deci, E. L., & Ryan, R. M. (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227-268. Duda, J.L. (in press). The conceptual and empirical foundations of Empowering Coaching™: Setting the stage for the PAPA project. Special issue of the *International Journal of Sport and Exercise Psychology* focused on the PAPA Project.

**ECOLOGICAL DYNAMICS IN ANALYSIS OF PERFORMANCE IN TEAM SPORT**

Davids, K.

*Queensland University of Technology*

Many theoretical attempts to understand performance in team sports have an implicit basis in enrichment theories, which focus on the role of psychological processes, such as perception, anticipation and decision-making, without appropriate consideration of participant actions. This is a critical issue since research has revealed differences in decision-making behaviours when participants are allowed to regulate their action patterns in situ, compared to when they are asked to verbally report their decisions or use small micro-movements, such as stepping or pointing in a specific direction (left or right). Alternatively, an ecological dynamics perspective construes the continuous and dynamic physical interactions between cooperating and competing individuals in team sports and their performance environments as emanating from the same psychological processes. Ecological dynamics research on team sport performance has demonstrated how spatio-temporal measures of behaviour, such as angles and distances capturing interrelations between competing and cooperating performers, and their rates of change, relative to key objects and other individuals in the performance environment (e.g., goal areas, ball, opponent locations), constrain decision-making. This presentation discusses how psychological measures of decision-making behaviour do not necessarily have to be construed as internally-located measures in each individual performer. Rather, theory and research in ecological dynamics suggest that the processes of cognition, perception and action are immutably intertwined and mutually co-influential in decision-making during team sports performance. This consideration has implications for understanding performance in team sports suggesting how decision making for action may be enhanced by by: (i) focusing on the ongoing spatial-temporal interactions of performers and their performance environments; and (ii), on the information which is used continuously to guide players' goal-directed behaviours.

**14:00 - 15:00****Mini-Orals****PP-PM68 Training and Testing [TT] 3****WELLNESS FACTORS THAT DISTINGUISH RESPONDERS AND NON-RESPONDERS TO TRAINING IN ROWING**

Tran, J.1, Main, L.C.1, Rice, A.J.2, Gastin, P.B.1

*1: Deakin University; 2: Australian Institute of Sport*

**Introduction** Unravelling the training-adaptation-performance phenomena is a long-standing problem in sports science. However, research to date has tended to focus on the relationships between training and athlete wellness, with relatively little exploration of how wellness subsequently impacts performance. The purpose of this study was to investigate whether self-reported symptoms of training distress, motivation, and burnout could distinguish between responders and non-responders to training in rowing. **Methods** Nineteen sub-elite rowers (11 males, 8 females) were monitored across a 12-week training block. Participants were grouped as Responders or Non-Responders if their rowing ergometer performance improved or did not improve. Athletes completed the Multidimensional Training Distress Scale (MTDS; Main et al., 2009) and training logs (Session-Rating of Perceived Exertion (S-RPE; Foster et al., 2001)) weekly. The Sport Motivation Scale (SMS; Pelletier et al., 1995) and Athlete Burnout Questionnaire (ABQ; Raedeke et al., 2001) were completed monthly. Data were collapsed into 3-week periods to represent the early, early/mid, mid/late, and late periods of the block. **Results** Significant main effects of Group were observed for the subscales "physical signs and symptoms", "identified regulation" (of motivation), "external regulation", and "reduced sense of accomplishment". A significant interaction effect was observed for "introjected regulation". In all cases, Responders rated themselves more highly on these subscales than Non-Responders. Moderate to very strong positive correlations were observed between Group and "sleep disturbances", "depressed moods", "physical signs and symptoms", "amotivation", "introjected regulation", "devaluation", and "reduced sense of accomplishment" (rho range = 0.49 to 0.89). No independent variables were predictive of athletes being Responders or Non-Responders. **Discussion** Responders provided higher ratings for several undesirable wellness factors than Non-Responders, despite no differences in training loads between groups. These unexpected results illustrate the complexities of interpreting athlete wellness data, and may suggest that Responders felt more invested in their performance outcomes, or were more sensitive to their biopsychosocial responses than Non-Responders. **References** Foster C, Florhaug J, Franklin J, Gottschall L, et al. (2001). *J Str Cond Res*, 15(1), 109-115. Main L, Grove J. (2009). *Eur J Sport Sci*, 9(4), 195-202. Pelletier L, Fortier M, Vallerand R, Tuson K, et al. (1995). *J Sport Exerc Psychol*, 17(1), 35-53. Raedeke T, Smith A. (2001). *J Sport Exerc Psychol*, 23(4), 281-306.

**VALIDATION OF A KAYAK ERGOMETER POWER OUTPUT**

Gullstrand, L.1,3, Lindberg, T.2, Cardinale, D.2, Tarassova, O.3, Bjerkefors, A.3

*1: Dept. Physiology and Pharmacology, Karolinska Institutet. 2: Elite Sports Centre, Bosön, Swedish Sports Confederation. Stockholm, 3. The Swedish School of Sport and Health Sciences*

**Introduction** It is of a significant interest that ergometers used for evaluating elite athletes are valid and reliable. In this study the aim was to investigate how well displayed power output on a widely used kayak ergometer, DS, (Dansprint ApS, DK) related to a validation setup. Previously Gore et al. (2013) described the accuracy of 12 of the same ergometer using a motor driven calibration rig simulating power between 50 up to 450 W. They found that the ergometers underestimated true mean power with 21-23%. The reference rig simulated a 1 dimensional (1D) movement; this study however, is based on 3D analysis, which was hypothesized to better describe real paddling movement's and allow more precise power calculations. **Methods** Two male national team kayakers took part in the study performing workloads from 70 up to 500 W (+30 W/stage) two times with 3 days between the measurement sessions. They were instructed to target the desired workloads displayed during 35 s bouts. The reference method included a ProReflex optoelectronic system (Qualisys AB, Gothenburg, Sweden) and force transducers (LCM 200, Futek Inc, Ca, US). The force transducers were connected with the rope from ergometer flywheel close to each end of the ergometer paddle to continuously measure force during the bouts of work. The kinematic set-up included eight cameras placed around the ergometer and two reflective markers were attached close to each force transducer. **Results** The reference method used here showed that the validated ergometer underestimated power with 37.7 % over the whole meas-

ured range compared to the reference method. The difference was systematic ( $r^2=0.989$ ) and the linear regression model could be applied (DS power =  $-2.362+0.628*x$ ). When applying a 1D analysis of the collected data, it coincided with the results from Gore et al. (2013). Discussion The data suggest that 1. The measurement solution and/or calculation for describing power output in the DS have limitations. 2. The testing rig referred to in the Introduction (Gore et al. 2013) do not fully estimate true power and 3. The reference method used here is suggested to more exactly represent true paddling power as it includes a 3D movement analysis and close to original paddling simulation set-up. Both reference methods (1D and 3D analysis) show linear differences vs. the DS ergometer, giving an option to adjust the displayed power to a true power produced by elite-athletes.

### **TIME TO EXHAUSTION AT MAXIMAL LACTATE STEADY STATE IN CONTINUOUS AND INTERMITTENT PROTOCOL IN TRAINED RUNNERS**

Guglielmo, L.G.A., Dittrich, N., Diefenthaler, F., de Lucas, R.D.

*Federal University of Santa Catarina*

**Introduction** The maximal lactate steady state intensity (MLSS) can be defined as the highest running velocity at which blood lactate remains stable during the last 20 min of constant load exercise (Beneke, 2003). The determination of the time to exhaustion (TTE), cardiorespiratory and metabolic responses at MLSS seems to be important for a better understanding of the mechanisms related to fatigue during long duration exercises (30 min or more), both continuously and intermittently, contributing to training prescription at this intensity. Hence, the aim of the present study was to determine and compare the TTE and physiological responses at continuous and intermittent (ratio 5:1) MLSS in trained runners. **Methods** Eleven male runners ( $32.7\pm 6.9$  years;  $75.3\pm 5.3$  kg;  $176.8\pm 5.7$  cm) performed the following tests: 1) maximal treadmill incremental test; 2) 3-5 submaximal tests (30 min) to determine the MLSS continuous (MLSScon) and intermittent (MLSSint); 3) 2 randomized TTE tests, in both protocols. Due to differences between tests duration, VO<sub>2</sub>, VE, and HR were expressed and analysed as percentage of each TTE (t10%, t20%, t40%, t60%, t80%, and t100%). In addition, blood lactate was analysed at 10th, 20th, 30th min and at the end of exercise on TTEcon, and at 11th, 23rd, 35th min and at the end of exercise on TTEint (t10, t20, t30, and tend). Two-way ANOVA with repeated measures was used to compare the changes in physiological variables over time at TTE and between continuous and intermittent exercise. Multiple comparisons were made with the Bonferroni post-hoc test. The significance level was set at 0.05 for all analyses. **Results** The velocity at MLSSint and lactate concentration ( $15.26\pm 0.97$  km.h<sup>-1</sup>;  $4.63\pm 1.78$  mM) were higher than in MLSScon ( $14.53\pm 0.93$  km.h<sup>-1</sup>;  $3.90\pm 1.21$  mM), while the TTE at MLSScon was longer than in MLSSint ( $67.9\pm 11$  min vs.  $57.8\pm 15$  min). Regarding the cardiorespiratory parameters (HR, VO<sub>2</sub>, and VE) during TTE, no differences were found between the two exercise protocols at the same percentages. **Discussion** The main finding of the present study was that the time to exhaustion at MLSScon was longer than TTE at MLSSint in trained runners. This could be explained by the higher velocity in MLSSint, which requires a higher metabolic demand and, consequently, greater substrate depletion, higher stress hormones release and higher metabolic acidosis. Moreover, the training volume of an interval session designed at MLSS should take into consideration this higher speed at MLSS and also the lower TTE, when compared with continuous exercise. **References** Beneke R. Maximal lactate steady state concentration (MLSS): experimental and modeling approaches. *Eur J Appl Physiol* 2003; 88:361–369.

### **MUSCLE OXYGENATION IN ELITE ICE SPEED SKATERS DURING INCREMENTAL TESTING – ADAPTATION OR ACUTE METABOLIC DEMAND?**

Born, D.P., Lindner, N., Hoppe, M.W., Sperlich, B.

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**Introduction** Elite long-track ice speed skaters were shown to have a remarkable oxygenation asymmetry between right and left legs quadriceps femoris muscle during cornering as well as the straight sections of the track (Born et al. 2012). Therefore, it can be questioned if chronic adaptations to the constant travelling anti-clockwise rather than the acute metabolic demand leads to the remarkable oxygenation asymmetry between right and left legs quadriceps femoris muscle. **Methods** 5 female elite German ice speed skaters ( $60.1\pm 8.1$ kg,  $167\pm 6$ cm,  $20.7\pm 2.6\%$ ,  $VO_{2max}$   $57.8\pm 5.9$  ml/min/kg) performed a 3000m on-ice race simulation on a 400m outdoor track matching the standards for international competitions. Additionally, in a laboratory test all participants cycled at two submaximal workloads (1.6 and 2.0W/kg) for 3min each followed by a ramp test until voluntary exhaustion. During both tests ventilation (VE), oxygen uptake (VO<sub>2</sub>), and heart rate (HR) were measured continuously with a portable gas analyzer (Cortex Metamax & Polar). Tissue saturation index and blood volume were determined by the concentrations of oxy-, deoxy- and total haemoglobin measured with wireless near-infrared spectroscopy devices (NIRS, Portamon) at both right and left vastus lateralis muscles. Mid-thigh skinfold thickness was determined using a Harpenden caliper (British Indicators Ltd) and body composition using a four-electrode bio-impedance analysis (Tanita Corp.). **Results** ANOVA revealed significant lower tissue saturation index in right compared to the left quadriceps femoris muscle ( $p<0.01$ ) during the 3000m on-ice race simulation when comparing 1st, 3rd and last minute. Interestingly, as well, this oxygenation asymmetry was evident during the ergometer test while cycling at submaximal and maximal workloads ( $p<0.01$ ). In contrast, changes in blood volume revealed no differences between right and left legs quadriceps femoris muscle throughout the 3000m on-ice race simulation ( $p=0.74$ ) as well as during the cycle ergometer test ( $p=0.94$ ). Mid-thigh skin fold thickness ( $p=0.17$ ) and leg muscle mass ( $p=0.30$ ) revealed no difference between the right and left leg. **Discussion & Conclusion** During the on-ice race simulation female elite ice speed skaters showed a more pronounced muscle deoxygenation in the right compared to the left legs quadriceps femoris muscle. Since this phenomenon was evident during submaximal and maximal cycling, it can be concluded that the oxygenation asymmetry is more likely due to chronic adaptation rather than the acute metabolic demand of elite ice speed skating.

### **ELECTROMYOGRAPHIC ACTIVITY DURING SLING-BASED PUSH-UP EXERCISE**

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**Introduction** Sling-based exercise is an effective training modality for improving throwing velocity and/or strength capability of upper extremity in both untrained individuals and athletes (Saeterbakken et al. 2011). However, no information concerning muscular activities during an exercise performed with sling device is available from previous reports. This study aimed to examine the effect of using sling device on muscular activities during push-up exercise by comparing it with those during the same exercise performed on the floor. **Methods** Thirteen healthy young adult men performed two types of push-up exercise (static: maintaining the posture with the elbow joint angle at 90 deg, dynamic: repeating push-up movements at 45 beats-per-minute) on a sling and on the floor conditions. The shapes of

grips for both conditions were matched by using a grip attachment and a push-up-bar for the sling and floor conditions, respectively. Surface electromyogram (EMG) activities of the pectoralis major (PM), latissimus dorsi (LD), triceps brachii (TB), biceps brachii (BB), rectus abdominis (RA), external oblique (EO), internal oblique (IO), and erector spinae (ES) muscles were recorded during exercise. The EMG data were normalized to those obtained during maximal voluntary contraction of each muscle (% EMGmax). Results In the static exercise, the sling condition showed significantly higher % EMGmax value than the floor condition in BB muscle (sling:  $11 \pm 2\%$  vs. floor:  $6 \pm 1\%$ ; means  $\pm$  SE;  $P < 0.05$ ). In dynamic exercise, % EMGmax values for PM (sling:  $96 \pm 12\%$  vs. floor:  $78 \pm 11\%$ ), BB ( $17 \pm 3\%$  vs.  $8 \pm 1\%$ ), RA ( $40 \pm 3\%$  vs.  $31 \pm 3\%$ ), EO ( $35 \pm 3\%$  vs.  $29 \pm 3\%$ ), and IO muscles ( $33 \pm 3\%$  vs.  $28 \pm 3\%$ ) were significantly higher in the sling condition than in the floor condition. Discussion Increased activity in BB under the sling condition may be attributed to the exercise-specificity of push-ups (i.e., elbow flexion on the sling is needed to control the position of unstable grip). It has been shown that the practice of lifting task on an unstable surface cause an increase in the activation levels of the core (trunk) muscles to maintain body balance (Behm and Colado 2012). In the current results, too, the activities of the trunk muscles were higher in the sling than in the floor condition. However, the increased activity of the trunk muscles in the sling condition was more prominent in the dynamic than static condition. This result indicates that the influence of using sling on the muscular activities of the trunk muscles may depend on the difficulty of the task or the severity of the unstable condition. References Behm D, Colado JC (2012). *Int J Sports Phys Ther* 7: 226-241 Saeterbakken AH, van den Tillaar R, Seiler S (2011). *J strength Cond Res* 25: 712-718

## JUMP SQUAT VARIABLES FOR COMPETITIVE SURFING ATHLETES

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1: ECU (Joondalup, Australia), 2: Hurley Surfing Australia HPC (Casuarina beach, Australia) Introduction Performance testing for surfing athletes should include lower extremity strength and power, because of the need for the athlete to produce and arrest force, primarily through the lower body, to execute manoeuvres. The jump squat and isometric mid-thigh pull tests (IMTP) have been validated previously as worthwhile discriminators between performance levels (Sheppard et al. In press). The aim of this study was to analyze variables that may have an effect on jump squat height (JH) in Junior to Elite surfers. Methods Twenty eight competitive surfers (11 Females and 17 Males), divided into two age groups (<16 and  $\geq$ 16, n=15 and 13), performed three jump tests and IMTPs where the maximum score was used for analysis (JH and Peak Force (PF) respectively). The jump test was a countermovement jump on a unidirectional force plate (Fitness Technology 400S, Adelaide Australia), with a linear encoder (IDM Instruments) attached to a wooden dowel that was held onto the back to measure height and velocity. Data was recorded simultaneously by personal computer (BMS Software, Innervations). The IMTP was performed as previously described (Haff et al., 1997), using an identical force plate. Variables extracted for correlation to JH was Peak Power (PP), Peak Force (PF), Peak Velocity (PV), Maximum Negative Velocity (MNV), Flight Time (FT), Rate of Force Development in take-off (RFDTO) and IMTP PF (normalized and relative to BW). Results The group means for JH were 0.35 m  $\pm$  0.03 for the <16 F, 0.39 m  $\pm$  0.06 for the <16 M, 0.40 m  $\pm$  0.05 for the  $\geq$ 16 F and 0.52 m  $\pm$  0.09 for the  $\geq$ 16 M. The variables that had a moderate to strong correlation with JH ( $p < 0.05$ ) for the <16 group was PP ( $r=0.60$ ), PV ( $r=0.73$ ), MNV ( $r=-0.91$ ) and FT ( $r=0.67$ ). For the group of  $\geq$ 16 the variables that had a strong correlation with JH ( $p < 0.001$ ) were: PP ( $r=0.87$ ), PF ( $r=0.95$ ), PV ( $r=0.90$ ), MNV ( $r=-0.88$ ) and RFDTO ( $r=-0.88$ ). IMTP PF normalized for BW had a moderate correlation to JH for the older group ( $r=0.66$ ,  $p < 0.05$ ). Discussion The variables that showed effect on jump height for both groups were PP, PV, MNV and FT, which is in accordance with previous results (González-Badillo and Marques, 2010). The correlation between JH and MNV shown in this study was very strong in comparison to other studies (González-Badillo and Marques, 2010), and may indicate that surfing athletes with the physical capabilities to execute a faster descendent phase during the CMJ may lead to greater JH. Also, possessing a greater isometric is likely important for JH performance for older athletes. References Haff GG, Stone MH, O'Bryant HS, et al. (1997). *J Strength Cond Res*, 11, 269-271. González-Badillo JJ, Marques MC. (2010). *J Strength Cond Res*, 24(12), 3443-3447. Sheppard JM, Nimphius S. et al. (In press) *Int J Sport Perf Phys*.

## HEART RATE VARIABILITY AND PRECOMPETITIVE ANXIETY IN JUDO

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Introduction Anxiety in sports is a complex phenomenon that is related to emotional and cognitive processes that can cause physiological changes in the participating athletes (Cervantes, Rodas and Capdevila, 2009). Judo is an activity with a high level of uncertainty and high physiological and psychological demands. Heart Rate Variability (HRV) parameters are sensitive to changes in rates of anxiety as measured through CSAI-2R in pre-competitive situations (Mateo et al., 2011). The aim of the study was to examine HRV in stressful situations before judo competitions and to observe the differences among judo athletes in official and unofficial competitions. Material and Methods 24 national-standard judo athletes participated in this study. All subjects underwent measurements of pre-competitive anxiety and HRV in the official and unofficial competition days. The HRV was recorded at rest with each participant using a cardio tachometer and the RR signal (beat to beat) for 10 minutes. HRV was analysed using time, frequency and nonlinear domain variables. Afterwards, the Revised Competitive State Anxiety-2 (CSAI-2R) was administered prior to weight control. A repeated measures ANOVA was performed to assess the effects of the competition type on the dependent variables related to pre-competitive anxiety (CSAI-2R) and derived from the HRV. Results The ANOVA showed significant main effects of the type of competition in CSAI-2R, in HRV time domain, in HRV frequency domain and in HRV nonlinear analysis ( $p < 0.05$ ). Judo athletes have lower somatic anxiety, cognitive anxiety, heart rate and low-high frequency-high frequency ratio in unofficial than in official competitions ( $p < 0.05$ ). The parameters of the nonlinear analysis were significantly greater ( $P < 0.05$ ) in the unofficial competitions than in the official competitions Discussion The major findings of this study is the observation of higher levels of pre-competitive anxiety in judo athletes is related with an increase in sympathetic nervous activity and decreased parasympathetic nervous activity. The relationship between CSAI-2R and HRV show that pre-competitive anxiety scores vary depending on the importance of the competition. These results are consistent with studies that have used a psycho physiological approach, in which the two methods have similar behaviours: in comparison with hormone levels (Filaire et al., 2001) or when using HRV (Oreshnikov, Tihorov and Agafonkina, 2009). References 1. Cervantes JC, Rodas G, Capdevila L. (2009) *Psicothema*, 21, 531-536. 2. Filaire E, Sagnol M, Ferrand C, Maso F, Lac G. (2001) *J Sports Med Phys Fit*, 41, 263-268 3. Mateo M, Blasco-Lafarga C, Martínez-Navarro I, Guzmán JF, Zabala M. (2011) *Eur J Appl Physiol*, 1, 1-11. 4. Oreshnikov E, Tihonov V, Agafonkina T. (2009), *Hum Physiol*, 35, 517-519.

## PACING STRATEGY DURING A 10-KM RUNNING RACE: CONTRIBUTIONS OF RPE, AND PHYSIOLOGICAL AND MUSCULAR PARAMETERS

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**Introduction** It has been hypothesised that the pacing strategy adopted by endurance athletes is based on the rating of perceived exertion (RPE) in order to prevent premature exhaustion. While physiological and muscular parameters are also considered fundamental to success in endurance events, the relationship between these parameters and speed distribution during a long-distance running race remains unknown. Therefore, the aim of current study was to determine the contributions of the RPE, and physiological and muscular parameters on speed distribution during the different phases of a 10-km running race using a stepwise multiple regression model. **Methods** Twenty-five male endurance runners performed: a) a maximal incremental treadmill test to determine the maximal oxygen uptake (VO<sub>2</sub>max), respiratory compensation point (RCP) and peak treadmill velocity (PTV), b) a 6-min running test at 12 km.h<sup>-1</sup> to determine running economy, c) a maximum dynamic half-squat strength test (1RM), and d) a 10-km running time trial on an outdoor track in order to determine pacing strategy and RPE responses. During the 10-km running time trial, both speed and RPE responses were registered at each 400 m and the average speed of the start (first 400 m), middle (400 to 9600 m), and end (last 400 m) phases was calculated. **Results** During the start phase, RPE was the only variable selected by the stepwise multiple regression model and explained 64% (p=0.001) of the speed variance. PTV explained 74% (p=0.001) of the speed variance during the middle phase, while VO<sub>2</sub>max and 1RM accounted for additional 8% (p=0.002) and 12% (p=0.003), respectively. During the end phase, the RCP explained 64% (p = 0.002) of the speed variance, while PTV accounted for an additional 14% (p=0.003). **Discussion** It is well established that RPE responses during exercise are related to some physiological variables (e.g. ventilation and VO<sub>2</sub>). As the time needed for the stabilization of these variables (3-6 min) is superior to the time required to complete the first 400 m of the 10-km race (~90 s), the observed relationship between RPE and initial speed distribution may result from an efferent copy that is sent directly from the motor to the sensory areas in the brain (Marcora et al. 2009; JAP, 106:2060-2). In turn, PTV and RCP have been related with anaerobic energy production, while VO<sub>2</sub>max and maximum dynamic strength have been related with aerobic ATP resynthesis and capacity of storing and utilizing elastic energy, respectively. Thus, ATP availability and stretch-shortening cycle appears to assume a major role on setting of speed distribution after 400 m of a 10-km running race. **Financial support:** FAPESP 2011/10742-9

## EFFECTS OF DIFFERENT EXERCISE TRAINING INTENSITIES OVER HYPERTENSIVE RATS

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**INTRODUCTION** Spontaneously hypertensive rats (SHR) are commonly used in hypertension research. In this specific field, exercise has been viewed as a non-pharmacologic agent as treatment for high blood pressure (BP) (MacDonald, 2002). Nevertheless, the exercise intensity should be taken into consideration. Thus, this work aims to evaluate the BP response in treadmill running at different exercise intensities. **METHODS** Fifteen SHR with 174.9 ± 11.8mm.Hg-1 systolic BP (SBP) were divided into three groups: control group (CG), low intensity (LI) and high intensity (HI). After adaptation, the maximal lactate steady state (MLSS) was determined according to Almeida et al. (2012). Treadmill running was performed 5x per week for 30 min during 8 weeks. LI was trained at 20% below and HI at 15% above its MLSS. Moreover, incremental tests (IT) were also performed before and after exercise training. One-way ANOVA was used and significance level was set at p <0.05. **RESULTS** The MLSS was found at 20m.min<sup>-1</sup>. There were no significant differences in IT before training: CG 27.2 ± 2.7 x LI 26 ± 4.2 x HI 26.5 ± 2.2m.min<sup>-1</sup> (p >0.05). After eight weeks, HI and LI presented significant reductions in SBP in relation to the CG: 148.6 ± 28.2 x 160.4 ± 2.9 x 170.5 ± 11.2, respectively (p <0.05). Regarding the exercise intensity, HI showed a larger reduction in SBP compared to LI (p <0.05). In relation to performance, in IT after training, the V<sub>max</sub> for HI increased 53% and LI 20.6% (p <0.05). **DISCUSSION** Although both exercise intensities were able to effectively reduce the BP, the decrease was higher in HI group (p <0.05). According to Lee et al. (2009), the SBP reduction may be associated with an increase in the nitric oxide (NO) release. Furthermore, exercise intensity seems to influence the reduction of SBP and also the NO release (Santana et al., 2011). Nevertheless, other mechanisms could be associated with the SBP reduction due to exercise training (MacDonald, 2002). Therefore, the exercise at 15% above MLSS was more effective in reducing SBP as well as in increasing the performance in IT onto SHR. **REFERENCES** Almeida JA, Petriz BA, Gomes CPC, Pereira RW and Franco OL. (2012). BMC Research Notes, 5: 661. Lee SK, Kim CS, Kim HS, Cho EJ, Joo HK, Lee JY, Lee EJ, Park JB, Jeon BH. (2009). Biochem Biophys Res Commun, 382: 711-714. MacDonald JR. (2002). J Hum Hypertens, 16: 225-236. Santana HAP, Moreira SR, Neto WB, Silva CB, Sales MM, Oliveira VN, Asano RY, Espindola FS, Nobrega OT, Campbell CSG, Simoes HG. (2011). BMC Cardiovascular Disorders, 11:71.

## REGULAR VOLUNTARY RUNNING IMPROVES COGNITIVE FUNCTIONS IN AN ANIMAL MODEL OF ATTENTION – DEFICIT/HYPERACTIVITY DISORDER

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**Introduction** Attention deficit hyperactivity disorder (ADHD) is a behaviorally defined psychiatric abnormality with unknown etiology and pathology. The dysregulation of dopaminergic transmission is in the background of the symptoms. Although hyperactivity shows remission over ageing, cognitive impairment still persist at adulthood. The neonatal dopamine (DA) depletion in rats is one of the most frequently used animal model for studying the disorder. In recent study we aimed at examining the cognitive performance of dopamine depleted animals (Luthman et al, 1997) following regular voluntary training at adult age. **Methods** At neonatal age (postnatal day 4) animals were DA-depleted by intraventricular injection of 20•g 6-hydroxydopamine. This intervention resulted in 70-90% decrement of extracellular DA content in dopaminergic brain areas. Control animals were sham operated. The half of adult depleted and control rats were placed into special cages containing a running wheel at the age of 3 months. The other half of each groups remained in normal cages by four animals per cage. Following 3 months of voluntary running animals were tested for hyperactivity and impulsivity in an open field. Attention and memory functions were assayed in novel object recognition paradigm (Wappler et al, 2009), spatial learning and memory were evaluated in a Morris water maze. **Results** Dopamine-depletion resulted in hyperactivity in open field. Depleted animals showed impaired attention and memory function both in novel object recognition and in spatial learning task. Regular voluntary running decreased hyperactivity of depleted rats. In the novel object recognition test trained animals showed significant improvement in attention as compared to controls. In spatial learning task voluntary running resulted in better working memory function, but could not influence the impaired reference memory of the dopamine-depleted rats. **Discussion** Our results indicate that 3 months of regular voluntary train-

ing decreased hypermotility and impulsivity of ADHD rats. Moreover, the regular exercise improved attention and memory function of DA-depleted animals comparing to those of untrained DA-depleted rats. These results strongly suggest that long-term and regular exercise can induce remarkable improvement in the symptoms of ADHD providing alternative or complementary therapy in the treatment of adult ADHD. References Luthman J, Bassen M, Fredriksson A, Archer T. (1997). *Behav Brain Res*, 82, 213-221. Wappler EA, Szilágyi G, Gál A, Skopál J, Nyakas C, Nagy Z, Felszeghy K. (2009). *Physiol Behav*, 97, 107-114

### MONITORING INTERNAL LOAD PARAMETERS DURING COMPETITIVE SYNCHRONIZED SWIMMING DUET ROUTINES IN ELITE ATHLETES

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**Introduction** Although recent research provided detailed information about the physiological responses elicited during synchronized swimming (SS) competition (Rodríguez-Zamora et al., 2013), monitoring the internal load also during training is critical to the success of each conditioning program, particularly considering that vigorous exercise combines with more than 60% of time spent underwater (Rodríguez-Zamora et al., 2013). This study aimed to compare the heart rate (HR) and perceived exertion (RPE) responses as internal load indicators while performing duet routines during training and competition. **Methods** Participants were 10 SS Olympic medallists (age: 17.4 ± 3.0 years, height: 164.0 ± 6.1 cm, body mass: 52.0 ± 6.4 kg, training: 36.3 ± 6.2 h/wk, experience: 9.2 ± 2.6 years). They were monitored while performing the same technical (TD) or free duet (FD) routines during a training session (T), and during an official competition (C). HR was measured from RR intervals (CardioSwim, Freelap, Switzerland). RPE was assessed using the Borg's category-ratio CR-10 scale after each performance. Results HR responses during T and C were almost identical: pre-exercise mean (±SD) HR was 131 ± 14 (T) and 134 ± 8 (C) beats/min, and quickly increased up to peak values of 185 ± 6 (T) and 185 ± 7 (C), with interspersed bradycardic events down to 87 ± 4 (T) and 86 ± 5 (C). Routines were perceived as "hard" to "very, very hard" by the swimmers in both conditions, and mean RPE scores (0-10+) were equally high in C (7.9 ± 1.2) and T (7.5 ± 1.2) (P=0.22). RPE inversely correlated with minimum (R=-0.55; P=0.008) and mean HR (R=-0.45; P=0.026), and positively correlated with HR range (R=0.52; P=0.011). **Discussion** The internal load imposed by SS duets routines can be monitored using objective (HR) and subjective (RPE) assessments, and is virtually identical during competition and training. This can be explained by the effects of automaticity, embodied through the replication of the same movement sequence during practice, and by the swimmers' long-term adaptations to specific routine exercises and apnoea. Practicing competitive routines is suitable for developing and maintaining the cardiovascular fitness necessary for specific conditioning in elite synchronized swimmers, with the added value of favouring exercise automaticity, inter-individual coordination, and artistic expression simultaneously. **References** Rodríguez-Zamora L, Iglesias X, Barrero A, Chaverri D, Erola P, Rodríguez, FA. (2012). *PLoS One* 7(11), e49098. Rodríguez-Zamora L, Iglesias X, Irurria, A, Barrero, A, Chaverri D, Rodríguez FA (2013) 18th Annual Congress of ECSS, Barcelona.

### EVALUATION OF THE UNDERWATER BUTTERFLY START AFTER SENSORY-PERCEPTIVE TRAINING

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**Introduction** The swimming speed depends on drag reduction and on the improvement of the propulsive actions [1]. A specific training addressed to the development of the sensory-perceptive skills and coordination might enhance the technical action and affect the previous parameters [2]. The effect of a sensory-perceptive training on the underwater kicking during the butterfly start phase of elite swimmers has been studied through a new software, which considers the data output of two common devices used for swimmers' evaluation. **Methods** Twenty-four elite butterfly male swimmers (Intervention group = IG: #12, 21.1±1.2 years, 72.1±4.9 kg, 180.8±3.5 cm, 22.0±1.0 kg·m<sup>-2</sup>; Control group = CON: #12, 20.6±1.8 years, 73.8±2.9 kg, 181.6±3.2 cm, 21.4±1.5 kg·m<sup>-2</sup>) volunteered to be included in the study. IG underwent 12 weeks of specific training based on sensory-perceptive exercises aimed to improve the dolphin underwater kicking. Before and after training, passive drag (Ben Hur, APLab, Rome, Italy) and speed variations (Speed RT, APLab, Rome, Italy) during underwater kicking without pushing-off the wall were measured. The peak power output was calculated with a new software (Underwater, CC, Busto Arsizio, Italy) which combines the measurements of Ben Hur and Speed RT devices. The performance of the start phase after diving was also measured in the 15 m. Results CON did not show difference between pre- and post- training. After sensory-perceptive exercise, IG lowered their passive drag (75.49±5.77 vs. 66.96±4.33 W, pre- vs. post-, p<0.001). During the underwater kicking, peak and mean power raised from 3375±299.9 to 4691±604.3 W, p<0.001 and from 1011±111.0 to 1468±208.4 W, p<0.001, respectively. The performance in the start phase lowered from 7.73±0.61 to 6.72±0.62 s, p<0.001. **Discussion** The analysis of the data with the new Underwater software allowed to verify the improvement of the performance of the IG underwater kicking. The lower passive drag after the sensory-perceptive training might originate from the better hydrodynamic position swimmer assumes, which would reduce the drag components [1]. The improvement of the propulsive actions might depend on the new motor pattern induced by sensory-perceptive training that would lead to a higher peak and mean power output. Altogether, in IG swimmers the hydrodynamics and the propulsive actions resulted in a better start phase compared to CON swimmers. **References** [1] Vorontsov AR, Rumyantsev VA (2000) Resistive forces in swimming. In: Zatsiorsky VM, Commission IM, Medicine IfoS (eds) *Biomechanics in Sport*. Wiley-Blackwell, pp 184-231 [2] Connaboy C, Coleman S, Sanders RH (2009) Hydrodynamics of undulatory underwater swimming: A review. *Sports Biomechanics* 8: 360-380

### THE ROLE OF RATE OF FORCE DEVELOPMENT OF THE PLANTAR FLEXORS IN SPRINT PERFORMANCE

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**Introduction** Rate of force development (RFD) is considered a very important characteristic in vertical jump and sprints [1]. However, the most research suggests a moderate or insignificant relationship between performance in different actions and RFD [2-3]. The aim of this study was analyze the relationship between RFD of plantar flexor (Pflex) muscles assessed dynamically and sprint and CMJ performance. **Method** Nineteen healthy men took part in this study (age 23.8±2.9 years, height 1.79±0.07m, body weight [BW] 78.8±9.0kg). The subjects performed Pflex test with the 30%, 50% and 70%BW, acceleration test in 30m (T10, T10-20, T20, T20-30 y T30) and CMJ test. Pflex test consisted heel rise from a vertical position. RFD in Pflex was measured as the average slope of the force-time curve over time intervals of 0-25 (RFD25), 0-50 (RFD50), 0-75 (RFD75) and 0-100ms (RFD100) relative to the onset of contraction [1], and the time interval between achieving 10% and 90% of maximum force (RFD-T10-90%). Results Neither correlation was found between RFD and CMJ or between RFD for 30%BW and sprint performance. However, significant negative correlations were found between all measures of RFD for 50%BW and

T10 and T20, except for RFD-T10-90%, that was significant positive correlations. Also were obtained significant negative correlation between all measures of RFD for 70%BW and T10. Moreover, RFD-T10-90% showed significant positive correlation with T20, T30 and T10-20, and between RFD100 and T20. Discussion To our knowledge, only two works have analyzed the relationship between RFD and sprint performance (2-3), but in neither of them was observed any correlation. In both studies, the RFD was measured in an isometric half squat. The discrepancy with our results may be due to the different way of measuring the RFD. We have not found correlations between RFD of Pflx muscles and CMJ. These results suggest that probably Pflx muscles are not determinants of vertical jump, since these muscles are involved fundamentally just before takeoff, when velocity is very high, decreasing the possibility of applying force by these muscles. In conclusion, RFD assessed dynamically in plantar flexors muscles explains a moderate variance of acceleration, but no present relationship with CMJ height. References 1. Aagaard P, Simonsen EB, Andersen JL, et al. Increased rate of force development and neural drive of human skeletal muscle following resistance training. *J Appl Physiol.* 2002;93(4):1318-26. 2. Wilson GJ, Lytle AD, Ostrowski KJ, Murphy A. Assessing dynamic performance: A comparison of rate of force development tests. *J Strength Cond Res.* 1995;9(3):176-81. 3. Mero A, Luhtanen P, Viitasalo JT, Komi PV. Relationship between the maximal running velocity, muscle fibre characteristics, force production and force relaxation of sprinters. *Scand J Sports Sci.* 1981;3:16-22.

### POSTURAL ADAPTATIONS IN PREADOLESCENT KARATE ATHLETES DUE TO A ONE WEEK KARATE TRAINING CAMP

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Introduction There are few studies dealing with the effect karate practice on body balance. However, only one study has addressed the effect of karate training in young population (Violan et al., 1997). In view of the fact that karate become increasingly popular among children, this investigation involved sectional design to evaluate the effect of one-week: intensive karate training (14-h) vs. moderate training (3-h) on preadolescent karateka's postural sway. Methods Seventy-four karatekas were randomly assigned to Karate Group: (KG=37, age 10.29±1.68 yrs); or Control Group: (CG= 37, age 10.06±1.77 yrs). KG performed two 60 minute training sessions per day (morning – afternoon) during the Summer Camp (7 days). They performed specific exercises during the training sessions: coordinative trunk, arms and legs exercises in different body planes; flexions, lunges and extra-rotations exercises followed by static-dynamic stretching and 35-minutes of Karate kicks exercises. CG received three days for week (total time four hours) in agree with the exercise of KG. All participants, before and after the week investigation, underwent a battery of postural stability on Nintendo™ Wii Balance Board (WBB) (Clack et al., 2010). Result Pre-Camp results showed that both center-of-pressure length (COPL) and velocity (COPV) in two conditions: eyes open (EO), eyes closed (EC), were found not to be significantly different between the two groups. In Post-Camp results, the analysis revealed significant differences between groups: in COPL  $F(1,72)=27.878$ ,  $p<0.0001$  ( $\eta^2=0.279$ ); interaction training type×time  $F(1,72)=5.789$ ,  $p=0.019$  ( $\eta^2=0.074$ ); COPV  $F(1,72)=25.862$ ,  $p<0.0001$  ( $\eta^2=0.264$ ) and the interaction training type×time  $F(1,72)=5.640$ ,  $p=0.020$  ( $\eta^2= 0.072$ ). KG revealed an improvement of COPL respect to baseline in EO -37.26% ( $p<0.0001$ ), EC -31.72% ( $p<0.0001$ ), while CG revealed small adaptations in EO 3.16%, EC 0.93%. Moreover, KG revealed a COPV improvement from baseline in EO -37.92% ( $p<0.0001$ ), EC -32.52% ( $p<0.0001$ ), while CG give out small variation in EO 1.79%, EC 5.73%. Discussion One-week of high intensity karate training induced significant improvement of static body balance in karate practitioners. As top-level karate performance require both high-level of both static and dynamic balance, further researches dealing with the effect of karate practice on dynamic body balance in young practitioners are required. References Clark RA, Bryant AL, Pua Y, McCrory P, Bennell K, Hunt M. (2010). Gait Posture, 31,307-310. Violan MA, Small EW, Zetaruk MN, Micheli LJ. (1997). *Pediatr Exerc Sci*, 9, 55-64.

14:00 - 15:00

## Mini-Orals

### PP-PM28 Nutrition [NU] 2

#### ROS MAY HAVE SUPPRESSIVE EFFECT ON ENDURANCE TRAINING-INDUCED IMPROVEMENT OF GLUCOSE METABOLISM

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Introduction The role of reactive oxygen species (ROS) in endurance training-induced improvement of glucose metabolism has not been fully elucidated (Listow et al., 2009; Yfanti et al., 2011). To gain insight into the role of ROS, the present study investigated whether or not vitamin C supplementation prevented the training-induced improvement of insulin sensitivity in rats. Methods Thirty two male rats aged 4 weeks were assigned to one of the four groups: sedentary (S, n=8), sedentary with vitamin C supplementation (SVC, n=8), trained (T, n=8) and trained with vitamin C supplementation (TVC, n=8). The rats of vitamin C supplemented groups were administered 500mg of vitamin C per kg body weight per day from 11 days before the start of the training until a sacrifice of the animals. The rats of the trained groups swam 6 hour per day with two 3 hour sessions separated by 45 min of rest. The training lasted for 10 days. After the training period, fasting blood sample was obtained and plasma isolated. Plasma glucose and insulin concentration was measured and insulin resistance evaluated using homeostasis model assessment (HOMA-R). Results and Discussion The training significantly decreased fasting plasma glucose and insulin concentration. The training also significantly lowered HOMA-R value. These favorable training effects were more prominent with vitamin C supplementation than without vitamin C supplementation. This finding is novel and do not accord with the previous studies (Listow et al., 2009; Yfanti et al., 2010). The vitamin C supplementation alone induced no significant changes in fasting plasma glucose and insulin concentration and HOMA-R. Conclusion This study indicates that more prominent training-induced improvement of glucose metabolism is induced with vitamin C supplementation. The finding suggests that ROS produced during training session has suppressive effect on training-induced improvement of glucose metabolism. References M. Ristow, K. Zarse, A. Oberbach, N. Klötting, M. Birringer, M. Kiehnopf, M. Stumvoll, C.R. Kahn, M. Bluher (2009). *Proc. Natl. Acad. Sci. U. S. A.*, 106, 8665–8670. Yfanti C, Nielsen AR, Akerström T, Nielsen S, Rose AJ, Richter EA, Lykkesfeldt J, Fischer CP, Pedersen BK. (2011). *Am J Physiol Endocrinol Metab*, 300(5), E761-770.

## PROTEIN SUPPLEMENTATION DOES NOT FURTHER INCREASE STRENGTH AND HYPERTROPHIC MUSCLE RESPONSE TO RESISTANCE TRAINING IN HEALTHY ACTIVE YOUNG SUBJECTS.

Paoli, A.1, Pacelli, F.Q.1, Cancellara, P.1, Toniolo, L.1, Moro, T.1, Canato, M.1, Miotti, D.2, Neri, M.3, Morra, A.4, Quadrelli, M.4, Reggiani, C.1

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**Introduction** It is well known that regular resistance training (RT) increase muscle mass through several and complex mechanisms that involve also nutritional factors. Even if protein supplementation is widely used by athletes involved in strength based sports and by body builders the researches on the effects of this practice on muscle hypertrophy are somewhat contradictory<sup>1,2</sup>. The aim of our study was to compare the effects of normal protein diet (NP=0.85 g·kg<sup>-1</sup>·day<sup>-1</sup>) or high protein diet (HP=1.8 g·kg<sup>-1</sup>·day<sup>-1</sup>) on strength, total muscle CSA and single muscle fiber CSA. **Methods** Eighteen undergraduate students underwent to a resistance training for 2 months. Subjects were randomly assigned to NP or HP diet protocol. Strength dynamic (lat pulldown) and isometric (isometric pullgrip) tests were performed before and after the training period. Moreover latissimus dorsi muscle samples were obtained via fine needle muscle biopsy to investigate muscle fibers CSA. Magnetic Resonance (MRI) was also performed to measure whole muscle CSA. Results Our results showed that training induced a significant gain in strength in all subjects both in dynamic (+ 17%; p<0.001) and isometric (+6%; p<0.05) tests. The increase in muscle strength was accompanied by a significant (p<0.05) hypertrophic response detectable in whole muscle (from 45.13±3.3 cm<sup>2</sup> to 47.94 ±4.4 cm<sup>2</sup>) and single muscle fibres (CSA measurements, from 4787±2810 μm<sup>2</sup> to 5846±3780 μm<sup>2</sup>). No significant differences were been detected between diet groups. **Discussion** Our data suggests that, in young healthy subjects, RT elicits an upper limbs hypertrophic muscle response comparable to those reported for lower limbs, whilst protein supplementation seems to does not further increase muscle response to RT. References 1 Verdijk LB et al. Am J Clin Nutr. 2009 Feb;89(2):608-16. 2 Hulmi JJ et al. Nutr Metab (Lond). 2010 Jun 17;7:51 3 Paoli A. J Transl Med. 2012 Nov 24;10:237.

## EFFECT OF LEUCINE SUPPLEMENTATION ON BODY COMPOSITION IN DETRAINED RATS SUBJECTED TO CALORIC RESTRICTION

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**Introduction** Physical detraining (PD) is associated with increased fat mass, body weight gain and changes in protein metabolism, accelerating muscle catabolism. One of the nutritional strategies used to minimize the increase in adipose mass is caloric restriction (CR). However, this strategy may potentiate the loss of muscle mass, as observed in PD. To mitigate these changes, there is supplementation with essential amino acids, particularly leucine. This seems to act effectively to promote protein balance and body fat reduction. Thus, this study aimed to evaluate the effect of leucine supplementation on body composition in detrained rats subjected to CR. **Methods** 48 adult male Sprague-Dawley rats were distributed into 2 groups: Sedentary (SED, n = 8) and Trained (TRAIN, n = 40); the animals of the latter group underwent training on a treadmill for 8 weeks. TRAIN animals were then re-distributed into four groups: Trained (TRAIN, n = 8): which continued following the physical training protocol; Detrained (DT, n = 8): consisting of animals who stopped training and had access to food ad libitum; Detrained + Caloric restriction (CR + DT): consisting of animals who stopped training and consumed 70% of DT caloric intake; Detrained + Leucine + Caloric restriction (CR + DT + LEU): composed of animals who stopped training and consumed 70% of DT caloric intake, and had 5% leucine supplementation. After 14 weeks the animals were euthanized and body composition was assessed using chemical carcass analysis. Throughout the experiment, body weight and food consumption were assessed weekly. Values are expressed as mean ± standard deviation. ANOVA was used for comparison between groups, along with Scheffé test, considering a 5% significance level. **Results** After 6 weeks of PD, a statistically significant difference was observed in the final body weight between groups TRAIN and DT (p <0.05). Regarding body composition, a statistically significant difference was observed between groups DT and CR+DT in fat-free mass (DT: 541,7g; CR+DT: 463,1g). A statistically significant difference was also observed in fat in groups CR+DT (16,08g) and CR+DT+LEU (15,98g) compared to other groups (SED: 61,46g; TRAIN: 39,98g; DT: 56,16g; DT + LEU: 44,87g). No statistical difference was observed in fat-free mass (g) and absolute protein (g) in the group supplemented with leucine. **Conclusion** Leucine supplementation was not effective to minimize the loss of lean body mass in the detrained animals subjected to caloric restriction.

## ACUTE EFFECT OF HMB SUPPLEMENT OF BONE MODULATING CYTOKINES AND DOWNSTREAM PROTEIN EXPRESSION: A PILOT STUDY

Hung, W.1, Li, S.H.2, Lin, C.L.2, Fang, S.H.1, Chang, C.K.1

1: National Taiwan University of Physical Education and Sport. 2: Chung Shan Medical University

**Introduction** Dietary supplement of β-hydroxy-β-methylbutyrate(HMB) had been proven to increase total bone mass, bone mineral density and bone strength in animal studies. In our previous study, HMB supplement not only increase bone formation but also inhibit bone resorption. The balance between osteoclast and osteoblast activity is central for maintaining the integrity of bone homeostasis. Result of our previous study indicates that HMB supplement regulates bone homeostasis in an un-coupled manner while the molecule transduction mechanism remains unknown. Therefore we designed presented to investigate the acute effect of HMB supplement within a week on noble bone modulating cytokines osteoprotegerin (OPG), RANKL and downstream protein DC-STAMP expression. **Methods** Young college male aged 20-24 who previous inexperience with ergogenic aids usage were recruited as subject of present study. All subjects ingest 3g of HMB supplement per day as previous described[1]. Blood sample were collected through venopuncture at 1, 2, 3, 6, 9, 12hours after first HMB supplement and early morning fasting blood sample were collected in the following 7 days. Circulating OPG and RANKL level were determined by ELISA. DC-STAMP and RANK protein expression were analyzed by Flow cytometry. **Results** RANKL level increased for nearly 2.5-5 fold within 2 hours after first HMB supplement and return to previous level 11 hours after supplement while OPG level remain stable during the same period. RANK expression increased within 2 hours after first supplement and remains higher than baseline level until 6th day. DC-STAMP expression was decreased 24hours after supplement. **Discussion** HMB increase osteoclastogenetic cytokine RANKL level within hours after supplement but downstream DC-STAMP protein expression were blocked. DC-STAMP has been proven to be essential for cell-cell fusion and maturation of osteoclast progenitors[2]. Decreased DC-STAMP expression also indicates decreased osteoclastogenesis and bone resorption. HMB supplement decreased bone resorption in a cellular manner while mechanisms of blocking DC-STAMP expression require further investigation. References 1. Vukovich, M.D., et al., beta-hydroxy-

beta-methylbutyrate (HMB) kinetics and the influence of glucose ingestion in humans. *J Nutr Biochem*, 2001. 12(11): p. 631-639. 2. Yagi, M., et al., DC-STAMP is essential for cell-cell fusion in osteoclasts and foreign body giant cells. *J Exp Med*, 2005. 202(3): p. 345-51.

### **FISH OIL ENHANCES MUSCLE STRENGTH AND FUNCTIONAL ABILITIES AFTER RESISTANCE TRAINING IN ELDERLY WOMEN: A PRELIMINARY STUDY**

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**Introduction** Anabolic resistance of muscle protein synthesis to resistance training (Greig et al., 2011) and nutrition (Guillet et al., 2004) has been proposed as a potential cause of sarcopenia. Fish oil supplementation has been found to increase muscle protein synthesis in response to insulin and amino acids in older adults (Smith et al., 2011) and may improve adaptations to resistance training in older women. However, this needs to be confirmed by results obtained from placebo controlled trials (Rodacki et al., 2012). The aim of the current study was to determine whether fish oil can enhance adaptations in skeletal muscle function after resistance training in elderly women. **Methods** A double-blind randomized placebo-controlled study design was used in this pilot study. Thirteen participants were randomly assigned to receive either 4 g fish oil (containing 1.7 g EPA and 0.4 g DHA) or 4 g control oil (olive oil) daily for 12 weeks. Participants also carried out resistance training twice a week for this period. Plasma profiles (i.e., phospholipid fatty acid composition, glucose, triglycerides, insulin and IL-6), a short performance battery test (Guralnik et al., 2000), and isometric and isokinetic quadriceps muscle strength were determined pre- and post-intervention. Results All baseline measures were similar between groups. Plasma EPA and DPA concentrations significantly increased in the fish oil group, compared with the control (P = 0.01 and P = 0.03 respectively), while insulin resistance, as measured by HOMA-IR, significantly decreased (P = 0.03). Post-intervention, the fish oil group showed a higher isometric muscle strength (change from baseline (N.m): 31.8 ± 8.7 vs. 15 ± 9.6 in fish oil and control group, respectively; P = 0.001) and a greater gait speed (change from baseline (m/s): 0.24 ± 0.12 vs. 0.09 ± 0.11 in fish oil and control group, respectively; P = 0.03) compared with the control group. However, post-intervention, there were no differences in isokinetic muscle strength, balance, chair rise time, or plasma IL-6 and triglycerides concentrations. **Discussion** We have demonstrated that 12 weeks supplementation with 4 g fish oil daily enhance the adaptive responses to resistance exercise and reduce markers of insulin resistance in elderly women. Combined with the data of Smith et al (2011) and Rodacki et al (2012) the present result suggests that fish oil may be beneficial to attenuate age-related loss of muscle mass, strength and function. **References** Greig CA, Gray C, Rankin D, Young A, Mann V, et al. (2011). *Exp Gerontol*. 46(11):884-90. Guillet C, Prod'homme M, Balage M, Gachon P, Giraudet C, et al. (2004). *FASEB J*. 18(13):1586-7. Smith GI, Atherton P, Reeds DN, Mohammed BS, Rankin D, et al. (2011). *Am J Clin Nutr*, 93(2):402-12. Rodacki CL, Rodacki AL, Pereira G, Naliwaiko K, Coelho I, et al. (2012). *Am J Clin Nutr*, 95(2):428-36. Guralnik JM, Ferrucci L, Pieper CF, Leveille SG, Markides KS, et al. (2000). *J Gerontol A Biol Sci Med Sci*, 55(4), M221-31.

### **OKARA SUPPLEMENTATION RELIEVES FATIGUE AND MUSCLE DAMAGE THAT OCCUR DURING EXERCISE TRAINING**

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**Introduction:** Okara, the soybean residue from soy milk production, contains nutrients and functional components such as isoflavones and phytosterols. Previous studies have found that okara has properties beneficial to health, but few studies have conducted human trials in relation to okara. To our knowledge, no research has been conducted on the possibility of okara as a functional ingredient with health-promoting attributes in the field of sports nutrition and medicine. Therefore, the objective of this study was to investigate the effect of okara supplementation on fatigue and muscle damage in university athletes over an exercise training season. **Methods:** A total of 23 male university baseball players aged 18-23 years attending a summer intensive exercise training program completed an 8-week exercise training-okara intervention study. The supervised exercise training program consisted of physical and technical training including warm-up exercises, physical and skill practice, and pre-game competition practice. Okara supplementation in this study was a randomized, double-blind and crossover dietary intervention in which subjects consumed 2 cookies/day containing 10 g of soybean or black soybean okara for a period of 6 weeks with a one-week washout period. Blood was drawn 4 times within an 8-week intervention period for measurements of biomarkers for fatigue and muscle damage. **Results:** The results demonstrated significant differences in blood levels of ammonia, free fatty acids, creatine kinase, myoglobin, and aspartate transferase between baseline and exercise training, indicating that fatigue and muscle damage occurred during exercise training. However, those increased markers of fatigue and muscle damage were significantly decreased after the okara supplementation regardless of whether soybean okara or black soybean okara cookies were consumed. **Conclusion:** This is the first study to demonstrate that okara supplementation is beneficial to university baseball players who experience exercise training-related fatigue and muscle damage. During the eight-week exercise training period in this study, creatine kinase, myoglobin, ammonia, aspartate transferase, and free fatty acids were significantly reduced in all the athletes after okara supplementation. Fatigue and muscle damage occurring during exercise training were both relieved, indicating that okara cookies are feasible sports nutrition supplements.

### **EFFECT OF B-ALANINE SUPPLEMENTATION ON INTERMITTENT HIGH-INTENSITY CYCLING SPRINT PERFORMANCE**

Cheng, C.F.1, Hung, C.H.1, Hsu, W.C.2, Chen, P.H.1

*1: National Taiwan Normal University (Taipei, Taiwan), 2: Taipei Physical Education College (Taipei, Taiwan)*

**Introduction** Carnosine, increased by β-alanine (BA) supplement, may act as a hydrogen ions (H<sup>+</sup>) buffer in skeletal muscle [1]. The heavy accumulation of H<sup>+</sup> naturally incurred during intermittent high-intensity sprint (IHIS) may interfere with muscle contraction and decrease power production [2, 5]. Therefore, this study examines the effect of BA supplement on pH buffer and IHIS performance. **Methods** Twenty-two athletes were recruited in the pre-season period, and randomly assigned to BA (n = 11, age 19 ± 1 years, height 176 ± 4 cm, weight 68 ± 5 kg) or placebo (n = 11, age 19 ± 2 years, height 176 ± 4 cm, weight 70 ± 6 kg) group. Before and after a 4 weeks supplement (6.4 g/day of BA or cellulose), participants performed the IHIS test (10 × 10-s sprint, 60-s rest interval) with a given load derived from body mass (BM) on a cycling ergometer to determine the effects of BA on peak (POpeak) and mean (POmean) power, and performance decrements (% fatigue). The blood samples were obtained before and after IHIS test to measure the blood lactate (La) and pH levels. **Results** No significant changes in BM were found in both groups. No significant time × group interactions were observed in total work, % fatigue, and average POpeak and POmean. There were significant main effects in average POpeak (pre vs. post, 863 ± 19 W vs. 928 ± 21 W) and average POmean (pre vs. post, 712 ± 14 W vs. 732 ± 14 W) by time in both groups. From the start to the end of the IHIS test, the La concentrations increased from ~1.1 to ~13.9 mmol/L (P < 0.05), whereas pH dropped from ~7.40 to ~7.18 (P < 0.05). However, La and pH values

were identical between groups, either in the pre-testing or in the post-testing. Discussion The ergogenic effects of BA supplement are evident in activities that elicit a strong intramuscular acidotic condition [1]; however, Sale et al. [4] found that BA supplement could not attenuate the decreased pH levels during high-intensity cycling exercise. The present study could not provide support for the improvements in IHL performance after BA supplement, which is in line with other studies [3, 5]. The training effects, increases in power output after supplement, may mask the ergogenic potential of BA. The BA supplement could neither offer protection against the fall in pH values nor improve the IHL performance. Further research on the effect of BA supplement on the intermittent-based exercise is necessary. Supported by grants from National Science Council, Taiwan (NSC 101-2410-H-003 -133). References 1. Artioli GG, Gualano B, Smith A, Stout J, Lancha AH Jr. (2010). *Med Sci Sports Exerc*, 42(6), 1162-1173. 2. Bishop D. (2010). *Sports Med*, 40(12), 995-1017. 3. Kern BD, Robinson TL. (2011). *J Strength Cond Res*, 25(7), 1804-1815. 4. Sale C, Saunders B, Hudson S, Wise JA, Harris RC, Sunderland CD. (2011). *Med Sci Sports Exerc*, 43(10), 1972-1978. 5. Sweeney KM, Wright GA, Glenn Brice A, Doberstein ST. (2010). *J Strength Cond Res*, 24(1), 79-87.

### COMBINATION OF $\alpha$ -GLYCEROPHOSPHOCHOLINE ( $\alpha$ -GPC) INTAKE AND AEROBIC EXERCISE ENHANCES GROWTH HORMONE SECRETION AND FAT METABOLISM IN YOUNG ADULTS

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**BACKGROUND:** Choline is an important nutrient, which relates to cholinergic neuronal action as well as fat and cholesterol metabolism. Since choline is not synthesized in vivo, it needs to be ingested from food, such as beans and eggs. Recently, we demonstrated that a single dose of  $\alpha$ -Glycerophosphocholine ( $\alpha$ -GPC) enhances growth hormone (GH) secretion and hepatic fat oxidation, with concomitant increases in choline levels, in young adults (Kawamura, et al. *Nutrition* 2012). Additionally, a single bout of exercise increases fat metabolism with GH secretion. However, the effect of  $\alpha$ -GPC administration and exercise combination on growth hormone secretion and fat metabolism in young adults remains unclear. **PURPOSE:** The purpose of this study was to clarify whether the combination of  $\alpha$ -GPC administration and exercise enhances growth hormone secretion and fat metabolism in healthy young men. **METHODS:** Nine healthy young men (23 $\pm$ 1 years) performed treadmill walking exercise for 30 min at a speed of 95m/min after 30 min  $\alpha$ -GPC 1000 mg or a placebo administrations in a double-blind randomized crossover study. Respiratory quotient (RQ) and fasting blood samples were obtained before the administration of  $\alpha$ -GPC and 30 (before exercise), 60 (immediately after exercise), 90 (30 min after exercise), 120 (60 min after exercise) and 180 (120 min after exercise) min after administration. All subjects repeated the identical protocol using the placebo. **RESULTS:** Plasma total choline levels significantly increased at 60 and 180 min after  $\alpha$ -GPC administration. Area under the curve (AUC) of plasma GH level for 180 min after  $\alpha$ -GPC administration was increased significantly as compared with the placebo intake. Furthermore, AUCs of serum FFA, glycerol, acetoacetate and 3-hydroxybutyrate levels for 180 min after  $\alpha$ -GPC administration were increased significantly as compared with the placebo intake. Additionally, RQ for 90-180 min after  $\alpha$ -GPC administration, i.e., 30-120 min after exercise, were significantly decreased compared with the placebo intake. No significant change in plasma glucose level was observed in either group. **CONCLUSION:** These findings suggest that the combination of  $\alpha$ -GPC administration and walking exercise may be effective in enhancing GH secretion and fat metabolism in healthy young men rather than a single bout of exercise or  $\alpha$ -GPC administration. **REFERENCES:** Kawamura T et al. *Nutrition* 28, 1122-1126, 2012. **GRANTS:** Supported by KAKENHI of the Japan Ministry of Education, Culture, Sports, Science and Technology (MI and KS).

### THE EFFECTS OF CREATINE SUPPLEMENTATION DURING RESISTANCE TRAINING ON STRENGTH AND BODY COMPOSITION IN OLDER ADULTS - A META-ANALYSIS

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*McMaster University*

**Introduction** Age-related sarcopenia has negative effects on muscle strength and the ability to perform activities of daily living, thus affecting quality of life. Regimes that retain or increase muscle mass and strength are of importance to the aging population. Resistance training (RT) increases muscle mass and strength in older adults and various supplements may augment this effect. However, whether the addition of creatine (Cr) supplementation enhances the gains in muscle mass and strength in this population is controversial. We aimed to determine whether the addition of Cr to a RT regime increased gains in muscle mass and strength in older adults over RT alone by conducting a systematic review and meta-analysis. **Methods** Pubmed and OVID Healthstar databases were searched. Randomized, placebo (PL) controlled trials that involved older adults supplemented with Cr and included RT regimes of at least 6 wk were included. Eight qualifying studies were identified. Anthropometric measures were reported in 4 - 6 trials. Changes in single repetition maximum (1RM) for leg press, chest press and knee extension were reported in 4 trials. Changes in isokinetic and isometric strength were reported in 3 and 4 trials, respectively. Data were analyzed using random effects meta-analysis and tested for publication bias (funnel plot) and heterogeneity (Cochrane's Q, I<sup>2</sup>). **Results** The meta-analysis comprised 234 subjects (Cr: age 62.1 $\pm$ 4.3; PL: age 62.8 $\pm$ 4.7 years) with 13.7 $\pm$ 0.7 wk of RT. There was no effect of Cr+RT over RT alone on any measure of body composition. Overall the Cr+RT vs RT alone increased leg press, chest press and leg extension 1 RM by 23.1 $\pm$ 3.7% vs. 21.6 $\pm$ 2.8; 25.6 $\pm$ 4.4% vs. 21.6 $\pm$ 3.6% and 34.2 $\pm$ 5.8% vs. 30.5 $\pm$ 5.5% respectively. There was no effect of Cr+RT over RT alone on leg press, chest press or leg extension 1RM (standard difference in means  $\pm$  SE: 0.247 $\pm$ 0.199, P = 0.215; 0.287 $\pm$ 0.208, P = 0.168; and 0.248 $\pm$ 0.209, P = 0.235, respectively). There was no effect of Cr+RT over RT alone on isokinetic (0.140 $\pm$ 0.172, P = 0.415) or isometric (0.200 $\pm$ 0.160, P = 0.211) strength. **Discussion** Overall there was no added effect of the addition of Cr to a RT regime on body composition or strength measures in older adults. While this meta-analysis includes data from 234 subjects, not all trials reported on all outcomes of interest. In fact, changes in 1 RM were based on data from only 4 qualifying trials that included 102 subjects. As retention of muscle mass is integral to healthy aging, further work investigating nutritional and exercise strategies, including Cr, to maintain or increase muscle mass during the lifespan are needed before Cr supplementation could be recommended for older adults engaging in RT.

### INFLUENCE OF CAFFEINE AND SODIUM CITRATE INGESTION ON 1500 M WHEELCHAIR PERFORMANCE

Flueck, J.L.1,3, Mettler, S.2, Perret, C.3

1: *Institute of Human Movement Sciences and Sport, ETH Zurich*, 2: *Swiss Federal Institute of Sports Magglingen* 3: *Swiss Paraplegic Centre, Institute of Sports Medicine, Nottwil*

**Introduction:** The influence of sodium citrate (SC) and caffeine (CA) ingestion on high-intensity exercise performance is well-documented in able-bodied athletes (Burke, 2008; Requena et al., 2005). However, there are no data available from wheelchair athletes. As spinal cord

injured subjects often suffer from gastrointestinal deceleration influencing absorption and effect of supplementation, data from able-bodied subjects can't be transferred to wheelchair athletes one-to-one. The aim of this study was to investigate whether a supplementation with CA, SC or the combination of CA and SC (COM) has an ergogenic effect on 1500 m time trial performance in elite wheelchair athletes. Methods: Nine healthy, elite (6 men and 3 women) wheelchair racing athletes (median [min, max]: age: 28 y [23; 54]; height: 173 cm [165; 188]; weight: 62.9 kg [48.9; 68.4]), including several Paralympic Games, World and European Championships medalists, participated in this study. A placebo-controlled, randomized, crossover and double-blind study design was employed. Subjects completed four 1500 m time trials (placebo, CA, SC or COM) on a wheelchair training roller. Time to complete 1500 m, pH, plasma bicarbonate, sodium and lactate concentrations were measured. Results: Time to complete the 1500 m time trial was not significantly different between the four treatments (median for placebo: 170.57 s [141.69; 231.95]; CA: 179.53 s [134.77; 239.61]; SC: 178.32 s [136.40; 247.04]; COM: 177.58 s [136.14; 256.18]). Plasma bicarbonate concentration and pH significantly increased after SC and COM trials compared to placebo and CA. Maximal lactate concentrations were significantly higher in CA and COM compared to placebo. Five of nine subjects suffered from gastrointestinal side effects after SC or COM supplementation. Discussion: In contrast to data from able-bodied athletes, supplementation with SC and/or CA did not show ergogenic properties on 1500 m time trial performance in elite wheelchair athletes. Although SC was absorbed and increased prestart blood bicarbonate concentration, this did not result in improved performance. As data showed some individual variability in response (enhanced performance vs. gastrointestinal side effects), we suggest individual practical considerations (compatible supplement, dosage, intake time) for every athlete. Burke, L. M. (2008). Caffeine and sports performance. *Appl Physiol Nutr Metab* 33, 1319-34. Requena, B., Zabala, M., Padial, P. and Feriche, B. (2005). Sodium bicarbonate and sodium citrate: ergogenic aids? *J Strength Cond Res* 19, 213-24.

### THE EFFECT OF BETA ALANINE SUPPLEMENTATION ON REPEATED BOUTS OF HIGH INTENSITY EXERCISE PERFORMANCE IN BOTH NORMOXIC AND HYPOXIC CONDITIONS

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Introduction  $\beta$ -alanine supplementation is a relatively new intervention in sport with few studies published on its effect on high intensity exercise (Hobson et al., 2012) and less on its effect on exercise in hypoxia.  $\beta$ -alanine supplementation has been shown to increase muscle carnosine which has been found to be an effective intracellular buffer during exercise (Harris et al, 2012). The aim of this study was to determine the effect on performance during repeated bouts of high intensity exercise in both normoxia and hypoxia following  $\beta$ -alanine supplementation. Methods Following baseline testing, 14 active participants (Mean  $\pm$ SD; age: 22  $\pm$ 2 yr, height: 179  $\pm$ 8cm, body mass: 79.2  $\pm$ 12.9kg) completed four weeks of supplementation of 5g.d-1 of either beta-alanine (treatment) or L-alanine (placebo). A randomised double blind trial was performed in which participants completed a high intensity exercise protocol (HIT) in normoxic and hypoxic (0.14) oxygen conditions before and after supplementation. HIT consisted of three isokinetic sprints of 6, 30 and 180 seconds on a SRM cycle ergometer interspersed with bouts of three and five minutes of active recovery at 50W. Peak and mean power outputs were calculated for each sprint in every trial, as well as the mean end power (last 30s) of the 180s effort. Heart rate, arterial oxygen saturation and blood lactate concentration were also recorded. Results In the treatment group mean power and end power of the 180s in hypoxia increased ( $p < 0.05$ ) 5.7% and 14.2% respectively after supplementation, from 240.6  $\pm$ 24W to 254 $\pm$ 29.4W and from 172.9  $\pm$ 17.9 W to 197.4 $\pm$ 30.8W. The peak power of the 180s effort in normoxic conditions in the treatment group increased 9.8% from 789.1 $\pm$ 146.1W to 866.1 $\pm$ 179.9W ( $p < 0.05$ ). There were no differences observed in power output after supplementation in the placebo group ( $p > 0.05$ ). There was no differences found in heart rate, arterial oxygen saturation or blood lactate concentration after supplementation in either treatment or placebo groups ( $p > 0.05$ ). Discussion The increase in mean power and end power of the 180s effort after  $\beta$ -alanine supplementation in hypoxia and not normoxia, may be explained by the increase in oxidative stress. The elevated carnosine content in skeletal muscle through supplementation may have improved performance by improving intracellular buffering capacity, increased Ca<sup>2+</sup> sensitivity and interacting with free oxygen species formed during exercise (Harris and Sale, 2013). Future research should consider changes in muscle metabolism following  $\beta$ -alanine supplementation and the addition of hypoxic exposure as a training stimulus. References Harris, R C, Sale, C. (2013). Acute Topics in Sport Nutrition, p1-17. Harris, R C, Wise, J A, Price, K A, Kim, H J, Kim, C K, Sale C. (2012). Amino Acids, 43 (1) p5-12. Hobson, R M, Saunders, B, Ball, G, Harris, R C, Sale, C. (2012). Amino Acids, 43 (1) p25-37.

### THE EFFECT OF DIETARY NITRATE SUPPLEMENTATION ON PHYSICAL PERFORMANCE IN HYPOBARIC HYPOXIA

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*Ruhr-University Bochum*

Introduction Exercise under hypoxic conditions is associated with impaired exercise tolerance. Dietary nitrate intake has been shown to improve or at least restore exercise tolerance in normobaric hypoxia. The present field study examined the effects of dietary nitrate supplementation in hypobaric hypoxia during a typical sojourn at high altitude on exercise performance and exercise related blood and urine parameters. Methods 18 healthy, moderately trained subjects (n=12 males; n=6 females) were exposed to hypobaric hypoxia (HH) during a climb of Mt Kilimanjaro (Tanzania) up to 5739 m above sea level for 7 days. Subjects were randomly selected into two groups according to their individual  $\dot{V}O_{2max}$  and consumed daily either 0.07 L of nitrate-rich concentrated beetroot juice (6.2 mmol of NO<sub>3</sub><sup>-</sup>; BR) or 0.07 L of nitrate-depleted concentrated beetroot juice as placebo (0.0047 mmol of NO<sub>3</sub><sup>-</sup>; PL) starting two days before HH. Uric acid (UA) and urea (U) were analyzed to determine metabolic stress and creatine kinase (CK) for muscle stress in blood serum at the 4th and 7th day of HH and post HH. Urinary urea (UU) was measured daily in 24hr urine samples. Anaerobic performance was assessed by the skipped frequency (SF) and the maximal lactate production rate ( $\dot{V}L_{max}$ ) when performing 15-seconds skipping tests to maximal exertion pre, during (2nd and 5th day of HH) and post HH. Maximum hand grip strength (GS) and hand grip endurance (GE) were measured pre, during (4th day of HH) and post HH. The Lake Louise Score (LLS) was used to indicate symptoms of acute mountain sickness (AMS). Data was analyzed using repeated measured ANOVA, Students t-test, Friedman- and Mann-Whitney-test. Results Values of UA, U and UU were within the reference range for all test days whereas CK was above the reference range in PL (m: 565  $\pm$  344, 406  $\pm$  283, 291  $\pm$  155 U/L; f: 219  $\pm$  104, 201  $\pm$  89, 198  $\pm$  71 U/L) but not in BR. Furthermore, CK decreased continuously during the test period (m: 426  $\pm$  279, 339  $\pm$  227, 254  $\pm$  119 U/L; f: 212  $\pm$  75, 170  $\pm$  77, 165  $\pm$  74 U/L). There were no differences between BR and PL for SF,  $\dot{V}L_{max}$ , GS and GE. PL showed slightly higher values in LLS compared to BR. Discussion and Conclusion Dietary nitrate intake during a typical mountain climb to high altitude did not influence exercise performance or metabolic stress. Muscle stress, however, seemed to be reduced by dietary nitrate during long-lasting trekking exercise at high altitude. This was accompanied by a slightly higher perceived rate of symptoms of AMS. Conclusively, we could not find a direct improvement of anaerobic exercise performance and muscle strength but indications for an improved muscular tolerance of long-lasting exercise at hypobaric hypoxia under dietary nitrate intake.

## CARBOHYDRATE-LOWERING EXERCISE REDUCES ANAEROBIC CONTRIBUTION AND IMPAIRS CYCLING TIME-TRIAL PERFORMANCE

Cavalcante, M.

*University of Sao Paulo*

**Introduction** Some studies (Miura et al., 2000; Langfort et al., 1997) have shown that performance during high-intensity exercise is impaired after a carbohydrate (CHO)-lowering protocol due to a lower overall anaerobic contribution (AC). However, the influence of CHO-lowering exercise on time trial (TT) performance has not been verified. This would be important since TT appears to be more reliable and to have greater external validity (Atkinson et al., 2007) compared to constant-workload tests until exhaustion. Therefore, the purpose of this study was to examine the effect of CHO-lowering exercise on AC and performance during a 4-km cycling TT. **Methods** Eight amateur cyclists performed two 4-km cycling TT using a cycling simulator. The trials were performed either after a CHO availability-lowering exercise protocol (DEP) or no previous exercise (CON). Time, mean power output (PO), RPE and plasma lactate were compared between treatments using a paired t-test. ANOVA (treatment x distance) followed by a Bonferroni adjustment was used to examine differences in PO and AC. Post-hoc comparisons were made using a paired Student's t-test. **Results** The time and PO were impaired (2.5 and 8.4%, respectively) in DEP compared with CON ( $P < 0.05$ ). The PO was less at 400, 2800 and 3200m in DEP than in CON ( $P < 0.05$ ). When PO values were analysed for each 1-km interval, it was verified a reduction in DEP just in the first 1 km, compared to CON ( $P = 0.04$ ). Overall AC was reduced (16.9%) in DEP compared with CON ( $P = 0.027$ ). The AC was lower in DEP than CON at 400m ( $P = 0.041$ ), and there was a tendency ( $P = 0.065$ ) at first 1 km. There was no significant difference in RPE and plasma lactate between treatments ( $P > 0.05$ ). **Discussion** The reduction in the PO at the first 1 km suggests that athletes adopted a more conservative starting pacing strategy after a CHO-lowering exercise. Furthermore, overall AC and performance were impaired in DEP. These results are consistent with those reported previously by Langfort et al. (1997), who showed that after three days of a low-CHO diet (~ 5% CHO) the mean PO during a 30-s Wingate test was reduced, compared with a normal diet (~ 50% CHO). Similarly, Miura et al. (31) found a reduction in the overall AC when exercise was performed after a muscle glycogen-depletion-protocol. Thus, our results suggest that CHO-lowering protocol impairs TT performance due to a reduction in the AC. **References** Atkinson G, Peacock O, Gibson AS, Tucker R. (2007). *Sports Med*, 37(8), 647-67. Langfort J, Zarzczyński R, Pilis W, Nazar K, (1997), *Eur J Appl Physiol*, 76(2), 128-33. Miura A, Sato H, Sato H, Whipp BJ, Fukuba Y. (2000). *Ergonomics*, 43(1), 133-41.

**14:00 - 15:00**

### Mini-Orals

#### PP-PM39 Physiology [PH] 6

##### ACUTE EFFECTS OF CYCLING EXERCISE ON BRACHIAL ARTERY SHEAR RATE PATTERNS IN HEART FAILURE PATIENTS

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**Introduction** Exercise training plays a central role in the treatment of heart failure (HF) patients, at least partly through improvements in vascular function. Exercise-induced shear rate patterns are a potent stimulus for vascular adaptations. However, the presence of endothelial dysfunction as well as impaired thermoregulation may alter the shear rate stimulus during exercise in HF. Therefore, we examined the effect of cycling exercise on vascular shear rate in HF patients and healthy controls. **Methods** Brachial artery shear rate was continuously measured using echo-Doppler during a bout of continuous moderate-intensity cycling exercise at 65% of maximal load in HF patients ( $n=9$ ,  $61 \pm 9$ yr) and healthy controls ( $n=9$ ,  $22 \pm 1$ yr). As cycling exercise-induced changes in brachial artery shear rate may relate to thermoregulatory changes, we continuously measured forearm skin temperature using portable thermistors. **Results** Leg exercise immediately increased antegrade shear rate in both groups, but more rapid and more pronounced in controls than in HF patients ( $P=0.006$ ). Brachial artery retrograde shear rate initially increased in both groups. Subsequently, retrograde shear rate returned towards baseline levels in controls within 20 minutes, whilst increased retrograde shear persisted in HF patients ( $P<0.001$ ). Forearm skin temperature increased in controls during exercise, which coincided with the normalization of retrograde shear, whilst HF patients showed no change in forearm skin temperature ( $P<0.001$ ). **Discussion** Compared with healthy controls, HF patients have a persistent increased retrograde shear rate during moderate-intensity cycling exercise, combined with an absent skin vasodilation. The prolonged presence of the pro-atherosclerotic retrograde shear, but also the distinct thermoregulatory responses, may alter the immediate impact of exercise training on the vasculature.

##### HEART RATE OF A PROFESSIONAL BULLFIGHTER DURING HIS PERFORMANCE IN TRAININGS AND REAL BULLFIGHT

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**Introduction** The bullfighter professional activity involves many hours of physical activity in either training or real bullfights. In fact, the professional standards of bullfighting entail the need for adequate physical preparation. In this regard, bullfighting has been considered as a sport or an artistic activity. However, research on the physiological demands of bullfighters activity is very limited. The aim of this study was to analyze the heart rate (HR) of a professional bullfighter during three characteristics stimuli of his professional work, to know the cardiac demand of this professional activity. **Methods** A professional bullfighter volunteered to participate in this study. We recorded HR, in 24 situations with fierce animals divided equally into 3 types of activity: training with wild cows, training with wild bulls and bullfights with public presence. HR was recorded by means of Polar Team2Pro® from the first contact with the animal until the last action. Descriptive statistics were analyzed with IBM SPSS Statistics 20. Previously, the bullfighter underwent a maximal exercise test on a treadmill, to get maximum heart rate (MaxHR), aerobic threshold (AeT) and anaerobic threshold (AT). **Results** The mean HR in trainings with

cows was 136bpm (74% MaxHR) being 35% of bpm above the AeT and 5% above the AT. In trainings with bulls, the mean HR was 157 bpm (85% MaxHR) being 73% of bpm above the AeT and 36% above the AT, while in real bullfighting the mean HR was 164 bpm (89% MaxHR) where the 79% of bpm were above the AeT and 61% of AT. Discussion This is the first study about the cardiac demand during real bullfighting. Emotional factors related to the presence of public, like anxiety and stage fright are inherent to the professional activity of bullfighters for regarding the real physical load in this activity(1). We have observed that this bullfighter present a heightened HR while he acts in bullfighting and in training with bulls, much greater than in trainings with cows, corresponding to heavy work, or very heavy in bullfight (2). References 1. Light, K. C. y Obrist, P. A. (1980). Cardiovascular response to stress: Effects of opportunity to avoid shock experience and performance feedback. *Psychophysiology*, 17, 243-252. 2. Fletcher G. F., Balady G., Froelicher V. F., Hartley L. H., Haskell W. L., & Pollock M. L. (1995). Exercise Standards. A statement for healthcare professionals from the American Heart Association. *Special Report. Circulation*, 91,580-615.

### **BRADYCARDIA DURING COLD FACE TEST AND CARDIOVASCULAR DISEASE RISK FACTORS IN SWIMMERS AND CONTROLS**

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**Introduction** Cold face test is a non-invasive challenge maneuver of the autonomic nervous system used to assess vagal activity (Heath et al., 1990). Although physical training improved vagal activity measured by heart rate variability (Amano et al., 2001), previous study has shown that physical training did not affect bradycardia during the cold face test (Schagatay et al., 2000). However, that study has limitations that the training term was short and that the participants were not athletes. Therefore, we compared bradycardia during the cold face test and cardiovascular disease risk factors between swimmers and controls. **Methods** Twenty two males participated in this study. The control group consisted of 12 male participants, 18-27 years of age, selected from university students, physically active, but non-athletes and non-swimmers. The swimmer group was composed by ten male swim-athletes, 20-21 years of age, who trained more than six years. The cold face test was performed in all participants in the sitting position with face immersion in cold water (3-5 degree) and apnea for 30 seconds. R-R intervals were recorded before and during the cold face test. Maximal oxygen consumption was assessed during an incremental cycle ergometer test, and pulse wave velocity (PWV) was examined at rest as cardiovascular disease risk factors. **Results** Both the swimmers and controls showed a heart rate reduction during the cold face test from baseline (swimmers:  $35.6 \pm 9.4\%$ , controls:  $22.8 \pm 8.1\%$ , mean  $\pm$  standard error,  $P < 0.01$ ). However, the rate of heart rate reduction and maximal R-R interval during the cold face test did not differ between groups. Maximal oxygen consumption was significantly higher ( $P < 0.05$ ) and PWV was significantly lower in the swimmers than in the controls ( $P < 0.01$ ). **Discussion** We found that the chronic physical training is negatively associated with arterial stiffness in young males, which is consistent with previous study (Otsuki et al., 2007). However, we did not observe the difference of bradycardia during the cold face test between the swimmers and controls. Therefore, the present study suggests that the swimming training may attenuate arterial stiffening but not affect bradycardia during the cold face test. **References** Amano M, Kanda T, Ue H, Moritani T. (2001). *Med Sci Sports Exerc*, 33(8), 1287-1291. Heath ME, Downey AJ. (1990). *Clin Sci*, 78(2), 139-147. Otsuki T, Maeda S, Iemitsu M, Saito Y, Tanimura Y, Aijisaka R, Miyauchi T. (2007). *Am J Hypertens*, 20(9), 967-973. Schagatay E, van Kampen M, Emanuelsson S, Holm B. (2000). *Eur J Appl Physiol*, 82(3), 161-169.

### **PHYSICAL DEMANDS OF FOOTBALL ASSISTANT REFEREES IN UNIVERSITY-LEVEL MATCHES**

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**Introduction** A number of studies have revealed physical and physiological demands of football field and assistant referees in professional matches (Krustrup et al., 2009; Mallo et al., 2009). These variables such as movement distance and speed, heart rate (HR) and rate of perceived exertion (RPE) imposed on football referring at lower match levels have yet to be thoroughly examined. We previously reported the physical demands of field referees in Japanese University-level matches. This study is an extension of our previous effort and aimed to investigate physical demands of assistant referees using the same matches observed. **Methods** Eleven male football assistant referees, who were accredited by Japan Football Association with the 2nd-class licence, were studied during Kanto region University football league in 2011. The observed variables representing their physical demands included movement distance and speed (GPS, Gpsports, Australia), HR (Polar T31, Polar, Finland) and RPE. Based on the recorded speed, their movements were classified into the following categories in conformity with the literature i) walking:  $\leq 6$  km/h, ii) jogging: 6-8 km/h, iii) low speed: 8-12 km/h, iv) moderate speed: 12-15 km/h, v) high speed: 15-18 km/h, and vi) sprinting:  $\geq 18$  km/s. The high-intensity running (HIR) was defined as the speed greater than 15 km/h (v and vi). The distance was calculated for each movement category, and the number of running bouts above HIR also counted. RPE was assessed after the completion of each match. **Results** The mean total distance covered throughout the match was  $6.65 \pm 0.53$  km, with walking accounting for the largest percentage (40 %), while HIR covering 20 % of it. The number of HIR bouts was  $29 \pm 10$  times throughout the match with no significant difference in number between halves. Mean HR and end-match RPE were  $140 \pm 16$  bpm ( $73 \pm 7.6\%$  HRmax) and  $13 \pm 2$ , respectively. **Discussion** Physical demands imposed on the assistant referees in Japanese University-level matches resembled those of FIFA top-level assistant referees (Krustrup et al., 2009; Mallo et al., 2009). The main movement pattern of assistant referees can be described as repeated brief high-intensity running (each lasting for 3-4 s) interspersed with 1-3 min of walking or low activity. However, as compared with the field referees that we examined previously, the assistant referees were required low physical demands, which well supports the earlier findings employing FIFA top-level field and assistant referees. To summarize, physical demands of assistant referees in Japanese University-level matches are similar to those in international matches, and exhibit need for intermittent anaerobic efforts and agility to keep up with play. **References** Krustrup et al. (2009). *J Sports Sci*, 27 (11): 1167-1176. Mallo et al. (2009). *Int J Sports Med*, 30: 331-336.

### THE EFFECT OF 16 WEEKS OF ENDURANCE TRAINING ON HEART RATE VARIABILITY IN OBESITY AND TYPE 2 DIABETES: A PILOT STUDY.

O'Hagan, C., Rodrigues-Krause, J., Medlow, P., Krause, M., Boreham, C., Davison, G., Collieran, G., Newsholme, P., Murphy, C., De Vito, G.

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**Introduction** Cardiovascular autonomic neuropathy (CAN) is a consequence of Type 2 Diabetes (T2D) which increases risk of mortality (1). Reduced heart rate variability (HRV) can be used as a marker of CAN (2), and reduced HRV has been observed in patients with T2D (3). Exercise training may improve HRV, but studies in T2D are lacking (4). The aim of this study was to investigate the effect of 16 weeks of walking training on HRV in obese patients with and without T2D, and to compare the effects of different training intensities. **Methods** Five obese males with Type 2 Diabetes (T2D; age  $47.6 \pm 5.2$  years, BMI  $33.8 \pm 3.7$  kg.m<sup>-2</sup>) and 18 matched controls (CON, age  $48.6 \pm 5.3$  years, BMI  $31.7 \pm 3.9$  kg.m<sup>-2</sup>) participated in this study. Time-domain parameters of HRV were obtained from ECGs recorded before and after completion of 16 weeks of endurance training (walking, 90 minutes per week) at either low-moderate (LO) or moderate-high (HI) intensity. Data are presented as mean  $\pm$  SD. Results Mean RR Interval (MRR), standard deviation of RR intervals (SDRR) and the root mean square of successive differences in RR (RMSSD) were all lower at baseline in T2D compared to CON; the difference was significant for SDRR and RMSDD (MRR:  $895 \pm 133$  ms vs.  $989 \pm 155$  ms,  $p = 0.219$ ; SDRR:  $2.73 \pm 0.99$  ms vs.  $4.08 \pm 2.3$  ms,  $p = 0.005$ ; RMSSD:  $21.93 \pm 3.92$  ms vs.  $38.20 \pm 20.29$  ms,  $p = 0.005$ ). Post-training data was available for only 13 participants. There was a non-significant increase in MRR from pre- to post-training ( $973 \pm 164$  ms vs  $1017 \pm 150$  ms,  $p = 0.09$ ), with no differences in the responses of CON and T2D. When results for T2D and CON were pooled to allow comparison of the effects of LO and HI training intensities there was a non-significant difference in the change in RMSDD (LO:  $+5.9 \pm 10.6$  ms vs HI:  $-8.06 \pm 13.4$  ms,  $p = 0.058$ ). Interestingly, the number of 'responders' (individuals who recorded increases in measures of HRV post-training) was higher in LO (5 of 6 participants) than HI (2 of 7). **Discussion** The sample sizes for this study were small and data displayed large inter-individual variability, as has been reported previously (5). Nevertheless, the trend for baseline differences between T2D and CON resembles previous observations, supporting a potential role for HRV as a marker of autonomic neuropathy in T2D. The effect of training on HRV in T2D and obesity cannot be determined from these data, and indeed previous research is inconclusive (6). However, as the importance of exercise training in treating other aspects of metabolic and cardiovascular disturbance in T2D and obesity increases, the effect of exercise training on CAN warrants further investigation. **References** 1. Maser, RE (2003). *Diabetes Care* 26: 1895. 2. Task Force of the European Society of Cardiology (1996) *European Heart J* 17: 354 – 381. 3. Astrup, AS et al. (2007) *J Hypertens.* 25: 2479 – 2485. 4. Routledge, FS et al. (2010) *Can J Cardiol* 26(6): 303 – 312. 5. Ryan, KL et al (2008). *FASEB J* 22: 1229. 6. Figueroa, A et al. (2007). *European J Appl Physiol* 100(4): 437-444

### CROSS-ANALYSIS OF VARIABILITY OF HEART RATE AND DURATION OF BREATHING CYCLE IN ATHLETES

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**Introduction** One of the most informative methods of study of vegetative nervous system is the spectral analysis of variability of heart rhythm (VHR). Simultaneous recording of breathing cycles (BC) at registering the ECG provides the opportunity for cross-analysis of VHR and variability of duration of breathing cycle (VDBC) to make the assessment of synchronization of these two systems. Goal of the study was to compare the findings of cross-analysis of elite athletes and young male non-athletes. **Methods** Twenty-five elite judoists (experimental group) and fifteen healthy young male non-athletes (control group) have been examined. VHR and VDBC parameters were studied with use of hard- and software complex VNS-Spectrum. Protocol of examination included a 5-minute synchronous registration of ECG and BC with use a respiration sensor. The pneumogram was used for building a histogram of BC duration, which graphically was applied on the spectrogram of VHR. Determination of spectral power of each frequency range of spectrum of heart rhythm was performed in accordance with the International Standard. Assessment of VDBC indicators included the count of histogram columns, determination of position of the mode of histogram, position of the mode of histogram in relation to the spectrogram peak in the area high frequency (HF) component ("D" is a distance between the mode of histogram and peak of HF-component). **Results** The athletes demonstrated 1-2 peaks on BC histogram, while the control group had 2-3 peaks, which evidenced to a better cardiorespiratory synchronization in athletes. In athletes, the distance D did not exceed 0.05 Hz. A slight disorder of cardiorespiratory synchronization was noted in one athlete. While four representatives of the control group demonstrated expressed disorder of synchronization that might be assessed as a deadaptation status. There were registered 4-5 peaks on the BC histogram or a noted divergence between the peak histogram of breathing and peak HF-component of VHR. Loss of coordination of cardiovascular and respiratory systems, impairment of synchronization and decoupling of correlation links are the objective signs of stress and depletion of regulatory systems of the body. Detection of the impaired breathing pattern serves as a ground for respiratory training. **Conclusion** Cross – analysis of VHR and VDBC provides for collecting the information of functional status of athletes, and detecting the fatigue.

### THE HEART RATE DURING SLEEP IS LOWER IN THE NIGHTS AFTER EXERCISE THAN WITHOUT EXERCISE

Ganeko, M.1, Kazama, S.2, Ito, S.2, Inagaki, Y.2, Uchida, S.3

*1&3: Waseda University, 2: Aisin Seiki Co., LTD.*

**Introduction** Recently there have been studies to investigate the effect of exercise on physiological parameters such as EEG, heart rate (HR) and core temperature during sleep. Some studies have showed exercise increased HR during sleep, but these studies mostly examine the effect of one-bout exercise on HR. In this study, we examined the effect of habitual one-year regular exercise on HR during sleep using non-contact sheet type sleep monitor. **Methods** Twenty-three healthy office workers, who hadn't had regular exercise habit participated in the study. They were instructed to do cycling ergometer exercise at home with a goal of 65~73%HRmax(220-age), over 20 minutes a day, more than 4 times per week. They filled out a daily diary of their exercise. A Sheet-type sleep sensor under the bed mattress of each subject was used to monitor HR and respiratory rate during sleep throughout the study period. In addition, we measured subjective sleep quality, mood and physical fitness regularly. **Results** The annual average exercise rate was 3.4 times per week. There was no significant difference in the number of monthly-averaged exercise day. The average HR during sleep was significantly lower in the 6th month than 1st and 9th month. The average HR during sleep was significantly lower in the nights after exercise than without exercise. **Discussion** Although there were significant differences in monthly-average HR during sleep, exercise less than 4 times per week did not have a long-term impact on HR during sleep. But HR during sleep was lower in the nights after exercise than without exercise.

This result indicates that one-bout public health level exercise may decrease HR during sleep. Further studies are needed to examine how different intensity and timing exercise affect following night sleep.

### MAXIMAL HEART RATE DOES NOT LIMIT VO<sub>2</sub>MAX IN HEALTHY PHYSICALLY ACTIVE MEN

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**Introduction** Beta-blockers reduce maximal heart rate (HR<sub>max</sub>) and VO<sub>2</sub>peak because they also reduce contractility and peak cardiac output. In the present experiments we show that healthy humans can reach their VO<sub>2</sub>max despite reducing their maximal heart rate by as much as 9 beats/min. **Methods** Ten healthy young men (age = 21.4 ± 2.1 yr, VO<sub>2</sub>peak = 3.6 ± 0.3 L/min; mean ± SD) performed six incremental exercise test to exhaustion (20W/min). The first two test were performed in random order in normoxia or hypoxia (inspiratory PO<sub>2</sub> (PIO<sub>2</sub>)=74 mmHg) and femoral venous and arterial blood gases were determined. The next four incremental exercise tests were composed of an initial incremental phase in severe hypoxia (PIO<sub>2</sub>=74 mmHg) (HYP1) until exhaustion (Exh1). At Exh1, subjects were strongly encouraged to continue the exercise (HYP2) when at the same time PIO<sub>2</sub> was changed swiftly to either 74 (placebo), 82, 91 or 99 mmHg. After 2 min the load was increased by 20 W/min until exhaustion (Exh2). At Exh2, the PIO<sub>2</sub> was increased to 142 mmHg (normoxia; NX3) and after 2 min of additional exercise, the load was increased by 20 w/min until exhaustion (Exh3). **Results** VO<sub>2</sub>peak was reduced in Exh1 in all tests (-33%, P<0.05) when compared to normoxia. Peak cardiac output (Q<sub>max</sub>) and arterial pressure was similar at exhaustion in Nx, hypoxia (PIO=74 mmHg), and Nx after hypoxia (PIO=74 mmHg) (21.4±2.3, 21.4±2.8, 21.5±1.7 L/min). Peak HR at Exh1 was similarly reduced in all conditions, and remained at this level when changing PIO<sub>2</sub> to 74 (placebo), 82, 92 and 99 mmHg in the HYP2 phases. However, at Exh2 and Exh3 in normoxia the HRpeak was 5-9 beats/min lower than the HR<sub>max</sub> (193±7 beats/min) (P<0.001). Despite this reduction VO<sub>2</sub>max was still reached at Exh3. Consequently, the oxygen pulse was 7% higher at Exh3 than in the control test in normoxia (P<0.05). **Conclusions** Since the reduction in maximal heart rate was without an effect on VO<sub>2</sub>max, Q<sub>max</sub> and systemic O<sub>2</sub> extraction, our results can be only explained if the lower HRpeak was compensated by a larger stroke volume. A greater sympathetic activation of the heart is unlikely at exhaustion with oxygenation since this should have increased heart rate, which remained unaltered with oxygenation. With a similar inotropic state and afterload, the most plausible explanation for our findings is that the slightly greater filling times with a lower HRpeak at Exh3 must have allowed attaining a 10-15 ml greater end-diastolic volume in each ventricle. Thus, it seems that in young healthy humans peak cardiac output is not limited by the achievement of maximal end-diastolic volume implying that peak cardiac output in healthy physical active young humans is unlikely limited by a pericardial constrain. *Granted by DEP2009-11638*

### CARDIOVASCULAR TIME COURSES DURING PROLONGED DRY APNEA IN EXERCISING DIVERS

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In static apnea, cardiovascular readjustments are such that, after an initial decrease in heart rate (HR) and increase in blood pressure (BP) (ph I, ~30 s duration), there are ~2 min of steady values (phII). Then HR decreases and BP increases again, up to the end of apnea (ph III), possibly due to chemoreflex activation. We hypothesize that the end of ph II corresponds to physiological apnea breaking point. This being so, in case of increased metabolic rate (M'), duration of phII would be shorter. **METHODS** 8 divers (age 36±7 yrs) performed voluntary maximal apnea: A) sitting at rest; B) pedaling at 30 W on a cycle ergometer. BP (finger photo-plethysmography) and arterial O<sub>2</sub> saturation (SaO<sub>2</sub>; infrared spectroscopy) were continuously recorded before, during and after apnea. M' was measured before and after apnea by a metabolic cart. Beat to beat HR, systolic (Ps) and diastolic (Pd) pressures were obtained. **RESULTS:** A): apnea lasted 227±62 s. In ph I (29±3 s), HR decreased from 98±11 b/min to 82±13 b/min, returning to control values (ctrl), Ps remained equal to ctrl (140±11 mmHg), Pd increased by 14 mmHg above ctrl (70±8 mmHg, p<0.05). In ph II (102±32 s), all parameters were stable, then HR fell to 57±5 b/min, while Ps and Pd increased, respectively, to 215±23 mmHg and 105±16 mmHg after 110±35 s (ph III). SaO<sub>2</sub> was 91±5 % at the end of ph II (p<0.05) and 75±13% at the end of apnea. B): apnea lasted 88±21 s, M' was twice as at rest. During the first 24±7 s (ph a), cardiovascular parameters remained unchanged. HR (112±9 b/min) was 15±10 b/min above exercise steady state values. Ps was 167±15 mmHg and Pd 81±15 mmHg. In the following 64±22 s (ph b), a continuous fall of HR and increase in Ps and Pd occurred. At the end of apnea, HR was 55±10 b/min, Ps 244±24 mmHg and Pd 112±13 mmHg. SaO<sub>2</sub> started to drop after ~30 s of apnea to 76±11% at the end. **CONCLUSIONS:** Apnea at exercise, with higher M', showed different cardiovascular trends from static apnea. The lack of stable cardiovascular values after the first phase a and the steep decrease in SaO<sub>2</sub> suggest early chemoreflex activation, inducing progressive bradycardia and hypertension. The absence of initial HR drop indicates that the level of autonomic activity affects the cardiac response to breath-holding.

### IMPACT OF DIFFERENT ENDURANCE RACES ON THE HEART: THE POINT OF VIEW OF THE BIOLOGIST

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**Objective** The aim of this study was to investigate the impact of intense exercise, represented by different endurance races, in relationship with oxidative stress and cardiac markers. In a second time, we tried to demonstrate if oxidative stress induced by physical activity is a physiological or pathological process, and to establish some issues to diagnose the risk of sudden death in athletes. **Methods** Four populations were compared, a control group of 16 participants "sedentary" (37 ± 4,39 years old), a group of 24 semi-marathon runners (41 years ± 8,76 years old), a group of 28 marathon runners (44,1 ± 8,37 years old) and a group of 33 ultra-trail runners (45,8 ± 8,7 years old). Three blood tests were done, one just before, one just after, and the last three hours after the end of the race. Different oxidative and stress and cardiac biomarkers were measured. The ultra-trail runners will be subject to an echocardiography and an ECG pre- and post-race. For statistical analysis, STATISTICA 10 software was used. We performed a non-parametric test of Kruskal-Wallis for independent sample and a Friedman ANOVA for paired samples. **Results** Myeloperoxidase increased during exercise, but the release is less important according to the level of training of the runners. GSH/GSSG ratio seems to remain stable during the race but it could increase during the 24 hours post-race. There is a decrease in lipidic peroxidation during exercise. But, we note an increase of creatine kinase, isoform MB, myoglobin and C-reactive protein during the race. We observe an increase of troponin T and natriuretic peptide but with a different kinetic than the kinetic obtained for a myocardial infarction. Medical imaging in ultra-trail runners present cardiac adaptations to endurance training, as left ventricular hypertrophy (LVH) and incomplete right bundle branch block (IRBBB). A decrease of systolic and

diastolic volumes of the left ventricle and a decrease of longitudinal strain were observed by echocardiography at the end of the race. Conclusion Endurance races induce the increase of oxidative stress objectified by different biomarkers increase, but a cell necrosis is not specially observed. In fact, the increase of the cardiac markers during endurance races but may be explained by a transient modification of myocyte permeability, with a release of pool cytosolic. These races may induce micro-muscle damages causing the appearance of an inflammatory process explaining our observations of markers of inflammation. For the medical imaging, it was observed a myocardial adaptation to training and a transient impairment of ventricular function due to dehydration.

### **CARDIAC SYSTOLIC AND DIASTOLIC FUNCTION FOLLOWING A SIMULATED 5KM RACE IN SPORTS-TRAINED ADOLESCENTS**

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1: Centre for Sport, Health and Exercise Research, Staffordshire University, Stoke-on-Trent, UK, 2: Department of Pediatrics, Baystate Medical Center, Springfield, MA, 3: Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, 4: School of Sport, Exercise and Health Sciences, Loughborough University, Loughborough, United Kingdom, 5: Sport and Exercise Physiology Research Team, Liverpool Hope University, Liverpool, United Kingdom Introduction Transient impairments of left ventricular (LV) systolic and diastolic function have been demonstrated in adult athletes following prolonged endurance exercise. The effects of a short, high-intensity bout of exercise, on cardiac systolic and diastolic function are less well understood in adolescent athletes. Consequently, the aims of the study were to: 1) evaluate global LV systolic function as well as segmental wall motion responses (cardiac strain), and 2) determine global LV diastolic function using Doppler and tissue Doppler imaging, both prior to and following a simulated 5 km cross-country race. Methods Twenty trained, male adolescents (age: 15.2 ± 0.7 years) volunteered for exercise testing. Cardiac systolic and diastolic measurements were taken prior to as well as 45 min and 3 hr 45 min following a simulated 5 km race. Measurements of resting LV dimensions obtained by M-mode echocardiography facilitate the measurement of LV systolic fractional shortening, a global measure of systolic function. Longitudinal myocardial strain and systolic strain rate of the LV septum were estimated using semi-automated speckle tracking software. Data was calculated for 3 septal wall segments (base, mid and apex) and then averaged. Global LV diastolic function was represented by peak blood flow velocities across the mitral valve during early (E) and late (A) diastole determined using pulsed-wave Doppler interrogation of transmitral blood flow. Tissue Doppler imaging was employed to determine peak longitudinal mitral annular septal tissue velocities. Results LV fractional shortening was significantly ( $P < 0.05$ ) higher 3 hr 45 min post-race ( $37.6 \pm 5.8\%$ ) compared to pre-race ( $34.5 \pm 4.7\%$ ) and 45 min post-race ( $34.9 \pm 5.4\%$ ). Despite this there was no alteration in segmental strain or strain rate measurements. There was a significant ( $P < 0.05$ ) decrease in the E:A ratio both 45 min ( $2.04 \pm 0.57$ ) and 3 hr 45 min post-race ( $2.20 \pm 0.66$ ) compared to the pre-race value ( $2.80 \pm 0.68$ ) but no alterations in tissue Doppler velocities were identified. Discussion The evidence suggests that a 5 km race does not lead to any significant post-exercise attenuation in regional LV systolic and diastolic function in trained adolescents. Minor changes in global LV systolic and diastolic indices were likely related to changes in heart rate during recovery.

### **TRAINING-INDUCED LEFT VENTRICULAR HYPERTROPHY AND RUNNING PERFORMANCE ARE NOT**

Rasmussen, T., Cress, M., Lindsey, B., Lonsdorf, B., Peterson, M., Wichern, C., Wolff, A., Stayton, M., Thomas, D.

*University of Wyoming*

Introduction Previous findings from removal of the pericardium (pericardiectomy) in both pigs<sup>1</sup> and dogs<sup>2</sup> have indicated a higher maximal cardiac output and  $\text{VO}_2\text{max}$  in both species. However, whether training carried out post-pericardiectomy leads to greater left ventricular hypertrophy or enhanced running performance has not been evaluated. Methods Young adult C57B6 mice were divided into pericardiectomized (P) or control (C) groups, and further subdivided into treadmill trained (P-T, C-T) or sedentary (P-S, C-S) groups. Pericardiectomized mice underwent sterile surgery under general anesthesia (ketamine/xylazine) also involving positive pressure ventilation (Harvard small animal ventilator). Both P-T and C-T groups ran on a treadmill at increasing speeds and duration up to 22 m/min, 60 min/day for 10 wk<sup>3</sup>. All mice underwent a final run-to-exhaustion test to evaluate running performance. Echocardiography was used to measure LVH, ventricular wall/chamber dimensions, and fractional shortening (%FS) as a measure of left ventricular (LV) function, as performed by us previously on mice<sup>4</sup>. Results Compared to combined S groups, both T groups documented a significant training effect by a 26% increase in run time-to-exhaustion ( $P < 0.05$ ) and body weight-normalized LVH ( $P < 0.05$ ) with no significant difference between the two T groups. There was also a trend ( $P < 0.09$ ) towards a thicker LV septum in T compared to S mice. However, there was also a trend for LV/BW in combined pericardiectomized groups (T, S) to be heavier ( $P < 0.08$ ) than in combined control groups indicating that pericardiectomy alone can increase LV mass. Pericardiectomy also resulted in significantly increased LV internal chamber diameters during both systole and diastole (LVIDs, LVIDd;  $P < 0.05$  and  $P < 0.01$  respectively) regardless of training status. LV function as assessed by %FS was unaffected by pericardiectomy or training, and normal in all 4 groups. Discussion Training does not result in additional LVH in pericardiectomized mice, even though there was a trend for pericardiectomy to increase LV/BW. However pericardiectomy does alter LV geometry without affecting exercise performance or resting LV function (%FS) as measured by echocardiography. References 1. Stray-Gundersen J, Musch T, Haidet G et al. (1986) *Circ. Res.* 58, 523-530. 2. Hammond H, White F, Bhargava V, Shabetai R. (1992) *Am. J. Physiol.* 263, H1675-H1681. 3. Høydal M, Wisløff U, Kemi J, Ellingsen Ø. (2007) *Eur. J. Card. Prev. Rehab.* 14, 753-760. 4. Ren J, Duan J, Thomas P, Anversa P. (2008) *Am. J. Physiol.* 294, R793-R802.

14:00 - 15:00

## Mini-Orals

## PP-PM45 Physiology [PH] 12

**EFFECTS OF LOWER BODY NEGATIVE PRESSURE ON PHASE I CARDIOPULMONARY RESPONSES AT EXERCISE ONSET IN HUMANS**

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**Introduction** The kinetics of cardiac output (CO) at the onset of exercise is characterized by two phases. The first rapid phase (phase I) is generally attributed to the sudden withdrawal of vagal tone (Fagraeus & Linnarsson, 1976). Yet, in acute hypoxia, with reduced vagal activity, the phase I amplitude (A1) for CO was still positive (Lador et al, 2008). Moreover, although vagal activation was greater supine than upright, the phase I of CO and stroke volume (SV) was not evident (Wieling et al, 1996). Thus, it was postulated that the phase I CO increase might also be due to the sudden increase in venous return and its effects on SV via the Frank-Starling mechanism (Sheriff et al, 1993). If this was the case, application of increasing levels of lower body negative pressure (LBNP) would generate a progressively greater increase in A1 of SV at exercise start. **Methods** To test this hypothesis, 8 subjects repeated 3 transitions of 5-min 50-W pedaling exercise supine, with 0 (control), -15, -30 and -45 mmHg of LBNP. LBNP was used as a tool to vary the amount of blood displaced in the lower limbs at rest. Heart rate (HR), SV, mean arterial pressure (MAP) and CO were continuously recorded using Portapres device and determined on a beat-by-beat basis using Modelflow method (Wesseling, 1993). After superposition of the 3 transitions, kinetics of CO, SV and HR were fitted using bi-exponential model, and model parameters were compared among the 4 conditions using repeated ANOVA (Tukey post-hoc test). Results LBNP significantly increased A1 of SV from  $7.5 \pm 3.7$  control to  $16.7 \pm 12.4$  and  $21.4 \pm 7.9$  ml, for -30 and -45 mmHg of LBNP respectively; A1 of HR decreased during -45 mmHg LBNP ( $14.1 \pm 8.5$ ) respect to -15 mmHg LBNP ( $22.4 \pm 3.2$ ). Thus, A1 of CO exhibited only a trend to increase. The time constant of phase I ranged between 1.5 and 3.5 s and was unaffected by LBNP exposure, for SV, HR or CO. At exercise start, there was a linear relation between HR and MAP, to attain a minimum MAP value, after which both parameters increased toward the range of exercise steady state values. **Conclusion** The tested hypothesis, namely that the phase I of SV is controlled by mechanical factors, was supported by these results. If HR kinetics was under neural control, then the phase I kinetics of CO would be under dual control: neural (vagal withdrawal) and mechanical. Moreover, the trends of the HR versus MAP relationship indicate that baroreflex resetting occurred after phase I, suggesting a role of sympathetic activation in it. **References** Fagraeus & Linnarsson, 1976. *J Appl Physiol* 40, 679-82 Lador et al, 2008. *Am J Physiol Regul Integr Comp Physiol* 295, R624-32 Sheriff et al, 1993. *Am J Physiol* 265, H1227-34 Wieling et al, 1996. *J Physiol* 494, 601-11 Wesseling, 1993. *J Appl Physiol* 74, 2566-73

**THE INFLUENCE OF PRIOR STEP EXERCISE ON THE AEROBIC CAPACITY DURING INCREASING RAMP RUNNING TEST IN YOUNG WOMEN**

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**Introduction.** After unusual physical activities (like bench stepping) including eccentric and concentric muscle contractions we might observe delayed onset muscle soreness (DOMS) which is mostly felt 24-72 hours after physical loads (Yanagisawa et al., 2010). There is some evidence how prior exercise affects lactate and ventilatory thresholds (Davies et al., 2011). There are no data about the effect of eccentric prior exercise on aerobic capacity changes during increasing ramp running test (IRT). Therefore, the aim of this study was to evaluate the effect of prior stepping on the indices of aerobic capacity during increasing ramp running test in young women. **Methods.** The subjects were healthy aerobics and dance specializations females students (n = 14) with an average age of 24.7 (6.4) years, height 168.0 (3.5) cm, weight 58.6 (6.4) kg, VO<sub>2</sub> max 2.475 (0.344) l/min. The studies were conducted in the Laboratory of Department of Applied Biology and Rehabilitation. The subjects performed three IRT on a treadmill (LE 200 CE, HP Cosmos) - a control one, 1 hour and 24 hours after stepping prior load (SPL). Maximal Oxygen Uptake (VO<sub>2</sub>max) („Oxycon Mobile“ (Germany) was determined according the dependence of average VO<sub>2</sub> during 15 s on the work intensity. The first (VeT1) and the second (VeT2) ventilatory thresholds were established according to the dependence of pulmonary ventilation. The highest value of VO<sub>2</sub> during 15 s of increasing running test was considered as VO<sub>2</sub> peak. At 5th and 20th min after IRT capillary blood samples of 0.1 ml from the subjects' fingers were taken using special one time devices using „Accutrend Lactate“ (Germany) analyzer. **Results.** We established that 1 h after SPL VeT2 (p = 0.024), VO<sub>2</sub>max (p = 0.049), maximal aerobic and maximal IRT speed (p = 0.036) and [La] 5 min. (p = 0.007) were decreased one hour after SPL. The majority of indices (VO<sub>2</sub>max (p = 0.030), the highest test speed (p = 0.036) and power (p = 0.014) were increased again 24 h after SPL, only VeT2 remained lower though the difference was not statistically significant (p = 0.898). Running economy at moderate and heavy intensities, the values of VEmax, HRmax and other indices did not change after SPL. **Conclusion.** The second ventilatory threshold and VO<sub>2</sub>max were decreased only 1h after stepping in young women. Other parameters of aerobic capacity were not changed at this moment of recovery and no significant changes of aerobic capacity were observed 24 h after stepping. **References.** Yanagisawa, O., Kurihara, T., Okumura, K., Fukubayashi, T. (2010). Effects of strenuous Exercise with eccentric Muscle Contraction: Physiological and Functional Aspects of Human Skeletal Muscle. *Magn Reson Med Sci*, 9 (4), 179-186. Davies, R. C., Rowlands, A. V., Pool, D. C. et al (2011). Eccentric exercise-induced muscle damage dissociates the lactate and gas exchange thresholds. *Journal of Sports Sciences*, 29, 2, 181-189.

**CARDIORESPIRATORY AND METABOLIC RESPONSES TO AN ACUTE BOUT OF HIGH RESISTANCE CIRCUIT TRAINING VS TRADITIONAL STRENGTH TRAINING IN SOCCER PLAYERS.**

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**Cardiorespiratory and Metabolic Responses to an Acute Bout of High Resistance Circuit Training vs Traditional Strength Training in Soccer Players.** **Introduction** Maximal strength training is essential to optimize the power levels in soccer players (1). Circuit weight training could be a good tool for strength training in this population because improve strength and power (2) and minimizes training time(3). To date

only one research has studied (3) the acute responses of high resistance circuit (HRC) training on mechanical power and heart rate (HR), however no studies have been found regarding cardiorespiratory and metabolic responses. Therefore, the aim of this study was to compare cardiorespiratory and metabolic responses during HRC protocol vs. traditional strength training (TS) in soccer players. Methods 10 semiprofessionals soccer players performed 4 sessions: familiarization, maximal test in a treadmill, HRC and TS training. Maximal oxygen consumption normalizes to body weight (VO<sub>2</sub>maxR) and maximal HR (HRmax) were obtained in the maximal test. The order of training sessions was randomly and cross-over. The difference between protocols was the time of rest between exercises: TS=3' and HRC=35". Local muscular rest was the same (31) in both protocols. During training sessions, VO<sub>2</sub>R and HR were measured using a portable gas analyzer. Blood lactate (Lac) concentration was measured after exercise (1.5', 5', 7'). Results Significant differences (p<0.001) were obtained for VO<sub>2</sub>R, HR and Lac between groups. VO<sub>2</sub>R during HRC was 75% higher than TS (HRC=30.9±3.0; TS=17.7±2.5% of VO<sub>2</sub>maxR). During HRC training HR was higher by 39%. After training session, Lac in HRC was higher in circuit training in the 3 measures (HRC=9.4±2.2; 8.7±1.7; 8.4±1.7, TS=4.4 ± 1.1; 3.9 ± 1.2; 3.2 ± 1.2 mmol•l<sup>-1</sup>). Discussion During HRC, cardiorespiratory and metabolic responses were significantly higher than when the subjects were training with TS protocol. Respect VO<sub>2</sub>R (4) the authors reported similar results (~32% of VO<sub>2</sub>maxR) in circuit weight training with lower resistances. With the same protocols, Alcaraz et al. (3), have been reported similar values for HR (HRC=~71; TS=~62% of HRmax). Metabolic responses, measured by Lac, show that HRC was significantly more intensive than TS protocol. A recent study (5) found values of Lac slightly higher (10.5±2.1 mmol•l<sup>-1</sup>) after 5' of high-intensity interval training which performed with 6RM loads. Therefore HRC could be considered as a good tool for achieve improvements in soccer players, as this may improve strength and endurance jointly and also reducing training time. References 1.Hoff et al. Sports Med. 2004;34(3):165-80. 2.Alcaraz et al. J Strength Cond Res. 2011 Sep;25(9):2519-27. 3.Alcaraz et al. J Strength Cond Res. 2008 May;22(3):667-71. 4.Beckham et al. J of Sports Medicine & Physical Fitness. 2000;40(2):118-25. 5.Paoli et al. J Transl Med. 2012;10:237. Do not insert authors here

### N-ACETYLCYSTEINE ALTERS SUBSTRATE METABOLISM DURING HIGH-INTENSITY CYCLING EXERCISE IN WELL-TRAINED HUMANS

Trewin, A.1, Petersen, A.C.1,2, Billaut, F.3, McQuade, L.4, McInerney, B.V.4, Stepto, N.K.1,2

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**Introduction** The generation of exercise induced reactive oxygen species (ROS) is a pertinent physiological event in order to facilitate optimal cellular signalling and function. Antioxidants balance ROS to provide a spatial-temporal equilibrium termed redox homeostasis. Disturbances in redox homeostasis may lead to suboptimal metabolic responses and alter exercise performance. This study investigated the effects of the antioxidant N-acetylcysteine (NAC) on metabolism during fixed work rate high-intensity interval exercise (HIIE) and self-paced 10 min time trial (TT10) performance. **Methods** Nine well-trained (mean ± SD; VO<sub>2</sub>peak 69.4 ± 5.8 ml.kg<sup>-1</sup>.min<sup>-1</sup>, peak power output (PPO) 385 ± 43 W) male cyclists participated in a double-blind, repeated measures, randomised crossover trial. Following maximal aerobic capacity testing and familiarisation, two separate trials (NAC/placebo supplementation) were performed on a cycle ergometer (Lode, Groningen, Netherlands) 7 days apart consisting of 6 × 5 min HIIE bouts at 82 % PPO (mean ± SD; 316 ± 40 W) separated by 1 min at 100 W. Then after 2 min recovery at 100 W, TT10 was performed. Oral NAC (100mg.kg<sup>-1</sup> per dose) supplementation was mixed with sports drink and consumed twice daily for 2 days, and 1h pre-trial. Expired gases for indirect calorimetry, electromyographic (EMG) data and venous bloods were collected. Results Respiratory exchange ratio (RER) was 2.9 ± 1.7% and 2.0 ± 1.4% lower with NAC in HIIE bouts 1 and 5, respectively (P<0.05). Fat oxidation was elevated with NAC compared to placebo during HIIE bouts 5 and 6 (9.9 ± 8.9 vs. 3.9 ± 4.8 μmol.kg<sup>-1</sup>.min<sup>-1</sup>; P<0.05), as was blood glucose throughout HIIE (4.3 ± 0.6 vs. 3.8 ± 0.6 mmol.L<sup>-1</sup>; P<0.05). Blood lactate was lower with NAC after TT10 and recovery (3.3 ± 1.3 vs. 4.2 ± 1.3 mmol.L<sup>-1</sup>; P<0.05). Blood glutathione was not significantly affected by NAC (P>0.05). Median EMG frequency of the Vastus lateralis was lower with NAC during HIIE (79 ± 10 vs. 85 ± 10 Hz; P<0.05), but not TT10 (82 ± 10 vs. 83 ± 12 Hz; P=0.32). Finally, NAC decreased mean power output 4.9 ± 6.6 % (effect size -0.29 ± 0.37, mean ± 90% CI) during TT10 (305.4 ± 57.4 W vs 319.1 ± 45.5 W). **Discussion** Our findings indicate that NAC altered glycolytic metabolism as shown by the reduced blood lactate concentration and RER during HIIE, along with a relative increase in fat oxidation. Furthermore, EMG frequency shifts were indicative of an attenuation of fast twitch glycolytic muscle fibre recruitment. In summary, these data suggest that NAC alters substrate metabolism and muscle fibre-type recruitment during HIIE and is detrimental to subsequent TT10 performance.

### LIPID PEROXIDATION AND ANTIOXIDANT ADAPTATION IN REGULAR TRAINING

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**Introduction** Exercise induces a multitude of physiological and biochemical changes capable to rise free radical production which trigger a chain of damaging reactions known as lipid peroxidation and oxidative stress. On the other hand continued presence of low concentration of RONS can serve as a stimulants for expression of antioxidant enzymes, indicating that regular exercise can decrease the incidence of wide range of RONS associated diseases. The aim of this work was to examine the effect of regular exercise on lipid peroxidation and antioxidant adaptation. **Methods** Lipid peroxidation markers (malondialdehyde-MDA, % ind MDA) and antioxidant status (ascorbic acid-Asc, ascorbat-A, dehydroascorbat-DHA and ratio DHA/A, GSH and CAT) were estimated at 30 sportsmen (regular training group) and 30 sedentary students (control group) at rest. Results Sportsmen under regular training showed increased level of MDA and %indMDA compared to control (4,26 vs. 3,04 μM/L, p<0,0001; 41,77% vs. 35%, p=0,045). Plasma antioxidant capacity was higher in sportsmen (Asc: 62,27 vs. 55,4 μM/L; DHA/A: 2,16 vs. 1,62 p=0,022; GSH: 25,8 vs. 22,4 μM/L p=0,0018). Only activity of CAT didn't show significant change (2,91 vs. 3,50 mK/L p=0,88). **Discussion** Our results are consistent with findings of other researchers (Brites et al., 1999). The potential role of RONS in exercise induced adaptation has been recognized and it seems that effects are systemic. They include increased antioxidant damage-repair enzyme activity, lower oxidative damage and increased resistance to oxidative stress. Antioxidant supplementation in regular exercise should be performed carefully since it can prevent useful adaptation effect (Radak et al., 2008). **Conclusions** Sportsmen under regular training showed increased lipid peroxidation but also an improved plasma antioxidant status compared to sedentary students. Training induced antioxidant adaptation reduces the risk of cellular injury during exercise. References Brites FD, Evelson PA, Christiansen MG, Nicol MF, Basilio MJ, Wikinski RW and Lesuy SF. (1999). Soccer players under regular training show oxidative stress but an improved plasma antioxidant status. Clinical Science, 96, 381-385. Radak Z, Chung HY and Goto S. (2008). Systemic adaptation to oxidative challenge induced by regular exercise. Free Radical Biology & Medicine, 44, 153-159.

### OXIDATIVE STRESS STATUS IN ELITE ATHLETES OF DIFFERENT SPORT DISCIPLINES

Hadzovic-Dzuvo, A.1, Valjavec, A.1, Hadzimiratovic, A.1, Mekić, A.2, Lepara, O.1

1:Faculty of Medicine, University Sarajevo (Sarajevo, Bosnia and Herzegovina) 2:Faculty of Sport and Physical Education, University of Sarajevo (Sarajevo, Bosnia and Herzegovina)

**Introduction** Exercise training may increase production of free radicals and reactive oxygen species (ROS) in different ways. The training type and intensity may influence free radicals generation, which leads to differences in oxidative stress status between athletes, but the results of the previous studies are inconsistent. The aim of this study was to estimate oxidative stress status in elite athletes of different sport disciplines. **Methods** The study included 40 male elite athletes divided in three groups according to the sport type: 15 wrestlers, 12 soccer players and 13 basketball players. All the athletes were highly skilled professional competitors with international experience (2 Olympic players). Blood samples were taken from 8-10 a.m. after 12 overnight fast. Serum total antioxidative capacity (ImAnOX) and advanced oxidation protein products (AOPP), as markers of oxidative stress status, were determined by photometric tests (Immun Diagnostik). The results were presented as mean±SD. The variables were tested by ANOVA. **Results** The mean ImAnOX concentration was 344.8±35.6 µmol/L in soccer players, 342.5±36.2 µmol/L in wrestlers and 345.0±31.3 µmol/L in basketball players ( $p=0.133$ ; NS). The mean AOPP concentration in soccer players was 60.0±23.0 µmol/L, in wrestlers 68.5±30.8 µmol/L and 69.9±29.1 µmol/L in basketball players, but the difference was not significant ( $p=0.424$ , NS). There was no significant correlation between ImAnOX and AOPP concentration in soccer players ( $r=0.13$ ), wrestlers ( $r=0.325$ ) nor in basketball players ( $r=-0.119$ ). **Discussion** Our results showed no significant differences in the levels of oxidative stress status markers among various elite sports athletes. In spite of this fact, average concentrations (tests instructions proposed values) indicated high level of oxidative stress accompanied with increased antioxidative response in all groups. In accordance to the previous studies (Marin DP et al., 2011; Djordjevic et al., 2012) our results indicate that elite sports engagement is a potent stimulus of oxidative stress that leads to the large recruitment of antioxidative defense. Oxidative stress status monitoring and intervention in consumption of antioxidants is recommended as a part of training regime. **References** Martinovic J, Dopsaj V, Kotur-Stevuljevic J, Dopsaj M, Stefanovic A, Kasum G, Vujovic A. (2010). *Serb Sport Sci*, 4, 75-81. Marin DP, dos Santos Rde C, Bolin AP, Guerra BA, Hatanaka E, Otton R. (2011). *Oxid Med Cell Longev*, 1-11. Djordjevic B, Baralic I, Kotur-Stevuljevic J, Stefanovic A, Ivanisevic J, Radivojevic N, Andjelkovic M, Dikic N. (2012). *J Sports Med Phys Fitness*, 52(4), 382-392.

### MUSCLE ISCHEMIC PRECONDITIONING DOES NOT IMPROVE EXERCISE PERFORMANCE DURING 5000 M RUNNING SELF PACED EXERCISE

Crisafulli, A.1, Marongiu, E.1, Ghiani, G.1, Sanna, I.1, Palazzolo, G.1, Olla, S.1, Pusceddu, M.1, Sanna, P.1, Corona, F.2, Concu, A.1, Tocco, F.1

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**Introduction** Classically, the ischemic preconditioning (IP) refers to a protective phenomenon against cell injury induced by infarction (Crisafulli et al. 2004). Moreover, muscle IP has been found capable of improving exercise performance in laboratory testing (Crisafulli et al. 2011, de Groot et al. 2010). This investigation aimed at verifying the hypothesis that IP improved performance during self-paced exercise (SPE) in the field. **Methods** Eleven healthy male well trained runners performed three randomly assigned 5000 m self-paced running tests in a outdoor athletic track. One was the reference (RT) test, while the others were performed after muscle IP (IPT) and a control sham test (ST). Average speed was measured during each test. Mean values of heart rate (HR), oxygen uptake (VO<sub>2</sub>), aerobic energy cost (AEC), and blood lactate (BLa) after race were also gathered. **Results** It was found that none of the studied variables were affected neither by IPT nor by ST with respect to the RT test. In detail, speed was on average 4.32±0.31, 4.79±0.29, and 4.45±0.32 m·s<sup>-1</sup> for the RT, the ST, and the IPT test respectively. HR was 176.4±8.8, 173.8±5.4, and 175.4±5.8 bpm. VO<sub>2</sub> was 3.5±0.69, 3.74±0.85, and 3.62±1.19 l·min<sup>-1</sup>. AEC was 1.04±0.15, 1.08±0.1, and 1.09±0.15 kcal·kg<sup>-1</sup>·km<sup>-1</sup>. Finally, BLa after races reached a level of 12.85±3.54, 11.88±4.74, and 12.82±3.6 mmol·l<sup>-1</sup>. **Discussion** Findings of the present investigation indicate that ischemic preconditioning is not capable to ameliorate performance during self paced exercise in the field. These results are in contrast to what previously found in the laboratory setting. Possible reasons for this outcome are: i) the different fitness level of the subjects enrolled in the present investigation with respect to that of other studies, as the present study was conducted in highly trained athletes; ii) the different setting between laboratory fixed-work output and SPE testing, since, apart from classical physiological and metabolic feed-backs, during SPE fatigue is the consequence of other factors such as athlete' experience, motivation, expected effort duration etc., which all may affect performance outcome. **References** Crisafulli A, Melis F, Tocco F et al (2004). *Am J Physiol (heart circ physiol)* 87, H235-H242. Crisafulli A, Tangianu F, Tocco F et al. (2011). *J Appl Physiol* 111, 530-536. de Groot PCE, Thijssen DHJ, Sanchez M et al. (2010) *Eur J Appl Physiol* 108, 141-146.

### INFLUENCE OF STRENUOUS EXERCISE ON LIPID PEROXIDATION AND NEUTROPHIL INFLAMMATORY RESPONSE IN SEDENTARY PEOPLE

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**Introduction** Beside the fact that sources of free radical production during exercise continue to be debated it is undoubtedly that intense exercise can result in oxidative modification of lipids and proteins. This process also leads to acute inflammation and diminished muscle force production. Inflammatory response is followed by infiltration of the affected areas by neutrophils, their degranulation, and increased metabolic activity associated with additional free radical formation. That process has been indicated by the increased concentration of myeloperoxidase (MPO) in circulation following an exercise bout. The purpose of this study was to examine influence of strenuous exercise on oxidative stress generation and neutrophil inflammatory response in sedentary students. **Methods** Experiment was conducted on 30 male sedentary students. Strenuous exercise was performed using Bruce treadmill protocol (Wilmore et al, 2005). Markers of lipid peroxidation (malondialdehyde MDA, indMDA, % indMDA) and myeloperoxidase activity (MPO) were estimated at rest and after exercise test. **Results** It was found that after the treadmill test the level of MDA in plasma increased from 3,04 to 4,39 µM/L,  $p<0,0001$ ; the same as indMDA (4,60 vs. 5,71 µM/L  $p=0,0006$ ). After the exercise protocol % indMDA significantly decreased (35% vs. 24,71%,  $p=0,0003$ ). MPO in plasma was also found to be higher after treadmill test comparing to rest level (45,8 vs. 62,5 U/L,  $p<0,0001$ ). **Discussion** Significantly increased concentration of MDA, indMDA and decrease of % indMDA after performed test demonstrate increased lipid peroxidation process and oxidative stress induced by strenuous exercise. Increased activity of MPO in plasma after exercise test pointed the role of acute inflammation and neutrophil degranulation in oxidative stress induced by strenuous exercise. Our results are consistent with findings of other researchers (Morzov et al, 2003). **Conclusions** This results clearly show that strenuous exercise performed by sed-

entary people induce oxidative stress generation pointing the role of neutrophil inflammatory response in that process. References Wilmore JH & Costill DL. (2005). *Physiology of Sport and Exercise: 3rd Edition*. Champaign, IL: Human Kinetics Morozov V, Pryatkin S, Kalinski M & Rogozkin V. (2003). Effect of exercise to exhaustion on myeloperoxidase and lysozyme release from blood neutrophils. *Eur J Appl Physiol*, 89, 257-262.

### **INFLUENCE OF STRENUOUS EXERCISE ON OXIDATIVE STRESS AND ANTIOXIDANT DEFENSE IN SEDENTARY PEOPLE**

Popovic, L.1, Mitic, N.1, Radic, I.1, Miric, D.2, Djokic, T.1

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Introduction It is well known that strenuous exercise, especially then sporadic, causes structural damage or inflammatory reaction within the muscle. Muscle cells are susceptible to oxidative stress and numerous mechanism have been postulated to explain the progressive cell and tissue damage produced by RONS. As a result of lipid peroxidation, cell membrane fluidity decrease leading to inhibition maintain of ionic gradient. Malondialdehyde (MDA) is consistent marker of exercise induced oxidative stress and lipid peroxidation. The blood antioxidant defense is a complex system consisting of various molecules capable to prevent, limitate and repair damages induced by RONS. The aim of this work was to examine the occurrence of oxidative stress during strenuous exercise and to determinate consequent antioxidant response. Methods Experiment was conducted on 30 male sedentary students. Strenuous exercise was performed using Bruce treadmill protocol (Wilmore et al, 2005). Markers of lipid peroxidation (MDA) and antioxidant status (ascorbic acid Asc, dehydroascorbate / ascorbate rate DHA/A, catalase CAT, glutathione GSH) were estimated at rest and after exercise test. Results MDA level in plasma significantly increased after exercise compared with the rest level (from 3,04 to 4,40  $\mu\text{M/L}$ ,  $p < 0,0001$ ). Increased levels of Asc (from 55,4 to 67,37  $\mu\text{M/L}$   $p < 0,0001$ ) and DHA/A rate (1,62 to 2,05  $p = 0,0014$ ) were also obtained in plasma after performed test. There was no significant change in GSH level (21,4 vs. 23,37  $\mu\text{M/L}$   $p = 0,19$ ) and activity of catalase significantly decreased (3,50 vs. 2,75  $\text{mK/L}$ ) after exercise. Discussion Increased concentration of MDA, after performed test demonstrate increased lipid peroxidation process and oxidative stress induced by strenuous exercise. Increased concentration of ascorbic acid and DHA/A rate in plasma after exercise suggest activation of antioxidant defense system and ascorbic acid mobilization from tissues (dominantly adrenal gland). Our results are consistent with findings of other researchers (Fisher-Wellman et al, 2009). Conclusions Strenuous exercise induces oxidative stress generation, increased lipid peroxidation and subsequently activation of antioxidant defense system. References Wilmore JH & Costill DL. (2005). *Physiology of Sport and Exercise: 3rd Edition*. Champaign, IL: Human Kinetics Fisher-Wellman K & Bloomer R. (2009). Acute exercise and oxidative stress: a 30 year history. *Dynamic medicine*, 8:1 doi:10.1186/1476-5918-8-1.

### **INTRADIALYTIC TRAINING PROGRAM EXERTS BENEFICIAL EFFECTS ON OXIDANT STRESS AND IMPROVES AEROBIC FITNESS IN PATIENTS SUFFERING FROM CHRONIC KIDNEY DISEASE**

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Introduction Patients with chronic kidney disease (CKD) suffer from a variety of co-morbid diseases creating a vicious circle that leads to gradually inactivity (Painter et al. 2005). Inactivity contributes, in turn, to reduced physical functioning and increases mortality. Cardiovascular (CV) diseases are recognized as the major cause of mortality in this population (Foley et al. 1998). However, the traditional CV risk factors cannot completely explain this increased CV risk. Chronic oxidant stress (OS) and inflammation state have been proposed as nontraditional CV risk factors in CKD (Himmelfarb et al. 2000). If it is well known that regular physical activity may improve OS and inflammation in healthy subjects, no study have investigated together, these 2 nontraditional CV risk factors in CKD. Therefore, the aim of this study was to determine whether an intradialytic aerobic training program 1)- reduce OS and inflammation markers and 2)- improve aerobic fitness and lipid profile in CKD patients. Methods Eighteen haemodialysis patients (66.5 $\pm$ 11,5yrs) were randomly assigned to either intradialytic physical training (30min of cycling, 60% VO<sub>2</sub>peak, 2x/week) group (EX; n=9) or a non-exercising control group (CON; n=9). At baseline and 3 months later, body composition (total body mass, fat free mass, fat mass), aerobic fitness ( , 6-min walk test) markers of pro/antioxidant status (plasma isoprostanes; erythrocytes SOD, GPX activities and GSH/GSSG ratio), inflammation (CRP) and lipid profile (TG, total cholesterol, HDL, LDL) were determined. Results Intradialytic aerobic training protocol did not alter body composition and inflammatory markers but had some beneficial effects on aerobic fitness, lipid profile and OS markers. Indeed, performance on the 6-min walk test significantly increased by 14.7% in EX, but did not change in CON. Plasma TG were significantly reduced by 23% in EX without no change in CON. After the 3 month period, the EX group exhibited lower isoprostanes level compared to CON (28.8 $\pm$ 9.5 vs 44.8 $\pm$  13.7 respectively,  $p < 0.001$ ). Conclusion These results demonstrate that intradialytic aerobic training protocol may improve OS, cardiorespiratory and lipid profiles in CKD patients leading to a decrease of CV risk factors. References Foley R, Parfrey P, Sarnak M. (1998). *Kidney Dis*, 32 :S112– 119 Himmelfarb J. *Contrib Nephrol* 2008; 161: 132–137 Howden E, Fasset R, Isbel N, Coombes J. (2012). *Sports Med*, 1,42(6),473-88 Lavrovsky Y, Chatterjee B, Clark R, Roy A. *Exp Gerontol* 2000; 35: 521–532 Painter P. (2005) *Hemodial Int*, 9, 218–235

### **ECONOMY OF CHILDREN'S MOVEMENTS TO TREADMILL SPEEDS AND PHYSICAL ACTIVITY LEVELS**

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Introduction Oxygen cost and metabolic/gross economy (GE) of movement to exercise (increasing speed (TS)) vary with increases in body stature/growth. Whether stature/growth profiles and/or body composition and fitness factors have a similar impact on children's GE when indexed to physical activity (PA) levels (quantified by accelerometry) is unclear. Is the relationship between GE for PA comparable to GE for TS? The purpose of this study was to determine the GE of children's participation to varying levels of physical activity and assess their relationships to stature, body dimensions and body composition. Procedures Children (9.8 $\pm$ 0.9 yrs) were assessed for VO<sub>2</sub>, HR, VCO<sub>2</sub>, and RER over treadmill speeds (66.6, 99.6 and 132.6m/min for 3 min each at 0% grade). Accelerometers (ActiGraph GT1X - hip) were used to quantify physical activity (PA) levels in counts/min (3sec epochs). Gross economy (GE) for treadmill speed (TS) was expressed as relative VO<sub>2</sub>/m/min from 66.6 and 132.6 m/min; and GE for physical activity (PA) was expressed relative VO<sub>2</sub>/cnt/min from 2000-6000 cnts/min. ANOVA and statistical comparisons were assessed at a  $p = 0.05$ . Results The GE-TS (VO<sub>2</sub>/m/min) for children (height 155.0 $\pm$ 5.6cm; weight 64.6 $\pm$ 11.3kg) increased from 0.170 $\pm$ 0.017 to 0.213 $\pm$ 0.018 over speeds of 66.6 and 132.6 metres/min ( $p < 0.05$ ). The relationships ( $r^2$ ) between GE-TS and height and leg length (LL) were -0.92 and -0.88, respectively ( $p < 0.05$ ). The PA levels varied from 2071 $\pm$ 308 to 5465 $\pm$ 1424 counts/min ( $p < 0.05$ ). The GE-PA (VO<sub>2</sub>/cnt/min) values ranged from 0.0056 $\pm$ 0.001 and 0.0057 $\pm$ 0.001, respective-

ly ( $p > 0.05$ ). The relationships ( $r^2$ ) between GE-PA and height and leg length (LL) were -0.13 and -0.31, respectively ( $p > 0.05$ ). BMI, body fatness and aerobic power were related to GE-PA but not GE-TS. Minimal relationship was observed for GE-TS and GE-PA ( $r^2 = 0.01$ ). Discussion The primary finding was that metabolic/gross economy for children participating over a range of treadmill speeds and physical activity levels are impacted differently by stature/growth. As predicted GE-TS was highly related to stature/growth; in contrast minimal impact was observed for GE-PA and stature/growth. The GE-PA was related to BMI and aerobic power over the range of PA assessed. Therefore, the GE differences observed for TS and PA needs to be considered when estimating children's oxygen consumption from ACC-derived PA linear regression during laboratory (i.e., TM), active play and/or activities of daily living. Supported by GSK, Canada

### **ELECTROMYOGRAPHIC THRESHOLD OCCURS AFTER ATTENUATION OF MUSCLE DEOXYGENATION DURING INCREMENTAL KNEE-EXTENSION EXERCISE**

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**BACKGROUND** Muscle deoxygenation follows an S-shaped profile and the response displays a slow down or plateau point (the attenuation point of muscle deoxygenation (APMD)) at high intensity despite further increase in pulmonary oxygen uptake during incremental whole body exercise, which mechanism is still unclear. However, previous studies suggested the mechanism might be a change in muscle fiber type recruitment where EMGT occurs incidentally to APMD, a change in muscle oxidative metabolism balance or a commencement of the other muscle deoxygenation (Osawa et al. 2012). However, no study has ever examined whether EMGT occurs after APMD during incremental small-muscle-mass exercise. **PURPOSE** To clarify whether EMGT occurs after APMD during incremental knee extension exercise in the rectus femoris (RF). **METHODS** Five subjects performed incremental knee extension exercise (20 Nm increment per a stage, every two minutes from 20 Nm until exhaustion) on the dominant leg using isokinetic ergometer (Biodex, BDX-4, Sakai Medicine). The exhaustion was defined as the point when the subjects were unable to achieve their target muscle power three repetitions in a row. The subjects were instructed not to eat foods and not to play hard exercise three hours prior to this test. Muscle deoxygenation using near-infrared spectroscopy (NIRS) and electromyography (EMG) activity using surface EMG in the RF were simultaneously measured during incremental knee extension exercise. The values of muscle deoxygenation and EMG were continuously plotted every 10 s. The error sum of squares of each regression line was calculated, and when the sum of the error sum of squares of the two lines was minimal, the intersection between the two lines was determined as APMD and EMGT. **RESULTS** During the incremental knee extension exercise, APMD occurred ( $462.0 \pm 78.5$  s) significantly earlier than EMGT ( $586.0 \pm 37.1$  s) ( $P < 0.05$ ). The subjects became exhaustive at  $618.0 \pm 44.4$  s. The power output at APMD ( $88.0 \pm 10.9$  Nm) was significantly lower than EMGT ( $116.0 \pm 8.9$  Nm) ( $P < 0.01$ ). There was no significant correlation between APMD and EMGT. **CONCLUSION** This study suggested that EMGT occurs after APMD in the RF and the possibility of the change in muscle fiber type recruitment could be excluded from the mechanism for the occurrence of APMD during incremental knee extension exercise. **REFERENCES** Osawa et al. Journal of Japanese College of Angiology 2012; 52: 103-107

### **ARTERIO-VEINUS OXYGEN DIFFERENCE AS A MEASURE OF RECOVERY KINETICS FOLLOWING CONCENTRIC-ECCENTRIC ISOKINETIC ARM AND LEG EXERCISE**

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*Bloomsburg University*

**Introduction** Assessments of dynamic changes in recovery respiratory kinetics following resistance exercise can provide information on the control and regulation of O<sub>2</sub> transport and utilization. An important parameter in this context is the arterio-venous difference in O<sub>2</sub> concentration (avDO<sub>2</sub>). The avDO<sub>2</sub> measured by respiratory oxygen uptake (V'O<sub>2</sub>) and cardiac output (CO) may be used as an indicator of the synchronization of muscle perfusion and muscular O<sub>2</sub> demands. Moreover, the delay between offset in exercise and changes in the avDO<sub>2</sub> can be used as an indicator of transport delays between muscle and lungs. **Methods** Thirteen healthy male subjects aged  $26.9 \pm 3.1$  years, performed a 20-repetition isokinetic (combined, concentric and eccentric) arm or leg exercise protocol at 60 deg/s, 150 deg/s, and 240 deg/s, in randomized order. Recovery (150 seconds) breath-by-breath V'O<sub>2</sub> and beat-to-beat CO by impedance cardiography were recorded to determine post-exercise avDO<sub>2</sub>. Statistical analysis for the peaks of avDO<sub>2</sub> (see below) were analyzed for amplitude and maximum time via a two-way (factors: 'limb' × 'speed') ANOVA for repeated measurements. **Results** The first peak was identified in 76 of 78 cases. Amplitudes of the first peak (mL/L) ranged from 186 (SD 52) at 60 deg/s to 174 (SD 32) at 240 deg/s for the arms; 174 (SD 32) at 60 deg/s to 179 (SD 42) for the leg exercise. Time to attain the first peak ranged from 7.2s at 60 deg/s to 6.8s at 240 deg/s for the arms; 8.2s at 60 deg/s to 5.6s at 240 deg/s for the legs. There were no significant between factors differences for the first amplitude of the avDO<sub>2</sub> curves. These first peaks were significantly influenced ( $P = 0.032$ ) by muscle mass (i.e. arm versus leg) involved. A second avDO<sub>2</sub> peak was identified in 45 of 78 cases. Since there was no systematic pattern of distribution of these second waveforms across the testing conditions, no further analyses were conducted. **Discussion** It can be assumed that the restriction of muscle blood flow during sets of concentric-eccentric contractions inhibits aerobic metabolism at the end of this phase. At the onset of recovery, the first avDO<sub>2</sub> wave is caused by the arrival of O<sub>2</sub> desaturated blood from the muscle to the lungs. This delay results from the occlusion of venous volume and blood flow within the active musculature. Therefore, the second avDO<sub>2</sub> 'wave' represents this imbalance in perfusion during recovery. This delay between the offset in exercise and changes in the avDO<sub>2</sub> can be used to gauge transport delays between the muscular and pulmonary sites. **References** Cunningham D, St Croix, C, Paterson D., Özyener F, Whipp B. (2000). Exp. Physiol. 85, 339-347. Haseler L, Hogan M, Richardson R. (1999). J. Appl. Physiol. 86, 2013-2018. Lai N, Nasca M, Silva M, Silva F, Whipp B, Cabrera M. (2008). Appl. Physiol. Nutr. Metab. 33, 107-117. Linnarsson D. (1974). Acta Physiol. Scand. 415, 4-68.

14:00 - 15:00

## Mini-Orals

## PP-PM51 Physiology [PH] 18

**THE INFLUENCE OF MOTORCYCLE CLOTHING ON HUMAN BODY**

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**Introduction** Since 20th century motorcycles alongside being a very popular sport, have also become a very popular means of transport. However, riding a motorcycle involves greater risk of accidents than car driving. A motorcyclist is not protected by any security cage. In fact, the only protection motorcyclists have is specialized motorcycle clothing. It is specifically designed to protect not only against the weather conditions, but also against burns from hot parts of a motorcycle and hits by small stones. But first of all, motorcycle apparel is the only protection at the time of the fall or collision with other vehicles or objects. This abstract presents the role of motorcycle clothing and its influence on a human body. **Methods** To verify the influence of motorcycle clothing on the human body, the experiments with the participation of 6 volunteers were conducted. Selected physiological parameters, e.g. core body temperature, skin temperature, humidity between underwear and a human body were measured. Tests were performed *inter alia* in a climate chamber. A single test of motorcycle clothing was divided into several stages, including: measurement of the above mentioned parameters at rest time (21-22°C laboratory and climatic chamber 28°C), during exercise (climatic chamber), and recovery time (climatic chamber). **Results** Based on the obtained results, it has been found out that the motorcycle clothing combined with moderate exercises (30min-75W) and a high temperature affects the human thermoregulatory system. In all testing sets of motorcycle clothing, volunteers obtained a high core temperature ( $t_{core} > 38^{\circ}\text{C}$ ). Moderate exercise resulted in an increase of the value by about  $1^{\circ}\text{C}$ . Even a physiological parameter, such as a skin temperature, exceeds the calculated value of the comfort temperature (at a rest phase). After the test the skin temperature remained within the range of  $35.4 \pm 0.2^{\circ}\text{C}$ . During the tests, in the space between clothing and a body, high values of relative humidity (90%) were noted (on the chest). Volunteers' subjective assessment revealed that thermal comfort was maintained only for leather clothing and it lasted 20min from the moment of putting the clothes on. **Discussion** The obtained results of this study showed that motorcycle clothing affects the human thermoregulatory system. According to the ISO 7933 the recommended threshold safe value of  $t_{core}$  is  $38^{\circ}\text{C}$ . It is inadvisable to exceed that value. The high relative humidity ( $>70\%$ ) in the space between a body and clothing can cause sensation of steaming, dyspnoea and severe discomfort, additional increased by the presence of liquid sweat on the skin (Bartkowiak 2010). Therefore, one should be aware of the impact of motorcycle clothing and climatic conditions on the thermal load of the body. **References** Bartkowiak G. (2010). FTEE 4(81) 82-86. ISO 7933:2004 Ergonomics of the thermal environment.

**ANTHROPOMETRICAL CHARACTERISTICS AND AEROBIC CAPACITY AS SUCCESS PREDICTORS IN DANCESPORT**

Liiv, H.1, Wyon, M.2, Jürimäe, T.1, Mäestu, J.1, Jürimäe, J.1

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**Introduction** Ballroom dancing has become a worldwide popular sport aspiring Olympic status. In competitions, dancers are judged both on technical skill and on expressiveness. The aim of the current study was to investigate international level dancesport participants' anthropometrical characteristics and aerobic capacity in relation to the gender, dance style and international ranking. It was hypothesized that dancers with better aerobic capacity are having higher places in international ranking and that anthropometrical characteristics are influencing international ranking result. **Methods** Thirty competitive dancesport couples served as subjects for this study. Twelve couples competed in Standard competitions, 7 Latin and 11 in Ten Dance. Their mean training experience was  $14.9 \pm 5.1$  yrs and training volume was  $11.8 \pm 6.3$  hours per week.  $\text{VO}_2 \text{ max}$  was measured during an incremental treadmill test and anthropometrical parameters followed ISAK guidelines (Norton and Olds, 1996). The Carter and Heath (1990) anthropometric somatotyping method was used to calculate participants body type. International ranking results were collected on testing day from DancesportInfo Rating System (<http://dancesportinfo.net/DisplayTopCouples.aspx>). **Results** Male and female dancers had mean  $\text{VO}_2 \text{ max}$  of  $60.0 \pm 5.2$  and  $51.5 \pm 6.0$   $\text{ml} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$ , respectively and no correlation with international ranking was evident. Standard dancers tend to be more ectomorphic with greater stature, arm span and sitting height compared with Latin American dancers. Although Standard dancers were ectomorphic, those dancers who had higher mesomorphic scores had higher international ranking. **Discussion** The results of present investigation demonstrated that international level dancesport participants of different styles have relatively high aerobic capacity values compared to dancers from other genres. However anthropometrical characteristics did influence international rating; in Standard dance participants with higher muscularity had a higher international ranking. **References** Carter, J E L, Heath, B H, (1990). Somatotyping-development and applications. In Lasker, G W, Mascie-Taylor, C G N., Roberts, D F. Cambridge Studies in Biological Anthropology. Cambridge University Press, Cambridge. Norton, K, Olds, T, (1996). Anthropometria. UNSW Press, Sydney.

**BRAIN CORTICAL ACTIVITY DURING PRONE BRIDGING**

Verschuere, J., De Pauw, K., Tellez, H.F., Roelands, B., Berckmans, B., Meeusen, R.

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**Introduction** Prone bridging (PB) is described as a timed isometric test to evaluate core endurance in which stability is regulated by supraspinal control mechanisms (Slobounov et al., 2005). The aims of this study are to examine brain functioning during PB until volitional exhaustion and to localize exercise induced changes in brain activity using spectral analysis. We hypothesize that cortical activation will increase during PB and that less core trained individuals will show a more pronounced shift towards higher brain oscillations during PB. **Methods** Forty university students ( $22.1 \pm 0.97$  years;  $\text{BMI}: 22.9 \pm 2.0$ ) participated in this study. Continuous EEG data (sampling rate: 500Hz, impedance  $< 5\Omega$ ) were derived from 32 active Ag/AgCl electrodes while participants performed a PB until volitional exhaustion. Subjects were divided in better (BCT) and less core trained (LCT) according to the duration of the PB, using percentile 25 for LCT and percentile 75 for BCT. Seven BCT and ten LCT were included for data analysis. Dorsolateral prefrontal, fronto-central and central brain areas were

selected for data analysis. EEGLab was used to clean and process the datasets. For each four seconds datasets (frequency bins: 0.25Hz) the discrete Fourier transform was calculated ( $\mu V^2$ ) to calculate the power spectrum. Kolmogorov-Smirnov tests and ANOVA repeated measures were conducted. Level of statistical significance was set at 0.05. Results Cortical activity decreases across the power spectrum at the beginning of PB compared to baseline, whereas cortical activity gradually increases during PB with highest values at the end of the PB. Time until volitional exhaustion was  $336 \pm 97$ s in BCT and  $129 \pm 30$ s in LCT ( $p < 0.05$ ). The most pronounced changes in the power spectrum were observed within  $\beta$ -2 and  $\gamma$  frequency bands, especially localized in FP1 and FP2. Although a shift to these higher frequencies and higher absolute power values during exercise was noticed earlier for LCT compared to BCT, no significant differences were found. Discussion Cortical activation increases during isometric postural control exercises until volitional fatigue. Furthermore, the LCT group showed a tendency toward higher activation of faster brain oscillations towards the end of the PB. Moraes et al (2007) suggest that an increased power in the  $\beta$  frequency band is in association with increased arousal, attention and stress. Further research is needed to determine if cortical activation can change using core stability training. References Slobounov et al. Clin. Neurophys 2005;116:315-323 Moraes, et al. Arq Neuropsiquiatr 2007;65(3-A):637-641

## EFFECTS OF COMPRESSION GARMENT FOR 10 HOURS BEFORE AND DURING WARM-UP ON SUBSEQUENT CYCLING AND RUNNING PERFORMANCE

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Compression garments (CG) have historically been used to treat circulatory illness, such as venous thromboembolism and leg ulcers (Dascombe, Hoare, Sear, Reaburn, & Scanlan, 2011). More recently, CG have been widely adopted by both competitive and recreational athletes before, during and after exercise and competitions (Sperlich et al., 2010). There are studies confirmed the ergogenic effects of CG on sport performance, such as attenuation of muscle oscillation (Bringard, Perrey, & Belluye, 2006), increased arterial perfusion (Bochmann et al., 2005), improved peripheral circulation and venous return (Agu, Baker, & Seifalian, 2004). The trend of effects of CG is more positive on the recovery process after exercise, but does not always shown significant effects during exercise from previous studies. Triathlon is one of the fastest developing sports in last decade. Athletes need to get their muscles warmed up to its optimal condition and be ready for the mass-start of swimming. At the same time, there are often limited time and space for athletes to warm-up on site before competition. It will be useful information for coaches and athletes to plan their warm-up strategies if CG can accelerate the warm-up process and enhance the readiness of muscle for the aggressive start of competition. There are also controversial results from previous studies of CG, and lack of scientific evidence on confirming those assertions in a triathlon setting. Therefore, the aim of this study is to investigate the effects of CG for 10 hours before and during warm-up on subsequent cycling and running performance. References Agu, O., Baker, D., & Seifalian, A. M. (2004). Effect of graduated compression stockings on limb oxygenation and venous function during exercise in patients with venous insufficiency. *Vascular*, 12(1), 69-76. Bochmann, R. P., Seibel, W., Haase, E., Hietschold, V., Rödel, H., & Deussen, A. (2005). External compression increases forearm perfusion. *Journal of Applied Physiology*, 99(6), 2337-2344. Bringard, A., Perrey, S., & Belluye, N. (2006). Aerobic energy cost and sensation responses during submaximal running exercise: Positive effects of wearing compression tights. *International Journal of Sports Medicine*, 27(5), 373-378. Dascombe, B., Hoare, T., Sear, J., Reaburn, P., & Scanlan, A. (2011). The effects of wearing undersized lower-body compression garments on endurance running performance. *International Journal of Sports Physiology and Performance*, 6(2), 160. Sperlich, B., Haegele, M., Achtzehn, S., Linville, J., Holmberg, H. C., & Mester, J. (2010). Different types of compression clothing do not increase sub-maximal and maximal endurance performance in well-trained athletes. *Journal of Sports Sciences*, 28(6), 609-614.

## PHYSIOLOGICAL CHARACTERISTICS OF ELITE FEMALE GYMNASTS

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Introduction Sporting performance is influenced by physical strength, body weight and body height (Latt et al. 2009). Especially in gymnastics age, height and strength of the upper and lower limbs seem to affect performance (Baxter et al. 2002). The purpose of the present study was to investigate the anthropometric and physiological characteristics of elite female gymnasts. Method Twelve elite female gymnasts (age:  $10.3 \pm 1.3$  yrs, body weight:  $31.3 \pm 5.8$  kg, body height:  $135.0 \pm 7.5$  cm and BMI  $17.1 \pm 1.3$  kg/m<sup>2</sup>) ranked first in the Greek national championship participated in this study. Upper limbs strength (handgrip), lower limbs strength (squat jump), flexibility (sit and reach test) and agility (agility T-test) were measured. Results are presented as mean  $\pm$  SD. Results Arm strength did not differ significantly between dominant and non dominant hand ( $12.3 \pm 4.7$  vs.  $11.9 \pm 5.5$  kg respectively,  $p = 0.43$ ). Participants also performed in high standards in squat jump ( $39.3 \pm 8.1$  cm), sit & reach test ( $34.7 \pm 3.5$  cm) and agility T-test ( $12.7 \pm 1.1$  sec). Discussion Results of the present study suggest that gymnastics training promotes symmetrical development of upper limbs strength along with lower limbs strength, agility and flexibility. References Lätt E, Jürimäe J, Haljaste K, Cicchella A, Purge P, Jürimäe T. (2009). *Coll Antropol*, 33(1):117-22. Baxter-Jones AD, Maffulli N. (2002). *Br J Sports Med*, 36(1): 13-5

## FUNCTIONAL ASYMMETRY OF MOTOR SYSTEM IN ELITE BOWLERS

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Introduction At the present time, there is limited literature that provides information about the assessment of elite bowlers' performance. Bowlers' motor activity during training and competing directly affects the athletes' entire motor system. However, the existing sources do not have any quantitative data characterizing the elite bowlers' motor system; this information is only available for cricket players (Kaminski et al, 2000; Kountouris et al, 2013). Bowlers' long-term muscular activity is associated with specific adaptational changes in their nervous and muscular systems. The goal of this study was to explore the specifics of functional asymmetry in the professional bowlers' motor system. Methods Subjects: 5 male elite bowlers taking part in European competitions (22 yrs, 177 cm high, and weighing 74 kg on the average). A Multi-Joint System Pro-4 and a Balance System SD (Biodex, USA) were used. In the first session, the athletes performed an isokinetic test by flexing and extending the left and right arm shoulder joints at various rates (90, 150, and 210 deg/sec), with 21 repetitions for both arms at each rate and 3 min pauses between sets. During the second session, the athletes performed static and dynamic balance tests; 3 attempts for both legs on a stable platform and 3 triesattempts on a dynamic platform; followed by 3 attempts for each leg on a dynamic platform. The next step was a single-leg stability test; 3 attempts for 30 seconds for each leg on a dynamic platform. The

final test was fall risk assessment; 3 attempts for 45 seconds for both legs separately on a dynamic platform. Results The tests showed some functional asymmetry between the subjects' left and right legs and shoulders. The right shoulder had more peak and average torque at different rates (both during flexing and extension) and was more stable at every rate. The right shoulder also had the best overall stability, workout during extension, power, and fatigue performance. The right leg demonstrated considerably better stability than the left leg in all tests. Discussion It is possible that the functional asymmetry of the bowlers' motor system is associated with specific neuromuscular adaptation (Fomin & Seliæv, 2011) to long-term training. In our opinion, bowlers should pay special attention to the functional asymmetry of the motor system and include exercises for reducing the asymmetry in their training programs. References Kaminski T, et al. (2000) Normative isokinetic shoulder strength values in division softball players. *J of Athletic Training*, 35 (2): 85-91. Fomin R, Seliæv M. (2011) Neuronal adaptation of corticospinal mechanisms of muscle contraction regulation in athletes. *Hum Physiol*, 37(6), 76-88. Kountouris A, et al (2013) Cricket fast bowlers without low-back pain have larger quadratus lumborum asymmetry than injured bowlers. *Clin J Sport Med*. Jan 31.

### **FAR INFRARED EMITTING FABRIC PROMOTES BETTER PERFORMANCE IN RUNNING**

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Introduction The fabric made from polyamide yarn far infrared emitting (FIRE) absorbs heat from the human body to return it in the form of far infrared rays. The infrared emission promotes an increase in mobility of body fluids promoting improvement of the circulation. This can delay fatigue and enhance performance by increasing the supply of oxygen and substrates, as well as the removal of metabolic waste. Thus, we believe that the use of FIRE(Emana®) garment promotes improvement running performance. The aim of the study was to assess the effect of FIRE garment on running performance of individuals undergoing cardiopulmonary test. Methods We analyzed 17 volunteers, 13 men (24.6 ± 3.1 years and 75.2 ± 9.5 kg) and four women (23.7 ± 4.3 years and 60.8 ± 8.4 kg), which performed two exercise tests on a treadmill until exhaustion, using FIRE and placebo garments in a cross-over, double blind and placebo control study. We measured the oxygen consumption (VO<sub>2</sub>) each breath, heart rate (HR), speed (S) and total time (TT) of running. To evaluate the efficiency of FIRE garment were compared (Student t-test) the results obtained in the peak oxygen consumption (VO<sub>2</sub>peak) and in the speeds achieved during the percentages of 60, 70, 80 and 90% of the VO<sub>2</sub>peak (ANOVA two-way). Results In the tests with FIRE garment were achieved significantly higher speeds in 70% (placebo = 9.2 ± 1.4 km/h; FIRE = 9.7 ± 1.4 km/h, p = 0.021), 80% (placebo = 10.3 ± 1.7 km/h; FIRE = 11.0 ± 1.7 km/h, p = 0.001) and 90% (placebo = 11.9 ± 1.8 km/h; FIRE = 12.6 ± 2.1 km/h, p = 0.001) of the VO<sub>2</sub>peak. However, no significant differences were found between the speeds achieved in 60% of the VO<sub>2</sub>peak, as well as in the variables VO<sub>2</sub>, HR, S and TT at the time of VO<sub>2</sub>peak. Discussion Similar results with the use of sportswear were found in the study of Youn et al. (2001) showed 3.2% increase in the performance between 75 and 80% of VO<sub>2</sub>peak with far infrared emitting garment and Kemmler et al. (2009) showed increase in performance from 1.5 to 2.2% at submaximal intensities with compressive garment. The present study found increases of 5.8%, 6.5% and 5.8% in the speed of running with FIRE garment in the percentages of 70, 80 and 90% of VO<sub>2</sub>peak respectively, two times higher than results reported in the literature. This effect may be related to the larger emitting area of the FIRE garment that covered the entire body, compared to the Youn et al. (2001) garment that consists of shorts and a shirt. Conclusion The garment made with FIRE fabric promotes an increase in the submaximal running speeds relative to peak oxygen consumption when compared to placebo garment. References Youn et al. *IJASS*, v.13, n.1, p.77-94, 2001. Kemmler et al. *J Strength Cond Res*, v.23, n.1, p.101-5, 2009.

### **A NOVEL APPROACH TO DETERMINE THE APPROPRIATE WORK RATE TO NORMALISE THE INTENSITY OF INTERVAL TRAINING TO THE MODERATE-INTENSITY DOMAIN IN POST-MENOPAUSAL WOMEN**

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Introduction: Interval Training (IT) promotes greater cardiovascular health benefits compared to traditional continuous training. However, determining the mechanistic benefit of IT requires delineation of the relative impact of work rate, work:recovery ratios and the resulting metabolic stress on the benefits attained. Conventional methods used to determine IT work rates (WR) such as % maximal oxygen uptake (VO<sub>2</sub>max) can lead to some participants training above and others below the lactate threshold (LT). Thus the exercise intensity of IT will be different between individuals, likely influencing the health benefits attained. The aim of this study was to investigate a novel method of determining the appropriate WR for IT which normalises all individuals to the moderate-intensity domain when using a work:recovery ratio of 10:10s. Methods: 9 post-menopausal women (55±4yr) completed a ramp-incremental test (RIT 15W/min) to exhaustion on a cycle ergometer. Breath-by-breath (BxB) gas exchange was used to determine VO<sub>2</sub>max and obtain a non-invasive estimate of LT. Participants then completed 2 IT sessions with a work:recovery ratio of 10:10s. Session 1: Cycling for 5 consecutive 6min blocks. WR for block 1 was set at 50% of the difference between WR at LT and VO<sub>2</sub>max from the RIT. WR for each subsequent block increased by 10W, with BxB data used to determine the highest WR at which participants remained within the moderate-intensity domain (0.05). These data confirm all individuals were exercising below the LT (1.17±0.17 l/min) and in the moderate-intensity domain. Discussion: Traditional methods used to determine WR do not account for the different influences that can affect the overall intensity of IT. The novel method proposed herein effectively determines the exact WR which will ensure IT is performed in the moderate-intensity domain.

### **CYCLING TIME TRIAL POSITION: TORSO ANGLE AFFECTS METABOLIC AND PHYSIOLOGICAL VARIABLES**

Fintelman, D., Highton, P., Adams, T., Sterling, M., Hemida, H., Li, F.X.

*University of Birmingham*

Introduction During the cycling time trial (TT), nearly 90% of the power output is used to overcome air resistance (Debraux et al. 2011). To minimize aerodynamic drag, cyclists adopt a TT position by lowering the torso. Previous studies showed that TT position reduces peak power output (PPO) compared to an upright position. However, torso angle was not systematically controlled or only a small number of positions were tested at sub maximal intensity. Therefore the aim of this study was to determine the effect of torso angle on metabolic and physiological variables in the complete range of TT positions. We hypothesised that lowering torso angle will affect these variables in a non-linear manner, with the effect decreasing as torso angle is increasing. Methods 19 trained male time trialists, performed 3-min stage incremental tests on a cycle ergometer at their preferred torso angle and at 0, 8, 16 and 24° relative to the ground. Heart rate (HR), PPO, cadence, O<sub>2</sub> uptake (VO<sub>2</sub>), CO<sub>2</sub> exhale, breathing frequency, ventilation (VE) and gross efficiency (GE) were measured throughout

the session. Results were analysed with a one-way rm ANOVA. Results All maximal values of the recorded variables increased with increasing torso angles ( $p < .001$ ). A reduction of 16% PPO was recorded between the most upright ( $24^\circ$ ) and flat ( $0^\circ$ ) position. Post hoc tests revealed the flat position limited the  $VO_2$  ( $p < .015$ ), HR ( $p < .007$ ), cadence ( $p < .041$ ) and VE ( $p < .017$ ) compared with all other torso angles. The  $VO_2$  of the preferred position fits perfectly in line with the other torso angles and consequently the mean GE was not different. Discussion The present study demonstrates that extreme torso angles limit cycling performance. These results are in contrast with previous research showing no significant difference in HR and  $VO_2$  between torso positions at maximal intensity (e.g. Origenes et al. 1993). However, previous studies have compared upright and TT positions and lack information about torso angles. The decrease in  $VO_2$  and VE in the flat position could be explained by the abdominal compression, which hinders the work of the diaphragm and limits lung volume. Another explanation could be that muscles are not working in their optimal range and therefore maximum force applied is progressively limited as torso angle is reduced. These results demonstrate that changes of torso angle produce a non-linear reduction in all metabolic and physiological variables measured. It is suggested that for non-elite cyclists, torso angles lower than  $8^\circ$  should be avoided. References Debraux P, Grappe F, Manolova AV, Bertucci W (2011). Sports Biomech 10(3):197-218 Origenes MM, Blank SE, Schoene RB (1993). Med Sci Sports Exerc 25(5):608-612

### THE EFFECT OF HIGH INTENSITY INTERVAL EXERCISE ON POSTPRANDIAL TRIACYLGLYCEROL AND LEUKOCYTE ACTIVATION

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Introduction Atherogenesis is thought to be a postprandial phenomenon associated with immune activation [1]. A single bout of high intensity interval exercise (HIIE) can attenuate postprandial triacylglycerol (TG) [2], although the longevity and mechanisms underlying this observation remain to be elucidated. The aim of this study was to determine whether this attenuation in postprandial TG remained 2 days after a bout of HIIE and to monitor markers of leukocyte activation. A secondary aim was to determine the mechanisms underlying the reduction in postprandial TG observed after HIIE. Methods Eight young men each completed two three day trials. On day 1: subjects rested (Control) or performed 5 x 30 sec maximal sprints (HIIE). On day 2 and 3 subjects consumed high fat meals for breakfast and 3h later for lunch. Blood samples were taken at various times and analysed for TG, glucose and TG-rich lipoprotein (TRL)-bound LPL-dependent TRL-TG hydrolysis (LTTH). Flow cytometry was used to evaluate granulocyte, monocyte and lymphocyte CD11b (indicates early leukocyte-endothelium adhesion) and CD36 (regulator of oxLDL uptake by monocytes) expression. Results On day 2 of HIIE TG area under the curve was lower ( $P < 0.05$ ) (7.46 [1.53] mmol/l/7h) compared to the control trial (9.47 [3.04] mmol/l/7h) with no differences during day 3 of the trial. LTTH activity was higher ( $P > 0.05$ ) in HIIE, at 2 hours of day 2, compared to control. Granulocyte, monocyte and lymphocyte CD11b expression increased with time over day 2 and 3 of the study ( $P < 0.0001$ ). Lymphocyte and monocyte CD36 expression decreased with time over day 2 and 3 ( $P < 0.05$ ), with no change within granulocytes. There were no differences between trials in CD11b and CD36 expression on any leukocytes. Discussion As previously shown [2], HIIE attenuated postprandial TG on day 2 of the study, with this effect abolished by day 3. This suggests that to benefit from HIIE, with respect to postprandial TG, HIIE will have to be performed on an almost daily basis. The reduction in postprandial TG was associated with an increase in LTTH (an indicator of LPL activity [3]). HIIE had no effect on postprandial responses of CD11b or CD36. References 1 van Oostrom et al. (2004). Atherosclerosis 177, 175–182 2 Gabriel et al. (2012). Clin. Sci. (Lond) 123, 313–321 3 Pruneta-Deloché et al. (2004). J. Lipid Res. 45, 859–865

### EMG FREQUENCY COMPONENTS OF LOWER LIMB MUSCLE ACTIVATION DURING CYCLING TO FATIGUE.

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Introduction It is uncertain whether fatigue and workload would affect muscle recruitment during cycling. Therefore, this study assessed the combined effects of changing workload and fatigue state on frequency components of lower limb muscle activation during cycling. Methods Twelve male well-trained cyclists underwent an incremental cycling test to exhaustion while muscle activation was recorded from the right and left vastus lateralis (VL), biceps femoris (BF) and gastrocnemius – medial head (GM). Muscle recruitment was assessed via frequency band analyses of muscle activation signals. Effects from workload/fatigue and differences between muscles were assessed using effect sizes. Large effect sizes have been chosen for discussion of results. Results Muscle activation increased with workload/fatigue due to greater contribution from low (BF only – 12%) but not from high frequency components and due to an overall increase in muscle activation (~64%). Greater overall low frequency activation were observed for VL (~6%) and BF (13%) compared to the GM. High frequency activation for GM was greater than observed for VL (~20%) and BF (~10%). Discussion Diefenthaler et al. (2012) showed no substantial changes in low frequency components followed by large decreases in high frequency components of muscle activation during cycling at constant load to exhaustion. However, in our results we found increases in low frequency contents of BF activation without changes in high frequency components of lower limb muscles. That could be due to its lower percentage of type I fibers and small motor units compared to VL. Only BF and VL were affected by fatigue and workload increment, which potentially was due to their role as motor drivers in trained cyclists. Diefenthaler et al. (2012) found similar results while others described changes for VL in non-cyclists (Von Tscherner, 2009). High and low-frequency components of GM did not change, different of reported in Von Tscherner (2009) assessing non-cyclists. We also observed that the high-frequency component of this muscle is greater than VL and BF. It suggests that GM could present a greater proportion of larger motor units, compared to BF and VL. In conclusion, this study demonstrated that workload/fatigue affected BF and VL without changes in GM and the different muscle activation may be attributed to a muscle fibers proportion. References Diefenthaler F, Bini RR, Vaz MA. Frequency band analysis of muscle activation during cycling to exhaustion. Rev Bras Cineantropom Desempenho Hum. 2012 Jan;14(3):243–253. Von Tscherner V. Spherical classification of wavelet transformed EMG intensity patterns. J Electromyogr Kinesiol. 2009;19(5):334–344.

### RELATIONSHIP BETWEEN ANAEROBIC THRESHOLD AND RATE OF PERCEIVED EXERCION IN HIGH LEVEL ATHLETES OF ANTIOQUIA, COLOMBIA

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INDEPORTES ANTIOQUIA - UNIVERSIDAD PONTIFICIA BOLIVARIANA UPB

Introduction The anaerobic threshold is the change from aerobic to anaerobic metabolism when sport action is executing with incremental characteristics. It is marked by multiple measurable parameters both quantitative and qualitative and determined by different meth-

ods. Rate of perceived exertion (RPE) as a qualitative and quantitative method has been used in training monitoring in high level athletes. This method has historically correlated with direct measurement methods and established a clear relationship between physiological parameters with incremental exercise test and RPE. Most studies show that RPE or Borg scale, in connection with anaerobic threshold values (12-13 on 6 to 20 scale value). Objective: RPE correlate with Ventilatory Anaerobic Threshold by ergospirometry. Methods: The study included 45 cycling, finswimming, hockey and triathlon athletes which had undergone a stress test with the RPE. Correlation was obtained between the Ventilatory Anaerobic Threshold (VT<sub>2</sub>), RPE and VO<sub>2</sub> in threshold point. We used a cycle ergometer and spirometer Oxicon Delta Jaeger, and Borg scale, ranging from 6 to 20, to determine RPE in all the subjects. For data analysis we used SPSS 15.0 software. Was carrying out a simple linear correlation in order to establish relation between oxygen consumption and RPE and calculated Pearson Correlation Coefficient. Results: It was observed that RPE in subjects analyzed was higher average to report in other studies. Furthermore, it was found that higher trainability and higher oxygen consumption, greater RPE. Conclusions The study established that analyzed variables have difference with those of previously reported studies. This is very different from findings of this study to establish a value of 16 for the threshold. It is also interesting to note that in subject available literature, correlation of VO<sub>2</sub> and RPE is similar and is given by high level training of these athletes. RPE determined by BORG scale could be a proper control method which reduces training costs and have permanent control in high level athletes. It also, could establish or correlate with other quantifiable methods such as the use of lactate to obtain a more valid criteria. References 1.Borg G. Perceived exertion as an indicator of somatic stress, *Scand J Rehabil Med.* 1970; 3: 82-88. 2.Moya J. La percepción subjetiva del esfuerzo como parte de la evaluación de la intensidad del entrenamiento. Madrid: Universidad Autónoma de Madrid; 2004 3.Chen MJ, Fan X. Criterion-related validity of the Borg ratings of perceived exertion scale in healthy individuals: a meta-analysis. *J Sports Sci.* 2002; 20 11: 873-899. 4.Anthony D, Glen E, Cheryl A. Blood lactate and perceived exertion relative to ventilatory threshold: boys and adults. *Med Sci Sports Exerc.* 1997; 29:1332-1337. 5.Baxter J, Maffulli N. Endurance in young athletes: it can be trained. *Br J Sports Med.* 2003; 37 7:96-98.

### THE INFLUENCE OF SLEEP ON RECOVERY FROM CENTRAL AND PERIPHERAL FATIGUE

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Introduction Sleep is crucial for restoring the physiological processes that maintain the body and brain properly functioning. However, it is unclear that mechanism of recovery in relation to central or peripheral fatigue resulting from muscle contraction. The interpolated twitch technique is generally used to assess voluntary activation of skeletal muscles (Kooistra et al., 2007). Additionally, the decline of voluntary activation in maximal efforts is the sign of central fatigue (Gandevia, 2001). This study, therefore, investigated the influence of sleep on recovery from sustained fatigue task using interpolated twitch technique. Methods Healthy young adults, who did not have sleep problem, underwent the 2 experimental conditions (sleep condition, control condition) in a counter-balanced order. In the sleep condition, subjects took a short sleep (about 2-hour), whereas in the control condition, subjects were instructed to maintain resting state without sleep. Subjects performed a set of six sustained (22-second) maximum voluntary contraction (MVC) of the elbow flexor muscles before and after each condition. After each sustained MVC, brief contractions were performed at 30, 60 and 100% MVC with superimposed electrical stimulation to biceps brachii muscle. During sleep, we recorded polysomnogram (PSG) including electroencephalogram (EEG), electro-oculogram (EOG), electromyogram (EMG), and heart rate (HR). Results MVC gradually decreased each set in sleep and control condition. Especially, there were quite differences between conditions with respect to rate of change of MVC and voluntary activation. Discussion The present study indicated that short sleep has a positive effect on recovery from fatigue of elbow flexor muscles assessed by interpolated twitch technique. Also, it is conceivable that sleep is essential for recovery from both central and peripheral fatigue. References Kooistra RD, de Ruyter CJ, de Haan A. (2007). *Eur J Appl Physiol*, 100(3), 309-320. Gandevia SC. (2001). *Physiol Rev*, 81(4), 1725-1789.

### PSYCHOPHYSIOLOGICAL EFFECTS OF AN ONSIGHT LEAD CLIMB FOR LOWER GRADE CLIMBERS

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Introduction Anecdotally rock climbers and their coaches have described elite climbers having a "no fall mindset" that perhaps set them apart from climbers of lower ability (Dickson et al.; Fryer et al. 2012). Regardless of whether climbing on a top rope or as a lead climb there are few differences in psychological of physiological makers. Although found to hold for elite climbers, the findings of recent studies in the field suggest that this ability to lock down the mind and focus on climbing without anxiety induced changes in physiological responses extends to advanced and intermediate level climbers (Dickson et al.; Draper et al. 2011; Fryer et al. 2012). Therefore the aim of this study was to examine whether the "no fall mindset" also held true for low-grade or novice climbers. Methods Twenty (12 male, 8 female) low grade rock climbers volunteered to take part in the study. Participants took part in three testing sessions, a VO<sub>2</sub>max test, a familiarisation sessions and the final test climb. Participants were randomly assigned to an on-sight top-rope or lead climb ascent of the test route. A range of physiological and psychological measure were taken during the testing sessions including VO<sub>2</sub> and HR during climb, lactate and cortisol concentrations as well as Profile of Mood State, Revised Competitive State Anxiety Inventory-2 and the National Aeronautics and Space Administration Task Load Index. Results There were though significant differences found between the groups for lactate and cortisol concentrations, concentrations, climb time, heart rate and VO<sub>2</sub>. Discussion The aim of this study was to examine if the no fall mindset, attributed to elite climbers and now found to extend to advanced and intermediate climbers also extended to novice climbers. Results indicate that there were significant differences between the psychological and physiological responses of climbers undertaking an on-sight top-rope climb when compared to an on-sight lead climb. It is possible that experience plays a key role in understanding the differences in safety protocols and impacts upon the physiological and psychological responses of climbers as well as differences in climbing ability. References Dickson, T., Fryer, S., Blackwell, G., Draper, N. and Stoner, L. (2012) Effect of style of ascent on the psychophysiological demands of rock climbing in elite level climbers. *Sports Technology* (early access online) <http://dx.doi.org/10.1080/19346182.2012.686504>. Draper, N., Dickson, T., Fryer, S. and Blackwell, G. (2011) Performance differences for intermediate rock climbers who successfully and unsuccessfully attempted an indoor sport climbing route. *International Journal of Performance Analysis in Sport* 11(3): 450-463. Fryer, S., Dickson, T., Draper, N., Blackwell, G. and Hillier, S. (2012) A psychophysiological comparison of on-sight lead and top rope ascents in advanced rock climbers. *Scandinavian Journal of Medicine and Science in Sports* (early access online) <http://dx.doi.org/10.1111/j.1600-0838.2011.01432.x>.

14:00 - 15:00

## Mini-Orals

## PP-PM73 Training and Testing [TT] 8

## A MULTIDISCIPLINARY COMPARATIVE APPROACH TO TALENT IDENTIFICATION IN TENNIS

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Introduction Tennis is a complex sport requiring a mixture of physical, technical/tactical and psychological skills. Due to this complexity, the relationship between physical/technical parameters and performance is scarce. Therefore, the aim of the present study was to compare the influence of selected technical and physical factors on tennis performance (i.e., ranking) in a group of elite young tennis players in relation to different age groups. Methods 267 nationally ranked young tennis players (male U12+U14 n=81, U16+U18 n=77; female U12+U14 n=70, U16+U18 n=39) were tested for strength, upper body power, speed, agility, jumping ability and tennis specific endurance (German Tennis Test). Moreover, 179 of these subjects (male U12+U14 n=50, U16+U18 n=56; female U12+U14 n=40, U16+U18 n=33) were evaluated by the national coaching staff through a questionnaire, including technical (i.e., serve, slice, volley), tactical (i.e., match strategy) and coordinative (i.e., timing) items. Multiple regression analysis was used to assess the relation between physical tests, questionnaire items and performance (i.e., national ranking). Results Results showed that in younger players (U12+U14) tennis performance is mainly explained by technical, coordinative and tactical factors (male:  $R^2(\text{technique}) = .68$ ,  $p < .05$ ;  $R^2(\text{tactic}) = .51$ ,  $p < .05$ ;  $R^2(\text{coordination}) = .57$ ,  $p < .05$ ;  $R^2(\text{condition}) = .22$ ,  $p > .05$ ; female:  $R^2(\text{technique}) = .45$ ,  $p > .05$ ;  $R^2(\text{tactic}) = .28$ ,  $p > .05$ ;  $R^2(\text{coordination}) = .55$ ,  $p > .05$ ;  $R^2(\text{condition}) = .33$ ,  $p > .05$ ). In older players (U16+U18) performance can be primarily attributed to their physical performance, while technique, tactics and coordination were found to be weak predictors (male:  $R^2(\text{technique}) = .17$ ,  $p > .05$ ;  $R^2(\text{tactic}) = .17$ ,  $p > .05$ ;  $R^2(\text{coordination}) = .33$ ,  $p > .05$ ;  $R^2(\text{condition}) = .42$ ,  $p < .05$ ; female:  $R^2(\text{technique}) = .58$ ,  $p > .05$ ;  $R^2(\text{tactic}) = .17$ ,  $p > .05$ ;  $R^2(\text{coordination}) = .58$ ,  $p > .05$ ;  $R^2(\text{condition}) = .64$ ,  $p < .05$ ). Discussion Our findings reinforce the idea that performance in tennis is multifaceted. Depending on the age group, the influencing factors (e.g., physical or technical/tactical) are different. While in young players technique and tactical skills seem to be strong predictors of tennis performance, physical qualities are more important in older players. This might be due to the effects of maturation, training experience and talent selection. According to the present results coaches should give more importance to the technical/tactical skills in early years (with an appropriate development of basic physical qualities (i.e., coordination)), while the physical training would have more importance in the puberty. References Reilly, T. et al. (2000). *J Sports Sci.*, 18 (9), 695-702. Malina, R.M. et al. (2007). *Br J Sports Med.*, 41 (5), 290-5.

## PERFORMANCE DIFFERENCES BETWEEN ANAEROBIC POWER TEST LABORATORY AND FIELD IN YOUNG BRAZILIAN SOCCER PLAYERS

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Anaerobic power is an important variable for soccer, because those actions such as kicking techniques require good levels of power. Thus, it is essential to investigate this variable, but most indicated that the evaluation of field or laboratory? The aim of this study was to investigate the differences between anaerobic power test laboratory and field in young Brazilian soccer players. Methods: 12 young soccer players (age  $13,5 \pm 0,5$ ; body mass  $58,5 \pm 17,7$  kg;  $1,70 \pm 0,1$  cm). They were evaluated by two power ratings, one field test (Rast - Running Based Anaerobic Sprint Test) first day and laboratory test (Wingate) on the second day. In the Rast protocol (Zacharogiannis et al., 2004), they performed warmup a 5-minute, a 5-minute rest interval, after 6 x 35 meters sprint separated by 10 seconds passive recovery. We used two photocells Electronic Sun Pack (China) arranged to 35m away, to capture the times of the sprints and calculated the variables, peak absolute power (PAP), relative peak power (RPP), mean absolute power (MAP), relative mean power (RMP) and fatigue indices (FI). Wingate test protocol (Mastrangelo et al., 2004) consisted 5-minute warmup, a 5-minute rest interval. Resistance to pedaling was based on body mass (BM) by (0,075 kg of resistance per kilogram of BM). Wingate test consisted 30-second sprint and the variables were calculated by software Ergometric 6.0 the same RAST (PAP, RPP, MAP, RMP, FI). Statistical analysis was performed by the Shapiro-Wilk test for normality, and the performance differences between laboratory and field tests were assessed using the Student t test for independent samples. SPSS 17.0 was used. Results: Differences were found between PAP x PAP  $p < 0,01$ , RPP x RPP  $p < 0,00$ , MAP x MAP  $p < 0,03$ , RMP x RMP  $p < 0,01$ . Discussion: The differences found show that it is necessary to be careful when choosing an assessment, regardless of the sport. Likewise, the limitations of the study should be considered, because the errors in the application of the protocol can influence the results. On field and laboratory tests, as well Wingate RAST can be reproducible and valid for measuring performance in anaerobic power (Zagato; Heck; Gobatto 2009; Hachana et al., 2012) but protocols must be in accordance with the characteristics of research participants. References Mastrangelo MA, Chaloupka EC, Kang J, Lacke CJ, Angelucci J, Martz WP, Biren GB. Predicting Anaerobic Capabilities in 11-13- Year-Old Boys. *J Strength Cond Res* 2004; 18(1):72-76. Hachana Y, Attia A, Nassib S, Shepard RJ, Chelly MS. Test-retest reliability, criterion-related validity, and minimal detectable change of score on an abbreviated Wingate test for field sport participants. *J Strength Cond Res* 2012; 26(5):1324-30. Zacharogiannis E, Paradisis G, Tziortzis S. An evaluation of tests of anaerobic power and capacity. *Med Sci Sports Exerc* 2004; Supp 36(5):116.

## TEST-RETEST RELIABILITY OF 3-MIN ALL-OUT TEST FOR RUNNING

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Introduction Critical power (CP) and anaerobic work capacity (W') could be successfully estimated from a single test, called 3-min all-out test (3MT), for cycling [5] and rowing [3]. Recently, the CP and W', defined as the critical velocity (CV) and maximal capacity for work above CP (D'), can be determined from 3-min all-out running test (3MRT) using the global positioning sensor (GPS) [4] and accelerometer [1]. Good reproducibility of CP and W' estimated from 3MT for cycling [2] and rowing [3] has been reported, however, the repeatability of 3MRT is unknown. Previous studies [2, 3] also found that VO<sub>2</sub>max was significantly related with VO<sub>2</sub>peak measured from the 3MT. There-

fore, this study examines the test-retest reliabilities of 3MRT, and investigates the relationship between  $VO_{2peak}$  and  $VO_{2max}$ . Methods Twelve collegiate male sprinters were recruited and performed an incremental exercise test on a treadmill at laboratory and two 3MRTs on a level outdoor track, separated by at least 48 hours. In the 3MRT trials, the portable Cortex metabolic analysis system (Metamax 3B) with GPS module was continuously used to measure the oxygen uptake, heart rate (HR), and running speed. The CV and D' derived from the 3MRT were analyzed according to the study of Pettitt et al. [4]. The blood samples were obtained before and after 3MRT to measure the blood lactate concentrations (La). Results There were significant test-retest reliabilities in CV (intraclass correlation coefficient [ICC] = 0.74, 95% confidence interval [CI] = 0.32 to 0.92 m/s,  $P < 0.05$ ) and D' (ICC = 0.70, 95% CI = 0.09 to 0.87 m,  $P < 0.05$ ) between the two 3MRT trials. No significant differences in La were found either before (~1.0 mmol/L) or after (~12.1 mmol/L) 3MRT. No significant differences in CV, D', % $VO_{2max}$  at CV, peak HR, and temperature were found between the two 3MRT trials. However, the peak HRs (~178 bpm) and  $VO_{2peak}$  (~49.4 ml/kg/min) in both 3MRT trials were significantly lower than maximal HR (~191 bpm) and  $VO_{2max}$  (~55.0 ml/kg/min) during incremental exercise test. Discussion These results, which are consistent with other studies [2, 3], indicate that 3MRT has moderate test-retest reproducibility in CV and D'. Our study failed to provide support for the relationships between  $VO_{2peak}$  and  $VO_{2max}$ . It can be partly explained by the differences in temperatures between indoor (22.0 ± 0.5 °C) and outdoor (34.5 ± 0.8 °C) environment. Nevertheless, 3MRT has appropriate test-retest reliability even at high temperature environment. References 1. Broxterman RM, Ade CJ, Poole DC, Harms CA, Barstow TJ. (2013). *Respir Physiol Neurobiol*, 185(2), 380-385. 2. Burnley M, Doust JH, Vanhatalo A. (2006). *Med Sci Sports Exerc*, 38(11), 1995-2003. 3. Cheng CF, Yang YS, Lin HM, Lee CL, Wang CY. (2012). *Eur J Appl Physiol*, 112, 1251-1260. 4. Pettitt RW, Jamnick N, Clark IE. (2012). *Int J Sports Med*, 33, 426-431. 5. Vanhatalo A, Doust JH, Burnley M. (2007). *Med Sci Sports Exerc*, 39(3), 548-555.

## AEROBIC AND ANAEROBIC POWER DURING ERGOMETER AND TRACK-CYCLING IN ADOLESCENT CYCLISTS

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Introduction Incremental exercise tests utilising cycle ergometers have long been used to prescribe exercise intensities for both outdoor training and to predict cycling performance. The use of ergometry tests is also endorsed by organisations like British Cycling for talent identification. In a recent study, the validity of the air-braked Wattbike ergometer (WB) showed acceptable accuracy when compared to the SRM mobile power-meter (Hopker et al., 2010). The aim of this study was to compare power outputs measured during performance tests on the WB compared to track-cycling in young cyclists. Methods Fourteen trained adolescent cyclists (age: 14.8 ± 1.1 y;  $VO_{2max}$ : 63.5 ± 5.6 mL/min/kg) randomly completed three performance tests of 10 s, 1 min and 3 min on either, a WB ergometer or on a wooden track using their own bikes mounted with SRM mobile power-meters. The participants were asked to produce the highest possible power output during all trials, which were separated by at least 30 min. During the 10-s performance test maximal ( $P_{max10s}$ ) and mean ( $P_{mean10s}$ ) power output, as well as, the optimal cadence (Cadopt) and the corresponding power output (Popt) was analysed. For the 1-min and 3-min performance tests, mean power output ( $P_{mean1min}$ ,  $P_{mean3min}$ ) and mean cadence (Cadmean1min, Cadmean3min) was determined. Results During the 10-s performance test  $P_{max10s}$  and  $P_{mean10s}$  were significantly higher on the WB compared to SRM (16.7 ± 1.9 W/kg vs 15.2 ± 1.5 W/kg and 14.8 ± 1.5 W/kg vs 13.2 ± 1.3 W/kg;  $p < 0.005$ ). The bias ± 95% limits of agreement were 9.1 ± 18.9% for  $P_{max10s}$  and 11.3 ± 15.5% for  $P_{mean10s}$ . No significant differences between WB and SRM were observed for Popt (15.2 ± 1.9 W/kg vs 14.6 ± 1.8 W/kg;  $p = 0.22$ ) and Cadopt (102 ± 9 rpm vs 97 ± 8 rpm;  $p = 0.06$ ).  $P_{mean1min}$  was 8.2 ± 0.5 W/kg and 6.8 ± 0.7 W/kg on the WB and SRM, respectively ( $p < 0.001$ ). The bias ± 95% limit of agreement was 18.0 ± 13.9%. Mean cadence was significantly different between WB and SRM (103 ± 5 rpm vs 114 ± 7 rpm;  $p < 0.001$ ). Likewise,  $P_{mean3min}$  was 5.5 ± 0.5 W/kg and 5.0 ± 0.7 W/kg on the WB and SRM, respectively ( $p < 0.001$ ) with a bias ± 95% limit of agreement of 9.3 ± 12.0%. Mean cadence was 97 ± 3 rpm on the WB and 104 ± 5 rpm during track-cycling ( $p < 0.001$ ). Discussion Trained adolescent cyclists were able to produce significantly higher power outputs during ergometer-cycling compared to track-cycling. The agreement between WB and track-cycling-derived power output is limited and therefore, talent identification based on ergometer-cycling should be used with caution. Young cyclists probably need more experience to develop the technical skills required for track-cycling to reach their potential assessed during ergometer-cycling. Hopker, J., Myers, S., Jobson, S. A., Bruce, W., & Passfield, L. (2010). Validity and reliability of the Wattbike cycle ergometer. *Int J Sports Med*, 31(10), 731-736.

## AEROBIC EXERCISE PRIOR TO RESISTANCE EXERCISE COMPROMISES FUNCTIONAL ADAPTATIONS, YET BOOSTS INCREASES IN MUSCLE SIZE

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INTRODUCTION Aerobic exercise (AE) may compromise resistance exercise (RE) induced muscle adaptations. However, 5 wks concurrent AE and RE interspersed by 6 h recovery, showed greater increase in muscle size with similar improvements in muscle strength and power, compared with RE only (Lundberg et al. 2013). We hypothesized that performing consecutive AE and RE, not allowing for recovery, would hamper increases in muscle size and function resulting from RE. METHODS Ten moderately trained men (26±5 yrs) were subjected to 5 wks unilateral (both legs) knee extensor RE 2-3 d/wk. In addition, one randomly assigned limb completed AE 15 min prior to onset of RE. Any AE session comprised ~45 min exhaustive concentric one-legged cycle ergometry. RE consisted of 4 x 7 maximal concentric-eccentric flywheel knee extensions. Peak power was measured during each RE session, and maximal isokinetic and flywheel torque and power were assessed before and after training. Likewise, volume and signal intensity of m. quadriceps were determined by means of magnetic resonance imaging (MRI). RESULTS Day by day peak power performance during RE sessions was 19% lower ( $p < 0.05$ ) for the leg subjected to AE. In the rested state before and after training, average concentric-eccentric torque (~10%) and power (~17%) improved similarly across legs. However, the increase in flywheel concentric peak torque was greater ( $p < 0.05$ ) after RE (10%) than AE+RE (4%). Similarly, isokinetic peak torque at 210 and 240°/s, tended to be reduced (-9%,  $p < 0.1$ ) after AE+RE but unchanged after RE. Both legs showed increased muscle volume after training, yet the increase was more prominent (interaction  $p < 0.05$ ) after AE+RE (6%) than RE (3%). Signal intensity of MRI scans increased ( $p < 0.05$ ) by 7% after AE+RE, with no change in RE. DISCUSSION There were less work and force produced when AE preceded RE than with RE alone. Increases in flywheel peak concentric torque was compromised by AE+RE, and performance at higher angular velocities was reduced, compared with RE. Notwithstanding, RE-induced increases in muscle size were exaggerated by concurrent AE. These results infer that performing consecutive bouts of AE and RE, alters aspects of muscle size and, in vivo muscle function, noted with RE alone. Some of these divergent responses may be counterproductive for athletes aiming at developing explosive strength, speed or power. REFERENCES Lundberg TR, Fernandez-Gonzalo R, Gustafsson T, and Tesch PA (2013). *J Appl Physiol* 114: 81-89.

### ANTIOXIDANT STATUS AFTER INTENSIVE EXERCISE REALIZED AT 1850 METERS IN NON-ACCLIMATED ENDURANCE TRAINED ATHLETES

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**Introduction** Endurance-trained athletes exhibit higher antioxidant capacities due to beneficial effects of training whereas intensive exercise leads to oxidative stress at sea-level (SL). Altitude can aggravate exercise-induced oxidative stress. Many studies were interested in exercise-induced oxidative stress and decreased in antioxidant status of athletes at altitude. However the most studies reported effect of altitude upper to 3000 meters and/or in the context of 'live high-train low' (Pialoux et al., 2009, 2010). This is not really the altitude for the majority of sporting events in which lowlanders athletes are the main actors on a half-day or a day nor for altitude training camp which interest more modest altitude. Therefore this study investigated the effect of 1850 meters altitude on a single bout exercise-induced changes in redox status in lowlanders endurance-trained athletes. **Methods** All athletes (n=9) performed an incremental exercise test VO<sub>2</sub>max at SL. A first cycle exercise at 85% VO<sub>2</sub>maxSL for one hour was realized at SL. One week later, the same exercise at 1850 meters (ALT, Font-Romeu) was performed without acclimatization. Athletes rose at altitude very early in the morning of the test and performed after an overnight fasting. Blood samples were collected before and after exercise. Results VO<sub>2</sub>max SL equal to 58.22 ± 0.96 ml.min<sup>-1</sup>.kg<sup>-1</sup>. During SL exercise, SpO<sub>2</sub> (hemoglobin O<sub>2</sub> saturation) was in mean 99 %. No difference occurred at SL before and after exercise in GPx (respectively 55.11 ± 3.77 vs 52 ± 4 U.l.g-1Hb) nor in SOD (983.7 ± 34.8 vs 946.7 ± 44.98 U.l.g-1Hb). No one was also observed before and after ALT exercise. No difference in both enzymes occurred between SL and ALT condition while SpO<sub>2</sub> was however decreased during ALT exercise (92 %). Ascorbic acid increased after exercise at SL and ALT, whereas no significant interaction occurred between exercise and condition. **Discussion** Endurance-trained athletes have antioxidant capacity to counterbalance an exercise-induced free radical production at SL. 1850 meters do not seem to be a level of hypoxia being enough for oxidative stress generation and so decrease of antioxidant capacity with out and with intense exercise. This study report the absence of effect of an acute exposure at 1850 meters on redox status of endurance athletes who would come to realize a unique event at this altitude and/or come to begin an altitude training camp. **References** Pialoux V, Mounier R, Rock E, Mazur A, Schmitt L, Richalet JP, Robach P, Coudert J, Fellmann N. (2009). *Int J Sports Med*, 30(2):87-93. Pialoux V, Brugniaux JV, Rock E, Mazur A, Schmitt L, Richalet JP, Robach P, Clottes E, Coudert J, Fellmann N, Mounier R. (2010). *Eur J Nutr*, 49(5):285-92.

### PSYCHO-PHYSIOLOGICAL STRESS RESPONSES DURING PRACTICE AND COMPETITION IN YOUNG FEMALE COMPETITIVE TENNIS PLAYERS

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**Introduction** Tennis induces important physical and psychological stress, which might play an important role during competition, as it requires steadiness, precision, motivation and motor control for effective shot making over the whole match. Salivary cortisol (SC) has been recommended as an index of training and competitive stress, although studies reported controversial results. Thus, the aims of this study were to compare the psycho-physiological responses to practice sessions (i.e., simulated tennis match play) and competitive games in high-level young tennis players and determine the possible differences in these responses between winners and losers. **Methods** Twelve young female elite tennis players (Age: 13.0 ± 0.3 years; weight: 51.4 ± 1.3 kg; height: 1.68 ± 0.3 m), participated in this study. Players were monitored during one match (MD) and a practice session (i.e., simulated match play; TD), separated by 2 weeks. Measurements included salivary collections for cortisol (SC) analyse (collected at 8 h; 10 min pre- and post-game, and 20 h); psychological variables using the revised Competitive Sport Anxiety Inventory (CSAI-2R), which was completed each time salivary samples were collected (i.e., 10 min pre and 10 min post-practice and competition), and physiological responses, by monitoring heart rate (HR) and rate of perceived exertion (RPE) at selected changeover breaks in play (that occurred at the end of the first, third and every subsequent odd game of each set) throughout the match/practice. **Results** Physiological responses (i.e., HR and RPE) were significantly higher for losers only during MD (HR: 158.9 ± 8.3 vs. 168 ± 6.7 beats•min<sup>-1</sup>; RPE: 12.9 ± 1.2 vs. 15 ± 0.8, for losers and winners respectively; p < 0.05). MD elicited higher SC values for losers at awakening (15.2 ± 0.7 vs. 14.0 ± 1.3 nmol•l<sup>-1</sup>; p < 0.05) and evening (38.9 ± 1.0 vs. 25.4 ± 1.4 nmol•l<sup>-1</sup>; p < 0.05) when compared to winners, as well as higher SC levels in all-time points during MD (p < 0.05). Both winners and losers showed significantly lower SC levels in TD when compared to MD at all-time points (p < 0.05). CSAI-2R results showed that winners on MD and TD situations had significantly higher Self-confidence and lower Cognitive Anxiety and Somatic Anxiety scores than losers (p < 0.01). **Discussion** Results indicate that both the independent variables of condition (match vs. practice) and status (winner vs. loser) influenced the psycho-physiological responses for these young athletes. The simultaneous measurement of cortisol and self-reported psychological indicators would provide an approach to examine changes in anxiety, and its relationship to performance. **References** Filaire, E., Alix, D., Ferrand, C. & Verger, M. (2009). *Psychoneuroendocrinology*; 34(1):150-7 Kudielka, B.M., Hellhammer, D.H. & Wüst, S. (2009). *Psychoneuroendocrinology*; 34(1):2-18. Salvador A, Suay F, González-Bono E, Serrano MA (2003). *Psychoneuroendocrinology* 28(3):364-75.

### PORTIMÃO RHYTHMIC GYMNASTICS WORLD CUP SCORES ANALYSIS. GROUP AND INDIVIDUAL HOOP ROUTINES

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The first time rhythmic gymnastics (RG) groups have participated in the Olympic Games, was in 1996 in Atlanta, the first individual participation was in 1984 in Los Angeles. Since that time the level of RG performance has continuously improved. These improvements were also determined by the new guidelines of International Federation of Gymnastics. In order to understand some immediate consequences of the RG code of points implementations we analyzed some key aspects of the hoops routines scores in the 2009 Portimão RG World Cup Series. We focused on the Difficulty scores analysis (body and apparatus difficulties) and on the Artistic and Execution scores in groups and individual routines. For this we analyzed all composition forms submitted by the groups and individual gymnasts competing in the World Cup competition. We divided the sample in 3 ranking groups categories: 1st, 2nd and 3rd part of the final ranking for hoops routines. SPSS version 17.0 was used to carry out the data statistical analysis. The significance level used was α=0.05. **Results:** a) In Difficulty scores: (1) Group routines had a higher departure score than individual gymnasts routines. However, individual routines actually achieved a higher final score in the 1st and in 2nd part of the final ranking; (2) The maximum departure scores for both individual and

group routines are 10 points or close to 10. When we analysed the maximum values achieved in the final scores we found significant differences between the departure score and the final score in the two types of routines (groups and individuals). b) In Execution and Artistic scores: (1) The artistic scores were higher than the execution scores both in groups and individual routines for all categories (1st, 2nd and 3rd part of the final ranking for hoops routines); (2) The execution scores were higher in individual routines when compared with all categories of groups routines; (3) The artistic scores were higher in group routines in the 2nd and 3rd part of the final ranking when compared to the individual gymnasts; (4) The execution and the artistic scores are almost similar in individual and in group routines; (5) There was a moderate positive correlation between the group's execution and artistic scores whereas in the individuals gymnasts there was a strong positive correlation between those scores. Conclusions: a) The individual gymnasts achieved a higher final score in Difficulty scores when compared to groups, the last with the same demand in the five gymnasts; b) We observed a substantial difference between the scores proposed by the coaches in the competition forms and the scores attributed by the judges; c) The lower the ranking position of the gymnast or the group, the higher is the difference between the departure and final scores in Difficulty evaluation. The lower performance level of the gymnasts or group, higher was the overvalued composition by the coaches.

### HEART RATE PROFILE IN SPRINT ON VARIOUS SLOPES

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**Introduction** The running uphill is an intense activity, which can be performed in several training programs as an alternative way to work at high intensity, stressing the cardiovascular system. Precisely, sprinting on incline requires a considerable muscle activation of the lower limb, which affects central aerobic responses, as changes in heart rate (HR) (1,2). Therefore, the aim of the study was to investigate the HR variation during individuals sprint on different inclinations, based on two assumptions: I. HRs rise faster when sprinting on high slopes compared to the level. II. HR reaches higher peaks with increasing slope. **Methods** Ten amateur soccer players carried out three "all-out" sprint lasting 6 seconds for each slope: level-7%-14%-18%. Every bout was separated by a complete recovery. Heart rate monitors (beat to beat) were used to record the time (milliseconds) among heartbeats before, during and after any sprint. **Results** Unlike what has been found during the sprints, heart rate assumed a different profile right after the effort between gradients. I. On slope of 18% heartbeats rose faster than what happened on the level reaching the peak value almost two second before ( $8368 \pm 451$ ms vs.  $10291 \pm 462.2$ ms;  $p < 0.05$ ). II. Statistical differences were not highlighted between heart rate peaks in all of the gradients: level= $154$ bpm, 7%= $159$ bpm; 14%= $155$ bpm, 18%= $157$ bpm ( $p > 0.05$ ). **Discussion** In accordance with the first assumptions, results suggest that running on high slopes (>14%) produces a marked rising of the heartbeats which stress the cardiac system. A possible explanation could regard the fact that intense activity, such as sprinting uphill, increases the ratio of concentric to eccentric muscle activation involving a great metabolic expenditure (3). Although heart's stroke volume is the parameter that mainly limits the aerobic performance (4), high rates of volume stroke (via the increase of heartbeats) are required to cover those demands of oxygen from the muscles, paying for any anaerobic debt. In conclusion, it is reasonable to assume that sprinting uphill is one of the best ways of training due to its significant impact on the central cardiovascular system. **References** 1) Yokozawa T., Fujii N., Ae Michiyoshi. (2007). *J Biomech*, 40(15), 3467-3475. 2) Roberts T.J., Belliveau R.A. (2005). *J Exp Biol*, 208(10), 1963-1970. 3) Pringle J.S., Carter H., Doust J.H., Jones A.M. (2002). *Eur J Appl Physiol*, 88(1-2), 163-9. 4) Hoff J. (2005). *J Sports Sci*, 23(6), 573-582.

### INTENSITY PACING STRATEGY AND DOWNHILL STRATEGY DURING A CROSS COUNTRY SKI RACE

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**INTRODUCTION** During a cross country ski race the intensity pacing strategy could be affected by different variables. It's not easy to choose the winner strategy. In a previous analysis we found no correlation between the mean heart rate (HR) during the race and the time of the race (RT). In a downhill, the HR normally decreases until the beginning of next flat or uphill. The HR-trend during downhill can be influenced by the payment of oxygen debt and different downhill strategy (Mognoni et al., 2001). The aim of this study was to investigate which intensity pacing strategy would give the best race time during a cross country ski race. **METHODS** During a 10 km interval start skating race, HR of 9 male cross country skiers (Category U-23) was recorded by Polar RS400® (Hz.5sec). We found that all the racers had a clear decrease in HR at about 7 km, in correspondence with a long downhill. We considered the percentage of HR max given by the subjects (%HRmax) pre and post the downhill ( $\% \Delta HR = \% HR_{pre} - \% HR_{post}$ ). In order to study the influence of downhill strategies on the RT, we calculated the correlation index between  $\% \Delta HR$  and RT for all the skiers. As indicator of intensity pacing strategy, we used the angular coefficient of the linear regression for all the HR profiles. HR data were analyzed by Polar Pro Trainer® and Microsoft Excel 2003®. **RESULTS** From angular coefficients, we noticed that all the subjects incremented their HR from the start to the end. There were no correlation between the angular coefficient and RT ( $R^2 = 0.013$ ), and between  $\% \Delta HR$  and the RT for all the skiers ( $R^2 = 0.005$ ), showing that the capacity of recovery during the downhill did not influence RT. The decrease in HR changes from subject to subject. **DISCUSSION** The increment of HR from the start to the end, as the angular coefficients show, has not a linear relationship with RT. This is in opposition with which was found by Lima-Silva (2010) in 10-km running race. The decrease in HR during the downhill, changing for each subject strategy, did not influence RT. The skiers could push faster to increase speed or let the ski flow to recover (Bilodeau et al., 1991).  $\% \Delta HR$  could be influenced by individual technique, ski wax, athletic condition and the kind of work during the downhill. The final part of the race reflects higher intensity as compared to the initial, even if each skier chose his preferred strategy both during the whole race and the downhill. We hypothesise that the skiers used different pacing and downhill strategies during this downhill, a new study is prepared to focus upon this. **REFERENCES** Bilodeau B. et al. (1991). *Int. J. Sports Med.* 12:71-76. Lima-Silva A.E. et al. (2010). *Eur. J. Appl. Physiol.* 108:1045-1053. Mognoni P. et al. (2001). *Eur. J. Appl. Physiol.* 85:62-27.

### BLOOD ALKALOSIS AFFECTED CARDIO-DYNAMIC AND OXYGEN UPTAKE RESPONSES DURING ALL-OUT SUPRA-MAXIMAL CYCLING EXERCISE

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**Introduction** The greater long sprint performance observed in trained compared to recreational subjects is partly attributable to greater oxygen uptake (VO<sub>2</sub>) (Bosquet et al. 2007). Hanon et al. (2010) noticed a VO<sub>2</sub> decrease before the all-out running exercise exhaustion. Previously, Berger et al. (2006) reported that metabolic alkalosis altered VO<sub>2</sub> adaptation especially in the second part of exercise, without

described the responses of its peripheral (a-vO<sub>2</sub>diff) and central (Qc) factors. Objective To investigate whether acid-base balance status affected the Qc - VO<sub>2</sub> relationships, 11 well-trained male cyclists performed on a cycle ergometer a progressive exercise to determine the peak of oxygen uptake (VO<sub>2</sub>peak) and two all-out supra-maximal events in random iso-kinetic conditions with (BICA) or without (PLAC) bicarbonate oral ingestion. Results The highest VO<sub>2</sub> values measured during PLAC and BICA trials were equal to  $92.2 \pm 6.3$  and  $96.6 \pm 8.2\%$  of VO<sub>2</sub>peak, respectively. At the end of all-out trials, VO<sub>2</sub> decrease was related to Qc drop in BICA ( $r = 0.67$ ,  $P < 0.05$ ) but not in PLAC conditions ( $r = 0.51$ ,  $P = \text{NS}$ ). Alkalosis moreover induced a higher heart rate at rest, a lower high stroke volume value and a significant drop of Qc during exercise ( $P < 0.01$ ). Finally, the decrease in mechanical power was not correlated with cardiorespiratory responses. Discussion Mortensen et al. (2008) already reported that Qc and VO<sub>2</sub> reached peak values after 60s and levelled off at values similar to 6% below maximal cycling. High intramuscular forces would affect the time course of the stroke volume (Nassis and Geladas 2002) and then cardiac output in our PLAC condition but not after BICA ingestion that induced a modified contribution of heart rate and stroke volume in Qc responses at rest and during exercise. Conclusion Suppressed acidosis by oral bicarbonate ingestion did not significantly change mean power output but induced different contribution of stroke volume in Qc responses during a long sprint event. Reference Berger et al. (2006). *Med Sci Sports Exerc*, 38, 1909-1917. Bosquet et al. (2007). *Int J Sports Med*, 28, 518-524. Hanon et al. (2010). *Eur J Appl Physiol*, 109, 233-240. Mortensen et al. (2008). *J Physiol*, 586, 2621-2635. Nassis GP, Geladas ND. 2002. *Pflügers Arch*, 445,398-404.

### **BODY BALANCE AND PROPRIOCEPTION AMONG DIFFERENT SPORT-SKILLS**

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INTRODUCTION Balance is important not only to improve athletes' performance, but also to guarantee an efficient lifestyle in daily activities for normal people(1). There are many clinical measure of balance abilities both in a static or dynamic way, but exist a simple test called "Y Balance Test" which requires proprioception, flexibility, strength and stability. This evaluation system is predictive of lower extremity injuries(2), and discriminating between athletes based on age and sport (3). The aim of this study was to compare balance abilities among 4 different categories of sport-skills: team sports(TS), water sports(WS), individual sport(IS) and sedentary(S). METHODS 137 male volunteers who participated in agonistic competitions were recruited: TS (n=30), WS (n=24), IS (n=54), S (n=29). To assess dynamic balance, participants performed multidirectional maximal single-leg reaches in 3 directions with both legs: anterior, posteromedial and posterolateral. This procedure was replicate for 3 times and for each limb was measured the Composite Score with the following formula:  $(AD+PLD+PMD)/(3 \times \text{limb length}) \times 100$ . RESULTS Observing the mean Composite Score with Right Leg, TS had an higher balance compared to WS(104.8% vs. 83.4%)( $p < 0.05$ ). IS was elevated with significant differences compared with other groups and S had a higher values from WS(102% vs. 83.4%), but lower from S(102% vs. 109%)( $p < 0.05$ ). Considering Left Leg, TS had an higher mean value only with WS(106.4% vs. 83.4%) but not with other groups. WS was significantly different from all sports with the lowest mean Composite percentage(83.4%). In terms of dynamic balance, individual sports (IS) reached the maximum mean value, whereas water sports (WS) obtained the lowest one, owing to their cyclic movements; although S and TS express good proprioception abilities, team sports have a greater control, due to their opens-skill actions. Surprisingly the right leg had a better Composite Score among groups rather the left one, and it could be attributed to a different cross dominance between limbs. Probably the dominant leg is more stable and strength, so it produces an effective major balance control. REFERENCES (1) Judge JO. Balance training to maintain mobility and prevent disability.(2003). *Am J Prev Med*. Oct;25(3 Suppl 2),150-6. (2) Gribble PA, Hertel J, Plisky P. Using the Star Excursion Balance Test to assess dynamic postural-control deficits and outcomes in lower extremity injury: a literature and systematic review.(2012). *J Athl Train*.47(3),339-57. (3) Thorpe JL, Ebersole KT. Unilateral balance performance in female collegiate soccer athletes.(2008). *J Strength Cond Res*. Sep;22(5),1429-33.

### **IS THE ABILITY TO CHANGE DIRECTION INFLUENCED BY HIP STRENGTH AND FLEXIBILITY IN YOUTH SOCCER PLAYERS?**

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Introduction The ability to change direction is an important characteristic of soccer. However, current understanding regarding factors important for change of direction (CoD) performance remain unclear. Therefore, the aim of the present study was to determine the relationship between measures of hip strength and flexibility and CoD performance. Method Sixteen trained youth team soccer players (mean  $\pm$  SD age:  $16.3 \pm 0.3$ y, weight:  $58.6 \pm 4.9$ kg, height:  $174.8 \pm 5.9$ cm) participated in the study. Hip strength (adduction and abduction) was measured using a hand held dynamometer and adductor flexibility (bent knee fall out test-the lower the value the better the flexibility) by the distance of the most distal part of the fibula and surface using an inflexible tape measure. Participants also performed a modified 20m L run test with timing gates placed at 2m before (8m) and 2m (12m) after the CoD in order to determine actual turn time. Data were normally distributed. Pearson's correlation between CoD and physical measures was performed. Results Average total times were 4.05s ( $\pm 0.16$ ) and 4.12s ( $\pm 0.16$ ) for the right and left side and mean CoD turn times were 0.91s ( $\pm 0.18$ ) and 0.97s ( $\pm 0.15$ ) for right and left side, respectively. A significant relationship ( $p < 0.05$ ) was observed between right flexibility and right (-0.50) and left (-0.58) CoD total time. No other correlations were found. Conclusion The main findings of the present study were 1) greater hip flexibility is associated with slower total CoD time 2) there was no relationship found between hip abduction and adduction strength and the ability to change direction. We speculate that greater flexibility may decrease the stiffness and elongate the durations of the eccentric and concentric action phase (Knudson et al., 2001). Although no relationship was observed between hip strength and CoD performance, other indices of strength and power e.g. rate of force development are worth investigating. In conclusion, a player's hip flexibility may be related to direction change ability and can possibly be considered as another facet to the complex paradigm of CoD performance. References Knudson D, Bennett K, Corn R, Leick D, Smith C. (2001). *J Strength Cond Res*, 15(1), 98-101.

### **EFFECT OF A PERIODIZED PRE-SEASON TRAINING PLAN ON INTERNAL TRAINING LOAD AND MEASURES OF STRESS, HORMONES, IMMUNITY AND PHYSICAL PERFORMANCE IN YOUNG TENNIS PLAYERS**

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Introduction To date, relatively few reports have examined the training stressors imposed on young elite tennis players during pre-season and there is no previous investigation examining the subsequent impact on physical performance capacity. Therefore, the study aim was

to investigate the effect of a periodized pre-season training plan on internal training load and subsequent stress tolerance, hormones, mucosal immunity and physical performance in tennis players. Methods Well-trained young tennis players (n=10) were monitored across the pre-season tennis period, which was divided into 4 weeks of overload training and a 1 week tapering period. Weekly measures of internal training load, training monotony, stress tolerance (sources and symptoms of stress) were taken, along with salivary testosterone, cortisol and immunoglobulin A (IgA). Maximum strength, running endurance, jump height and agility were assessed pre- and post-training. Results The periodized training plan led to significant weekly changes in training load (i.e. increasing in weeks 3 and 4, decreasing in week 5) and post-training improvements in strength, endurance and agility ( $P < 0.05$ ). Cortisol concentration and the symptoms of stress also increased in weeks 3 and/or 4, before returning to baseline in week 5 ( $P < 0.05$ ). Conversely, the testosterone to cortisol ratio decreased in weeks 3 and 4, before returning to baseline in week 5 ( $P < 0.05$ ). Discussion The periodized pre-season training plan evoked similar weekly changes in external and internal training load in young tennis players. The training plan also produced adaptive changes in stress tolerance, cortisol and the testosterone to cortisol ratio, which may have mediated the improvements in performance capacity. The results of the present study confirm the effectiveness of a simple periodized training plan (initial overloading and then tapering) for improving the performance capacity of young tennis players pre-competition. The presented findings support the use of the session-RPE and DALDA as practical tools for monitoring training in the field setting. In addition, hormonal responses could also be useful physiological measures of training responses. When used as part of a multi-factorial monitoring program, these psychometric and physiological measures may assist coaches making decisions regarding how a group or individual are responding to training.

### VARIABILITY EFFECTS OF THROWING WITH „OVERSIZE-BALL“ AND „SHOOTING-RING“ IN BASKETBALL

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Introduction In Basketball two training devices are used to improve hit rate: an oversized ball with regulation weight (OS) and a shooting ring to be mounted on top of the regulation rim to reduce its diameter (SR). Both devices have the goal to enhance the pressure of throwing with higher accuracy (i.e. with less variability of ball trajectories at the rim level). There is no empirical evidence of positive effects of OS or SR. Moreover, negative effects cannot be excluded since altered size and moment of inertia of OS as well as a varied perception caused by SR can influence the throwing movement. We therefore analyzed acute effects on performance and kinematics with focus on variability measures in this study. Methods 29 Junior Basketball players (national level; Mage = 15.5; SDage = 1.9) performed 100 throws with OS and SR each and 200 throws with regulation ball and rim in the laboratory. The sequence of conditions was balanced. Ball flight and movement execution was recorded with a marker-based 16 camera VICON-MX system. Hit rate, variability/dispersion of ball trajectories at the rim level as well as release angle and velocity were compared between conditions (OS, SR, regulation). Results The hit rate decreased in throws with OS ( $t(28) = 7.0, p < .001, d = 1.3$ ) and SR ( $t(28) = 7.6, p < .001, d = 1.4$ ). Preliminary kinematic results of 15 participants showed no differences in variability/dispersion of ball-flight curves at the rim level between conditions. However, with OS, release angle as well as release velocity were higher compared to the regulation condition (angle:  $t(14) = 5.96, p < .001, d = 1.6$ ; velocity:  $t(14) = 2.51, p = .02, d = 0.8$ ). Discussion Throws with OS and SR lead to lower hit rates, which is a consequence of the reduced hit area. The training devices do not seem to cause negative effects on stability or variability of the throws. In fact, players temporarily adapted their throwing movement at least with OS. They released the ball with higher angle and faster velocity, which might be a form of a more error-tolerant movement execution. Whether training with OS or SR can transfer the more beneficial throwing execution/strategy to the regulation condition, is currently tested.

**14:00 - 15:00**

### Mini-Orals

#### PP-PM63 Sports Medicine [SM] 7

### TRAINING ADAPTATION DOES NOT CORRELATE WITH SONOANATOMIC CHANGES IN QUADRICEPS MUSCLE IN AN ELDERLY HEALTHY GROUP

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Introduction The aim of this study was to assess: the functional capacity, the quadriceps muscle size and the walking speed after a physical activity plan (PAP) in an elderly group. Methods Participants were 30 healthy volunteers  $\geq 64$  years, 24 were subjected to an activity program (AG) and 5 were the control group (CG). The program included 4 weekly sessions (focusing on strength, endurance, balance and proprioception) for 20 weeks. Two of these weekly sessions took place in the laboratory, while the other two were conducted at the patients' home. At the beginning and at the end of the program, we carried out a graded treadmill stress test until exhaustion with cardioventilatory monitoring, an ultrasound measurement of the anteroposterior diameter of the quadriceps, the thigh perimeter measurement and a test of walking speed along 10 meters (modified from JAMA 2011). Results The values at the start and at the end of the program, showed significant changes in both groups in:  $VO_2$  peak, ventilation and heart rate. We found significant differences in the 10 meters walking speed test ( $p = 0.002$ ) and the maximal heart rate ( $p = 0.005$ ) during the maximal stress test when comparing the two groups. There were no changes in: the quadriceps diameter, the thigh perimeter and the other ventilatory variables. Significant correlations were observed between the diameters of the quadriceps and the respiratory equivalent for  $O_2$  and  $CO_2$  ( $p < 0.003$ ), the fractional exhaled  $O_2$  and  $CO_2$  ( $p < 0.001$ ) and the heart rate ( $p < 0.05$ ); also between the thighs perimeters and the respiratory equivalent for  $O_2$  and  $CO_2$  ( $p < 0.05$ ), fractional exhaled  $O_2$  and  $CO_2$  ( $p < 0.03$ ) and  $O_2$  consumption/weight ( $p < 0.04$ ) both before and after PAP. Discussion The participants in the program of physical activity referred an improvement in carrying out daily living activities of the participants but without changes neither in the ultrasound measurements of quadriceps diameter nor in thigh perimeter. Other factors, such a decrease in fatty infiltration of the muscle, could compensate the possible increase in the lean muscle size. The walking speed along 10 meters seem to correlate with the increase in  $VO_2$  max. References Perula LA, et al. (2012) Arch Phys Med Rehabil. 93(10):1677-84. Raj IS, Bird SR, Shield AJ. (2012) Clin Physiol Funct Imaging 32:65-70. Studensky S et al (2011) JAMA 305:50-58.

### COMPARISON BETWEEN OBESITY AND METABOLIC SYNDROME IN THE CARDIOMETABOLIC RESPONSE TO INCREMENTAL EXERCISE

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**Introduction.** It was recently observed that higher fitness should be considered a characteristic of metabolically healthy but obese phenotype by converse obesity is often associated with metabolic syndrome (MS) that is a condition of accumulated risk factors of metabolic origin including central obesity, hypertension, insulin resistance, impaired glucose tolerance and dyslipidaemia. This study was devised to assess the difference on cardiometabolic response to incremental exercise between female subjects affected by obesity and metabolic syndrome. **Methods.** One group consisted of 36 sedentary obese woman were selected according to be (18 subjects, OB group) or not to be affected by Metabolic Syndrome (18 subjects, MS group) matched for age and body mass index. A normal-weight group (NW) matched for age, consisting in 16 female subjects has been also recruited. Each participant underwent an incremental exercise test on a cycle-ergometer up to exhaustion. Maximal oxygen uptake (VO<sub>2</sub>max), carbon dioxide production (VCO<sub>2</sub>), heart rate (HR) and oxygen pulse, were measured by using a gas analyzer. Blood arterial pressure was also assessed. **Results.** The main results was that there were no significantly differences between OB group and MS group respectively on average (mean ± standard deviation) in VO<sub>2</sub>max 17.3±2.9 mL•Kg•min<sup>-1</sup> vs. 17.2±2.8 mL•Kg•min<sup>-1</sup> (NW value was 21.9±5.7 mL•Kg•min<sup>-1</sup> p<0,005); VCO<sub>2</sub> 1841.1±415.9 mL•min<sup>-1</sup> vs. 1647.9±307.2 mL•min<sup>-1</sup>; oxygen pulse 9.6±1.8 mL•min<sup>-1</sup> vs. 10.4±2 mL•min<sup>-1</sup>. However the OB group reached a significantly higher maximal heart rate value that was on average 162.4±11.4 bpm while that of the MS group was on average 150.7±20 bpm, although both group have reached similar maximal workload (OB 122.2±25.5 watt•min<sup>-1</sup> vs. MS 107±22.2 watt•min<sup>-1</sup>). As regards the blood pressure level reached at maximal workload there were no significantly differences between two groups. **Discussion.** In our study OB and MS group showed a significantly lower fitness with respect to NW, without any differences between patients groups, suggesting the main role of obesity per se. **References.** Ortega F.B. et al (2013) *Eur. Heart J.*, 34(5):389-97 Lee DC et al (2013). *J Am Coll Cardiol.*, 59(7):665-72

### EVALUATION OF THE PARAMETER Tlim IN COPD PATIENTS

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**1**Sport Science Laboratory FH JOANNEUM, **2**Institut of Sport Science, University of Graz **3**LKH Hörgas-Enzenbach **Introduction** A multitude of studies have shown that respiratory muscle training has positive effects on inspiratory muscle strength and endurance [1]. The measurement of inspiratory muscle strength has been well established. Questions about the determination of inspiratory muscle endurance are still open. **Aim** Aim of the study was to evaluate the parameter Tlim in COPD patients, to investigate the value of inspiratory muscle strength as a predictor for inspiratory muscle endurance. **Methods** 24 COPD patients (GOLD B-D: 8 Patients B, 10 Patients C, 6 Patients D), 68±7.8 years of age, participated in this study. Patients P<sub>max</sub> was defined as the maximal inspiratory mouth pressure, during ten completed manoeuvres with a break of 10 seconds. The mean value of the best three measurements was taken. Tlim was determined as the time span in seconds until exhaustion, while breathing against a resistive load of 60% P<sub>max</sub>. Measurement stopped when four breaths were not completed successively. All measurements were performed with RespiFit S (E. Biegler GmbH, Mauerbach, Austria). A bodyplethysmography to define forced expired volume in the first second (FEV<sub>1</sub>), forced vital capacity (FVC), FEV<sub>1</sub>%FVC ratio, residual volume (RV), total lung capacity (TLC) and RV%TLC ratio was initially conducted in all patients. Correlation analysis was performed accordingly. **Results** Mean Tlim reached from 149±135 sec., mean P<sub>max</sub> from 62±18,54 mbar (e.g. mean value in COPD B-D: 75,51±27,45 mbar, [2]) No significant correlation was found between the Tlim and P<sub>max</sub>, Tlim and height, weight and lung function parameter, except a negative correlation between Tlim and FEV<sub>1</sub> (-0,474; p=0,019). **Conclusion** Inspiratory muscle endurance has to be determined in addition to inspiratory muscle strength when evaluating inspiratory muscle function in COPD patients. The results confirm studies completed with healthy subjects [3]. A reason for the negative correlation between Tlim and FEV<sub>1</sub> could be justified by completing the bodyplethysmographie a few days before testing P<sub>max</sub> and Tlim. **References** [1] Loetters F., van Tol B., Kwakkel G. & Gosselink R (2002). *Eur Respir J* (20), 570-576. [2] Terzano C., Ceccarelli D., Conti V., Graziani E., Ricci A. & Petroianni A. (2008). *Respiratory Research* 9(1). Download at 10.01.2013 from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2244619/pdf/1465-9921-9-8.pdf> [3] Reiter M., Totzauer A., Werner I., Koessler, W., Zwick H. & Wanke T. (2006). *Respiration* (73), 590-596.

### FUNCTIONAL CLASSIFICATION OF LOWER BACK DISORDERS IN ATHLETES

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**Introduction:** The pathomechanism of low back pain (LBP) among young athletes is not clear owing to the lack of radiological findings. We classified lower back disorders of collegiate athletes according to the functional findings. **Methods:** In total, 115 collegiate athletes who had LBP visited the orthopaedic clinic in our university during 2008 to 2012. They were examined by an orthopaedic surgeon, and the spinal findings, tenderness points, and neurological findings were recorded. The subjects were classified into 4 pathomechanism categories according to the findings of clinical examinations: intervertebral disc pain (IVD), zygapophysial joint pain (facet), sacroiliac joint pain (Sij), and non-specific LBP (NS). The athletes whose LBP exaggerated with lumbar flexion motion, as evident on magnetic resonance images, were determined as having IVD pain. The athletes whose LBP exaggerated with lumbar extension motion, particularly with posterior oblique extension, were determined as having facet pain. The athletes with LBP localized at the posterior sacroiliac spine and tenderness at the Sij, which exaggerated after Sij stress tests, were determined as having Sij pain. **Results:** Fifty-nine (39%) athletes had IVD pain; of these, 24 (16%) showed positive neurological and MRI findings and were diagnosed with IVD herniation, and the other 35 (23%) were diagnosed with discogenic LBP. Fifty-six (37%) athletes had facet pain and 18 (12%) had Sij pain. Ten athletes did not show exaggerated LBP during both flexion and extension and were classified in the NS category. Several athletes were categorized into 2 or more pathomechanism categories. **Discussion:** Identification of the pathomechanism of lower back disorders is important for their prevention. Therefore, we estimated the pathomechanism of LBP on the basis of the functional and clinical findings; among collegiate athletes, the prevalence of discogenic pain was 39%; facet pain, 37%; Sij pain, 12%; and non-specific LBP, 9%.

**THE EXAMINATION OF THE EFFECT OF ORAL-DENTAL HEALTH STATUS ON FEMALE ATHLETES' PERFORMANCE**

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Introduction Researches has shown that insufficient oral health has negative effects on general health status (Cameron et al, 2006; Matilla et al, 1995; Tenevuo et al, 1990). Training programmes on solving that incompetence of athletes which should be carefully designed by exercise physiologists, sports medicine specialists and trainers can also increase the effect of itself and minimize the time spending on reaching the goal. The aim of this research was to examine the relationship between female athletes' (basketball, handball, soccer) oral-dental health status  $DMFT \geq 4.00$ - $DMFT < 4.00$  and their speed, agility and Bosco Test results. Methods 52 female athletes participated in this research. Bosco Test, different agility tests, and 10,20,30 m sprint tests (Meckel et al, 2009) were conducted. Oral-dental examination of the sample group was done in the clinics of Faculty of Dentistry and performance tests were done in the sports hall of Kirikkale University. To determine oral-dental health status decayed, missing, filled tooth (DMFT) index suggested by World Health Organization (World Health Organization, 2010) was used. After gaining approval from the ethics committee of Faculty of Medicine, performance tests were conducted and dental examinations were made and finally statistical analysis were done. Results The mean age of participants were  $19,3 \pm 1$ (yr), mean weight was  $57,6 \pm 8$ (kg), mean height was  $164,4 \pm 0,5$ (cm), and mean sport age was  $4,5 \pm 2$ (yr). Results revealed that there was a significant difference between performance test results of female athletes who have less than 4 DMFT values and those who have equal or over 4 DMFT values ( $p < 0.01$ ). On the contrary, Bosco test results of athletes whose DMFT values were equal or over 4 were significantly better than the other group. Discussion Recently, many studies have urged that athletes have insufficient oral-dental health which can affect their performance. Insufficient health status of oral-dental region can cause pneumonia by means of increased number of gram negative bacteria and decreased level of saliva (Marik and Zalaga, 2001; Ostajic, 2004). In this research, athletes who had worse oral-dental health status also had worse performance test results. Similar results were also found other studies (Gay-Escoda et al, 2001; Jason et al, 2009; Tenevuo et al, 1990). References MARIK PE., ZALAGA GP. (2001). Early enteral nutrition in acutely ill patients: A systematic review. *Critical Care Medicine*, 29(12), 2264-2270. MATILLA KJ, VALTONEN VV, NIEMINEN M, HUTTUNEN JK. (1995). Dental infection and the risk of new coronary events: prospective study of patients with documented coronary artery disease. *Clin Infect Dis*, 20,588-592. OSTAJIC SM. (2004). Elite and Non-Elite Soccer Players; Preseasonal Physical And Physiological Characteristics. *Research in Sports Medicine*,12,143-150.

**ENDURANCE TRAINING IMPROVES METABOLIC PARAMETERS IN CACHECTIC CANCER PATIENTS.**

Matos-Neto, E.M., Camargo, R.G., Neves, R.X., Ribeiro, H.Q., Enju, L.M., Capel, F., Figuerêdo, R.G., Alcantara, P.S., Pinhata, J., Maximiano, L., Seelaender, M.

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Introduction – Cachectic patients usually show lower cardiorespiratory fitness, profound wasting, endocrine disorders, fatigue and decreased quality of life. On the other hand, endurance exercise training is considered a strategy to reduce these symptoms (Fong et al. 2012). Therefore, the goal of the study was to test the effectiveness of a protocol of endurance training in reducing cachexia effects. Methods – Both group of patients with gastric carcinoma – non-cachectic cancer (NcC, n = 15), cachectic cancer (cC, n = 7) – Cancer group, and the group of patients with umbilical hernia. Control group (N, n = 22), were submitted to an endurance training protocol (Dimeo et al. 1997, adapted), consisting of 6 weeks of walking on a treadmill with increasing volume and intensity, assessed individually after a submaximal test (Kline et al., 1987), to estimate each volunteer's  $VO_{2max}$ . The submaximal test and plasma lactate evaluates were carried out at the first, third and sixth week of the experimental protocol to ensure the maintenance training intensity. None of the patients received anticancer drugs. Results – Volunteers had significant difference in the body mass (N:  $78.52 \pm 3.46$  Kg, NcC:  $76.43 \pm 4.96$  Kg and cC:  $54.32 \pm 6.71$  Kg) ( $p = 0.01$ ). Significant differences were found to serum glucose levels (N:  $98.0 \pm 4.33$  mg/dL, NcC:  $101.5 \pm 4.85$  mg/dL and cC:  $167.5 \pm 1.5$  mg/dL) ( $p = 0.001$ ). The significant difference at the end of the sixth week (N:  $23.7 \pm 3.55$  ml.kg.min and Cancer group:  $23.38$  ml.kg.min  $\pm 3.91$ ) compared with the first week (Control group:  $11.43 \pm 3.98$  ml.kg.min and Cancer group:  $5.52 \pm 2.59$  mL.kg. min) ( $p = 0.001$ ), proved the protocol to be effective in increasing estimated  $VO_{2max}$  in the groups. Plasma lactate decreased at the end of the sixth week as a result of training (Control group:  $0.88 \pm 0.06$  mmol/L and Cancer groups:  $0.35 \pm 0.91$  mmol/L) compared to the first week (Control group:  $1.03 \pm 0.21$  mmol/L and Cancer groups:  $1.31 \pm 0.13$  mmol/L) ( $p = 0.004$ ). Discussion – Patients with cancer often show reduction of cardiorespiratory fitness and increased fatigue. Physical training improves physical fitness and quality of life of patients (Pekmezi and Demark-Wahnefried, 2011). Our results show that cachectic patients may benefit from the practice of regular exercise. References Dimeo FC, Tilmann MH, Bertz H et al. *Cancer* 1997; 79: 1717-1722. Fong DY, Ho JW, Hui BP et al. *BMJ* 2012; 344: e70. Kline GM, Porcari JP, Hintermeister R et al. *Med Sci Sports Exerc* 1987; 19: 253-259. Pekmezi DW, Demark-Wahnefried W. *Acta Oncol* 2011; 50: 167-178.

**THE TEST-RETEST RELIABILITY OF EUCAPNIC VOLUNTARY HYPERVENTILATION AND PULMONARY FUNCTION IN DIAGNOSING EXERCISE INDUCED BRONCHOCONSTRICTION**

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Introduction EVH is commonly used to diagnose EIB and can reveal the condition in previously undiagnosed athletes (Dickinson et al., 2011). The within-subject test-retest reliability of EVH responses have not been reported but are of interest to those using EVH as an outcome measure in intervention-based studies. The aim of the study was to assess the within-subject test-retest reliability of pulmonary function before and after EVH, and subsequent EIB diagnosis over four, weekly sessions in both non-EIB controls (CTRL) and EIB sufferers. Methods Eight recreationally active EIB positive ( $\geq -10\% \Delta FEV_1$  after EVH) males and 8 (age and activity matched) non-EIB males volunteered for the study. Following familiarisation all participants performed 4 EVH tests each separated by 5-7 days. During EVH participants breathed a dry (<5% RH) gas mixture (5%  $CO_2$ , 21%  $O_2$ , balance  $N_2$ ) and maintained a minute ventilation of  $30 \times$  baseline  $FEV_1$  for 6 min. FVC and FEV1 were measured before and 3, 6, and 16 min after EVH. Reproducibility of pulmonary function parameters pre and post EVH was assessed, intraclass correlation coefficient (ICC)  $> 0.70$  was considered a minimum acceptable reliability (Baumgartner & Chung, 2001). Within-subject coefficient of variations for raw pulmonary function data were calculated to assess the within-participant reproducibility in response to EVH. Independent samples t-tests compared pulmonary function differences between EIB and CTRLs. Results Excellent (ICCs  $\geq 0.70$ ) test-retest reliability was observed over the four weeks for FVC, FEV1,  $\% \Delta FEV_1$  and absolute change in FEV1 at each time point for both CTRL and EIB groups. Mean within-subject CVs for FVC were  $\leq 0.02 \pm 0.01$  for CTRLs and  $\leq 0.09 \pm 0.08$  for EIBs over the four weeks

for all time points. Mean within-subject CVs for FEV1 over the four weeks at all time points for CTRL and EIB were  $\leq 0.02 \pm 0.01$  and  $\leq 0.1 \pm 0.12$  respectively. Importantly the diagnostic outcome measure of  $\% \Delta FEV1$  showed excellent relative reliability over the four weeks with high ICC values of  $\geq 0.95$  for each time point. Pre EVH values of FEV1 were significantly lower in the EIB group when compared to CTRLs ( $p < 0.05$ ).  $\% \Delta FEV1$  was greater for the EIB group (3min  $26 \pm 16\%$ ; 6min  $28 \pm 19\%$ ; 16min  $22 \pm 16\%$ ) compared to CTRLs (3min  $3.3 \pm 2.1\%$ ; 6min  $2.2 \pm 2.0\%$ ; 16min  $1.5 \pm 1.4\%$ ) at all post EVH time points ( $p < 0.05$ ). Conclusion The within-subject response to EVH, assessed by changes in pulmonary function, was highly reliable in this small sample of both CTRL and EIB participants. This supports the use of EVH to assess EIB intervention-based research. References Dickinson J, McConnell A, Whyte G. (2011). *Br J Sports Med*, 45(14):1126-1131 Baumgartner TA, Chung H. (2001). *Meas Phys Educ Exerc Sci*, 5(3):179-188

### PHYSICAL INACTIVITY AND OTHER LIFESTYLE RISK FACTORS FROM CATALAN PHYSICIANS

Pardo, A.1, McKenna, J.2, Mijangas, A.3, Camps, B.4, García, J.5, Aranda, S.6, Violán, M.1

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Introduction Previous literature has shown that physicians with poor personal habits such as physical inactivity or overweight are less likely to counsel patient about healthy lifestyle (Reilly, 2007; Frank et al., 2010). The present study identifies lifestyle risk factors (LRF) such as physical inactivity, overweight and smoking habit and their combination in a sample of physicians from the Catalan Medical Council. Methods 2,400 physicians (30 to 55 years) were randomly selected; each received a self-administered mailed questionnaire identifying medical specialization, work setting, health self-perception, body mass index (BMI), physical activity (PA) and smoking habits. Results 762 physicians responded (52% female). Half of physicians (49.7%) were under-exercisers (do not exercise enough to meet current PA guidelines (WHO, 2010)), nearly all self-perceived good health, while 80.5% were non-smokers. Almost 6 in 10 males reported overweight or obesity (56.9%) versus 18.2% of females. 72.6% presented one or more LRF from under-exercising, BMI  $\geq 25 \text{ kg/m}^2$  and a current smoking habit. Physical inactivity was the commonest of the LRFs (24.1%), while the most common combination paired under-exercising with BMI  $\geq 25 \text{ kg/m}^2$  (17.5%). Males were three times more likely than females to present the combination of under-exercising and a BMI  $\geq 25 \text{ kg/m}^2$  (OR=3.38; 95% CI=2.31-4.95,  $p < .01$ ). Those who perceived 'Poor' health status were three times more likely to report both LRFs (OR=3.61; 95% CI=1.88-6.94) than those who perceived positive health status ( $p < .01$ ). Conclusions Our findings suggest that females physicians support the most optimal lifestyles, yet almost one of four physicians in the current study presented one or more LRFs, with under-exercising or/and overweight/obesity being the most prevalent. Being male physician and having poor health were the strongest predictors for both under-exercise and obesity. Low compliance with PA recommendations could adversely influence the PA promotion that, in turn, influences patients' health. References Reilly JM. (2007). *Am Fam Physician*.1;75(5):738, 741. Frank E, Segura C, Shen H, Oberg E., (2010). *Can J Public Health*.101(5), 390-395. WHO. (2010). Geneva.

### SELF-REPORTED EXERCISE LIMITATIONS IN ASTHMATIC ADOLESCENTS

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Introduction Physical activity (PA) is associated with several health benefits. Optimal use of asthma medications in asthmatic adolescents may enable a physically active lifestyle.(1) However, children and guardians perceiving asthma medication as potentially harmful may accept a lower level of PA.(2) The aim of the present study was to determine whether use of medications, asthma exacerbations, self-reported exercise induced asthma (EIA) symptoms and lung function is associated with self-reported exercise limitations (EL) in adolescents with asthma. Methods From the birth cohort, Environment and Childhood Asthma study in Oslo, Norway,(3,4) 95 13-years old adolescents with asthma participated in a structured interview concerning asthma symptoms and exacerbations, use of medication and provoking factors during the last 14 days. Lung function was measured by maximum forced expiratory flow-volume curves. Data were analyzed using logistic regression analysis. Results Exercise limitation due to asthma was reported by 22% of the adolescents. Use of inhaled corticosteroids (ICS) and  $\beta_2$ -agonists were reported by 32% and 37%, respectively. Subjects reporting EL significantly more often than those who did not, reported asthma exacerbations (24% vs 8%  $p=0.047$ ), EIA symptoms (57% vs 30%  $p=0.021$ ), use of ICS (71% vs 20%  $p < 0.001$ ) and  $\beta_2$ -agonists (67% vs 29%  $p=0.002$ ). Forced Expiratory Volume in 1 second (% of predicted) was not significantly reduced in adolescents with EL. In multivariate analysis only use of ICS ( $p < 0.001$ ) was associated with EL and explained 28% of the variance in self-reported EL. Discussion The use of ICS may indicate greater severity of asthma and and/or the importance of perceived asthma severity, whereas no use of  $\beta_2$ -agonists in 33% of adolescents with EL may indicate non-adherence or limited knowledge of therapeutic options for preventing EIA symptoms. Further analysis on associations between EL, self-reported disease and symptom perception, and objectively measured EIA is needed. References 1. Berntsen S. Physical activity in childhood asthma: Friend or foe? *American Journal of Lifestyle Medicine*. 2011;5(1):33-39. 2. Williams B, Powell A, Hoskins G, Neville R. Exploring and explaining low participation in physical activity among children and young people with asthma: a review. *BMC Family Practice*. 2008;9:1-11. 3. Lødrup Carlsen KC. The Environment and Childhood Asthma (ECA) Study in Oslo: ECA-1 and ECA-2. *Pediatr. Allergy Immunol*. 2002;13:29-31. 4. Berntsen S, Carlsen KCL, Anderssen SA, et al. Norwegian adolescents with asthma are physical active and fit. *Allergy*. 2009;64(3):421-426.

### SAFETY OF HIGH-INTENSITY INTERVAL TRAINING IN PATIENTS WITH TYPE 2 DIABETES TREATED WITH ORAL HYPOLYCEMIC AGENTS: DIABETES EM MOVIMENTO® PILOT STUDY

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Introduction High-intensity interval training (HIIT) is characterized by brief periods of high-intensity aerobic exercise separated by recovery periods of lower-intensity aerobic exercise or rest and has been recently recognized to improve health outcomes in non-athletes population. However, studies about its effects in type 2 diabetic patients are still lacking. This study aims to analyze the metabolic and cardiovascular safety of high-intensity interval training in patients with type 2 treated with oral hypoglycemic agents. Methods Twelve individuals with type 2 diabetes (diagnosed at  $5.83 \pm 3.13$  years; 6 men and 6 women; age  $58.67 \pm 5.35$  years; glycated hemoglobin  $7.08 \pm 1.18\%$ ; body mass index  $30.07 \pm 5.64 \text{ kg/m}^2$ ) treated with oral hypoglycemic agents (metformin, N = 5; metformin + sitagliptin, N = 4; metformin + vildagliptin, N = 3) underwent a single exercise session of HIIT on treadmill. After a 5-min warm-up, subjects performed 5 sets of 3 min brisk walking at 70% of heart rate reserve, interspersed with 3 min at 30% of heart rate reserve. In the end a 5-min cool-down was carried, totaling a 40-min exercise session. Treadmill speed and grade were adjusted to induce the defined intensity. Training zones were calculated with Karvonen heart rate reserve method. Exercise sessions were held in the morning period during standardized break-

fast postprandial state. Capillary blood glucose was measured at baseline, during exercise and during 50 min recovery. Blood pressure was measured at baseline and during 50 min recovery. Capillary blood glucose and blood pressure were assessed in 10-min periods. Results No acute adverse events occurred during exercise or recovery: no symptomatic hypoglycemia, hyperglycemia, hypotension, hypertensive crises, no symptoms of myocardial ischemia or stroke and no musculoskeletal injuries. Both blood glucose and blood pressure decreased with exercise. Minimum capillary blood glucose values were registered at the end of exercise ( $91.17 \pm 38.71$  mg/dl) and minimum systolic blood pressure values were registered at 40 min of recovery ( $108.67 \pm 9.65$  mmHg). Conclusions HIIT appears to be a safe exercise strategy to control glycemia and cardiovascular risk in patients with type 2 diabetes treated with metformin or with a combination of metformin and DPP-4 inhibitors sitagliptin and vildagliptin. Trial funding and registration Diabetes em Movimento® is funded by Portuguese Foundation for Science and Technology with reference SFRH/BD/47733/2008 and is registered in Current Controlled Trials with reference ISRCTN09240628.

### **BENEFITS OF INTEGRATIVE TRAINING TO BREAST CANCER PATIENTS' HEALTH. A PILOT STUDY.**

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Introduction Breast Cancer is the most common cancer in occidental women (SEOM). It presents a very high survival (SEOM) with a lot of side effect produced by the treatments such as chemotherapy, which decreases patient lean mass (Demark-Wahnefried, 2001). Research has showed important decrease in specific-cancer mortality in active patients (Irwin, 2008). Our goal is to know the effect of a guide exercise program on global strength of women with breast cancer. Methods: The design of the project was one arm, pre-post test. This program consisted in 24 classes of combined exercise (strength and aerobic activities), guided by a qualified, developed in Universidad Politécnica de Madrid. The intensity was monitored by Polar FT7 heart rate monitors. 31 women were studied. Global strength was assessed by Grip T.K.K.5401, functional capacity was assessed by 6 minutes walking test, quality of life was assessed by FACT-B questionnaire and depression was assessed by CES-D test. Results: A positive change was observed in the global strength ( $p=0.009$ ) and in the functional capacity ( $p=0.005$ ). Also they showed an increase in their quality of life ( $p=0.034$ ), and in different psychological aspects as depression ( $p=0.029$  y  $p=0.003$ ) Discussion: Related to our primary outcome, the results showed an improvement in global strength. Strength is an important factor to improve in this target population because of the existent relationship between strength improvements and lean mass increase (Demark-Wahnefried, 2001). Demark-Wahnefried et al. (Demark-Wahnefried, 2008) assessed the effect of combined exercise in this population and results showed that lean mass was preserved in intervention group. Women presented better functional capacity at the end of the program agree with previous interventions (Eyigor, 2010) what showed a survival increasing in this population (Kasymjanova, 2009). Study conclusions suggest that this kind of global intervention could improve global strength and functional capacity, important to increase the survival. References: SEOM. <http://www.seom.org/es/infopublico/info-tipos-cancer/cancer-demama-raiz/cancer-de-mama/2208-epidemiologia-y-factores-de-riesgo>. Demark-Wahnefried W, Peterson BL, Winer EP, Marks L, Aziz N, Marcom PK, et al (2001). *J Clin Oncol*, 19, 2381-2389. Irwin ML, Smith AW, McTiernan A, Ballard-Barbash R, Cronin K, Gilliland FD, et al. (2008). *J Clin Oncol*, 26, 3958-3964. Eyigor S, Karapolat H, Yesil H, Uslu R, Durmaz B. (2010). *Eur J Phys Rehabil Med* 46, 481-487 Demark-Wahnefried W, Case LD, Blackwell K, Marcom PK, Kraus W, Aziz N, et al. (2008). *Clin Breast Cancer* 8, 70-9 Cote CG, Pinto-Plata V, Kasprzyk K, Dordelly LJ, Celli BR. (2007). *Chest*, 132,1778-1785. Kasymjanova G, Correa JA, Kreisman H, Dajczman E, Pepe C, Dobson S, et al. (2009). *J Thorac Oncol*, 4, 602-607.

### **EFFECTS OF PHYSICAL EXERCISE IN PATIENTS WITH ACUTE LEUKEMIA UNDERGOING INDUCTION CHEMOTHERAPY**

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Introduction In recent years some clinical trials have demonstrated, that physical activity is feasible and has positive physical and psychological effects on patients with haematological malignancies undergoing chemotherapy. Little is known about the contributions of resistance and endurance training to the results found and data in acute leukemia are limited anyway. First cycles of chemotherapy for acute leukemia (induction chemotherapy) are one of the most intense chemotherapy. The medical therapy as well as extended hospitalisation causes a lot of side effects including physical deconditioning which are affecting quality of life. Therefore the aim of this ongoing study is to investigate and compare the effects of two exercise varieties – resistance and endurance training with patients diagnosed with acute leukemia. Methods Twenty-nine patients, diagnosed with acute leukemia were included in the study. Prior to induction-chemotherapy the patients were randomly assigned to one of three training groups: endurance, resistance or stretching/ mobilisation (control condition) and will perform a 30-minute program (3x/week) for the duration of their hospitalisation (4-6 weeks). Endurance capacity (incremental bicycle exercise test, blood lactate measurement), maximum strength (isokinetic strength test; knee extension/flexion), body composition (bioelectrical impedance analysis) and quality of life (EORTC QLQ-C30) were compared pre and post exercise intervention. Results So far we were able to recruit 29 patients in 2,5 years. Seven patients dropped out, due to insufficient physical and/ or mental condition. On an average, 65% (endurance: 64%, resistance: 78%, stretching/mobilisation: 58%) of the planned training sessions could be carried out and no adverse events due to physical exercise (i.e. bleeding, fracture) occurred. On the basis of mean differences, the stretching/ mobilisation group show the largest decline in physical capacity compared to both training groups. Further there is a weak superiority of resistance over endurance exercise training. Discussion Up to now the results give an indication that these patients benefit from our exercise programs, especially from resistance training. However, a larger sample size is needed to confirm this existing trend. The results provide a basis for further investigations to learn more about the impact of exercise and the mechanisms in that special clinical context.

### **ACUTE CENTRAL AND PERIPHERAL EFFECTS OF MAXIMAL EXERCISE IN HYPOXIA AND COLD IN PEOPLE WITH SPINAL CORD INJURY.**

Frauzino, F.C.1, Miguel, M.2, Delicado, M.C.1, Vidal, J.3, Soto, C.1, Barbany, J.R.1, Medina, J.3, Ventura, J.L.1, Javierre, C.1

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Introduction We have studied the differences in respiratory adaptation and peripheral vascular response after maximum exertion in environmental conditions similar to those practiced in winter sports, in people with spinal cord injury (SCI) and in able-bodied subjects (AB) physically active. Methods Twenty-four healthy volunteers have participated: 12 had a history of clinical SCI (the degree of the injury lesion following ASIA scale were: A 62%, B 23%, C 8% and 8% D) and 12 were AB subjects. Each subject performed three maximal exer-

cise testing with ventilatory monitoring but changing environmental circumstances: at sea level and 22-24 °C, at 3000 m of simulated altitude in a hypobaric chamber and 22-24 °C and at 3000 m of simulated altitude and 5-6 °C. Diameters were measured in: brachial artery, radial artery and posterior tibial artery by ultrasound means at rest and after active hyperemia. Results Comparing the values of simulated altitude tests in respect to sea level, we detected significant decreases in the VO<sub>2</sub> uptake accompanied by changes in ventilation, respiratory rate and tidal volume. In parallel, exhaled O<sub>2</sub> and CO<sub>2</sub>, the respiratory equivalent for O<sub>2</sub> and CO<sub>2</sub> and end-tidal O<sub>2</sub> and CO<sub>2</sub> showed statistically significant changes. The ultrasound measures did not show significant changes, neither between SCI and AB subjects nor between sea level and simulated altitude or between cold and 22-24° C. Discussion The acute response to physical exertion in SCI, compared with AB subjects, does not present significant differences in the peripheral vascular response, but significant ventilatory changes in hypoxia for the two groups and without substantial changes in the cold environment References Phillips AA, Krassioukov AV, Ainslie PN, Warburton DE (2012). *J Neurotrauma* Oct 10;29(15):2431-2445. Previnaire JG, Soler JM, Leclercq V, Denis P (2012). *Clin Auton Res* 22:9-15.

## 14:00 - 15:00

### Mini-Orals

#### PP-PM16 Health and Fitness [HF] 10

##### MUSCLE POWER, STRENGTH AND PHYSICAL PERFORMANCE ARE ASSOCIATED WITH VENTILATORY FUNCTION IN HEALTHY OLDER PEOPLE

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Introduction: Several physiological performance tests have been used to describe the associations between ventilatory function and functional capacity in patients suffering chronic obstructive lung diseases, while few studies have been conducted in healthy older adults. Methods: 135 healthy 69 to 82-yr-old men and women participated in the study, which was performed as a part of European research co-operation (Myoage). Associations between lung function (forced vital capacity (FVC), forced expiratory volume in 1s (FEV1), flow rate in the middle of exhalation (FEF50), FEV1/FVC) and functional capacity (quadriceps and grip strength, muscle power in jumping action, 6-min walking, timed up and go test (TUG)) were tested by partial correlations and stepwise linear regression models adjusted with body size and composition. In addition functional capacity in participants with normal ventilatory capacity and COPD stage I (GOLD definition, FEV1/FVC below 0.70) were compared with Student's T-test. Results: 6-min walking and grip strength were independently associated with FVC ( $r_{2adj}=0.68$ ,  $p<0.001$ ) and muscle power with FEV1 ( $r_{2adj}=0.52$ ,  $p<0.001$ ), FEF50 ( $r_{2adj}=0.16$ ,  $p=0.001$ ) and FEV1/FVC ( $r_{2adj}=0.094$ ,  $p=0.004$ ). Time taken in TUG test was significantly longer in COPD stage I participants compared to counterparts with normal ventilatory function ( $p=0.023$ ). Discussion: Muscle power production is stronger predictor of ventilatory variables that are related to rapid expiration, than other commonly used performance measurements. In contrast, variance in FVC was explained by muscle strength and aerobic components of functional capacity. Muscle power related performance is better in participants with normal ventilatory function compared to those with early stage COPD. The results suggest that age-related decreases in muscle strength and power are related to lung function also during healthy aging.

##### REPRODUCIBILITY AND VALIDITY OF THE PORTUGUESE VERSION OF THE PREGNANCY PHYSICAL ACTIVITY QUESTIONNAIRE

Santos, P.C.1,2, Maciel, P.1, Moreira, C.2, Abreu, S.2, Santos, R.2,4, Silva, P.2,3, Mota, J.2

Escola Superior de Tecnologia da Saúde do Porto

1 ESTSP (Porto, Portugal); 2 FADEUP (Porto, Portugal); 3 ISMAI (Maia, Portugal) Introduction Physical activity (PA) during pregnancy has been encouraged by several national and international entities aiming health promotion. However, there are few specific questionnaires for the assessment of PA in this condition. Aim was to adapt the cultural and linguistic Pregnancy Physical Activity Questionnaire (PPAQ) into Portuguese, and analyze its reliability and validity. Methods The translation and cultural adaptation followed three steps. 1) double independent forward translation was carried out and analyzed by a translation expert panel that achieved the reconciliation form. 2) back translation of the reconciled version was made to ensure the conceptual equivalence. 3) cognitive equivalence was tested with a panel consisted in six pregnancy women, native speakers of Portuguese, and a key nursing. A sample of 116 pregnant women in different trimesters of pregnancy completed the self-administered PPAQ and wore the accelerometer - ActiGraph for the following seven days to determine the validity of the questionnaire. Reproducibility was assessed at the end of the seven days period, when the questionnaires were repeated. Results Intra class correlation coefficients used to measure reproducibility of the PPAQ were 0.86 for total activity, 0.91 for sedentary, 0.84 for light activity, 0.85 for moderate activity, 0.81 for vigorous activity, and ranged from 0.85 for household/caregiving to 0.99 for occupational activity. Overall, Pearson correlations between the PPAQ and the Actigraph measures using the three previously published cut points were positive but poor, with data ranged from 0.077 to 0.107 for total activity (all trimesters vs 1st and 2nd trimester), 0.054 to 0.238 for vigorous activity (all trimesters vs 1st and 2nd trimester), 0.002 to 0.083 for moderate activity (all trimesters vs 1st and 2nd trimester) and 0.023 to 0.069 for light-intensity activity (all trimesters vs 1st and 2nd trimester). Discussion/Conclusion Analyses of current study showed moderate to high values of reproducibility what confirmed PPAQ as an accurate measure of a broad range of physical activities during pregnancy. However, concerning validation, the comparison with results obtained by Atigraph did not show adequate degrees of agreement. This suggests that PPAQ may be valid for ranking individuals' behavior, but limited to quantify PA. Its difficult to obtain a valid estimation of a highly variable behavior such as free-living physical activity by self-report. However, the questionnaire allows us to know the type of activities which makes PPAQ a good addition to biophysical measures. References ACSM. (2006). *Exerc Sport Sci Rev*, 28(2), 93-96. Chasan-Taber L, Schmidt MD, Roberts DE, Hosmer D, Markenson G, Freedson PS. (2004). *Med Sci Sports*

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### WORKPLACE HEALTH PROMOTION AND ITS IMPACT ON THE WORK ABILITY OF YOUNGER AND OLDER EMPLOYEES IN A MEDIUM-SIZED BUSINESS

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**Introduction** Demographic change, an extended work life and the employee's health show growing importance in today's professional world. Thus, employers face the challenge of finding qualified trainees. In addition, older employees need more time to convalesce. Promoting the health of older employees strongly is crucial in order to employ them until retirement. **Methods** 157 younger (< 45 years) and older workers (≥ 45 years) (102 men, 55 women) in a medium-sized business took part in a two-year project regarding workplace health promotion. All employees were tested at the beginning (T1) and at the end of the project (T2) towards their work ability and physiologic parameters (body mass index, lipoproteins). The physiologic parameters were measured through diagnostic methods, work ability was assessed through the work ability index (WAI). An intervention focused on both condition oriented (i.e. physical activity, nutrition) and behaviour oriented prevention (i.e. job-analysis, ergonomics). **Results** Work ability ( $p > .05$ ) and physiologic parameters ( $p > .05$ ) showed no age-related difference. Age was not associated with work ability. Age was positive associated with body mass before ( $r = .31^{**}$ ;  $p \leq .01$ ) and after the intervention ( $r = .30^{**}$ ;  $p \leq .01$ ). Age was also positive associated with LDL-cholesterol before ( $r = .35^{**}$ ;  $p \leq .001$ ) and after the project ( $r = .30^{**}$ ;  $p \leq .01$ ). **Discussion** We could not find any association between age and work ability. This is in accordance to other studies (Berg et al., 2009; Freude et al., 2000). Younger employees were less likely to be overweight than older employees. This positive association is consistent with findings from further research (Reas et al., 2007). Also, older workers showed a higher LDL-cholesterol than younger workers. This finding was expected, since it is assumed that the LDL-cholesterol level rises with increasing age (Parhofer et al., 2007). The results indicate the importance of work place health promotion for the health status of employees, especially older workers. **References** BERG, E. van den, Zwart, B. de, Burdorf, A. (2009) The effects of work-related and individual factors on the Work Ability Index: a systematic review. *Occup Environ med*, 66:211-220. Freude, G., Ullsprenger, P., Dehoff, W. (2000) (Hrsg.: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin). Zur Einschätzung von Vitalität, Leistungsfähigkeit und Arbeitsbewältigung älterer Arbeitnehmer. Wirtschaftsverlag NW, Bremerhaven. Reas, D.L., Nygård, J.F., Svensson, E., Sørensen, T., Sandanger I. (2007) Changes in body mass index by age, gender and socio-economic status among a cohort of Norwegian men and women (1990-2001). *BMC Public Health*, 7:35-47. Parhofer, K.G. (2007) Hohes Alter und hohe Bluffette – was nun? Gültige Empfehlungen für die Therapie der Hyperlipoproteinämie bei alten Patienten. *CME*, 4(6):60-67.

### ASSOCIATION BETWEEN INTRA-ABDOMINAL PRESSURE AND MUSCLE ACTIVITY LEVELS OF TRUNK MUSCLES

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**Introduction** Increasing intra-abdominal pressure (IAP) plays an important role in acquiring stability and stiffness of the spine (Cholewicki et al. 2002). IAP is increased during various tasks, e.g. lifting and jumping. However, how IAP varies among tasks remains question. Furthermore, it is also unknown whether IAP measurement has good repeatability inter- and intra-day. We examined 1) the repeatability of IAP measurement over repeated trial inter- and intra-day, and 2) the exercise-related difference in the increase of IAP with relation to the activity level of trunk muscles during various tasks. **Methods** Six young males performed bracing, drawing, isometric trunk flexion and extension tasks with maximal voluntary effort. During these task, IAP with a pressure transducer placed in the rectum and surface electromyography (EMG) activities from rectus abdominis (RA), oblique external (OE) and internal (OI) muscles, and erector spine muscle (ES) were determined. All subjects performed each task twice in inter- and intra-day. **Results** There was no significant difference in IAP during each of the task in either the inter- or intra-day comparisons. Intra-class correlation coefficient for IAP measurement was 0.987 for inter-day and 0.779 for intra-day. To examine the association between IAP and EMG amplitude, the data were averaged across trials and days in each task. The maximal IAP value obtained in each task was  $86.4 \pm 13.0$  mmHg for bracing,  $74.4 \pm 14.4$  mmHg for trunk extension,  $55.9 \pm 12.4$  mmHg for trunk flexion, and  $9.5 \pm 4.5$  mmHg for drawing. The IAP in drawing was significantly lower than those in the other tasks. For all tasks except for drawing, IAP linearly increased with increases in the exerted force ( $r = 0.711 - 0.943$ ) and EMG amplitude ( $r = 0.297 - 0.704$ ). The slope of the regression line in the relationship between IAP and muscle activity levels for each muscle differed among the tasks. **Discussion** The findings obtained here were 1) IAP measurement has good inter- and intra-day repeatability, satisfying the standard value of repeatability ( $\geq 0.75$ ) (Vincent, 1995), and 2) increase of IAP differs among the tasks although IAP increases in proportion to exerted force and muscle activity levels of trunk muscles in each task. The current findings on the association between IAP and muscle activity levels of trunk muscles are consistent with earlier findings (Cresswell et al. 1992; Cholewicki et al., 2002). On the other hand, the task-related difference observed in the association between IAP and muscle activity levels indicates that the contribution of trunk muscle activation to IAP depends on exercise modality. In general, drawing maneuver has been considered to elevate IAP, but the current result did not support this. This may be derived from the posture-dependent difference (standing vs. prone). **References** Cholewicki J, Ivancic P.C, Radebold A (2002) *Eur J Appl Physiol* 87:127-133. Cresswell AG, Grundstrom H, Thorstensson A (1992) *Acta Physiol Scand* 144:409-418. Vincent, W.J. (1995) *Statics in Kinesiology*. Champaign IL: Human Kinetics.

### 1RM BENCH PRESS PERFORMANCE: A NEW METHOD OF EVALUATION IN RECREATIONAL MALE AND FEMALE

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**Introduction** It is widely recognized that the bench press test is the most valid in determining upper body maximal strength in both athletes and sedentary. Various approaches are used for its evaluation, both through prediction equations or practical attempts. The aim of this study is to use a new method for the evaluation of the bench press test (BP) using combined previous validated theoretical and practical procedures. **Methods** Fifteen participants (8 male Age=23,5±2,3 FM%=17,3±9,2 and 7 female Age=27,9±10 FM%=25,6±6,9) with no specific training history were tested. Physiological parameters were recorded before, during and after each attempt. In first instance, the participants had to perform repetitions to fatigue (RTF) with 1/3 of their body mass (BM) for a maximum of 25 repetitions. After a 5-minute rest, RTF were assessed with 1/2 of BM and the number of repetitions performed was then used on the theoretical Mayhew's equation. Subsequently the participants were invited to attempt the Mayhew 1-RM for a maximum of three attempts. RPE scale was used during

experimentation. Results  $\frac{1}{2}$  BM workload was significantly (.001) gender related with RTF showing higher performance values for male ( $25 \pm 6,6$  repetitions) compared to female ( $11 \pm 10,6$  repetitions). Moreover, compared to 1RM performance the Meyhew's equation showed a percentage accuracy of 01,7% in female and an underestimation of 18,3% in male. No significant difference between genders were found on Blood Lactate (BL) and RPE recorded immediately post 1RM performance. Oxygen uptake (VO<sub>2</sub>) and Heart rate (HR) showed some significant differences. Conclusions Despite the study at this stage is still a pilot it leads to consider this new method effective for recreational male and female. High accuracy percentage suggests low time consuming testing sessions and easiness in estimating 1RM on the bench press. At this stage the study confirms the safety and feasibility of the BP test and the accurateness of Meyhew's equation in particular in female.

## EVALUATION OF CHRONOTYPES IN YOUNG ITALIAN PHYSICALLY ACTIVE ADULTS

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**INTRODUCTION** The expression of circadian rhythms can be different in people and this trait can be defined as "circadian typology" or "chronotype". There are three different chronotypes: Evening-type (E-type), Morning-type (M-type) and Neither-type (N-type). Morning-types show an early sleep-wake cycle and have their best performances in the morning, on the contrary evening-types show a late sleep-wake cycle and they have the best performances in the evening. The circadian typology emerges especially during adolescence and it is influenced by individual factors, like age and sex, and by environmental factors. The chronotype is typically defined by a validated questionnaire, the Morningness-Eveningness Questionnaire (MEQ). **METHODS** 500 subjects, Italian students of Sports Sciences from University of Milan, 345 males and 155 females, mean age:  $21,9 \pm 2,24$  have been recruited. They compiled voluntarily the MEQ to determine their chronotype. The MEQ has been related with age, sex and photoperiod at birth for each subject. None of the participant was a shift worker. Ten subjects for each category of chronotype (10 M-types, 10 E-types and 10 N-types) wore an actigraph to evaluate the sleep-wake cycle and the level of physical activity across the day. **RESULTS** MEQ scores showed that the subjects were 334 N-types, 117 E-types (105 Moderate E-types and 12 Extreme E-types) and 49 M-types (48 Moderate M-types and 1 Extreme M-type). The mean score of MEQ was  $48.18 \pm 8.66$  but, as we expected, women totalized a higher mean score ( $49.54 \pm 8.57$ ) if compared to men's mean score ( $46.82 \pm 8.69$ ). The data collected by the actigraphs showed that E-types were more physically active starting from the late afternoon until night and the M-types were more active in the morning. **DISCUSSION** We observed that individual factors, age and sex, influenced the chronotype: being our sample composed by young students, there were, as expected, more E-types (23,4%) than M-types (9,8%) and girls showed greater scores of the MEQ with a predisposition toward morningness compared to men. E-types had the predisposition to be active and to practice physical activity in the late afternoon/evening and M-types had the predisposition to be active and to practice physical activity in the morning. Training programs should be scheduled according with the individual's chronotype. **REFERENCES** 1. Horne, J.A., Brass, C.G. & Peititt A.N. (1980). *Ergonomics* 23: 29-36. 2. Horne, J.A., & Ostberg, O. (1976). *Int J Chronobiol*, 4(2), 97-110. 3. Kim, S. J., Lee Y.J., Kim H., Cho I.H., Lee J.Y., & Cho S.J. (2010). *J. Psychosom. Res.* 68: 159-164. 4. Park, Y.M., Matsumoto, K., Seo, Y.J., Kang, M.J., & Nagashima, H. (2002). *Perceptual and motor skills*, 94, 1199-1213.

## EFFECTS OF SOCIAL AND ENVIRONMENTAL DETERMINANTS ON OVERWEIGHT AND OBESITY AMONG BRAZILIAN SCHOOLCHILDREN

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**Introduction** Current evidence suggests that the development and execution of intervention programs related to prevention and management of overweight and obesity require the identification of obesogenic social and environmental determinants [1]. Studies available in literature have shown the complex association between social and environmental determinants and obesity [2,3]. The aim of this study was to identify the social and environmental determinants that are most strongly associated with the prevalence of overweight and obesity in a representative sample of Brazilian schoolchildren assisted by Parana Health Program. **Methods** The Parana Healthy Program is an action of the State of Parana' Secretariat of Sport serving approximately 2 million of schoolchildren. Its activities are focused on the prevention and weight management through nutrition education and physical activity. The study used multistage sampling to obtain representative estimates of the schoolchildren population from the State of Parana, Brazil. A total of 5460 subjects (2946 girls and 2514 boys) aged 4 to 20 years were included in the study. Overweight and obesity were defined by body mass index, based on sex-and-age-specific cut-off recommended by the IOTF. Social and environmental determinants were collected using a structured questionnaire. The impact of social and environmental determinants on the prevalence of overweight and obesity were analyzed using odds ratios (OR), established by binary logistic regression adjusted for the remaining independent variables included in the regression models. **Results** In girls, prevalence of overweight and obesity were 18.9% and 8.2%, respectively, whereas the corresponding numbers in boys were 18.6% and 9.5%. The chance of overweight was higher in schoolchildren that engaged in 2 hours or more of daily screen time (OR = 2.41; 95% CI 1.52-3.48), whose parents had higher educational levels (OR = 1.82; 95% CI 1.42-2.37),  $\leq 2$  siblings (OR = 1.92; 95% CI 1.39-2.67) and high economic class (OR = 2.07; 95% CI 1.47-2.75). Schoolchildren who traveled by car to school (OR = 1.60; 95% CI 1.24-1.97), lived within a radius of  $\leq 5$  km from school (OR = 1.56; 95% CI 1.17-2.11) and consumed foods sold in the school cafeteria (OR = 1.88; 95% CI 1.49-2.34) presented a high odds of overweight. **Conclusions** The background from a particular region of a country should be considered when implementing preventive measures regarding overweight and obesity. Measures taken should consider a multi-level intervention that includes the family, school and physical environment. **References** [1] Swinburn B, Egger G, Raza F. *Prev Med.* 1999; 29:563-570. [2] Johnson-Taylor WL, Everhart JE. *Obesity (Silver Spring)*. 2006; 14:929-966. [3] Dunton GF, Kaplan J, Wolch J, Jerrett M, Reynolds KD. *Obes Rev.* 2009; 10:393-402.

## SPEED OF TREADMILL WALKING AND SURVIVAL IN PATIENTS WITH CARDIOVASCULAR DISEASE. A 10-YEAR FOLLOW UP STUDY

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**Introduction:** Walking speed has been shown to be associated with survival in older adults [1]. In this study the association between the speed maintained in a 1 Km walking test and all-cause mortality in patients with cardiovascular disease has been determined. **Methods:** 1255 male patients, aged 25-85 years at baseline, completed 1 km treadmill walking test [2] at moderate intensity corresponding to a

perceived exertion of 11-13 on the 6-20 Borg scale. Subjects were followed for all-cause mortality for up to 10 years. Cox proportional hazard models were employed to determine variables associated with mortality. Based on the average speed (AWS) maintained during the test the subjects were subdivided into quartiles and mortality risks were calculated across quartiles. To assess the discriminatory accuracy of walking speed in estimating survival, receiver-operating-characteristics curves were constructed. Results: During a median 8.2 years of follow-up, a total of 141 deaths from any cause occurred, with an average annual mortality of 1.4 percent. The best predictor of increased risk of death was AWS (95% CI 0.45-0.75,  $P < 0.0001$ ). Mortality increased in a graded fashion from the highest to the lowest AWS quartile. Compared to the first quartile, the relative mortality risk for the second, third, and fourth quartiles were progressively reduced with hazard ratio (HR) of 0.77 (95%CI 0.52-1.13,  $P = 0.18$ ) for the second; of 0.41 (95%CI 0.24-0.70,  $P = 0.01$ ) for the third; and of 0.36 (95%CI 0.19-0.68,  $P = 0.002$ ) for the fourth quartile ( $P$  for trend  $< 0.0001$ ). A further reduction in mortality risk was observed among subjects in the fittest quartile who improved their AWS relative to the subjects of the same quartile who did not improve. Conclusions: The AWS determined by 1-km treadmill walking test is a useful tool for predicting survival and guiding rehabilitation in subjects with stable cardiovascular disease. References: 1. Studensky S, Preera S, Patel K et al. Gait speed and survival in older adults. *JAMA*. 2011;305(1):50-58. 2. Chiaranda G, Myers J, Mazzoni G et al. Peak oxygen uptake prediction from a moderate, perceptually regulated, 1-km treadmill walk in male cardiac patients. *JCRP*. 2012;32(5):262-9.

## IMPLEMENTING HEALTH PROMOTION PROJECTS IN SPORTS CLUBS – SUPPORTING AND LIMITING FACTORS

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Implementing health promotion projects in sports clubs – supporting and limiting factors Zillmann, N., Mairinger, F. & Tschirk, B. University of Vienna (Vienna, Austria) Introduction For some time now sports clubs provide a setting for the initiation of educational and developmental processes through physical activity in various target groups and as a result attract public attention (Breuer & Feiler, 2012). Furthermore, in recent years a trend emerged showing that sports organisations engage increasingly in health promotion initiatives to meet expectations of public and private entities alike. At the same time, with initiating such projects, sports clubs face a variety of challenges that quickly lead them to experience both personal and structural limits (Bette, 2009). As part of the evaluation of the Austrian health promotion initiative UGOTCHI limiting and supporting factors for sports club project participation were investigated. Methods Both quantitative and qualitative methods were applied in the two-year UGOTCHI evaluation. Representatives of participating sports clubs were invited to partake in an online survey (2011,  $n=137$ ; 2012,  $n=125$ ) investigating their appraisal and effects of the project. In addition, in 2012 all non-participating sports clubs were asked to participate in an online questionnaire covering amongst others aspects of reasons for their non-participation ( $n=1098$ ). Furthermore, focus group discussions were initiated with representatives from participating and non-participating sports clubs to identify influencing factors that determine the involvement in the health promotion initiative UGOTCHI. Results Through the evaluation various supporting and limiting factors for project participation could be identified. For example the major restraining factor for both participating and non-participating sports clubs were deficient resources (material, spacial and personal) to implement additional (health promotion) projects that are not core competence of sports clubs. Supportive elements are the organizational support through the sports association and the financial aids provided. Overall, the results of the qualitative and the quantitative examinations were comparatively similar. Discussion The results will be discussed in the light of the increasing challenges for sports clubs and their club work. Similarities and dissimilarities between participating and non-participating sports clubs will be demonstrated. In addition, some aspects not directly linked to the project emerged, that seem to impact the everyday work of a sports club. References Bette, K.-H. (2009). Beratung von Sportorganisationen: Konzepte und Voraussetzungen Handbuch Sportmanagement (2., erw. Aufl., S. 131-147). Schorndorf: Hofmann. Breuer, C. & Feiler, S. (Mai 2012). Sportentwicklungsbildung 2011/12 - Analyse zur Situation der Sportvereine in Deutschland. Accessed 25th January 2013 [http://www.dosb.de/fileadmin/fm-dosb/arbeitsfelder/wiss-ges/Dateien/2009/SIEGEL-Bundesbericht\\_SEB\\_Welle\\_4.pdf](http://www.dosb.de/fileadmin/fm-dosb/arbeitsfelder/wiss-ges/Dateien/2009/SIEGEL-Bundesbericht_SEB_Welle_4.pdf)

## CARDIORESPIRATORY FITNESS AND NUTRITIONAL STATUS OF STUDENTS: EVOLUTION IN 30 YEARS

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*CELAFISCS*

Introduction Longitudinal projects seem to be the most appropriate approach to understand development of aerobic power (AP). The objective of this study was to compare the changes of AP according to the decade and nutritional status among schoolchildren in a period of 30 years Methods Data were selected from a longitudinal cohort study with more than 16.000 evaluations from 1978 to 2010. Sample consisted 1.212 students that should have performed a complete physical evaluation and be in pre puberty between 10 and 11 years. The evolution of 30 years was analyzed in the years 1978/1980, 1988/1990, 1998/2000, 2008/2010. They were classified according to the age and sex according to the parameters of the growth curves of body mass index. It was considered overweight those with z-score above 1 and below a normal weight. AP was evaluated by a sub-maximal progressive protocol on a bicycle ergometer with a mechanical load calculated from the weight. To calculate the  $VO_{2max}$  used the nomogram Astrand. MANOVA analysis was performed followed by Bonferroni and percent delta to determine the percentage difference in values between groups and between decades. Results The AP values were significantly higher in the normal weight (14.29 to 24.71%) than the overweight. Regarding the evolution of the AP analyzed every decade, the results showed that  $VO_{2max}$  ( $ml \cdot kg^{-1} \cdot min^{-1}$  and  $l \cdot min^{-1}$ ) decreased significantly in the three decades analyzed in both normal ( $46.50 \pm 12.0$  to  $35.43 \pm 11.7$  and  $1.56 \pm 0.3$  to  $1.17 \pm 0.3$ ) and in overweight ( $37.70 \pm 9.6$  to  $30.33 \pm 10.33$  and  $1.72 \pm 0.3$  to  $1.35 \pm 0.4$ ) groups. The normal weight group has decreased AP either absolutely or relative (25% and 23.8%) and overweight has decreased absolute and relative in 21.5% and 19.5% in three decades. Discussion In a period of 45 years there was a decline per year of AP (Tomkinson, Olds, 2007). These changes have been very consistent according to gender and nutritional status (Craggs et al, 2011). Conclusion Nutritional status particularly overweight affects negatively the AP pre-pubescent school. Changes in environmental, socioeconomic, nutritional and physical activity of recent decades seemed to have a negative effect on AP of school regardless of nutritional status. The impact could be even more deleterious among children with overweight and obesity as they have the same values up to 25% less than AP. References Craggs C, Corder K, Esther MF, Sluijs V, and Griffin SJ. (2011). Determinants of change in physical activity in children and adolescents: A systematic review. *Am J Prev Med*, 40(6), 645-658. Tomkinson GR, and Olds TS. (2007). Secular changes in pediatric aerobic fitness test performance: the global picture. *Med Sport Sci*, 50, 46-66.

## IS KNOWLEDGE OF PHYSICAL ACTIVITY GUIDELINES MOTIVATIONAL BENEFICIAL FOR BEHAVIOUR CHANGE? RESULTS FROM A NATIONAL SURVEY

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**Introduction** The publishing of global recommendations for physical activity (PA) and health (WHO, 2010) marked a concerted effort to raise the profile of PA for health and place it on the health agenda of policy-makers. Despite this, no plan has yet been formed to promote and disseminate the information in these guidelines. The guidelines key messages are: aim for 150 minutes of moderate-to-vigorous PA a week; PA can be accumulated in bouts of 10 minutes or more; PA should raise the heart rate and breathing rate; lifestyle activities can be made more active; and more health benefits result from more PA. National campaigns all over the world have taken the lead in promoting these messages e.g. 'Swap 4 wheels for me own two feet to get going for 150 minutes a week' (Change4Life, UK); 'Find thirty, find a better you! It's not a big exercise' (Find30, WA). The following research examined whether knowledge of the key messages of the PA guidelines could contribute towards a greater intention to engage in more PA. **Methods** The 2007 Health Survey for England provides data on 14,385 individuals from the UK. Individuals were excluded if they were <18 years old and if they had illnesses/disorders likely to restrict PA, leaving a sample of 4,691 (88% white, 55% female, 50% under 45 years old and 62% non-manual workers). Ordinal logistic regression examined the degree to which intentions (agree/disagree with statement; 'Would like to engage in more PA') could be predicted by agreement with the following statements: 'PA can be accumulated in daily life' (N=3,392); 'PA is good if only 10 minutes' (N=3,413); 'physical activity is good even if it is moderate' (N=3,414); 'PA is better for health if at least 30 minutes' (N=3,384); and 'PA is better for health if I get out of breath' (N=3,369). **Results** Agreement that sufficient PA can be achieved in daily life (OR=.75), PA is good even if only 10 minutes (OR=.14), and PA is good even if it is moderate (OR=.59) significantly contributed to greater intentions to become more active ( $p > .001$ ). Agreement that PA is better for health if at least 30 minutes (OR=-.35) and PA is better for health if you get out of breath (OR=-.42) significantly predicted lower intentions to become more active ( $p < .05$ ). All models showed good fit ( $p < .001$ ). **Discussion** Knowledge of three of the key messages of the PA guidelines (i.e. 10 minute bouts and moderate PA is beneficial, and physical activity can be accumulated in daily life) significantly predicted greater intentions to become more physically active. Future efforts which focus on the convenience of PA appear preferable to those which emphasise greater durations and intensity. Research is needed to determine the best way to educate the general population about PA guidelines and motivate increased engagement. **References** Change4Life. 'Get Going Everyday'. 2011. NHS Choices: Crown Find30. Heart Foundation media release. 2010. WHO. Global recommendations on physical activity for health. 2010

## THE EVALUATION OF PHYSICAL FITNESS PARAMETERS OF TURKISH JUNIOR GOLFERS

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**Introduction:** Golf is a very popular sports in the world and more than 50 millions players in all ages and levels around the world (Lephard et al., 2007). Physical conditioning is one of the most important parameter in golf performance and proper swing movement (Lephard et al., 2007; Tsang and Hui-Chan, 2004). Strength, power, flexibility, balance, core stability, endurance, body awareness they are all physical traits that every consistent golfer must possess. In order to improve performance in golf, training must be specific to the demands of the game involved. It is important to recognize how physical attributes relate to the swing, pata so the aim of this study was to determine to physical fitness parameters of junior golfers in Turkish National Golf Team. **Method:** In study, 14 males and 13 females (mean ages  $14.6 \pm 1.07$  and sport ages 1.5-5.5 years) in total 27 golfers joined as subjects voluntarily. Physical tests were consisted measurement of height, weight, height of sitting, arm span, subcutaneous fat thickness from the 6 body areas. Also body composition was calculated by using Yuhaz's formula. In physical fitness parameters, muscular endurance, muscular strength, left and right swing body flexibility and static balance were measured. All golfers' data collection were taken in the same day. All data results were analysed by using SPSS program (version 18.0; SPSS, Inc., Chicago, IL). **Results:** In results there were no significant differences between all parameters and sport ages of the golfers. Male golfers had more results in parameters of height, height of sitting, right foot balance, 30s body flexion, right swing flexibility, hand grip mean values and push up values rather than female golfers. However, female golfers had more results in parameters of average values of body fat, average values of shuttle run, left swing flexibility and body flexibilities. **Discussion:** As a conclusion, it can be say that there were no any differences according to the gender-specific in age group. So in future researches might be determining the specific relationships between physical characteristics and launch characteristics by gender and also creating golf-specific training program for fitness parameters can also improve flexibility, strength and balance abilities for junior golfers. **References:** Lephart, M.S.; Smoliga, J.M.; Myers, J. B.; Sell, T.C.; Tsai, Y-S. (2007) *Jour. of Strength and Conditioning Resrch*, 21(3), 860–869. Tsang, W.W., and C.W. Hui-Chan. (2004). *Med. Sci. Sports Exerc.* 36: 658–667.

## MAXIMAL AEROBIC PERFORMANCE AND HEART RATE VARIABILITY DURING EARLY RECOVERY AFTER REPEATED SPRINT TEST IN SMOKING FEMALE

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**Introduction:** Smoking is an important risk factor for cardiovascular disease. Many individuals engage in a physical activity to reduce their cardiovascular risk associated with smoking, but heart rate variability (HRV) during the early phase of the recovery after a repeated sprint test (RST) has barely been studied. Therefore, the purpose of this study was to investigate the effects of cigarette smoking on a maximal aerobic capacity, anaerobic capacity, and HRV in college female students. **Methods:** 8 smokers (S) and 27 non-smokers (NS) randomly completed the experimental design. All of the participants performed a 20 meter shuttle run test for measuring the maximal aerobic capacity, and a repeated sprint test for estimating anaerobic capacity. RST consists of 6x10-s sprints with 60-s active recovery between every single sprint. HRV was recorded in a supine position for 30-min following RST. A power-spectral analysis of R-R intervals was performed to obtain the low-frequency (LF), and high-frequency (HF) components. **Results:** Peak power, mean power, and the heart rate were observed no significantly difference between S and NS groups during the RST ( $p > 0.05$ ), but fatigue index was significantly higher in the S group than in the NS group during the RST ( $34.2 \pm 13.5$  vs.  $26.2 \pm 13.2$  %,  $p < 0.05$ ). Maximal oxygen uptake was significantly higher in the NS group than in the S group ( $p < 0.05$ ). The SDNN (standard deviation of the NN interval), and the RMSSD (root mean square successive difference) were not significantly different between the S and NS groups; however, NS group has a significantly higher HF % relative to S group (95 % CI = 12.1-16.5 vs. 3.8-11.8,  $p < 0.05$ ). **Discussion:** Smoking may increase exercise fatigue during the RST, and decrease the

maximal aerobic capacity in college female students. Smoking also reduces parasympathetic nerve activities, but smoking as previous hypothesized does not activate the sympathetic cardiac control. We suggested that the possible reasons for the higher fatigue index, and the lower cardiovascular fitness in smoking females may derive from either, an aerobic metabolism restriction (Spencer et al., 2005), or the muscle O<sub>2</sub> uptake limitation (King et al., 1987). A smoker should receive more encouragement, and educational information about suitable smoking cessation strategies, in order to improve cardiac autonomic function. References: Spencer M, Bishop D, Dawson B, Goodman C. (2005). *Sports Med*, 35, 1025-44. King C. E., Dodd S. L. (1987). *J Appl Physiol*, 63, 726-32.

### ATTEMPT TO DEVELOP A SIMPLE AND LESS DEMANDING GLUCOSE TOLERANCE TEST

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1: *Shikoku University (Tokushima, Japan)*, 2: *The University of Tokushima (Tokushima, Japan)*

**Introduction** Evaluating blood glucose regulation is important in preventing type II diabetes. In current oral glucose tolerance tests (OGTT), plasma glucose concentration is measured before and 2 hours after ingestion of a solution containing 75 g glucose. On the day prior to testing, efforts should be made to control confounding factors, such as exercise and carbohydrate content of meals (Kaneko et al., 1998). Thus, the OGTT is rather demanding, restricted its use primarily to diagnosis in medical settings. This study was performed to develop a simpler, less demanding type of OGTT that can be used in exercise and sports instruction settings. **Methods** Subjects were healthy males and females aged 20–74 years, with serum HbA<sub>1c</sub> concentrations <6.1%, randomized to 60 min rest OGTT (n=69) or 60 min exercise OGTT (n=32). The 60 min rest OGTT consisted of ingesting 1 ml/kg body weight of glucose solution (75g/225ml) and drawing blood samples in resting condition at 0, 15, 30, 45 and 60 min after ingestion for measurement of glucose concentration. The protocol for the 60 min exercise OGTT was identical, except that subjects performed step exercises from 30 to 45 min after glucose injection. The step exercise period consisted of 3 sets of 4 min of exercise and 1 min of rest. An index of blood glucose regulation capacity was determined by calculating the area under the time-glucose curve using the trapezoidal method and dividing by 100. **Results** The mean index of blood glucose regulation capacity for the 60 min rest OGTT was 76.4 (SD: 12.4) (range, 56.1-118.6), with three subjects having index values >100. The mean index for the 60 min exercise OGTT was almost identical 76.6 (SD: 11.8) (range, 60.2 and 110.9). The index was significantly related to body mass index (BMI) for the 60 min rest, but not for the 60 min exercise, OGTT (p<0.05). **Discussion** Although we expected that the index would be lower for exercise than for rest OGTT, because step exercises consume glucose (Larose et al. 2010), we found that the mean values of the index for both tests were almost the same. This finding indicates that subjects with normal blood glucose regulation capacity are able to maintain normal glucose concentrations during both rest and exercise OGTTs. Small amounts of glucose solution (1 ml/kg-wt) and a 60 min OGTT may be valuable in screening for glucose regulation, but not for a diagnosis of type II diabetes. **References** Kaneko T, Wang PY, Tawata M, et al. (1998). *Lancet*, 352, 289. Larose J, Sigal RJ, Boule NG, et al. (2010). *Med Sci Sports Exerc*, 42, 1439-1447.

### HIGH IMPACT EXERCISE INCREASED CORTICAL THICKNESS AT THE SUPERIOR FEMORAL NECK IN OLDER MEN: A 12-MONTH RANDOMISED BLINDED TRIAL USING MULTI-SLICE COMPUTED TOMOGRAPHY

Allison, S.J.1, Folland, J.P.1, Rennie, W.J.2, Summers, G.D.3, Poole, K.E.S.4, Brooke-Wavell, K.1

1: *Loughborough University (UK)*, 2: *University Hospitals of Leicester (UK)*, 3: *Derby Hospitals NHS Trust (UK)*, 4: *University of Cambridge (UK)*

**Introduction** Hip fractures in older adults are a major public health problem leading to loss of independence and large health-care expenses. Hip fractures in old age are associated with cortical thinning in the superior femoral neck. Interventions that increase cortical thickness at this region would be beneficial in fracture prevention. This study evaluated the influence of high impact exercise on regional cortical thickness at the femoral neck in older men. **Methods** Fifty, healthy community-dwelling older men were prescribed a 12-month high impact unilateral exercise intervention, which progressed to 50 multidirectional hops performed daily on one randomly allocated leg. Multi-slice computed tomography (CT) scans of the hips were performed at baseline and after 12-months of exercise by observers blind to the leg allocation. Regional CT analysis of the mid femoral neck was used to examine cortical thickness in anatomical quadrants. Cortical thicknesses were square root transformed to achieve normal distribution prior to statistical analysis. Two-way repeated measures ANOVA was used to identify leg (exercise leg [EL] vs. control leg [CL]) x time (pre vs. post) interactions. **Results** Thirty-four men (mean±SD, age 70.0±3.9 yrs) exercised for 12-months, attending 92±9% of prescribed sessions. Fourteen men did not complete the 12-month exercise intervention due to: medical conditions or injuries unrelated to the intervention (n=9), time commitments (n=2), or discomfort during exercise (n=3), whilst two participants' data were excluded due to image artefacts. Cortical thickness in the superoposterior quadrant increased more in the EL compared to the CL (EL from 0.29 [95%CI: 0.19-0.41] to 0.44 [0.29-0.61] mm; CL from 0.34 [0.22-0.47] to 0.40 [0.26-0.57] mm; ANOVA interaction, P=0.001) as did superoanterior quadrant cortical thickness (EL from 0.81 [0.61-1.00] to 0.93 [0.72-1.17] mm; CL from 0.81 [0.65-1.0] to 0.85 [0.66-1.00] mm; ANOVA interaction, P=0.016). Inferoposterior quadrant cortical thickness also increased in the EL relative to the CL (EL from 2.94 [2.74-3.15] to 3.08 [2.87-3.30] mm; CL 2.91 [2.66-3.17] to 2.90 [2.67-3.14] mm; ANOVA interaction, P=0.014), although inferoanterior quadrant response did not differ between legs (ANOVA interaction, P=0.090). **Discussion** Brief high impact exercise substantially increased cortical thickness (up to 52%) at regions considered critical in terms of hip fragility. Although high impact exercise may not be feasible for all older people, carefully targeted high impact exercise may significantly reduce the risk of hip fracture.

14:00 - 15:00

## Mini-Orals

## PP-PM07 Health and Fitness [HF] 1

**AGE AND GENDER DIFFERENCES IN THE CORRELATION BETWEEN MUSCLE MASS AND PHYSICAL PERFORMANCE AMONG OLDER JAPANESE ADULTS.**

Kitano, N., Tsunoda, K., Mitsuishi, Y., Tsuji, T., Jindo, T., Saghazadeh, M., Soma, Y., Okura, T.

*University of Tsukuba*

**Introduction** It is well-known that muscle mass correlates with physical performance (Visser et al., 2002); however, the correlation between muscle mass and physical performance may differ by age because individual differences, e.g. shape of body, cognitive function and muscle mass are extended with aging. We determined whether age and gender differences affected the relationship between muscle mass and physical performance. **Methods** We randomly selected 1,700 community-dwelling older adults aged 65–85 years from Kasama city, Japan and obtained 336 eligible subjects (169 men, 167 women; average age  $73.2 \pm 5.0$  years). We assessed whole-body and lower-limb muscle mass using a bioelectrical impedance method (MC-980A, TANITA, Japan). To evaluate physical function, we used 7 physical performance tests: 1) grip strength, 2) one-leg balance, 3) standing time from a long sitting position, 4) sit-to-stand, 5) habitual walk, 6) timed-up-and-go and 7) choice stepping reaction time. Participants were divided into 4 groups by age and gender: 1) young-old ( $\leq 74$  years) men, 2) old-old ( $\geq 75$  years) men, 3) young-old women and 4) old-old women. To reveal the correlation between muscle mass and physical performance, a partial correlation analysis was performed controlling for body mass index and clinical history pertaining to heart disease, stroke, knee pain, and low back pain. **Result** We confirmed significant correlations between whole-body muscle mass and grip strength in every group ( $|r| = 0.27\text{--}0.52$ ). In young-old women, 3 other performance tests ( $|r| = 0.20\text{--}0.29$ ) also correlated with whole-body muscle mass, whereas, there were no significant correlations between these pairs in old-old women. Lower-limb muscle mass correlated with grip strength in young-old men ( $|r| = 0.31$ ) and was associated with 4 performance tests in young-old women ( $|r| = 0.23\text{--}0.39$ ), although no significant relationships were found among these pairs in old-old adults. **Discussion** A previous study reported that appendicular skeletal muscle mass is significantly related to a comprehensive score which considered balance, sit-to-stand test and habitual walk (Kim et al., 2012). Our study revealed that young-old women, in particular, had a significant correlation between muscle mass and physical performance. This new finding suggests that, not only sufficient muscle mass, but other factors such as nerve function and skilled movements might be necessary to maintain a high level of physical function in both old-old men and old-old women. **References** Visser M., Kritchevsky SB., Goodpaster BH., et al. (2002). Journal of the American Geriatrics Society, 50(5), 897–904. Kim KE., Jang SN., Lim S., et al. (2012). Age and Ageing, 41(6), 799–803.

**WALKING PROGRAM IMPACT ON DIABETIC ELDERLY POPULATION**

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**Introduction** In 2011, 366 million adults had Diabetes Mellitus, leading to 4.6 million deaths all over the world. In 2010, the prevalence among Portuguese population ranging 20-79 years-old was 12.4% (991,000 individuals), one fourth of which, were 60-79 years-old. Physical activity benefits are well documented on the literature, and include improvements on body composition, fitness, HbA1c and blood pressure. The aim of this study was to analyze the impact on Diabetes Mellitus control through a walking program at VO<sub>2</sub>R60% in elderly people. **Methods** 13 diabetic subjects (Hb1Ac  $\geq 6.5\%$ ) aged 60-72 years-old volunteered to participate in this program. Program consisted of 2 non-consecutive walking sessions a week at VO<sub>2</sub>R60% for 10 weeks. VO<sub>2</sub>Max was assessed with the Rockport One-Mile Fitness Walking Test. Body fat and visceral adiposity were assessed with a Tanita monitor (BC-420MA) and waist circumference taken at the iliac crest. Blood pressure was assessed with a Rappaport Premium sphygmomanometer. A Roche Unimate 5 kit was used for HbA1c data. All analyses were conducted in SPSS software V.20 for Windows. **Results** Weight ( $80.4 \text{ kg} \pm 14.01$  vs.  $79.4 \text{ kg} \pm 13.94$ ;  $p=0.017$ ), visceral adiposity ( $13.1 \pm 3.54$  vs.  $11.8 \pm 3.33$ ;  $p=0.010$ ), body fat ( $35.9\% \pm 8.75$  vs.  $32.5\% \pm 8.21$ ;  $p=0.005$ ), waist circumference ( $102 \text{ cm} \pm 10.82$  vs.  $99 \text{ cm} \pm 10.24$ ;  $p=0.011$ ), SBP ( $134.6 \text{ mmHg} \pm 7.92$  vs.  $129.2 \text{ mmHg} \pm 5.41$ ;  $p=0.031$ ), HbA1c ( $6.9\% \pm 0.95$  vs.  $6.2\% \pm 0.51$ ;  $p=0.005$ ) and VO<sub>2</sub>Max ( $18.2 \text{ ml.kg.min} \pm 7.45$  vs.  $23.1 \text{ ml.kg.min} \pm 6.62$ ;  $p=0.005$ ) improved significantly over the 10 week program. **Discussion** This study shows that a 10 week long VO<sub>2</sub>R60% walk, performed twice a week, has a positive impact on the diabetic and body composition profile of elderly people, in line with previous researches (Gan et al., 2003; Westoff et al., 2007; Umpierre et al., 2011). **References** Boulè, NG., Haddad, E., Kenny, GP., Wells, GA. & Sigal, RJ.(2001). Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus: a meta-analysis of controlled clinical trials. JAMA, 286 (10), 1218-1227. Gan, SK., Kriketos, AD., Ellis, BA., Thompson, CH., Kraegen, EW. & Chisholm DJ.(2003). Changes in aerobic capacity and visceral fat but not myocyte lipid levels predict increased insulin action after exercise in overweight and obese men. Diabetes Care, 26, 1706-1713. Umpierre, D., Ribeiro, P., Kramer, C., Leitão, C., Zucatti, A., Azevedo, M., Gross, J., Ribeiro, J. & Schaan, B. (2011). Physical activity advice only or structured exercise training and association with HbA1c levels in type 2 diabetes: a systematic review and meta-analysis. JAMA, 305 (17), 1790-1799. Westhoff, TH., Franke, N., Schmidt, S., et al.(2007). Too old to benefit from sports? the cardiovascular effects of exercise training in elderly subjects treated for isolated systolic hypertension. Kidney Blood Press Res, 30, 240–247.

**ELDERLY PERFORMANCE ASSESSMENT IN STEP TEST USING OPTOJUMP. 'ACT ON AGEING': A PILOT STUDY**

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**Introduction** During the aging process physical function declines and an important locomotion change can be seen (Chodzko-Zajko et al., 2009). This decline is an important indicator of impaired mobility in elderly and seen during daily activities such as climbing stairs (Spiriduso & Cronin, 2001). The aim of this cross sectional pilot study on elderly people, is to observe the changes of Step Number (SN), Contact Time (CT) and Execution Time (ET) during a Step Test protocol and also to determinate gender differences. **Methods** The pilot study included 38 sedentary elderly subjects (M:F ratio of 1:1,  $73.11 \text{ yrs} \pm 5.13$ ) living in Piemonte, Italy. Data were collected using the 3 minutes

Step Test (3ST), the Six-Minute Walk Test (6MW) and the Chair Rise Stand Test (CR). OptoJump © instruments and software were used to assess changes in CT and ET during 3ST performances. We analyzed the relationship among 3ST, 6MW and CR data and we used Mann Whitney's test to determine gender differences. The significance level was  $p < .05$ . Results Descriptive 3ST analyses showed that SN decreased during the test, while ST and SP increased. Significant correlations were found among 3ST and 6MW ( $p < .001$ ) and CR ( $p < .05$ ). A Significant gender difference was found in SN ( $U=102$   $Z=-2.280$   $p < .05$ ), and in SP ( $U=109$   $Z=-2.087$   $p < .05$ ) and in 3ST ( $U=110$   $Z=-2.058$   $p < .05$ ). In particular, a significant gender difference was found after the second ( $U=113.5$   $Z=-2.255$   $p < .05$ ) and third minute ( $U=96$   $Z=-2.473$   $p < .05$ ) in SN and after the third minute of CT ( $U=91$   $Z=-2.655$   $p < .05$ ) and ET ( $U=98$   $Z=-2.409$   $p < .05$ ). A significant gender difference was observed in 6MW ( $U=104.5$   $Z=-2.219$   $p < .05$ ), but not in CR ( $U=165.5$   $Z=-.169$   $p=.869$ ). Discussion This pilot study showed that 3ST parameters changed during performance. However the data showed significant differences between women and men in the third minute. Probably this difference was due to the significant differences of aerobic endurance. In fact the level of aerobic endurance could affect performance of 3ST results. These results suggest the need of a different gender-specific cut off in 3ST assessment in elderly. References Chodzko-Zajko, W. J., Proctor, D. N., Fiatarone Singh, M. A., Minson, C. T., Nigg, C. R., Salem, G. J., & Skinner, J. S. (2009). American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Med Sci Sports Exerc*, 41(7), 1510-1530. Spirduso, W. W., & Cronin, D. L. (2001). Exercise dose-response effects on quality of life and independent living in older adults. *Med Sci Sports Exerc*, 33(6 Suppl), S598-608; discussion S609-510.

## EFFECTS OF SQUARE-STEPPING EXERCISE ON PHYSICAL FITNESS AND COGNITIVE FUNCTION IN HEALTHY OLDER ADULTS

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Introduction: Older adults generally have not only reduced muscle mass and reduced functional fitness, but also less cognitive function than younger adults. Numerous studies have found that exercise habituation including resistance training, aerobic exercise and balance training might offer many significant health benefits for older adults. However there are few reports about the cognitive benefits associated with exercise for older adults. This study was to undertaken investigate the intervention effects of square-stepping exercise (SSE) on physical fitness and cognitive function in healthy older adults. Methods: Participants were thirteen healthy older adults (age  $72.4 \pm 3.5$  years). Six participants performed SSE program for 90 min, 2 days a week, for 12 weeks. Seven participants completed a resistance training program for 90 min, 2 days a week, for 12 weeks. SSE was performed using a thin-felt mat that was partitioned into 40 squares (Shigematsu et al., 2006). Additionally, we advised them to perform their respective training programs in their daily life. Physical fitness (hand-grip strength, 10-m walking, timed up & go, 8-foot up & go, functional reach, single limb stance with eyes open, single limb stance with eyes closed, sit & reach, 30-sec chair stand, 30-sec arm curl, and stand-up from lying position), muscle mass in forearms, upper arms, lower legs, thighs and trunk, and cognitive function (Five-Cog. Test: Yatomi et al., 2005) were measured 2 times (first day session, 3 months after the initial session) of all participants. Results: Regarding physical fitness, SSE group had significant improvement in the 8-foot up & go (pre:  $25.0 \pm 4.8$  sec, post:  $21.5 \pm 4.2$  sec,  $P < 0.05$ ), timed up & go (Pre:  $5.5 \pm 1.0$  sec, Post:  $4.8 \pm 1.2$  sec,  $P < 0.05$ ), and 30-sec chair stand (Pre:  $18.6 \pm 5.0$  times, Post:  $22.7 \pm 5.8$  times,  $P < 0.05$ ). Furthermore, there were significant changes in the cognitive function including motor task (Pre:  $34.5 \pm 7.1$ , Post:  $44.7 \pm 9.7$ ,  $P < 0.05$ ), position judgment task (Pre:  $46.5 \pm 6.7$ , Post:  $50.8 \pm 9.5$ ,  $P < 0.05$ ), word memory task (Pre:  $54.2 \pm 12.5$ , Post:  $60.3 \pm 9.5$ ,  $P < 0.05$ ), animal name imagination task (Pre:  $47.7 \pm 9.8$ , Post:  $51.0 \pm 7.6$ ,  $P < 0.05$ ), and common word task (Pre:  $46.0 \pm 8.1$ , Post:  $57.0 \pm 13.6$ ,  $P < 0.05$ ). Discussion: This study suggests that square-stepping exercise has some beneficial effects to maintain or improve the mobility including lower muscle strength and endurance, agility and dynamic balance, and the cognitive function in healthy older adults. References: Shigematsu R, Okura T. (2006) *Aging Clin Exp Res*. 18(3), 242-248. Yatomi N. (2005) *Jpn J Gerontol*. 27(1), 74-80.

## PRACTICING SPORTS AT ADOLESCENCE: IS IT BETTER AT PROMOTING HEALTHY LIFESTYLES THAN DOING REGULAR PHYSICAL ACTIVITY?

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Introduction: A high percentage of 17-years-old boys (61%) in Europe play sports regularly (European Comission, 2010). However, it is not clear if sports participation in adolescence is better at promoting healthy lifestyles than regular physical activity (PA) (i.e. walk to school) (Peretti-Watel et al., 2001). Therefore the main aim of this study is to investigate the differences between practicing sports and doing regular PA on the adoption of healthy behaviors (smoking, alcohol, fruit and vegetable consumption) among 16-17 years old Spanish boys. Methods: A survey was conducted with 317 boys (92 % response rate) from 12 secondary schools in Osona (Barcelona) that agreed to participate in the study (75%). Participants completed measures of PA (adolescent version of the IPAQ), smoking, alcohol, fruit and vegetable consumption (STEPS Instrument) and sports participation (Maurice Pieron Questionnaire). Chi Square tests, t-test, and one way ANOVA were used to analyze the data. Results: Seventy-one percent of boys participated in sport, 17% engaged in regular PA and 11% were sedentary. Alcohol consumption was significantly more frequent among boys who practiced team sports than individual sports ( $p=0.001$ ). Twenty-two percent of team sport players drank alcohol 1 to 4 times a week while 19% of physically active reported consumption at this level. Individual sports players and sedentary boys significantly reported less alcohol consumption ( $p < 0.001$ ) than sport players (13.7% and 13.8% respectively). Smoking behavior was greater among boys practicing team sports compared to those physically active or sedentary but differences were not significant ( $p=0.15$ ) (44.5% vs. 29% individual sport, 33% sedentary and 37% active). Fruit and vegetable consumption was similar across all groups except for the sedentary who were less likely (17%) to meet the healthy recommendations (5 pieces per day). However, approximately only 1 in 3 met the guidelines in the sporty and active groups. Discussion: Practicing sports at adolescence is not associated to the adoption of healthier lifestyles in boys. Participating in sports -particularly team sports- was associated to a higher alcohol consumption and smoking than being regularly active or even sedentary. Thus, promoting regular PA among male adolescents could be an effective way to adopt healthy lifestyles. Furthermore, sport promotion programs should include the promotion of other healthy habits. References Directorate-General Education and Culture. Comissió Europea. (2010). Special Eurobarometer. Sport and Physical Activity. 9-14. TNS opinion and Social, Brussels.<sup>1</sup> Peretti-Watel, P., Beck, F., Legleye, S. (2001). *Addiction*. Vol. 97, pp. 707-716.<sup>2</sup>

**ALPINE SKIING WITH UNILATERAL TOTAL KNEE ARTHROPLASTY**

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**Introduction** With a growing aged population in Europe the prevalence of e.g. rheumatic diseases will increase and with this the incidence of total joint replacements. Until now studies investigating sports participation following Total Knee Arthroplasty (TKA) are limited. Alpine skiing stimulates leg muscle strength and cardiovascular fitness and can be practiced until old age. Studies on the feasibility, benefits and risks associated with alpine skiing after TKA are warranted. In this study we focused on muscle growth and metabolism after practice of alpine skiing following TKA. **Methods** 26 patients with TKA were divided into an intervention group (IG, n=16; 11 males) and a control group (CG, n=10; 3 males) which were matched for age, BMI and time since TKA ( $69.8 \pm 1.1$  (mean  $\pm$  SE) and  $71.5 \pm 1.2$  yrs.;  $29.6 \pm 1.2$  and  $29.0 \pm 1.1$  kg/m<sup>2</sup>;  $2.7 \pm 0.3$  and  $3.3 \pm 0.2$  yrs., respectively). IG underwent 12 wk skiing training with an instructor with 2-3 skiing days/wk of 3-4h pr. session. Fasting blood samples and muscle biopsies (v. lateralis) on both legs were obtained before and after (6-9 days) the intervention. The data was tested for statistical significance by t-tests. **Results** No difference between the operated leg and the non-operated leg in fiber type composition (FT), cross-sectional area (CSA) and capillary density (CD) before or after the intervention was seen, and the data are shown as pooled data. FT, CSA and CD did not change with skiing (data not shown). Before training CD was higher ( $P < 0.05$ ) in IG ( $3.98 \pm 0.2$  cap/fiber) vs. CG ( $2.69 \pm 0.2$  cap/fiber) and a similar difference was found after skiing ( $4.06 \pm 0.2$  and  $2.61 \pm 0.1$ , respectively). Plasma insulin concentrations decreased ( $P < 0.05$ ) with skiing in IG ( $44 \pm 6.4$  to  $36 \pm 5.8$  pM) but not in CG ( $55.5 \pm 12.9$  to  $49.1 \pm 8.2$  pM). Plasma glucose concentrations tended ( $P < 0.1$ ) to decrease in IG but not in CG (data not shown). HOMA2 (index of insulin sensitivity) improved ( $P < 0.05$ ) from  $0.86 \pm 0.12$  to  $0.70 \pm 0.11$  with skiing in IG, while it did not change in CG ( $1.08 \pm 0.26$  and  $0.95 \pm 0.17$ ). No effect of skiing on blood lipids was observed (data not shown). No adverse events occurred. **Discussion** and **conclusions** In contrast to the prevailing view, practice of alpine skiing is indeed possible after TKA. There were only modest effects on the muscle parameters, while glucose metabolism was improved with skiing. The effect size is similar to what has been found in healthy elderly after a similar training program (1). It could be speculated that increased training intensity would have shown a higher response on CSA and CD. 1. Dela F, et al. Glucose homeostasis and cardiovascular disease biomarkers in older alpine skiers. *Scand J Med Sci Sports* 2011 (21) Suppl 1:56-61.

**DANCE AS A FACTOR IN ELDERLY QUALITY OF LIFE**

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**Introduction:** Quality of life is related to self-esteem and well-being covering variety of factors such as health condition, socioeconomic level, emotional state, socialization, intellectual activity, self care, family support, cultural and ethical values, life style, satisfaction with daily activities and the environment (Flangan, 1982). Several authors have reported connexion between seniors and biological aspects, the decline of physical and psychological conditions, loss of will to perform usual tasks and memory (Flangan, 1982; Spirduso et al., 2005). The activities practice related dance makes everyday life healthier, because develops areas such as socio-affective, psychomotor and perceptual-cognitive; it's also considered pleasurable activity for elderly (Cress et al., 2005; Federici et al., 2005; Rikli & Jones, 1998). **Objective:** determine the importance of dance in elderly physical activity level, taking into account their initial physical/ psychological conditions. **Methodology:** Quantitative, hypothetical-deductive, quasi-experimental longitudinal study was used and based on questionnaire adapted from Quality of Life Scale, Flanagan EQVF (Santos et al., 2002), WHO Quality of Life-Bref (2004), and Functional Fitness Test Battery (Rikli & Jones, 1998). Was applied on two occasions (beginning and after 2 months). A not random sample was used, consisting 29 elderly (7 males and 22 females) with age of  $78.6 \pm 5.5$  years from two retirement homes in Porto. Data processing was performed using descriptive analysis, t-test, Factor Analysis (search for uncorrelated variables), ANOVA (test for equality means corresponding to each level of IMC). Statistics were performed using SPSS 19 with 5% significance level. **Results:** Considering loneliness in elder age as a fact, study proved that dance led to a significant increase in awareness for improvement quality of life, with significant enhancement in their physical fitness. Variables such as medication and weight had no influence on the variation of dance motivation. Women were able to improve their physical fitness level better than men. **Conclusions:** The elderly have improved their quality of life significantly with few dance classes. **References:** Cress et al. (2005). Best practices for physical activity programs and behaviour counselling in older adult populations. *Journal Aging Physical Activity*, 13(1), 61-74. Federici et al. (2005). Does dance-based training improve balance in adult and young old subjects? A pilot randomized controlled trial. *Aging Clinical and Experimental Research*, 17(5), 385-9. Flangan, J. (1982). Measurement of quality of life: current of art state. *Archives of Physical Medicine & Rehabilitation*, 3, 56-59. Rikli, R. & Jones, C. (1998). Development and Validation of a Functional Fitness Test for Community-residing Older Adults. *Journal of Aging and Physical Activity*, 7(2), 129-161. Spirduso et al. (2005). *Physical dimensions of aging*. (2nd ed). Champaign, Illinois: Human Kinetics Publishers.

**FUNCTIONAL LIMITATION AND ASSOCIATED FACTORS: DATA FROM BRAZILIAN ELDERLY**

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**Introduction** The functional limitation assessment provide useful preliminary knowledge about healthy elderly subjects and risk or progression to disability in non-disabled older subjects. The objective of this study was to investigate the factors associated with functional limitation among elderly of a rural community in southern Brazil. **Methods** In this cross-sectional and household-based study a total of 477 elderly ( $\geq 60$  years; random sampling) were examined in 2010/2011. The study was conducted in the city of Antônio Carlos, state of Santa Catarina. Three motor performance tests verified the functional limitation: 'chair stand', 'pick up a pen' (assessed by time) and 'balance' (Barbosa et al. 2005). The score of each test ranged from 0 (unable to perform the test) to 3 (good performance). A scale, based on the sum of the scores (0 to 9) obtained in the three tests found functional limitations: with functional limitation (0 to 5) and without functional limitation (6 and more). The independent variables were sex, age group (60-74;  $\geq 75$  years), living arrangements (living alone/accompanied); education (no schooling / 1 year / 2 years or +); currently working (yes/no); cognitive function (normal/altered) and sedentary behavior ( $\leq 4$ ; 4-5;  $\geq 6$  hours/day). Poisson regression (Prevalence ratio [PR] and CI 95% [confidence interval]) was employed to analyze data. **Results** Of the 477 subjects, 207 are males ( $73.3 \pm 9.0$  years) and 270 are females ( $73.2 \pm 8.8$  years). The prevalence of functional limitation was 24.0% (CI95%: 19.9 to 28.1). Functional limitation was positively associated with older age (PR 1.70; CI95%: 1.23 to 2.36), not working (PR: 2.87; CI95%: 1.69 to 4.85) and cognitive deficit (PR 2.37; CI95%: 1.63 to 3.43). **Discussion** The association between functional limitation and older participants can be explained by greater fragility and number of chronic diseases (Kim et al., 2011). Elderly

who work at home or are retired have worse health status (Schunck & Rogge, 2010) and a greater prevalence of excess weight (Martin et al., 2008). These factors may explain the difficulty in performing motor tasks. Individuals with cognitive deficit may have decreased motivation, resulting in reduced physical activity, exercise and social activities (Raji et al., 2002), reflecting the decline in physical function / muscle. References Barbosa AR, Souza JMP, Lebrão ML, Laurenti R, Marucci MF. (2005) *Cad. Saúde Pública*, 21:1177-85. Kim IH, Chun H, Kwon JW. (2011). *J Korean Med Sci*, 26, 250-257. Marfin AR, Nieto JMM, Ruiz JPM, Jiménez LE. (2008). *Appetite*, 51, 266-272. Raji MA, Ostir GV, Markides KS, Goodwin JS. (2002). *J Gerontol Med Sci*, 57A(10), M678–M682. Schunck R, Rogge BG. (2010). *Int J Public Health* 55: 271-278.

### ACUTE EXERCISE DECREASE PTP-1B PROTEIN LEVEL AND IMPROVE INSULIN SIGNALING IN THE LIVER OF OLD RATS

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1:Course of Science Sport, School of Applied Science, State University of Campinas (UNICAMP), SP – Brazil 2: University of Southern Santa Catarina, SC, Brazil 3:Course of Physical Education and Sport, State University of São Paulo (USP), SP – Brazil Introduction It is established that insulin resistance associated with a progressive decrement in insulin action occurs with aging. In the present study, we investigated whether the improvement in insulin sensitivity and insulin signaling, mediated by acute exercise, could be associated with modulation of protein-tyrosine phosphatase 1B (PTP-1B) in the liver of old rats. Methods Aging rats were subjected to swimming for two 1.5-h long bouts, separated by a 45 min rest period. Sixteen hours after the exercise, the rats were sacrificed and proteins from the insulin signaling pathway were analyzed by immunoblotting. Results Our results show that the fat mass was increased in old rats. The reduction in glucose disappearance rate (Kitt) observed in aged rats was restored 16h after exercise. Aging increased the content of PTP-1B and attenuated insulin signaling in the liver of rats, a phenomenon that was reversed by exercise. Aging rats also increased the IRbeta/PTP-1B and IRS-1/PTP-1B association in the liver when compared with young rats. Conversely, in the liver of exercised old rats, IRbeta/PTP-1B and IRS-1/PTP-1B association was markedly decreased. Moreover, in the hepatic tissue of old rats, the insulin signalling was decreased and PEPCK and G6Pase levels were increased when compared with young rats. Interestingly, 16h after acute exercise, the PEPCK and G6Pase protein level were decreased in the old exercised group. Conclusion These results provide new insights into the mechanisms by which exercise restores insulin signalling in liver during aging. Fapesp process n° 2010/12091-2, 2010/12718-5 and 2012/01750-0.

### COMPETITION RESULTS - APPROPRIATE CRITERIA FOR TALENT ION?

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Introduction To qualify for talent promotion programs in Germany a successful participation in Junior World Championships (JWCh) is required. Therefore, it is generally assumed that the most successful junior athletes will also be the most promising senior elite athletes. The aim of the study was to examine whether senior elite triathletes have already been successful in the junior age and to discuss the suitability of competitive results as selection criteria in triathlon. Methods For the world's top 20 triathletes from 2004-2011 rankings in the JWCh and the rankings of the Olympic Games and/or the Senior World Championships were assembled and analysed retrospectively by Fisher-Freeman-Halton test. From the date of birth and event date the age of the first appearance on senior elite level was calculated and compared between the JWCh participants and the Non-JWCh- participants using t-test for independent samples. Results Almost half of the international male and 62 % of the female senior elite athletes did not finish in the top 20 at JWCh. There is no association between ranking in JWCh and the rankings on senior elite level. Considering German athletes 75 % of the successful seniors had also been successful in JWCh, which is the highest value of all nations, whereas only 8 % of USA senior triathletes participated successfully in JWCh. Non-JWCh- participants (male and female) become senior elite performer at a significantly higher age. Discussion The German system of long-term athlete development, focusing strongly on international junior competitions, seems to choose the most promising junior athletes and is capable to set the base for top rankings. However, the career development of international elite athletes proves, that previous runners resp. swimmers or late bloomers can similarly be successful. Selection policy of leading triathlon nations also include performance prerequisites tests (as eg. standardised time trials in each discipline) and discretionary criteria in addition to performance criteria to comply with those typical pathways to elite performance in triathlon. Talent selection guidelines should always take the amount of sport-specific training into account and should regularly be adjusted to performance developments on senior elite level. References Triathlon New Zealand. (2012). High Performance Programme. Squad Selection Policy. Retrieved from <http://www.triathlon.org.nz> Triathlon Australia. (2012). 2012 National Performance Standards. Retrieved from [www.triathlon.org.au](http://www.triathlon.org.au) Swiss Triathlon (2009). The Way to Top. Nachwuchssportkonzept - Leistungsorientiert. Bern Deutsche Triathlon Union. (2012). Struktur 2012. Retrieved from <http://www.dtu-info.de/nominierungskriterien.html>

### CHANGES OF JUMPING SKILL IN FEMALE VOLLEYBALL PLAYERS DURING AN ANNUAL TRAINING CYCLE

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Introduction Measurements of power output and the height of jump in jumps on force plate are a routine methods used in laboratory testing (Häkkinen, 1993; Busko, 2009). Aim The aim of the study was to follow the changes of the maximal power and height of jump measured in spike jump and counter movement jump in female volleyball players during an annual training cycle. Methods Six Second Division female volleyball players took part in the study. Their mean ( $\pm$ SD) age, body height, body mass and duration of training practising amounted 21.8 $\pm$ 1.9 years, 180.6 $\pm$ 3.7 cm, 67.6 $\pm$ 4.1 kg and 7.7 $\pm$ 2.9 years, respectively. The maximal power output and the height of rise of the body mass center during vertical jumps were measured on a force plate for counter-movement jumps (CMJ) and spike jumps (SPJ). Four measurements were carried out: before (I) and after (II) the preparatory period, after the end of first (III) and second (IV) competitive season. The results were statistically processed using analysis of variance (ANOVA) with repeated measures (post-hoc Tukey test,  $p < 0.05$ ). Results The values of CMJ height of jump significant decreased from 0.394 $\pm$ 0.038 m before the preparatory period (I) to 0.371 $\pm$ 0.038 m after the end of preparatory period (II), 0.371 $\pm$ 0.031 m after the end of first competitive season and 0.368 $\pm$ 0.041 m (III) and after the end of second competitive season (IV) while the relative maximal power output were 24.72 $\pm$ 2.83 W/kg, 24.56 $\pm$ 5.9 W/kg, 24.36 $\pm$ 4.26 W/kg and 24.11 $\pm$ 5.07 W/kg, respectively. The relative maximal power output values of SPJ changed insignificantly from 37.01 $\pm$ 7.11 W/kg (I) to 36.93 $\pm$ 8.23 W/kg (II), 36.90 $\pm$ 10.21 W/kg (III) and 35.41 $\pm$ 9.29 W/kg (IV). The height of SPJ jump were 0.479 $\pm$ 0.054 m,

0.493±0.072 m and 0.495±0.080 m and 0.465±0.074 m, respectively. Discussion In our study, there were no significant changes in the power output measured in SPJ and CMJ and in the SPJ height of jump during an annual training cycle. Height of jump in CMJ significantly decreased throughout the all season. The results obtained in this study are not agreement with the results of the paper of Häkkinen (1993) and Busko (2009), who reported an increase in the power output and the height of jump during the preparatory period and then reducing the value during competitive season. Acknowledgements: The study was supported by Ministry of Science and Higher Education (Grant No. AWF - Ds.-150). References Busko K. (2009). *Human Movement*, 10(2), 149-152. Häkkinen K. (1993). *Sports Med Phys Fitness*, 33, 323-332.

### IS AGILITY ASSOCIATED WITH CORE STRENGTH, BALANCE AND STRAIGHT SPRINTING SPEED IN HIGH-LEVEL YOUTH SOCCER PLAYERS?

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**Introduction** The ability to change direction quickly and easily (i.e. agility) is considered important for successful performance in soccer (Sporis et al., 2010). Agility requires maintaining and controlling body position while quickly decelerating and accelerating. Thus, it might be assumed that balance, core strength, and sprint performance may be correlated with agility. We therefore investigated the association between agility and various measures of balance, core strength and sprint ability in high-level youth soccer players. **Methods** The under-13 to under-21 teams of a professional Swiss soccer club participated in the present study. Due to age-related differences in physical performance the under-13 to 16 (N = 39 players, age: 14.0 (SD 1.1) y, height: 1.66 (0.10) m, weight: 51.7 (11.3) kg) and the under-17 to 21 (N = 28 players, age: 17.9 (1.3) y, height: 1.77 (0.05) m, weight: 70.6 (7.5) kg) age categories were separately analyzed. After a familiarization session during regular training, all players performed the following tests in a gym: 30-m straight sprint (10-m and 20-m split times), an agility test (total distance: 32 m incl. three 180° turns), static balance on a force plate (center-of-pressure (COP) path length displacement for each leg separately), isometric peak force during back extension and trunk flexion, strength endurance in prone plank position, and a dynamic core strength test (modified Russian twist). **Results** In the older players, agility was significantly correlated with trunk flexion strength (r=0.44), balance performance (COP displacement right leg: r=0.39, left leg: r=0.49), and sprint acceleration (10-m split: r=0.46, 20-m split: r=0.43). Multiple regression analysis revealed left leg balance performance being the single best predictor of agility time (R<sup>2</sup>=0.56, P=0.01, SEE=2.4%). In the younger age group, agility was significantly correlated with height (r=-0.53), weight (r=-0.65), trunk flexion (r=-0.44) as well as back extension strength (r=-0.45), dynamic core strength (r=-0.38), and sprint times (10-m split: r=0.47, 20-m split: r=0.64, 30-m time: r=0.69). Multiple regression analysis revealed 30-m sprint time being the single best predictor of agility time (R<sup>2</sup>=0.59, P<0.001, SEE=3.0%). **Discussion** We conclude that in different age groups different physical abilities are predictive for agility. While mainly balance and acceleration are related to agility in older players, anthropometric characteristics, core strength and sprinting speed are more important in younger players. The current results may serve as a basis for interventional strategies to improve agility in high-level youth soccer. Sporis G, Jukic I, Milanovic L, Vucetic V. (2010). *J Strength Cond Res*, 24, 679-686.

### VALIDITY AND RELIABILITY OF A TRIGONOMETRIC METHOD TO EVALUATE RIGHT AND LEFT STRAIGHT LEG RAISE TEST AND HIP ABDUCTION TEST

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*INEFC-Barcelona*

**Purpose:** The aim was to present a trigonometric method for estimating the range of movement (ROM) from field-based tests and to assess the concurrent validity and intra- and interrater reliability when this method is applied to the right and left straight leg raise test (SLR) and hip abduction test (HIP-ABD). **Methods:** Thirty trained young men (age, 22.2 ± 5.4 years; height, 176.5 ± 8.8 cm; body mass, 70.3 ± 9.1 kg) participated in this study. The gold standard used to establish the concurrent validity of the flexometer method (FM) was goniometry. Measurements were taken in two positions, corresponding to a submaximal and close to maximal ROM for the evaluated tests. All measurements were taken by two trained raters. The ROM assessed by the FM was calculated in degrees using trigonometry. Descriptive statistics were used to summarize ROM measurements in the FM and the goniometric technique (GT). Concurrent validity was evaluated using Pearson's correlation coefficient (PCC) and the interclass correlation coefficient (ICC). Inter- and intraobserver reliability was evaluated using the ICC, the standard error of measurement (SEM) and the minimal detectable change (MDC). **Results:** Both the SLR and the HIP-ABD showed high concurrent validity and good inter- and intra-rater reliability with an ICC value that was always > 0.9. The estimated errors (SEM) and the minimal detectable change (MDC) in repeated measurements appeared to be less in FM than in GM. **Conclusions:** This study indicated that the FM is a valid and reliable method for assessing hip ROM. Due to its convenience and cost-effectiveness, this new method could be widely used to measure the ROM of several joints. **References:** Boone, D. C., Azen, S. P., Lin, C. M., Spence, C., Baron, C. & Lee, L. (1978). Reliability of goniometric measurements. *Physical Therapy*, 58(11), 1355-1360. Hastad, D. N. & Lacy, A. C. (Eds.). (1989). *Measurement and evaluation in contemporary physical education*. Scottsdale, Ariz.: Gorsuch Scarisbrick Publishers. Hyytiäinen, K., Salminen, J. J., Suviitie, T., Wickstrom, G. & Pentti, J. (1991). Reproducibility of nine tests to measure spinal mobility and trunk muscle strength. *Scandinavian Journal of Rehabilitation Medicine*, 23(1), 3-10. Malliaras, P., Hogan, A., Nawrocki, A., Crossley, K. & Schache, A. (2009). Hip flexibility and strength measures: reliability and association with athletic groin pain. *British Journal of Sports Medicine*, 43(10), 739-744. Moras, G. (2003). *Amplitud de moviment articular i la seva valoració: el test flexomètric*. University of Barcelona, Barcelona. Ng, J. K. F., Kippers, V., Richardson, C. A. & Parnianpour, M. (2001). Range of Motion and Lordosis of the Lumbar Spine: Reliability of Measurement and Normative Values. *Spine*, 26(1), 53-60. Reese, N. B. & Bandy, D. W. (Eds.). (2002). *Joint Range of Motion and Muscle Length Testing*. Philadelphia, Pennsylvania: W.B. Saunders Company. Verducci, F. M. (Ed.). (1980). *Measurement concepts in physical education*. St Louis: Mosby.

14:00 - 15:00

## Mini-Orals

## PP-PM05 Biochemistry [BC] 1

**INFLUENCE OF 30-HOURS SLEEP DEPRIVATION AND EXERCISE ON LIPID METABOLISM DURING MAXIMAL EXERCISE**

Górecka, M.1, Kozacz, A.1, Bogdan, A.2, Mikulski, T.1, Żernicka, E.1

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**Introduction** Popularity of ultra-endurance events is increasing. Most of the time the exercise intensity is moderate during event but ends with a sprint finish. Thus, the purpose of this study was to evaluate changes in lipid metabolism in physically active individuals prior and after prolonged exercise combined with complete sleep deprivation followed by graded maximal effort. **Methods** Graded maximal test (50 W every 3 min) to volitional exhaustion was performed on cycloergometer by 11 endurance trained men before (trial B) and immediately after (trial A) 30 hours of prolonged exercise (simulated adventure race) combined with complete sleep deprivation. Triglyceride (TG), free fatty acids (FFA), total (C) and high density lipoprotein cholesterol (HDL-C), glucose (G) and angiotensin-like protein 4 (ANGPTL4) concentrations in plasma were measured before and at the end of the maximal exercise. **Results** There were significant differences between B and A trials in rest/basal TG ( $1.30 \pm 0.21$  vs.  $0.44 \pm 0.07$  mM), C ( $4.09 \pm 0.29$  vs.  $3.61 \pm 0.30$  mM), HDL-C ( $1.35 \pm 0.12$  vs.  $1.46 \pm 0.10$  mM) and FFA ( $2.017 \pm 0.336$  vs.  $1.152 \pm 0.119$  mM) concentrations in plasma. ANGPTL4 concentration in plasma was increased by 30% in trial A at rest. No difference was found in resting G concentration between trials. After maximal exercise performed in trial B significantly higher values were found in C and HDL-C concentrations ( $4.09 \pm 0.29$  vs.  $4.63 \pm 0.27$  and  $1.35 \pm 0.12$  vs.  $1.59 \pm 0.10$  mM, respectively). Concentration of FFA was reduced after exercise from  $2.017 \pm 0.336$  to  $0.865 \pm 0.131$  mM ( $p < 0.05$ ). In trial A plasma TG concentration was significantly higher after maximal exercise than at rest ( $0.438 \pm 0.075$  vs.  $0.867 \pm 0.110$  mM, respectively) but no difference was found in FFA concentration. As in trial B plasma C and HDL-C concentrations were significantly increased ( $p < 0.001$ ). A significant decrease from  $5.73 \pm 0.32$  to  $3.63 \pm 0.24$  mM in plasma glucose after maximal exercise in trial A was noted. **Discussion** The experimental protocol of the study required that all the individuals were well trained amateurs who often take part in ultra-endurance events. Thus, their ability to use fat energy substrates should be increased by repeated aerobic endurance training. The interesting finding of the study is that the well-known healthy changes in lipid profile associated with exercise are also present in such an extreme conditions. Fall in blood glucose found after maximal exercise in trial A is a syndrome of fatigue.

**CARDIOPROTECTIVE EFFECTS OF EXERCISE TRAINING ON LEFT VENTRICULAR REMODELING AND NEUROHUMORAL ACTIVATION IN EXPERIMENTAL PULMONARY ARTERIAL HYPERTENSION**

Schmidt, C.1, Bovolini, A.1, Sousa, G.C.1, Hoffmann, M.1, Girardi, D.1, Moreira-Gonçalves, D.1, Leite-Moreira, A.2, Duarte, J.A.1, Henriques-Coelho, T.2

*1: FADEUP (Porto, Portugal), 2: FMUP, (Porto, Portugal)*

**Introduction** Pulmonary arterial hypertension (PAH) directly affects the right ventricle but left ventricle dysfunction (LVD) was recently described in PAH patients, which can be due to left ventricle (LV) cardiac atrophy and/or neurohumoral activation (Lourenço et al., 2006; Hardziyenka et al., 2011). Exercise training (ExT) was shown to prevent doxorubicin-induced cardiac atrophy (Scott et al., 2011) and neurohumoral activation in other settings of heart failure (Crimi et al., 2009). The present study analyzed the preventive effect of exercise preconditioning on LV in a rat model of PAH induced by monocrotaline (MCT). **Methods** Male Wistar rats were randomly separated in sedentary (SED; 4 weeks sedentary) and trained groups (EX; running sessions of 60 min/day, 5 days/week, at 25 m/min, during 4 weeks). After, animals were injected with MCT (60mg/kg; SED+MCT and EX+MCT) or the same volume of vehicle (SED+V and EX+V). Afterwards, all animals remained sedentary for additional 4 weeks. Next, animals were submitted to LV hemodynamic evaluation in baseline and isovolumic conditions. Samples from LV were collected for histological analysis and RT-PCR analysis. **Results** In baseline conditions, systolic (peak systolic pressure and dP/dtmax) and diastolic function (dP/dtmin and Tau) were compromised in SED+MCT but not in EX+MCT ( $P < 0.05$ ). Under isovolumic conditions, SED+MCT showed additional deterioration in the same parameters, but exercise training prevented it ( $P < 0.05$ ). This improved hemodynamic profile in EX+MCT was associated with preservation of LV mass and cardiomyocyte area, as well as reduced fibrosis ( $P < 0.05$ ). Regarding neurohumoral activation, ET-1 mRNA levels were increased in SED+MCT group and normalized in EX+MCT ( $P < 0.05$ ). **Discussion** The present work shows that ExT exerts a positive impact on LV, protecting from functional impairments in baseline and under stress conditions. These improvements were related with less cardiac atrophy and fibrosis, as well as lower ET-1 mRNA, all of which have been previously implicated with cardiac dysfunction (Lourenço et al., 2006; Hardziyenka et al., 2011). Of note, this protective effect was observed 4 weeks after the last training session, highlighting that cardioprotection could be sustained for several weeks. **References** Lourenço J, Roncon-Albuquerque R Jr, Brás-Silva C, Faria B, Wieland J, Henriques-Coelho T, Correia-Pinto, Leite-Moreira AF. (2006). 291:H1587-94 Hardziyenka M, Campian ME, Reesink HJ, Surie S, Bouma BJ, Groenink M, Klemens CA, Beekman L, Remme CA, Bresser P, Tan HL. (2011). 57:921-8 Crimi E, Ignarro LJ, Cacciatore F, Napoli C. (2009). 57:921-8

**VOLUNTARY PHYSICAL EXERCISE ATTENUATES THE CARDIAC CHANGES INDUCED BY AGE IN FEMALE WISTAR RATS.**

Hoffmann, M.1, Bovolini, A.1, Schmidt, C.1, Castro e Sousa, G.1, Girardi, D.1, Moreira-Gonçalves, D.1,2, Leite-Moreira, A.2, Henriques-Coelho, T.2, Fonseca, H.1, Duarte, J.A.1

*Faculdade de Desporto da Universidade do Porto, 1:FADEUP (Portugal), 2:FM*

**Introduction** Aging is associated with functional and structural cardiac alterations, which compromise the organ ability to sustain stressful stimuli. Regular physical activity is known to provide a cardioprotective phenotype, preventing or delaying the deterioration of cardiac function in response to several cardiac insults. Our aim was to determine if long-term voluntary wheel running is able to attenuate the age-induced impairment of cardiac function in laboratory animal. **Methods** Female Wistar rats ( $n = 19$ ) with 5 months of age were randomly divided into three groups: Sedentary Young (SED-Y,  $n = 7$ ; immediately sacrificed); Sedentary Old (SED-O;  $n = 6$ ; standard housing for

9 months) and Active Old (ACTIVE-O; n =6; housed in cages with a running wheel for 9 months). At the end of experimental protocol, rats were prepared for hemodynamic evaluation of the left ventricle (LV) function with conductance catheters. After sacrifice LV samples were collected from all animals for histological analysis of cardiomyocytes cross-sectional area (CSA; H&E) and fibrous tissue expression (sirius red staining). Results Physical activity improved systolic (higher dP/dtmax) and diastolic function (higher dP/dtmin and faster relaxation evaluated by Tau) in the Active Old group. This functional improvement was associated with lower levels of interstitial collagen (P<0.05). Discussion Chronological age induces gradual and deleterious alterations in the heart and compromises cardiac functionality (1, 2). Our results, in agreement with others (1,3), show that the structural and functional age-related impairments can be mitigated by regular exercise providing a cardioprotective phenotype. Regular physical exercise seems to prevent or delay structural and functional alterations induced by ageing. References A. M. Bronikowsky, P. A. Carter, T. J. Morgan, T. Garland, JR., N. Ung, T. D. Pugh, R. Weindruch, T. A. Prolla (2002). *Physiol Genomics* 12: 129-138, 2003. M. Juhaszova, C. Rabuel, D. B. Zorov, E. G. Lakatta, S. J. Sollott (2004). *Cardiovascular Research* 66: 233-244, 2005. A. Navarro, C. Gomez, j. M. López-Cepero, A. Boveris (2003). *American Journal of Physiology* 206: R505-R511, 2004.

### EFFECT OF WHOLE-BODY CRYOTHERAPY ON SKELETAL MUSCLE REGENERATION IN ELITE GRECO-ROMAN WRESTLERS

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**Introduction** In response to intense exercise or trauma, myogenic satellite cells become activated, proliferate, and repopulate the myofiber population by fusing together or fusing with existing myofibers. This process is largely mediated through nitric oxide, pro-inflammatory cytokines and growth factors that are produced and release in response to the injury (Zembron-Lacny et al., 2012). In sports medicine, a number of post-exercise recovery strategies are used to improve satellite cells activation and muscle regeneration such as whole-body cryotherapy (WBC), often without scientific evidence of their benefits (Banfi et al., 2010). The purpose of the study was to assess the efficacy of WBC combined with intensive training on extracellular markers of satellite cells activity and their relationship with skeletal muscle damage in elite Greco-Roman wrestlers. **Methods** Blood samples were collected before a 8-day course of daily WBC sessions (-120oC, twice a day), and then before and after the last single WBC session during the conditioning camp (in-season, May). Results Creatine kinase (CK), myoglobin (Mb) and tumour necrosis factor alpha (TNFalpha) demonstrated the highest levels after 8-day training and cryotherapy but did not change following the single WBC session. By contrast, nitric oxide (NO) and interleukin IL-1beta significantly decreased after the single WBC. The C-reactive protein (hsCRP) as well as growth factors HGF, IGF-I, PDGF-BB and BDNF increased after training and WBC, and then significantly decreased after the last single WBC session. The changes in muscle damage markers as well as inflammatory mediators, growth factors IGF-I and PDGF-BB were not different compared with group participated only in the training, except for growth factors HGF and BDNF. **Discussion** We have concluded that wrestling training has significant influence on factors regulating the myogenic satellite cells whereas WBC dose not induce general or specific positive effects in muscle regeneration. WBC seems to be an ineffective recovery strategy in non-injured athletes but it requires the further studies to confirm the present observations. **References** Banfi G, Lombardi G, Colombini A, Melegati G. (2010). *Sports Med*, 40, 509-517 Zembron-Lacny A, Krzywanski J, Ostapiuk-Karolczuk J, Kasperska A. (2012). *Ortop Trumatol Rehabil*, 14, 1-11. **Acknowledgements** This study was supported by a grant NNZ705282 from the Ministry of Science and Higher Education Poland Do not insert authors here

### THE INFLUENCE OF LOW-MODERATE ALTITUDE TRAINING ON THE CELL-MEDIATED IMMUNITY OF ELITE SPEED SKATERS

Yu, T., Chang, Y.

*China Institute of Sport Science*

**Introduction** Altitude training has been widely applied in the athletes to improve their performance. While altitude training could enhance the oxygen-transporting ability, altitude-associated hypoxia is considered as an environmental stressor and its potential negative effects on immune system have not been well addressed. In this study, we tested the effects of altitude training on the T lymphocytes in the elite speed skaters in order to evaluate the role of altitude training on the cell-mediated immunity. **Methods** Elite speed skaters underwent low-moderate altitude training for 1 week. Peripheral whole blood samples were extracted from the athletes before, during and after the altitude training and analyzed by flow cytometry for the detection of total T cells (CD3+), helper/inducer T cells (CD4+) and suppressor/cytotoxic T cells (CD8+) using monoclonal antibodies against CD3, CD4 and CD8, respectively. T-test and ANOVA were employed to compare the difference among distinct groups using SPSS software and p < 0.05 was considered statistically significant. **Results** We found that one week low-moderate altitude training could lead to a significant decrease of the percentage of total T cells in the whole blood samples in the elite speed skaters when compared to the data at sea level one week before the altitude exposure (66.94% vs 74.01%, respectively, p=0.013). Interestingly, the declined T cell proportion during the low-moderate altitude training was recovered 8 weeks after the athletes returned to sea level. A decreasing tendency of CD4+ and CD8+ T cells was also observed during low-moderate altitude training; however, the ratio of the percentage of CD4+ T cells to CD8+ T cells kept unchanged, suggesting the balance of distinct subpopulation of T cells is not disturbed by the low-moderate altitude training. **Conclusion** Taken together, low-moderate altitude training transiently suppresses the proportion of T cells in peripheral whole blood and thus may weaken the cell-mediated immune functions in the athletes, which should be considered for the health care of the athletes and the plan-making during the altitude training to obtain better results.

### THE EFFECT OF DIFFERENT CARBOXYHEMOGLOBIN ANALYZERS ON HB-MASS ESTIMATIONS.

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**Introduction:** The determination of Hemoglobin mass by the optimized carbon monoxide rebreathing method is an emerging technique in the field of sport science and sport medicine [1]. For the calculation of the resulting mass mainly the change of the baseline carboxyhemoglobin fraction (COHb%) from before to the COHb% after CO administration is used. The analysis of COHb% is performed by CO-Oximeters or blood gas analyzers with oximeter module. The functional principle for all analyzers used is similar; however, as athletes can be monitored by different institutions like i.e. Olympic training center, sport institute or university the question comes up how comparable the test results are. While Ulrich et al. showed differences between OSM3 and RapidLab 1245 we decided to investigate

differences between OSM3, ABL80 and Cobasb221 [2]. Methods: 9 subjects performed two times the CO-Rebreathing procedure to estimate their total HB-Mass. The blood was analyzed directly in quintuplicate for COHb% on an OSM3 CO-Oximeter (Radiometer, Copenhagen, Denmark), an ABL80 FLEX CO-OX analyzer (Radiometer, Copenhagen, Denmark) and a Cobas b221 blood gas analyzer (Roche, Mannheim, Germany). Venous blood was taken instead of capillary blood to have enough sample volume for all measurements. Results: The correlations of the HB-Mass between the analyzers were within a range of  $R^2=0.91 - 0.99$ , however the Bland Altman Plot showed depending on the analyzer type mean differences of 41 – 86g. Compared to the other two analyzers the OSM3 method seemed to have a trend to higher differences depending on the height of the HB-Mass. Discussion and Conclusion: We could demonstrate that the obtained HB-Mass determination values depend on the spectrophotometer that is used for COHb% measurement. The mean differences were comparable to those obtained by Ulrich et. al. [2]. To avoid misinterpretation of HB-Mass values by different institutions information about the applied analyzer should be always included in a report. 1. Schmidt, W. and N. Prommer, The optimised CO-rebreathing method: a new tool to determine total haemoglobin mass routinely. *Eur J Appl Physiol*, 2005. 95(5-6): p. 486-95. 2. Ulrich, G., et al., Dependence of hemoglobin mass estimation with the optimized CO-rebreathing method on different spectrophotometers. *Scand J Med Sci Sports*, 2012. 22(2): p. 224-31.

### PHYSICAL EXERCISE ANTAGONIZES DOXORUBICIN-INDUCED TOXICITY ON HEART AND BRAIN MITOCHONDRIA

Marques-Aleixo, I.1, Santos-Alves, E.1,2, Mariani, D.1, Coxito, P.2, Rocha-Rodrigues, S.1, Balça, M.M.1, Moreira, P.I.2,3, Oliveira, P.J.2, Magalhães, J.1, Ascensão, A.1

1: CIAFEL/FADEUP (Porto, Portugal) 2: CNC (Coimbra, Portugal) 3: Laboratory of Physiology, FMUC (Coimbra, Portugal)

**Introduction** The highly effective anticancer drug Doxorubicin(Dox) induces unwanted effects in non-target tissues, particularly cardio and neurotoxicity involving mitochondrial dysfunction (Carvalho et al. 2009). To counteract its toxic effects, physical exercise has been proposed (Ascensao et al. 2012). We here analyzed the effect of endurance training(ET) and voluntary physical activity(VPA) against heart, brain cortex and cerebellum mitochondrial dysfunction induced by sub-chronic treatment of Dox. **Methods** Sprague-Dawley rats were divided in six groups (n=6 per group): saline sedentary (Sal+Sed), saline ET (Sal+ET; 12wks of endurance treadmill running), Sal+VPA (12wks of voluntary free wheel running), Dox sedentary (Dox+Sed; 2mg.kg<sup>-1</sup> x 7wks of treatment), Dox+ET and Dox+VPA. Heart, brain cortex and cerebellum mitochondria were isolated and in vitro endpoints of oxygen consumption, membrane potential( $\Delta\Psi$ ) and susceptibility to permeability transition pore(PTP) were evaluated. Results Dox treatment affected heart, brain cortex and cerebellum mitochondrial oxygen consumption as seen by state 3 and by respiratory control ratio and  $\Delta\Psi$  endpoints as well as the susceptibility to PTP induction by calcium. Physical exercise per se, particularly ET, ameliorated heart and brain mitochondrial bioenergetics and increased mitochondrial tolerance against calcium-induced PTP opening. Dox-induced mitochondrial bioenergetics impairments was positively modulated by both ET and VPA. **Discussion** Generally, our data suggest that both types of physical exercise, characterized by distinct intensities and durations, modulate mitochondrial bioenergetics isolated from the studied tissues into a more resistant phenotype, including ATP generating capacity and the vulnerability to mitochondrial mediated apoptotic cell death. It is possible that chronic exercise stimulation may up-regulate important cellular and mitochondrial defense systems that contributed to the observed protect against Dox-related mitochondrial impairments. The study of the molecular mechanisms associated with exercise-induced cardiac and brain cortex and cerebellum mitochondrial protection is warranted. Supported by FCT (SFRH/BPD/66935/2009 JM, SFRH/BD/61889/2009 IA, SFRH/BD/36626/2007 PC, SFRH/BD/89807/2012 SR, SFRH/BDP/4225/2007, SFRH/BDP/4225/2007, PTDC/DTP-DES/1071/2012 and PTDC/DTP-DES/1246/2012 AA and PEst-OE/SAU/UI0617/2011 CIAFEL). **References** Ascensao A, Oliveira PJ, Magalhaes J (2012). *Int J Cardiol.* 156, 4-10. Carvalho C, Santos RX, Cardoso S, Correia S, Oliveira PJ, Santos MS, Moreira PI. (2009). *Curr Med Chem.* 16, 3267-3285.

### HIGH-INTENSITY INTERVAL TRAINING ENHANCES HIPPOCAMPAL BDNF SIGNALING: POSSIBLE NEW EFFECT OF HIT ON COGNITIVE FUNCTIONS

Daisuke, M., Lee, M., Okamoto, M., Inoue, K., Soya, H.

University of Tsukuba

**Introduction** Exercise is effective for enhancing both aerobic capacity and brain function. What type of exercises is most effective, however, is still uncertain, as most past studies have focused on endurance training (ET). Recently, low-volume high-intensity interval training (HIT) has been shown to enhance aerobic capacity as effectively as ET (Gibala et al., 2006). Furthermore, we have already demonstrated that voluntary resistance wheel running (RWR) enhances spatial memory related to hippocampal brain-derived neurotrophic factor (BDNF) (Lee et al., 2012). Voluntary RWR is intermittent exercise and produces shorter distances but higher work levels than does forced running. This allows us to postulate that HIT plays a beneficial role in hippocampal functions. To address this, we tried to establish a model of HIT for animals and to examine its effects on hippocampal plasticity. **Methods** Male Wistar rats (10 weeks old) were randomly assigned to three groups: untrained sedentary control (n=8), ET (n=9), and HIT (n=9). Exercised animals were habituated to treadmill running for 1 week before starting training, which was carried out for 4 consecutive weeks with 5 sessions per week. ET consisted of 30-min of continuous running at 20 m/min. HIT consisted of 10 bouts of 30-sec sprinting, and the sprint bouts were separated by 2.5-min recovery periods. The initial treadmill speed was 30-40 m/min in the first week and was increased gradually to 60 m/min by the final week. The ratios of HIT to ET were 1:6 in exercise time and 1:2~1:4 in exercise volume. After 4 weeks of training, we measured VO<sub>2</sub>max, and 3 days later, we sacrificed the rats and took samples. We determined CS activity of the plantaris and soleus muscles to evaluate aerobic capacity. To determine the effect of training on the brain, we evaluated the expression of hippocampal proteins, BDNF, the receptor TrkB, and the transcription factor p-CREB using a Western blot analysis. **Results and Discussion** The plantaris CS activity significantly increased in each training group. Furthermore, a tendency toward increased VO<sub>2</sub>max values was seen in the HIT group (p<0.08). Although there was no significant difference in VO<sub>2</sub>max values between groups, the relative intensity (% value of VO<sub>2</sub>max) at the same speed was significantly lower in training groups than in the control group. These results suggest that ET and HIT enhance aerobic capacity equally. Regarding BDNF signaling, HIT significantly increased hippocampal BDNF, TrkB, and p-CREB protein levels. ET enhanced only TrkB expression, although it produced a strong tendency toward increased BDNF (p<0.07) and p-CREB (p<0.08) protein levels. Taken together, our findings suggest that HIT, which is more effective for improving aerobic capacity, also increases hippocampal BDNF signaling leading to improved spatial memory. HIT would play a role in the enhancement of cognitive functions. **References** Gibala MJ et al. *J Physiol*, 575, 901-911 (2006). Lee MC et al., *J Appl Physiol*, 113, 1260-1266 (2012).

## MODELLING THE HUMAN NEUROMUSCULAR JUNCTION IN VITRO TO INVESTIGATE THE MECHANISMS OF SKELETAL MUSCLE PLASTICITY

Player, D.J., Martin, N.R.W., Ferguson, R.A., Hill, E.J., Lewis, M.P.

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Introduction: Human in vitro models to study skeletal muscle (SkM) plasticity in response to exercise have taken the form of monolayer or tissue engineered cultures, in the absence of neuronal input. Electrical stimulation has been used to mimic the nerve. The presence of a functioning neuronal input would allow for the investigation of activated mechanisms in response to contraction (exercise) in vitro without the necessity for an electrical stimulus. Methods: Human primary muscle derived cells (MDC's) were isolated through explant culture of Vastus Lateralis biopsies. Human SkM constructs were engineered as previously described (Smith et al., 2012). At 14 days, constructs were sampled for immuno-histochemical (IHC) analysis. Neurons were generated from neuron-committed human teratocarcinoma (NT2) cells and were differentiated as described (Podrygajlo et al., 2009). NT2's were plated to form neurospheres with the addition of retinoic acid for differentiation. Experiments were also conducted to ascertain the compatibility of culturing MDC's in NT2 media. Results: Isolated MDC's displayed  $36.8 \pm 10.4\%$  Desmin positivity and fusion of  $64.9 \pm 7.6\%$  in monolayer culture ( $n = 5$  independent cell populations,  $n = 3$  donors). Matrix contraction of MDC seeded collagen constructs was observed within hours of initial preparation, confirming cell attachment and matrix remodelling. Constructs displayed a high degree of cell alignment and density, with the presence of multinucleate myotubes in multiple focal planes. Microscopy illustrated NT2 neurosphere formation and early neurite outgrowth with retinoic acid treatment. Media compatibility experiments showed that there were no differences in Desmin positivity or fusion of MDC's cultured in NT2 media or NT2 media supplemented with IGF-I, compared to control MDC media. Discussion: The data described provides a preliminary foundation for future experiments to examine the co-culture of human MDC's and human derived neurons in a bio-mimetic SkM model. Future experiments will utilise the cells and SkM model characterised herein, to investigate muscle-nerve interaction and neuromuscular junction formation in vitro. This will provide the foundation of a pre-clinical model that can be utilised for the study of potential 'exercise', pharmacologic and genetic therapies for SkM disease. References: Podrygajlo G, Tegenge MA, Gierse A, Paquet-Durand F, Tan S, Bicker G, Stern M. (2009), *Cell Tissue Res.* 336(3):439-52. Smith AS, Passey S, Greensmith L, Mudera V, Lewis MP. (2012) *J Cell Biochem.* 113(3):1044-53.

## INFLUENCE OF DIETARY NITRATE SUPPLEMENTATION ON THE POWER-DURATION RELATIONSHIP FOR HIGH-INTENSITY EXERCISE

Kelly, J., Vanhatalo, A., Wilkerson, D.P., Wylie, L., Jones, A.M.

*University of Exeter*

Introduction: Dietary nitrate supplementation has been reported to improve tolerance to constant power output, high-intensity cycling, knee-extensor exercise and running. Typically, enhanced exercise tolerance has been reported in exercise trials of 6-15 min in duration. However, it remains unknown whether nitrate supplementation may be ergogenic during shorter-duration, higher-intensity exercise. Improvements in cycling time trial (TT) performance over 4 km and 16.1 km and 10 km, with a range of maximal exercise durations of 6-30 min, have also been reported following nitrate supplementation. Collectively, these results suggest a beneficial shift in the power-duration relationship (rightwards and/or upwards) for severe-intensity exercise as a result of nitrate supplementation. The increased ratio of power output to  $Vo_2$  reported following nitrate supplementation suggests that this effect might be related to an increased critical power (CP). We tested the hypothesis that dietary nitrate supplementation would increase the CP and/or  $W'$  during cycling exercise. Methods: In a double-blind, randomized, crossover study, nine recreationally-active male subjects supplemented their diet with either nitrate-rich concentrated beetroot juice (BR; 2 x 250 ml/day,  $\sim 8.2$  mmol/day nitrate) or a nitrate-depleted beetroot juice placebo (PL; 2 x 250 ml/day,  $\sim 0.006$  mmol/day nitrate). In each condition, the subjects completed four separate severe-intensity exercise bouts to exhaustion at 60% of the difference between the gas exchange threshold and peak power attained during incremental exercise (60% $\Delta$ ), 70% $\Delta$ , 80% $\Delta$  and 100% peak power, and the results were used to establish CP and  $W'$ . Results: Nitrate supplementation improved exercise tolerance during exercise at 60% $\Delta$  (BR:  $696 \pm 120$  vs.  $593 \pm 68$  s,  $P < 0.05$ ), 70% $\Delta$  (BR:  $452 \pm 106$  vs. PL:  $390 \pm 86$  s,  $P < 0.05$ ), and 80% $\Delta$  (BR:  $294 \pm 50$  vs. PL:  $263 \pm 50$  s,  $P < 0.05$ ) but not 100% peak power (BR:  $182 \pm 37$  vs. PL:  $166 \pm 26$  s,  $P > 0.05$ ). The power-duration relationship was rightward-shifted by BR compared to PL as a consequence of small but non-significant improvements in both CP (BR:  $221 \pm 27$  vs. PL:  $218 \pm 26$  W,  $P > 0.05$ ) and  $W'$  (BR:  $19.3 \pm 4.6$  vs. PL:  $17.8 \pm 3$  kJ,  $P > 0.05$ ). Conclusion: Dietary nitrate supplementation results in a rightward-shifted power-duration relationship in recreationally-active subjects, leading to improved endurance during severe-intensity exercise ranging from 4-12 minutes. These modulations may be expected to translate into a  $\sim 2$ -3% improvement in cycling TT performance in sub-elite cyclists.

## CAFFEINE AND CARBOHYDRATE SUPPLEMENTATION WAS UNABLE TO IMPROVE INTERVAL EXERCISE PERFORMANCE AND AGILITY IN ATHLETES

Lee, C.L.1, Cheng, C.F.2, Lee, C.J.2, Huang, H.W.3, Kuo, Y.H.3, Lee, M.C.4

*1:National Sun Yat-sen University (Taiwan), 2:National Taiwan Normal University (Taiwan), 3:National Taiwan Normal University (Taiwan), 4:Yu Da University (Taiwan)*

Introduction: Caffeine (CAF) added to carbohydrate (CHO) has been suggested improve endurance performance via a central nervous system activation (Carter et al. 2004; Doherty et al. 2005); however, little is known about the acute effect of the ergogenic benefits of the CAF+CHO on high-intensity interval sprint performance (HIS), agility capacity and blood metabolic profile. Hence, the purpose of our study was to characterize the effects of CAF+CHO ingestion on the physiological performance measurements. Methods: Twelve team-sport male athletes ( $20 \pm 1$  yrs,  $179 \pm 7$  cm, and  $75 \pm 9$  kg) underwent four interventions at least one week apart in a randomized, double blind fashion experiment, and a cross-over-design. Participants ingested the placebo (PLA) or CAF (6 mg/kg BW) of 1-h before high-intensity interval sprint test and agility test, with pre-exercise PLA or CHO solution (0.8 g/kg BW) ingestion immediately before testing protocol. The HIS protocol included ten sets of 5x4-second sprints on a cycle ergometer with 20-second recovery between bouts. Two bouts of agility were performed pre-HIS and post-HIS. The statistical significance was determined using a two-factor repeated measure ANOVA with the level of significance set at  $p < 0.05$ . Results: The peak power, mean power, and agility capacity were not significantly different between trials ( $p > 0.05$ ). Related to PLA, CAF+CHO resulted in a 5.2% reduction in total work, which corresponded with a 24.7-25.7% increase in fatigue at the end stage of the HIS. CAF+CHO supplementation also resulted in an 11.1% increase in blood lactate, and elevations in higher blood glucose concentration throughout the HIS while compared with PLA ( $p < 0.05$ ). The cortisol concentration also increased with

CAF+CHO and CAF related to PLA (244.3 vs. 242.6 vs. 190.7 ng/ml), but there was no significant effect of CAF+CHO supplementation on testosterone concentration ( $p > 0.05$ ). Discussion: These findings show that caffeine co-ingested with carbohydrate did not improve high-intensity interval sprint performance, agility capacity, and fatigue in team-sport male athletes. There was a trend towards a greater catabolism in cortisol and smaller anabolic hormone in testosterone/cortisol ratio, when the participants ingested CAF+CHO or CAF. It confirms that the recommendation to ingest this in a fashion of CAF+CHO provides less benefit, nor additive effects on the magnitude of the interval intense performance (Conger et al. 2011). References: Carter J. M., Jeukendrup, A. E., Jones, D. A. (2004). *Med Sci Sports Exerc*, 36(12), 2107-2111. Conger S. A., Warren G. L., Hardy M. A., Millard-Stafford M. L. (2011). *Int J Sport Nutr Exerc Metab*, 21(1), 71-84. Dohery M., Smith P. M. (2005). *Scand J Med Sci Sports*, 15(2), 69-78.

**14:00 - 15:00**

## Mini-Orals

### PP-PM21 Molecular Biology [MB] 1

#### THE EFFECT OF LOCAL BIOACTIVE ANDROGEN PRODUCTION ON SKELETAL MUSCULAR HYPERTROPHY

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**Introduction** Androgens such as testosterone play important roles in exercise-induced skeletal muscular adaptation (Storer et al., 2003). Testosterone is converted by 5 $\alpha$ -reductase (Srd5a1) into a dihydrotestosterone (DHT), which is the most powerful androgen. Recently, we reported that the androgen production occurs in various peripheral tissues including skeletal muscle and is activated by exercise (Aizawa et al., 2007, Aizawa et al., 2010). Although, exercise training activates local androgen production in skeletal muscle, the physiological role of the bioactive androgen production through Srd5a1 in skeletal muscle is unknown. **Methods** We generated a Srd5a1 expression vector and evaluated its protein expression by western blot. Then, the Srd5a1 expression vector was transfected into C2C12 myoblasts to evaluate DHT production. Moreover, the Srd5a1 vector was introduced into tibialis anterior muscle of mice to examine the function of Srd5a1 in vivo. **Results** The Srd5a1 protein was successfully produced by the Srd5a1 vector and it promoted an intracellular conversion of DHT from testosterone in vitro. Forced expression of Srd5a1 increased skeletal muscle mass in vivo. In addition, levels of muscular DHT concentration and phospho-p70s6k, which indicates protein synthesis, were increased with the Srd5a1 expression in skeletal muscle. **Discussion** The local bioactive androgen production through Srd5a1 activated skeletal muscle protein synthesis and increased muscle mass. We previously reported that exercise training-induced increase in muscular DHT was associated with muscular hypertrophy in rats (Aizawa et al., 2011). These data suggested that local bioactive androgen production plays an important role in skeletal muscular hypertrophy. **References** TW. Storer, L. Magliano, L. Woodhouse, ML. Lee, C. Dzekov, J. Dzekov, R. Casaburi, S. Bhasin. (2003). *J Clin Endocrinol Metab*, 88, 1478-1485. K. Aizawa, M. Iemitsu, S. Maeda, S. Jesmin, T. Otsuki, C. N. Mowa, T. Miyauchi, N. Mesaki. (2007). *Am J Physiol Endocrinol Metab*, 292, 571-576. K. Aizawa, M. Iemitsu, S. Maeda, T. Otsuki, K. Sato, T. Ushida, N. Mesaki, T. Akimoto. (2010). *Steroids*, 75: 219-223. K. Aizawa, M. Iemitsu, S. Maeda, N. Mesaki, T. Ushida, T. Akimoto. (2011). *Med Sci Sports Exerc*, 43, 2072-2080.

#### DOES EXERCISE INFLUENCE THE APOPTOSIS RELATED PROTEINS IN HEALTHY TRAINING SENSITIVE AND TRAINING RESISTANCE RATS' BRAIN?

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**Introduction** Apoptosis is well regulated form of cell death that is important to maintain the homeostasis of organisms. In the recent years numerous studies are published what are related to apoptosis after traumatic brain injury, ageing brain or diseased brain. Among these papers fewer studies are investigated apoptosis and the effect of exercise in healthy brain. Therefore we were interested whether exercise does influence the apoptosis related proteins in healthy training sensitive and training resistance rats' brain. **Methods** 27 selective breeding 11th generation for low response to training (LRT) and high response to training (HRT) rats were training for 3 months at the 70% of maximal oxygen uptake (VO<sub>2</sub>max) at 30 min/day. Animals were divided into 4 groups: low response to training control (LRTC) and exercise trained (LRTE) and high response to training control (HRTC) and exercise trained (HRTE). The brain function was evaluated by Morris-maze test and passive avoidance test. Moreover we have measured VO<sub>2</sub>max, and the content of some of the proteins that are related to or playing a key role in apoptosis. Statistical significance was assessed by non-parametric Kruskal-Wallis ANOVA and Mann-Whitney U-test for post-hoc analyses. The significance level was set at  $p < 0.05$ . **Results** In the results of Morris-maze could not see any significant changes, but in the case of long time memory we measured a significantly difference between HRTC and HRTE group. VO<sub>2</sub>max is increased significantly in both of exercised groups. Level of silent mating type information regulation 2 homolog 1 (SIRT1) is significantly higher in HRTC compare with LRTC group. Furthermore the levels of SIRT1 were lower in HRTE group compare with HRTC and LRTC. Exercised training is increased the level of the tumor suppressor protein, p53 in the LRT and HRT groups. In the case of acetylated p53 we measured lower levels in HRTE compare with HRTC and LRTE group. Bcl-2-associated X protein (Bax) is decreased in HRTE group compare with LRTE group. Level of B-cell lymphoma 2 (Bcl-2) is not changed in our investigation; however we can see decreasing tendency in HRT group by effect of exercise. **Discussion** We suggest that regular exercise training can influence the level of p53, which is a key regulator of apoptosis. The exercise training-associated decreasing tendency of Bcl-2 is HRTE group might be support our hypothesis that different trainability rats have various response to apoptosis. Data suggest that physical activity play a role in the apoptosis in the brain.

### THE EFFECT OF EICOSAPENTAENOIC AND DOCOSAHEXAENOIC ACID ON PROTEIN SYNTHESIS AND BREAKDOWN IN MURINE C2C12 MYOTUBES

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*University of Aberdeen*

Introduction Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) have been found to stimulate protein synthesis (Smith et al., 2010) with little information regarding the effects on protein breakdown. Furthermore whether there are distinct effects of EPA and DHA remains to be established. The aim of the current study was to determine the distinct effects of EPA and DHA on protein synthesis, protein breakdown and signalling pathways in C2C12 myotubes. Methods Fully differentiated C2C12 cells were incubated for 24 hours with 0.1% ethanol (control), 50µM EPA or 50µM DHA prior to experimentation. After serum (4h) and amino acid (1h) starvation cells were stimulated with 2mM L-leucine and protein synthesis measured using 3H-labelled phenylalanine. Protein breakdown was measured using 3H-labelled phenylalanine. Signalling pathways (Akt, mTOR, p70S6k, 4EBP1, rps6 and FOXO3a) were measured via western blots. Results Data revealed that after incubation with EPA protein synthesis was 25% greater (0.89(0.24) DPM/ng protein vs 1.12(0.14) DPM/ng protein, in control and EPA cells respectively; P<0.05) compared to the control cells, with no effect of DHA. Protein breakdown was 22% (16.7(2.9) DPM/ng protein vs 13.0(1.8) DPM/ng protein, in control and EPA cells respectively; P<0.05) lower, compared to control cells, after incubation with EPA, with no effect of DHA. Analysis of signalling pathways revealed that both EPA and DHA incubation increased (P<0.05) p70s6k phosphorylation, EPA increased (P<0.05) FOXO3a phosphorylation, with no alteration in other signalling proteins. Discussion The current study has demonstrated distinct effects of EPA and DHA on protein metabolism with EPA showing a greater likelihood to result in skeletal muscle protein accretion. These alterations to protein metabolism occurred alongside and increase in phosphorylation of p70s6k, a key regulator of protein translation (e.g. Miyazaki & Esser, 2009), and FOXO3a, a key regulator of the ubiquitin proteasome system which may account for up to 80% of proteolysis during muscle wasting (Tawa et al., 1997). References Miyazaki, M. & Esser, K. A. (2009). *Journal of Applied Physiology* 106, 1367-1373. Smith, G. I., Atherton, P., Reeds, D. N., Mohammed, B. S., Rankin, D., Rennie, M. J., & Mittendorfer, B. (2010). *The American Journal of Clinical Nutrition* 93, 402-412. Tawa, N. E., Odessey, R., & Goldberg, A. L. (1997). *The Journal of Clinical Investigation* 100, 197-203.

### PHYSICAL INACTIVITY AND HIGH FAT DIET SYNERGISTICALLY ENHANCE THE ACCUMULATION OF INTRAMYOCYELLULAR DIACYLGLYCEROL AND INDUCE INSULIN RESISTANCE IN MURINE SOLEUS MUSCLE.

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Introduction Intramyocellular lipids, especially intramyocellular diacylglycerol (IMDG) has been reported that one of the causes of insulin resistance in skeletal muscle#1. In human, long term (~4wks) bed-rest increased intramyocellular lipid (IMCL) accumulation accompanied with muscle atrophy#2, in addition short term only 3days high fat diet (HFD) increase IMCL levels and decrease insulin sensitivity. Both physical inactivity and long-term (generally more than 4wk) high fat diet (HFD) induce insulin resistance in skeletal muscle, however, the combined effect of these factors on insulin resistance and its mechanism have not been clarified yet. Methods To elucidate them, C57BL6J mice were randomly assigned to four groups; control group, 24h hind-limb cast immobilization (HCl) group, short-term (2wk) HFD group, and 24h HCl after 2wk HFD group. Then, we evaluated ex-vivo insulin-stimulated 2-deoxy glucose uptake (2DG-uptake) and insulin signal. Results Twenty four hours HCl significantly decreased insulin-stimulated 2DG-uptake by ~40%, while 2wk HFD did not alter 2DG-uptake. On the other hand, 24h HCl after 2wk HFD dramatically decreased insulin-stimulated 2DG-uptake by ~75%. In parallel with decreased insulin-stimulated 2DG-uptake, we observed decreased insulin stimulated tyrosine phosphorylation of insulin receptor substrate (IRS)-1 after 24h HCl, which were more exacerbated in 24h HCl after 2wk HFD group, while only 2wk HFD did not change. Then, we examined intracellular fat composition and protein level of DGAT1 that mediate the formation of triacylglycerol (TG) from diacylglycerol (DG) and Acyl-CoA, thus reduce the accumulation of DG level. Intriguingly, we found that 24h HCl increased intramyocellular DG (IMDG) in soleus by ~190%, while the amount of intramyocellular TG (IMTG) was not changed. Moreover, whereas IMDG and IMTG were not changed by 2wk HFD, 24h HCl after 2wk HFD dramatically increased IMDG and IMTG by ~330% and ~140%, respectively. Associated with these IMDG accumulations, DGAT1 level was down regulated by ~50% in both 24h HCl group and 24h HCl after 2wks HFD group. Conclusion These results suggested that physical inactivity and HFD synergistically induce IMDG accumulation and insulin resistance in soleus muscle. Reduced DGAT1 expression induced by 24h HCl seems to be involved in this mechanism at least in part. reference #1.Itani SI, Ruderman NB, Schmieder F, Boden G. Lipid-induced insulin resistance in human muscle is associated with changes in diacylglycerol, protein kinase C, and IκappaB-α. *Diabetes*. 2002 Jul;51(7):2005-11. #2.Bergouignan A, Rudwill F, Simon C, Blanc S. Physical inactivity as the culprit of metabolic inflexibility: evidence from bed-rest studies. *J Appl Physiol* 2011;111:1201-1210

### USING RADIOLABELED ATP KINASE ASSAYS TO ASCERTAIN RESISTANCE EXERCISE AND FEEDING-INDUCED CHANGES IN AMPK AND P70S6K ACTIVITY.

McGlory, C.1, Drust, B.2, Close, G.L.2, MacLaren, D.P.M.2, Campbell, I.T.2, Morton, J.P.2, Hamilton, D.L.1

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Introduction: Resistance exercise-induced increases in muscle growth are thought to be underpinned by activation of the mTOR-p70S6K signalling axis (Drummond et al., 2009). Conversely, endurance exercise is believed to stimulate mitochondrial biogenesis mediated by the AMPK-PGC1α pathway (Atherton et al., 2005). However, activation of these diverse signalling pathways is thought to be incompatible and performing resistance and endurance-type exercise in close proximity results in a compromised adaptation (Hawley, 2009). Contemporary methods to ascertain the activity of these pathways are semi-quantitative. However, assays of protein kinases using radiolabeled ATP are the gold standard for the assessment of kinase function offering a fully-quantitative assessment of changes in activity. The aim of this study was to identify the molecular response of human skeletal muscle to resistance exercise and feeding in well-trained males employing radiolabeled ATP kinase assays. Methods: Six, healthy, well-trained males performed a bout of resistance exercise (70% 1RM, 4\*10 repetitions of leg press and leg extension) followed by the immediate consumption of 20g of egg white powder in a 500 mL solution. Muscle biopsies were obtained pre exercise and at +1h and +3h post egg white consumption. Results: Data are expressed as pmol/min/mg (mean ± SD). AMPK activity was significantly reduced from pre at 3h post drink (24.15 ± 3.29 to 15.64 ± 2.62; p<0.05) whilst p70S6K activity significantly increased from pre at 1h (8.84 ± 1.91 to 17.18 ± 6.43; p<0.05) and 3h post drink (15.62 ± 7.64 p<0.05). Conclusion: These data suggest that resistance exercise and feeding suppress AMPK activity whilst concomitantly increasing the

activity of p70S6K. This finding lends support to the notion that the integration of resistance and endurance exercise may result in a compromised muscle adaptation. References 1. Atherton, P. J., Babraj, J., Smith, K., Singh, J., Rennie, M. J. & Wackerhage, H. (2005). *FASEB J*, 19, 786-788. 2. Drummond, M. J., Dreyer, H. C., Fry, C. S., Glynn, E.L & Rasmussen, B. B. (2009). *J Appl Physiol*, 106, 1374-1384. 3. Hawley, J. A. (2009). *Appl Physiol Nutr Metab*, 34, 355-361.

### NO ASSOCIATION OF THE ACTN3 GENOTYPE WITH THE UPPER BODY ANAEROBIC CAPACITY IN YOUNG SWIMMERS

Orysiak, J.1, Zmijewski, P.1, Sitkowski, D.1, Majorczyk, E.2, Dybek, T.2, Zembron-Lacny, A.3, Grochowska, J.1, Pokrywka, A.1  
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**Introduction** It was suggested, that  $\alpha$ -actinin 3 gene (ACTN3) R577X polymorphism could influence athletic performance. In previous research the frequency of allele R or RR genotype was higher in power athletes (Ma et al., 2013, Yang et al., 2009). Moreover, this genotype was associated with higher strength and shorter sprint time (Yang et al., 2009). The aim of the present study was to examine the association of the ACTN3 genotype with the upper body anaerobic capacity among young swimmers. **Methods** Ninety national-level (medallists in national championships) swimmers (46 males aged  $15,0 \pm 1,3$  and 44 females aged  $15,0 \pm 1,0$  years), and 110 (50 males and 60 females) non-athletes participated in this investigation. In swimmers, upper body anaerobic power was measured by the Wingate Anaerobic Arm Test (WAAT) on arm cycloergometer. Peak power (PP), mean power (MP) and fatigue index (FI) were determined. Genomic DNA was extracted from blood cells. Genotyping for the ACTN3 R577X polymorphism was performed based on methods described by Mills et al. 2001. Results ACTN3 genotype distributions met Hardy-Weinberg equilibrium in swimmers ( $\chi^2=0,10$ ;  $P=0,75$ ) and non-athletes ( $\chi^2=0,68$ ;  $P=0,41$ ). The frequency of the ACTN3 genotype was similar in swimmers and non-athletes (RR= 44%, RX= 43%, XX= 12% vs. 36%, 51%, 13%;  $\chi^2=1,42$ ;  $P=0,50$ ). The distribution of the R and X alleles in swimmers was similar, compared to non-athletes ( $\chi^2=1,42$ ;  $P=0,50$ ). We did not observe any effect of ACTN3 R577X polymorphism on the PP, MP, FI, even after adjustment for age and somatic features. Separately conducted analysis in men and women also did not reveal significant effect of ACTN3 genotype on WAAT results. Neither RX genotype nor homozygotes conferred an advantage on the PP, MP, FI. **Discussion** In this study, the distribution of the ACTN3 genotype was similar between nonathletic controls and national-level young swimmers as well as we found no effect of ACTN3 R577X polymorphism on anaerobic capacity (PP, MP, FI) in young, competitive swimmers, both male and female. These results could indicate that ACTN3 R577X polymorphism alone does not allow to identify individuals with predisposition for sprint performance, probably other factors i.e. ability to coordinate and properties of muscle tissue may be at least as important as single gene polymorphism. **References** Ma F, Yang Y, Li X, Zhou F, Gao C, Li M, Gao L. (2013). *PLoS One*, 8(1), e54685. Yang N, Garton F, North K. (2009). *Med Sport Sci*, 54, 88-101. Mills MA, Yang N, Weinberger RP, Vander Woude DL, Beggs AH, Eastel S, North KN. (2001). *Hum Mol Genet*, 10(13), 1335-1346.

### NONFUNCTIONAL OVERREACHING IS ASSOCIATED TO LOW-GRADE CHRONIC INFLAMMATION IN SWISS MICE.

Pereira, B.C.1, De Souza, C.T.2, Pauli, J.R.3, Ropelle, E.R.3, Rocha, E.M.4, Cintra, D.E.3, Freitas, E.C.1, Papoti, M.1, Da Silva, L.E.4, Lira, F.S.2, Silva, A.S.1

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**Introduction** Nonfunctional overreaching (NFOR) is characterized by a performance decrement that can be reversed after weeks or months of recovery (1). Pereira et al. (2) developed a new OT protocol that induced NFOR in 100% of mice. The innovation of this protocol was the inclusion of downhill running sessions at a -14% grade during four weeks. Davis and co-authors (3) linked the performance decrease induced by a single acute session of downhill running with high concentrations of interleukins (i.e. IL-1 $\beta$  and IL-6) in soleus muscles. Thus, we aimed to verify whether the performance decrease induced by chronic sessions of downhill running (2) is linked to high concentrations of cytokines in Swiss mice. **Methods** Swiss mice were divided into control (C), trained (TR) and overtrained (OTR). The body weight and food intake of all groups were recorded weekly. The incremental load test (ILT) and exhaustive test (ET) were used to measure performances before and after exercise protocols. 24h after ET, muscle samples (i.e. extensor digitorum longus - EDL and soleus) were removed and stored for subsequent determination of the protein contents of IL-6 and tumour necrosis factor- $\alpha$  (TNF- $\alpha$ ) by immunoblotting. One-way ANOVA followed by Bonferroni's post hoc test was used to examine the differences between the studied parameters. Results TR and OTR groups diminished significantly their body weight compared to C group. While TR group increased the exhaustion velocity and time to exhaustion compared to C group, OTR group diminished these performance parameters compared to TR group. TR group presented significantly lower levels of IL-6 in serum, and TNF- $\alpha$  for EDL and soleus compared to C group. On the other hand, OTR group presented significantly higher levels of IL-6 and TNF- $\alpha$  for EDL and soleus compared to TR group. **Discussion** The main difference between IL-6 increase in response to physical exercise or severe infections is the behaviour of TNF- $\alpha$  (4). Generally, TNF- $\alpha$  did not increase in response to exercise (4). The high values of TNF- $\alpha$  in the OTR group indicate that the IL-6 increase is possibly linked to inflammation instead of regular response to physical exercise. In summary, Pereira's protocol (2) led to low-grade chronic inflammation marked by high values of IL-6 in serum and muscle samples, and TNF- $\alpha$  in muscle samples. **References** 1. Meeusen R, et al. (2010). Diagnosing overtraining in athletes using the two-bout exercise protocol. *Br J Sports Med* 44, 642-648. 2. Pereira BC, et al. (2012). A new overtraining protocol for mice based on downhill running sessions. *Clin Exp Pharmacol Physiol* 39, 793-798. 3. Davis JM, et al. (2007). Curcumin effects on inflammation and performance recovery following eccentric exercise-induced muscle damage. *Am J Physiol Regul Integr Comp Physiol* 292, R2168-2173. 4. Pedersen BK FM (2008). Muscle as an endocrine organ: Focus on muscle-derived interleukin-6. *Physiol. Rev.* 88, 27. **Acknowledgments:** FAPESP (process numbers: 2010/08239-4, 2011/02652-0).

### VARIATION OF THE HIF1A AND MB GENES IN LITHUANIAN ATHLETES

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1: Vilnius University, 2: Lithuanian Educational University

**Introduction** The efficiency of energy supply to human skeletal muscle in the hypoxic state is dependent on many factors. Hypoxia-inducible factor 1 (HIF-1) is a transcription factor that regulates gene expression in response to hypoxia and has been associated with athletic performance. A polymorphism (Pro582Ser) of the HIF1A gene has been shown to be associated with changes of maximal oxygen consumption ( $\dot{V}O_{2max}$ ) during training. Myoglobin plays a crucial role in energy metabolism by carrying molecular oxygen between the capillaries and the mitochondria to satisfy the requirement for sustained work. There is little information on the functional implications of MB (A79G) variation and no research related to the performance of elite athletes. As HIF1A is an essential mediator of the adaptive re-

sponse to hypoxia and myoglobin is the primary oxygen-carrying protein of muscle tissues, we hypothesized that variants of the HIF1A and MB genes might be associated with Lithuanian elite athletes' status. Methods A total of 165 Lithuanian elite athletes (78 endurance-oriented, 38 power-oriented, 49 "mixed group") and 240 healthy unrelated individuals (controls) were genotyped (PCR-RFLP). Anthropometric measurements, anaerobic muscle strength and VO<sub>2</sub>max were evaluated. Results The results revealed no significant HIF1A allele or genotype frequency differences between the athletes and the controls (Pro/Pro 77.6%; Pro/Ser 21.8%; Ser/Ser 0.6% vs. Pro/Pro 75.0%; Pro/Ser 21.3%; Ser/Ser 3.8%; P=0.134). The frequency of the HIF1A Ser allele was higher in the power-oriented (17.1%) athletes compared to endurance-oriented (11.5%), "mixed group" (7.1%) and controls (14.4%). Muscle strength phenotypic indexes did not differ between athletes depending on their HIF1A genotype (P>0.05). Interestingly, we found that athletes carrying the Pro/Ser genotype exhibited significantly higher VO<sub>2</sub>max (69.5 vs. 60.3 ml/kg/min, P<0.05) than those carrying the Pro/Pro genotype. MB genotypes in athletes group showed differences from controls (AA/AG/GG: 19.4/63.0/17.6% vs. 27.9/45.0/27.1%; P=0.002). The frequency of MB A allele was higher in endurance athletes than in controls (53.2% vs. 50.4%; P=0.001). The power-oriented athletes with the MB GG genotype were significantly higher, with larger muscle mass, grip strength and short-term explosive muscle power (vertical jump test) than AA genotyped athletes (P<0.05). Conclusions We found preliminary evidence that the HIF1A (Pro582Ser) and MB (A79G) variants may be associated with Lithuanian elite athletes status: athletes carrying the HIF1A Pro/Ser genotype associated with higher aerobic capacity; the MB GG and A/G genotypes are related to speed-power sports, and AA genotype to endurance demanding sports. We conclude that the HIF1A and MB variants may belong to a group of several genetic variations that influence top-level physical performance.

### PROTECTIVE ROLE OF 17-BETA-ESTRADIOL TOWARD IL-6 LEUKOCYTE EXPRESSION INDUCED BY INTENSE TRAINING IN YOUNG FEMALE ATHLETES

Vitale, J., Scala, L., Silvestri, I., Scurati, R., Michielon, G., Alberti, G., Venerando, B., Tringali, C.

*University of Milan*

Several experimental data demonstrated that the levels of physical activity during childhood could influence the growth and development of muscle, fat, and bone (Eliakim et al., 1996) so, setting the levels of training appears to be crucial so that physical activity could be beneficial to children growth (Cooper et al., 2004). Exercise performed at a competitive level could deeply modify the immune system and the cytokine response of athletes. In this report, we demonstrated that young elite female artistic gymnasts (n.16; age: 9-15 years), showed an increase of interleukin 6 (IL-6) and tumour necrosis factor alpha (TNF-alpha) mRNAs expression in blood mononuclear cells (PBMCs), in comparison to young girls performing the same sport at a recreational level (n.16; age: 10-15 years). The increase of IL-6 and TNF-alpha mRNAs appeared to be directly linked to the intensity and to the duration of the training. Moreover, in elite athletes engaging in artistic gymnastics and, also, in synchronized swimming (n.34; age: 9-15 years), IL-6 gene expression appeared to be modulated by the levels of circulating oestrogens: pre-pubertal athletes (n. 20; age: 11 +/- 1 years) revealed higher increases of IL-6 than pubertal athletes (n. 14; age: 14 +/- 1.6 years). In pre-pubertal athletes, body mass index (BMI) percentile was inversely correlated with both the increases of IL-6 and TNF-alpha. The consequence of these events was the shift of the cytokine profile toward a pro-inflammatory status. These modifications induced by training performed at an elite level risk to negatively affect the growth of female children athletes (Marchovecchio et al., 2012). REFERENCES 1. Cooper DM, Nemet D & Galassetti P. (2004). *Curr Opin Pediatr*:16:286-92. 2. Eliakim A, Brasel JA, Mohan S, Barstow TJ, Berman N & Cooper DM. (2006). *J Clin Endocrinol Metab*: 81:3986-92. 3. Marchovecchio ML, Mohn A & Chiarelli F. (2012). *Curr Opin Endocrinol Diabetes Obes*:19:57-62.

### IMPAIRED DIFFERENTIATION IN SKELETAL MUSCLE MYOBLASTS IS RESTORED WITH TESTOSTERONE ADMINISTRATION

Hughes, D.C.1,2, Deane, C.S.1, Sculthorpe, N.3, Stewart, C.E.2, Lewis, M.P.1,4, Sharples, A.P.1,2

*University of Bedfordshire*

1 Muscle Cellular and Molecular Research Group (MCMPRG), Institute of Sport and Physical Activity Research (ISPAR), University of Bedfordshire, UK. 2 Stem Cells, Ageing & Molecular Physiology (SCAMP) unit, Research Institute for Sport and Exercise Sciences (RISES), School of Sport and Exercise Sciences, Liverpool John Moores University, Tom Reilly Building, Byrom Street, Liverpool, UK. 3 Institute for Clinical Exercise and Health Science (ICEHS), University of the West of Scotland, Hamilton, UK. 4 Cellular and Molecular Physiology, Musculoskeletal Biology Research Group, School of Sport, Exercise and Health Science, Loughborough University, Loughborough, UK. Abstract: We investigated the ability of testosterone (T) to restore differentiation in multiple population doubled (MPD) murine myoblasts, previously shown to have a reduced differentiation in monolayer (Sharples et al. 2011) and bioengineered skeletal muscle cultures (Sharples et al. 2012) vs. their parental controls (CON). Cells were exposed to low serum conditions in the presence or absence of T (100 nM) ± PI3K inhibitor (LY294002) for 72 hrs and 7 days (early/late muscle differentiation respectively). Morphological analyses were performed to determine myotube number, diameter (µm) and myonuclear accretion as indices of differentiation and myotube hypertrophy. Changes in gene expression for myogenin, mTOR and myostatin were also performed using real time-polymerase chain reaction (RT-PCR). Myotube diameter in CON and MPD cells increased from 17.32 ± 2.56 µm to 21.02 ± 1.89 µm and 14.58 ± 2.66 µm to 18.29 ± 3.08 µm (P≤0.05) respectively after 72 hrs of T exposure. The increase was comparable in both MPD (+25%) and CON cells (+21%) suggesting a similar intrinsic ability to respond to exogenous T administration. Addition of PI3K inhibitor (LY294002) in the presence of T attenuated these effects in myotube morphology (in both cell types) suggesting a role for this pathway in T stimulated hypertrophy. Finally, myoblasts showed reduced responsiveness to T stimulated expression of mTOR and T reduced myostatin in MPD myoblasts only. The present study demonstrated T's ability to rescue differentiation and hypertrophy in myoblasts that displayed reduced differentiation capacity vs. their parental controls, the action of testosterone in this model appeared to be mediated by PI3K/Akt signalling. References Sharples AP, Al-Shantti N, Lewis MP, Stewart CE. (2011) Reduction of myoblast differentiation following multiple population doublings in mouse C12 C12 cells: A model to investigate ageing? *J Cell Biochem* 112: 3773-3785. Sharples AP, Player DJ, Martin NR, Mudera V, Stewart CE, Lewis MP. (2012) Modelling in-vivo skeletal muscle ageing in-vitro using three dimensional bioengineered constructs. *Aging Cell* 11: 986-95.

### EFFECTS OF CAFFEINE ON AEROBIC PERFORMANCE IN SELF-PACED MANNER IN THERMONEUTRAL AND HOT ENVIRONMENTS.

Matsumoto, T., Katsumata, N., Yamashita, N., Fukaya, T., Narita, T., Kashima, D., Fan, M., Matsuoka, D.

*School of Health and Sport Sciences, Chukyo University*

Introduction There are many reports in which caffeine supplementation increases aerobic exercise performance in thermoneutral condition, however those effects in hot environments are controversial. On the other hand, athletes competes the race in self-paced manner,

not in constant pace used in many studies. The purpose of the present study was to clarify the effects of caffeine on aerobic performance in self-paced manner both in thermoneutral and hot conditions. Methods Eight healthy recreationally active men (age: 23 years, height: 173.3 cm, mass: 65.3 kg, VO<sub>2</sub>max: 48.5 ml/min/kg) volunteered in this study. Each subject performed 4 trials of 15-min time trial in self-selected pace after a 20-min pre-exercise at 22 C using a bicycle ergometer with caffeine (CAF, 5 mg/kg) or placebo (CON), taken 60 min before in the double-blind manner and in randomized order, either in thermoneutral (WBGT 20 C) or hot (WBGT 31 C). Rectal temperature (Tre), heart rate (HR), oxygen consumption (VO<sub>2</sub>), work output and RPE were recorded. Results Mean Tre did not exceed 38C during 15-min time trial both at WBGT20 and WBGT31. Total work of CAF (170.0 kJ) was significantly higher than CON (161.6 kJ) at WBGT20, however there was no difference (CAF: 161.8 kJ, CON: 159.3 kJ) at WBGT31. There was no significant difference in the relative work (%VO<sub>2</sub>max) between CAF and CON at WBGT20, however %VO<sub>2</sub>max of CAF was significantly higher than CON at 7-9, 10-12, 13, 14 and 15 min periods (p<0.05) at WBGT31. HR of CAF was significantly higher than CON at 10-12, 13 and 14 min periods (p<0.05) at WBGT20, and at 4-6, 7-9 and 10-12 min periods (p<0.05) at WBGT31. RPE of CAF was significantly higher at 10-12, 13, 14 and 15 min periods (p<0.05) at WBGT20, and significantly lower than CON at 1-3 min period (p<0.05) at WBGT31. There was no significant difference in work output per RPE (kJ/PRE) between CAF and CON at WBGT20, however kJ/PRE of CAF was significantly higher than CON at 7-9 min period (0.73 vs 0.6 kJ/PRE, p<0.05) at WBGT31. Discussion At thermoneutrality (WBGT20), caffeine increased aerobic performance in self-selected pace manner with the increased HR and RPE. It is suggested that caffeine-induced increase in aerobic work capacity is attributed to the suppression of PRE during exercise. In the hot environment (WBGT31), caffeine did not increase total work, but increased kJ/RPE at 7-9 min period. Effects of caffeine could not deny even at hot condition. References Del Coso et al, Med Sci Sports Exerc, 2011. Ganio M et al, Eur J Appl Physiol, 2011. Astorino T et al, Physiol Behav, 2012.

**14:00 - 15:00**

## Mini-Orals

### PP-PM27 Nutrition [NU] 1

#### **CARBOHYDRATE CO-INGESTION WITH PROTEIN DELAYS DIGESTION AND ABSORPTION BUT DOES NOT MODULATE POSTPRANDIAL MUSCLE PROTEIN ACCRETION**

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1: Top Institute Food & Nutrition (Wageningen, the Netherlands), 2: Department of Human Movement Sciences and 3: Human Biology, NUTRIM, MUMC+ (Maastricht, the Netherlands)

**BACKGROUND:** Sarcopenia is thought to arise from a blunted responsiveness of skeletal muscle tissue to food intake. Recent evidence suggests that this is, at least partly, attributed to senescent muscle becoming more resistant to the capacity of postprandial insulin release to enhance skeletal muscle perfusion. **OBJECTIVE:** To determine the impact of carbohydrate co-ingestion with protein on dietary protein digestion and absorption kinetics and subsequent postprandial muscle protein accretion in healthy young and older men. **DESIGN:** Twenty-four healthy young (age: 21±1 y, BMI: 21.8±0.5 kg•m<sup>-2</sup>) and 25 older (age: 75±1 y, BMI: 25.4±0.6 kg•m<sup>-2</sup>) men received a primed continuous L-<sup>15</sup>N-phenylalanine infusion and ingested 20 g intrinsically L-[1-<sup>13</sup>C]-phenylalanine-labeled protein with (Pro+CHO) or without (Pro) 60 g carbohydrate. Biopsies were collected from the vastus lateralis in a postabsorptive state and at 2 and 5 h after protein ingestion. **RESULTS:** Carbohydrate co-ingestion delayed the postprandial rise in exogenous phenylalanine appearance rate (P=0.001). Dietary protein-derived phenylalanine availability over the 5 h postprandial period was lower in the older (62±2 %) when compared with the young group (74±2 %, P=0.007), with no differences between the Pro and Pro+CHO conditions (P=0.202). Carbohydrate co-ingestion did not modulate postprandial muscle protein synthesis rates (0.035±0.003 vs 0.043±0.004 and 0.033±0.002 vs 0.035±0.003 %•h<sup>-1</sup> following Pro vs Pro+CHO in the young and older group, respectively). In accordance, no differences in muscle protein-bound L-[1-<sup>13</sup>C]-phenylalanine enrichments were observed between conditions (0.020±0.002 vs 0.020±0.002 and 0.019±0.003 vs 0.022±0.004 MPE following Pro vs Pro+CHO in the young and old, respectively). **CONCLUSION:** Carbohydrate co-ingestion with protein delays dietary protein digestion and absorption, but does not modulate postprandial muscle protein accretion in healthy young or older men.

#### **REMARKABLE REDUCTION OF FAT MASS IN OVERWEIGHT MEN IN FOUR DAYS WITH PROLONGED EXERCISE AND SEVERE CALORIC RESTRICTION**

Pérez-Suárez, I., Ponce-González, J.G., Calle-Herrero, J., Holmberg, H.C., Calbet, J.A.

University of Las Palmas de Gran Canaria

**Introduction** Obesity can be treated by reducing energy intake and/or increasing energy expenditure to achieve a negative energy balance. One of these interventions alone, either with or without pharmacological aid, produces only a moderate loss in mean weight (2-3 kg or less); while dieting in combination with exercise for 3-12 months reduces body weight by an average of 1.1 kg more than simply dieting (Shaw et al. 2009). A similar or more pronounced reduction in body mass can be achieved much more rapidly (i.e., within 3-10 days) by combining severe caloric restriction, with extensive daily exercise. It has been shown that elevating the amount the protein relative to carbohydrate in weight-loss diets lessens the loss of lean mass and promotes loss of fat mass. **Methods** To determine if fat mass can be reduced by 3-4 kg in four days of low energy intake (LE) and 9 hours of daily low-intensity exercise. Fifteen healthy overweight men were enrolled in this study divided in five experimental phases: a pre-test, walking+LE for 4 days (W+LE), control diet+reduced exercise for three days (DIET), and follow-up 4 weeks (POST1) and one year later (POST2). During W+LE, the participants were randomly assigned to consume a diet consisting solely of protein (n=8) or sucrose (n=7) (0.8 g/kg body weight each day in both cases). **Results** Whole-body fat mass was reduced by a mean of 2.3, 2.9, 4.0, and 2.1 kg following the four last phases, respectively (P<0.05). About 2/3 of the fat was loss from the trunk. After W+LE, serum levels of glucose, insulin, HOMA, total and LDL cholesterol levels, and triglycerides were reduced; FFA and cortisol were increased. Serum leptin concentration was reduced by 64, 50 and 33 % following W+LE, DIET and POST1, respectively (P<0.05). The effects were similar in both groups. **Discussion and conclusions** Prolonged walking for several hours in consecutive days combined with a very low calorie diet can be used to reduce fat mass by 0.7-0.9 kg/day in overweight adults. The main advantage of this weight loss method is that fat is mostly lost from the trunk and that the effect is achieved in a rather

short time. The intervention is accompanied by improvements in blood lipids and a fast and sustained reduction of leptin serum concentration. This indicates reduced leptin resistance after the intervention; which may help to maintain body weight. Also some lean mass is lost, this only represents less than 15% of the whole mass lost. For these reasons it would be worthy to determine if this weight loss program could be repeated periodically to achieve greater reduction of fat mass over a much shorter period of time than achieved with other weight reducing programs. References Shaw et al. (2009). Cochrane Database Syst Rev. CD003817. Granted by MEC (DEP2010-21866).

### **MATCHING ENERGY INTAKE TO EXPENDITURE OF ISOCALORIC EXERCISE AT HIGH AND MODERATE INTENSITIES**

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**Background:** Those seeking to manage their bodyweight use a variety of strategies, but the most common approaches involve attempting to exercise more and consume fewer calories (Weiss et al., 2006). A poor comprehension of the energy cost of exercise and the energy content of food may contribute to weight gain and the poor success rate of "exercise alone" weight-loss interventions. **Purpose:** To investigate individuals' ability to consciously match energy intake with energy expenditure after exercise at moderate and high intensity. **Method:** In a counterbalanced cross-over study design, 14 low- to moderately-active, lean individuals (7 male; mean age  $23 \pm 3$  years; mean BMI  $22.0 \pm 3.2$  kg·m<sup>-2</sup>) completed both a moderate-intensity (60% VO<sub>2</sub>max, MOD) and a high-intensity (90% VO<sub>2</sub>max, HIGH) exercise bout on a treadmill, matched for energy expenditure, EE, (450 kcal). Participants were blinded to the intensity and duration of each bout. Thirty minutes post exercise, participants were presented with a buffet, where they were asked to consume food in an attempt to match energy intake with the energy expended during the exercise bout. This was termed the "matching task," providing a EL<sub>match</sub> value. Upon finishing the matching task, a verbal estimate of energy expenditure (EST) was obtained before the participant was allowed to return to the buffet to consume any more food, if desired. This intake was covertly measured and added to EL<sub>match</sub> to obtain an ad libitum intake value (EL<sub>ad lib.</sub>). **Results:** A significant condition x task interaction showed that, in MOD, EST was significantly lower than EE ( $298 \pm 156$  kcal vs.  $443 \pm 22$  kcal,  $p = 0.01$ ). In the HIGH condition, EE, EL<sub>match</sub> and EST were similar. In both conditions, participants tended to over-eat to a similar degree, relative to EST, with EL<sub>match</sub> 20% and 22% greater than EST in MOD and HIGH respectively. Between condition comparisons demonstrated that EL<sub>match</sub> and EST were significantly lower in MOD, compared with HIGH ( $374 \pm 220$  kcal vs.  $530 \pm 248$  kcal,  $p = 0.002$  and  $298 \pm 156$  kcal vs.  $431 \pm 129$  kcal,  $p = 0.002$  respectively). For both conditions, EL<sub>ad lib.</sub> was approximately 2-fold greater than EE. **Discussion:** Participants exhibited a strong ability to estimate exercise energy expenditure after high-intensity exercise. Participants appeared to perceive moderate-intensity exercise to be less energetic than an isocaloric bout of high-intensity exercise. This may have implications for exercise recommendations for weight-loss strategies, especially when casual approaches to exercise and attempting to eat less are being implemented. References Weiss, E. C., Galuska, D. A., Khan, L. K., & Serdula, M. K. (2006). Weight-Control Practices Among U.S. Adults, 2001–2002. *Am J Prev Med*, 31(1), 18–24.

### **DIETARY NITRATE CO-INGESTION WITH PROTEIN DOES NOT FURTHER ENHANCE WHOLE-BODY PROTEIN SYNTHESIS RATES IN OLDER, TYPE 2 DIABETIC MEN**

Kouw, I.W.K., Cermak, N.M., Burd, N.A., Gijzen, A.P., van Kranenburg, J., van Loon, L.J.C.

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**INTRODUCTION:** Impairments in insulin-mediated capillary recruitment and muscle tissue perfusion have been suggested to result in a blunted postprandial muscle protein synthetic response following protein ingestion in the elderly population. Dietary nitrate supplementation may serve as an effective nutritional intervention strategy to enhance amino acid delivery to skeletal muscle tissue and thus augment postprandial muscle protein accretion. The present study investigates whether ingestion of dietary nitrate prior to the consumption of a meal-like amount of protein modulates dietary protein digestion and absorption kinetics and improves whole-body protein synthesis rates in older, type 2 diabetic patients. **METHODS:** Twenty-four older, type 2 diabetic men (age  $72 \pm 1$  y; BMI  $26.7 \pm 0.4$  m<sup>2</sup>·kg<sup>-2</sup>; HbA<sub>1c</sub>  $7.3 \pm 0.2$ %) received a primed, continuous infusion of L-[2H<sub>5</sub>]phenylalanine, L-[2H<sub>2</sub>]tyrosine, and L-[1-13C]leucine and ingested 20 g specifically produced intrinsically L-[1-13C]phenylalanine-labelled dietary protein with (PRONO3) or without (PRO) a single bolus of sodium nitrate (0.15 mmol·kg<sup>-1</sup> body weight). Muscle biopsies were taken from the vastus lateralis before and 2 and 5 h after protein ingestion. Blood samples were collected at regular intervals to assess protein digestion and absorption kinetics and whole-body protein balance. **RESULTS:** Exogenous phenylalanine appearance rates significantly increased in both groups following protein ingestion ( $P < 0.001$ ), with no differences between groups. The percentage of dietary protein-derived phenylalanine that appeared in the systemic circulation over the 5 h postprandial period was  $59 \pm 2$ % (PRO) and  $57 \pm 3$ % (PRONO3;  $P > 0.05$ ). Whole-body protein synthesis rates significantly increased ( $P < 0.001$ ), whereas breakdown rates were significantly reduced in the postprandial phase when compared with the postabsorptive phase ( $P < 0.001$ ), with no differences between groups. **DISCUSSION:** Ingestion of a meal-like amount of dietary protein stimulates whole-body protein synthesis rates and inhibits protein breakdown, resulting in a positive net protein balance. Prior ingestion of sodium nitrate does not modulate dietary protein digestion and/or absorption kinetics and subsequent whole-body protein net balance in older, type 2 diabetic patients. Further analyses are necessary to assess the specific impact of nitrate co-ingestion on postprandial muscle protein accretion.

### **CARBOHYDRATE MOUTH RINSING DOES NOT IMPROVE TIME TRIAL PERFORMANCE IN THE FASTED OR FED STATE**

Trommelen, J., Cermak, N.M., Mullers, M., Loon, L.J.C.

*Maastricht University*

**Introduction:** It has previously been reported that carbohydrate (CHO) mouth rinsing during exercise may enhance the performance of short (45–60 min), high intensity (>75% VO<sub>2</sub>peak) exercise bouts. However, not all studies investigating this phenomenon have found evidence to support this claim. The discrepancy in these findings may be due to testing subjects in the fasted (post-absorptive) or fed state when liver glycogen stores may be more or less compromised. The purpose of this study was to define the impact of a CHO mouth-rinse on ~1 h time trial performance in trained cyclists in both the fasted and fed condition. **Methods:** Using a double blind, repeated-measures crossover design, 16 trained male cyclists ( $26 \pm 2$  y;  $4.9 \pm 0.1$  W·kg<sup>-1</sup>) were selected to perform 4 time trials of ~1 h in duration (1020 ± 31 kJ) on a cycle ergometer while rinsing their mouths with a 6.4% sucrose solution (CHO) or a non-caloric sweetened placebo (PLA) for 5 s after every 12.5% of their set amount of work. Two trials were performed in an overnight fasted state (12 h), whereas two other trials were performed 2 h after consuming a standardized breakfast (36 kJ·kg<sup>-1</sup>, 65 En% carbohydrate). Power output and heart rate were recorded continuously throughout the test. **Results:** Performance time did not differ between treatments and averaged  $69.27 \pm 1.75$  vs  $68.10 \pm 1.80$

min in the CHO and PLA treatment, respectively ( $P = 0.10$ ). The lack of any ergogenic benefit from the CHO rinse was apparent in both the fasted (CHO:  $69.58 \pm 2.00$  vs PLA:  $68.57 \pm 1.93$  min) and fed state (CHO:  $68.96 \pm 1.68$  vs PLA:  $67.63 \pm 1.77$  min: treatment  $\times$  prandial state interaction:  $P = 0.84$ ). In line, mean power output and heart rate did not differ between treatments. Furthermore, after dividing the time trial into 12.5% segments, no differences in power output or RPM's were observed over time between treatments. Conclusion: Carbohydrate mouth rinsing does not improve ~1 time trial performance when performed in either the fasted or the fed state.

### EFFECTS OF SEVERE ENERGY DEFICIT ON MUSCLE MASS: INFLUENCE OF PROTEIN INGESTION AND EXERCISE VOLUME .

Maldonado Marfínez, E., Ponce-González, J., Losa-Reyna, J., Pérez-Suárez, I., De La Calle-Herrero, J., Guadalupe-Grau, A., Holmberg, H.C., Calbet, J.A.L.

*University of Las Palmas de Gran Canaria*

**Introduction:** The signaling phosphatidylinositol-3-kinase (PI3K) signaling pathway plays a central role in the regulation of muscle mass in response to fasting, diet changes, and exercise. However, little is known on the signaling changes in this pathway in response to a severe energy deficit (SED) in combination with varying extents of low-intensity exercise and different levels of protein in the diet. The hypothesis we tested here was that down-regulation of the PI3K/AKT/mTOR/70S6K pathway caused by SED is attenuated both by such exercise (in a volume-dependent manner) and by ingestion of whey protein, thereby helping to preserve muscle mass. **Methods:** Fifteen overweight male volunteers first performed 4 days of prolonged exercise (45 min of one-arm cranking at 15% of their maximal intensity followed by 8 h walking each day) with caloric restriction (0.8 g whey protein (PRO) ( $n=8$ ) or sucrose (SU) ( $n=7$ ) per kg body weight each day) (designated as the PE+CR period). Thereafter followed 3 days of reduced exercise and resume a normal diet that was isoenergetic with their usual diet prior to PE+CR (designated CD). Muscle biopsies were taken from both the deltoid and one of the vastus lateralis muscles (135 biopsies in all) and the phosphorylation levels of SER473 and Thr308AKT, SER2448mTOR, Thr37/454EBP1, Thr642AS160 and p70S6K determined in these samples by Western blotting. **Results:** In comparison to the baseline values prior to PE+CR, the serum concentration of insulin was 48 and 31% lower, and the lean mass 1.1 and 0.5 kg less after PE+CR and CD, respectively ( $P < 0.05$ ), independent of the type of diet. Compared to PRE, the total amount of Akt protein was reduced by 24% after CD in the PRO group ( $P < 0.05$ ), but unaltered in the SU group. Phosphorylation at Ser473Akt was 32% higher in the PRO group ( $P < 0.05$ ) and this increase was more pronounced in the exercised arms and legs, with no difference between these extremities; whereas the total amount of Ser473Akt remained constant. No changes were observed in Thr308Akt and the only alteration in Thr642AS160 was a 16% increase from PE+CR to CD in the PRO group ( $P < 0.05$ ). The total levels of phosphorylated Ser2448mTOR and the mTOR protein were elevated after both PE+CR and CD, particularly in the PRO group and to a greater extent in the exercised muscles ( $P < 0.05$ ). The amount of exercise or type of diet had no influence on phosphorylation of No 70S6K or 4EBP1. **Discussion:** Although ingestion of whey protein enhanced phosphorylation of Akt/mTOR, particularly with extensive exercise, phosphorylation of the downstream components of this signaling cascade that stimulates protein synthesis remained unaltered. The observation that lean mass was reduced to the same extent with both diets indicates that during severe energy deficit, ingestion of protein neither stimulates the synthesis nor inhibits the breakdown of proteins. **Granted by CSD 028/UPB10/12**

### THE EFFECT OF A SINGLE BOLUS, 7 DAYS AND 28 DAYS DECAFFEINATED GREEN TEA EXTRACT INGESTION ON FAT OXIDATION DURING EXERCISE

Randell, R.K., Hodgson, A.B., Lotito, S.B., Jacobs, D.M., Rowson, M., Mela, D.J., Jeukendrup, A.E.

*University of Birmingham, Unilever R&D (Sharnbrook), Unilever R&D (Vlaardingen, NL)*

**Introduction:** Ingestion of a decaffeinated green tea extract (GTE) in the 24 h before a bout of steady state moderate intensity exercise has been found to increase fat oxidation rates by up to 17%, in healthy males [1]. Other studies have shown that GTE ingestion, alongside exercise training, increases fat utilisation during exercise, compared to exercise training alone [2]. However, recently no change in fat oxidation rates during exercise was observed following 1 and 7 day ingestion of a caffeinated GTE [3]. To date no study has directly compared the effects of acute, long term and chronic GTE ingestion on substrate metabolism during exercise. **Purpose:** The aim of this study was to investigate the effects of a single bolus decaffeinated GTE (dGTE) (day 1) and following 7 and 28 days ingestion (day 7 and 28,) on whole body fat oxidation rates during moderate-intensity exercise in healthy lean males. **Method:** In a cross over, placebo controlled design 19 healthy, lean males [ $\pm$  SD weight  $75.0 \pm 7.0$  kg; body mass index (BMI)  $23.2 \pm 2.2$  kg·m<sup>-2</sup>; maximal oxygen consumption (VO<sub>2</sub>max)  $55.4 \pm 4.6$  mL·kg<sup>-1</sup>·min<sup>-1</sup>] ingested dGTE or placebo for 28 days, separated by a 28-day wash-out period. Participants completed a 30-min cycle exercise bout (50% W<sub>max</sub>) at 2 h after a single bolus of dGTE or placebo (day 1), and after 7 and 28 days of ingestion. Indirect calorimetry was used to calculate rates of whole body fat and carbohydrate oxidation during exercise. Blood samples were collected at rest and during exercise for analysis of plasma fatty acids (FA), glycerol and (-)-epigallocatechin gallate. **Results:** Ingestion of dGTE did not result in statistically significant changes in fat oxidation rates during exercise after a single bolus and following 7 and 28 days supplementation, compared to placebo. In addition, plasma concentrations of FA and glycerol, at rest and during exercise, were unaltered by dGTE ingestion at any of the time points. **Conclusion:** A single bolus of dGTE and following 7 and 28 days supplementation did not alter whole body fat oxidation rates or fat metabolism-related blood metabolites during exercise in healthy males. Research investigating the mechanisms of GTE in relation to fat metabolism is needed to determine the factors generating inconsistencies in reported efficacy. 1. Venables, M.C., et al., *Am J Clin Nutr*, 2008. 87(3): p. 778-84. 2. Ichinose, T., et al., *Scand J Med Sci Sports*, 2011. 21(4): p. 598-605. 3. Randell, R.K., et al., *Med Sci Sports Exerc*, 2013. (in press).

### EFFECTS OF CAFFEINE CONTAINING ENERGY DRINK ON SIMULATED VOLLEYBALL PERFORMANCE

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**Introduction** Consumption of caffeine or caffeine-containing products prior to competition has been reported as a frequent behavior in athletes. While the effects of caffeine on endurance sport activities have been well established (Jenkins et al., 2008), the outcomes of caffeine ingestion on team-sports performance are scarce (Del Coso et al., 2011; Schneider et al., 2006; Stuart et al., 2005). The purpose of this study was to assess the effects of caffeine containing energy drink on volleyball players' performance during a simulated match and specific testing. **Methods** A double-blind, placebo controlled and randomized experimental design was used in this study. On two different days, 15 amateur volleyball players ( $179.5 \pm 7.9$  cm and  $80.2 \pm 13.3$  kg) ingested 3 mg of caffeine per kg of body mass in the form of an energy drink (Fure®, ProEnergetics) or the same drink without caffeine (placebo). After sixty minutes for caffeine absorption, participants performed six tests: a) spike test; b) manual dynamometry; c) squat jump (SJ); d) counter-movement jump (CMJ); e) 15-s rebound jump

(15RJ); f) agility T-test. Later, a simulated volleyball match was played and recorded. Afterward time motion analysis was done. Results In comparison to the placebo drink, the ingestion of caffeinated energy drink increased the mean jump height in SJ ( $31.1 \pm 4.3$  vs.  $32.7 \pm 4.2$  cm;  $P < 0.05$ ), CMJ ( $35.9 \pm 4.6$  vs.  $37.7 \pm 4.4$  cm;  $P < 0.05$ ) and 15RJ ( $29.0 \pm 4.0$  vs.  $30.5 \pm 4.6$  cm;  $P < 0.05$ ). Manual dynamometry for right ( $41.3 \pm 9.0$  vs.  $44.7 \pm 6.8$  kg;  $P < 0.05$ ) and left hand ( $39.8 \pm 7.1$  vs.  $42.9 \pm 7.3$  kg;  $P < 0.05$ ) was also increased after the energy drink ingestion. The time to complete the T-test was significantly reduced with the energy drink ( $10.8 \pm 0.7$  vs.  $10.3 \pm 0.4$  s;  $P < 0.01$ ). In addition, spike test velocity tended to be increased with the caffeinated energy drink ( $73 \pm 9$  vs.  $75 \pm 10$  km/h;  $P = 0.07$ ). Finally, during the simulated match, actions played precisely were more frequent ( $24.6 \pm 14.3$  vs.  $34.3 \pm 16.5$  %;  $P < 0.05$ ) with the ingestion of the energy drink. Discussion The pre-exercise ingestion of a caffeine-containing energy enhanced jump height in volleyball specific tests, handgrip force, spike and displacement velocities and improved the frequency of actions with precision during a volleyball match. Thus, caffeine-containing energy drink was effective to improve specific physical performance in volleyball. References Del Coso J, Munoz G, Munoz-Guerra J. (2011). *Appl Physiol Nutr Metab*, 36(4), 555-61. Jenkins NT, Trilk JL, Singhal A, O'Connor PJ, Cureton KJ. (2008). *Int J Sport Nutr Exerc Metab*, 18, 328-42. Schneiker KT, Bishop D, Dawson B, Hackett LP. (2006). *Med Sci Sports Exerc*, 38(3), 578-85. Stuart GR, Hopkins WG, Cook C, Cairns SP. (2005). *Med Sci Sports Exerc*, 37(11), 1998-2005.

## THE EFFECT OF BEETROOT JUICE ON MECHANICAL EFFICIENCY AND PERFORMANCE DURING ROWING

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*Oxford Brookes University*

Introduction Previous studies with human subjects have demonstrated that ingestion of nitrate rich beetroot juice can lower resting blood pressure, reduce the sub-maximal oxygen of exercise and enhance performance (Lansley et al., 2011a, Lansley et al., 2011b). However, these results were observed during cycling and running tasks which do not substantially engage the upper body musculature. Potentially, the effects of dietary nitrate supplementation may be greater in tasks that require significant use of both lower and upper muscle mass. Therefore, this study examined the effect of beetroot juice ingestion on resting blood pressure, rowing economy and 1500-m rowing performance in moderately trained oarsmen. Methods Eight moderately trained male rowers completed the study (age  $27 \pm 5$  yrs; weight  $79.0 \pm 10.7$  kg; height  $1.81 \pm 0.09$  m). Subjects completed a progressive incremental test to determine lactate threshold (1 mmol.L<sup>-1</sup> above baseline) and VO<sub>2</sub>max (VO<sub>2</sub>max =  $4.55 \pm 0.53$  L.min<sup>-1</sup>) and then performed a 1500-m time trial for familiarisation. On two occasions, subjects arrived at 07:00 after an overnight fast and were randomly assigned to ingest either 70 ml of beetroot juice concentrate or a denitrated beetroot juice placebo (nitrate: 4.8 mmol vs <0.005 mmol; James White Drinks Ltd). Resting blood pressure was monitored during the next 150 min before subjects completed 20 min of rowing (0-10min: work rate of 10% below LT; 5 min rest; 10-20 min: work rate of 10% above LT) and then performed a 1500m time trial on a rowing ergometer (Model E, Concept 2, Nottingham, UK). All trials were separated by at least 7-days and data analysed using repeated measures ANOVA. Results Beetroot juice supplementation did not show any effect on oxygen consumption at LT-10% ( $3.30 \pm 0.26$  L/min) and at LT+10% ( $3.82 \pm 0.12$  L/min) compared with placebo ( $3.26 \pm 0.24$  and  $3.87 \pm 0.11$  L/min, respectively). Time to completion of the 1500 m was also not affected by beetroot juice ( $306.1 \pm 5.6$  s) compared with placebo ( $306.6 \pm 5.3$  s). No significant changes were observed in systolic and diastolic blood pressure after beetroot juice ingestion compared with placebo. Discussion This study suggests that the ingestion of beetroot juice containing 4.8 mmol of nitrate, 150 min before exercise does not improve oxygen economy or 1500-m time trial performance in moderately trained rowers. References Lansley KE, Winyard PG, Fulford J, Vanhatalo A, Bailey SJ, Blackwell JR, Dimenna FJ, Gilchrist M, Benjamin N, Jones AM. (2011a). *Journal of Applied Physiology*, 110, 591-600. Lansley KE, Winyard PG, Bailey SJ, Vanhatalo A, Wilkerson DP, Blackwell JR, Gilchrist M, Benjamin N, Jones AM. (2011b). *Medicine and Science in Sports and Exercise*, 43, 1125-1131.

## THE EFFECT INGESTION OF CARBOHYDRATE AND CAFFEINE ON ENDURANCE EXERCISE PERFORMANCE IN HYPOXIA ENVIRONMENT

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1: *NCHU (Taichung, Taiwan)*, 2: *NTUPES (Taichung, Taiwan)*, 3: *TPEC (Taipei, Taiwan)*

Introduction Ingestion of carbohydrate may significantly increase the exogenous carbohydrate oxidation rate and delay muscle glycogen depletion during exercise. Intake of caffeine, on the other hand, increases the rate of fat oxidation during exercise, and which may reduce the demand of muscle glycogen during endurance exercise, thus to delay the onset fatigue. Hypoxic environment, however, may lower the rate of fat oxidation. The current study was to examine the effect of carbohydrate and caffeine supplementation on endurance exercise performance in hypoxic environment. Methods Eight healthy young males completed 4 experimental trials: caffeine (6mg/kg)(C), glucose (1g/kg)(G), caffeine (6mg/kg) plus glucose (1g/kg)(C+G) and placebo (P) trials, in a double-blind, cross-over design. Subjects consumed the drinks 60min before exercising on a cycle ergometer in the 15%O<sub>2</sub> hypoxia chamber. Subjects were asked to exercise at 50% W<sub>max</sub> for 90min and followed by 85%W<sub>max</sub> to exhaustion. The blood samples were collected during fasting, pre-exercise, every 30 minute throughout the experiment, and immediately after exhaustion. Results The C, G, and C+G trials showed significantly better endurance performance (C:  $433.8 \pm 85.1$  sec; G:  $377.9 \pm 100.0$  sec; C+G:  $479 \pm 110.3$  sec) than P trial ( $245.5 \pm 60.4$  sec) ( $p < 0.05$ ). Plasma free fatty acid and plasma glycerol concentrations were higher in C and P trials than in G and C+G trials ( $p < 0.05$ ). Estimated rate of fat oxidation were higher in C and P trials than in G and C+G trials ( $p < 0.05$ ). There were no significant differences in plasma glucose concentration, and rating of perceived exertion between trials. Discussion Ingestion of caffeine, glucose, or caffeine+glucose 60min before exercise was found to improve endurance performance in an acute hypoxia environment, which was similar to the normoxia condition (Desbrow et al., 2012). The ingestion of caffeine showed significantly increase in plasma concentrations of free fatty acid and glycerol during exercise. The increased rate of fat oxidation in the C trial might contribute to the ergogenic effect on endurance performance (Ivy et al., 2009). References Desbrow B, Biddulph C, Devlin B, Grant GD, Anoopkumar-Dukie S & Leveritt MD (2012). *J Sports Sci*, 30(2), 115-120. Ivy JL, Kammer L, Ding Z, Wang B, Bernard JR, Liao YH, Hwang J. (2009). *Int J Sport Nutr Exerc Metab*, 19(1), 61-78. Katayama K, Goto K, Ishida K, Ogita F. (2010). *Metabolism*, 59(7), 959-966.

## EFFECT OF CHRONIC SUPPLEMENTATION WITH L-ARGININE ON THE EXPRESSION OF PROTEINS THAT REGULATE MUSCLE PROTEIN SYNTHESIS IN RATS TRAINED IN HIGH-INTENSITY EXERCISE.

Gomes, M.R., Bonvini, A., Tirapegui, J.

*University of São Paulo*

**Introduction** The arginine is an amino acid conditionally essential that participates in innumerable metabolic reactions like the urea cycle, the synthesis of creatine and production of nitric oxide. Besides those functions, arginine is associated most recently with muscle protein synthesis. Therefore the aim of this study was to investigate the effect of L-arginine chronic supplementation on the muscle protein synthesis, through mTOR pathway. **Methods** Wistar male adult rats were distributed into four groups: Trained-Arginine, sedentary-Arginine, Trained Diet-Control and Sedentary Diet-control. Both diets were elaborated based on the AIN-93 recommendations, considering that the enriched diet with arginine was added 2% of that amino acid. The animals training consisted of anaerobic exercise with ten-jump four series in a PVC cube filled with water to the level of 150% of the animal's body length. The jumps were performed with a load of 50% of the animals' body weight attached in its trunk, five days a week over six weeks. In the end of experiment, each animal were anesthetized to collect muscles, before and after an iv administration of insulin. The molecular analysis of the Akt-1, mTOR, 4E-BP1 and p70S6K were performed by western blotting method for its total and phosphorylated form. Data comparison was made using one-way ANOVA. **Results** There was neither increase in Akt-1, mTOR, 4E-BP1 and p70S6K content ( $p < 0,05$ ) nor in their phosphorylation ( $p < 0,05$ ) of both trained and sedentary rats. **Discussion** The present study demonstrated that arginine had no effect on the expression of proteins involved in the regulation of muscle protein synthesis in rats, against some studies in the literature. Yan et al (2008) found increased expression of mTOR supplementation with 0,6% arginine in the diet of pigs for 7 days. Studies using cultured cells showed increased expression of mTOR when cells were incubated with arginine (Kong et al 2012). The ineffectiveness of the arginine supplementation observed in this study may be explained by the fact that in vivo, this amino acid can be degraded easily, because according Dioguardi (2011) arginine supplementation increases progressively arginase activity that leads to the idea that the more arginine is supplemented more arginine is degraded. **Conclusion** There hasn't been any increase in the muscle protein synthesis through mTOR pathway with arginine supplementation in these experimental conditions. **References** Yao K, Yin Yi, Chu W, Liu Z, Deng D, Li T, Huang R, Zhang J, Tan B, Wang W, Wu G (2008). *J Nutr*, 138, 867-872. Kong X, Tan B, Yin Y, Gao H, Li X, Jaeger LA, Bazer FW, Wu G (2012). *J Nutr Biochem*, 23, 1178-83. Dioguardi F (2011). *J Cachexia Sarcopenia Muscle*, 2, 75-80.

## THE EFFECT OF DIETARY NITRATE SUPPLEMENTATION ON CYCLING AND RUNNING PERFORMANCE AND SUBMAXIMAL OXYGEN UPTAKE IN WELL-TRAINED TRIATHLETES.

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Dietary nitrate (NO<sub>3</sub>-) supplementation has been reported to improve physiological and performance responses during submaximal and high-intensity exercise in both cycling and running exercise modalities. High-intensity exercise adaptations include an increased endurance capacity during cycling time to exhaustion (TTE) trials, adaptations that have been subsequently demonstrated to have a performance enhancing effect in applied cycling laboratory performance tests (Lansley et al. 2011). Limited research exists concerning the effect of NO<sub>3</sub>- supplementation on high-intensity running. The aim of this study was to assess the effect of dietary NO<sub>3</sub>- supplementation on both cycling and running performance in well-trained triathletes. Eleven male triathletes (mean  $\pm$  SD, age 28  $\pm$  9 yr, height 180  $\pm$  7 cm, body mass 73  $\pm$  9 kg, V O<sub>2</sub>peak 64  $\pm$  9 ml  $\cdot$  kg<sup>-1</sup>  $\cdot$  min<sup>-1</sup>) were assigned in a randomised, double-blind, crossover design, following control tests, to receive 6 d supplementation with either dietary NO<sub>3</sub>- (BR; 70 ml  $\cdot$  d<sup>-1</sup> organic beetroot juice containing  $\sim$ 5.0 mM NO<sub>3</sub>-) or placebo (PL; 70 ml  $\cdot$  d<sup>-1</sup> organic NO<sub>3</sub>- depleted beetroot juice containing  $\sim$ 0.04 mM NO<sub>3</sub>-) with a 10 d washout. Following familiarisation tests, subjects performed identical main tests on day four and six of each supplemental condition. Day 4 consisted of measurement of submaximal cycling VO<sub>2</sub> and a 25 minute cycling performance trial. Day 6 included measurement of resting blood pressure (BP), submaximal running VO<sub>2</sub> and a 5 km running time trial. NO<sub>3</sub>- supplementation reduced resting SBP by 6% (BR: 117  $\pm$  10 vs. PL: 124  $\pm$  12 mmHg), DBP by 10% (BR: 57  $\pm$  8 vs. PL: 63  $\pm$  7 mmHg) and MAP by 7% (BR: 77  $\pm$  8 vs. PL: 83  $\pm$  9 mmHg) with a 20% reduction in plasma [aldosterone] (PL: 196  $\pm$  69 vs. 156  $\pm$  59 pmol  $\cdot$  l<sup>-1</sup>). Submaximal cycling and running VO<sub>2</sub> values were not significantly reduced in the BR condition. A non-significant 1.7% improvement in mean power output during the 25 min cycling performance trial was observed during NO<sub>3</sub>- supplementation (PL: 296  $\pm$  35 vs. BR: 301  $\pm$  35 W) along with a non-significant 0.8% improvement in 5 km running TT performance (BR: 1117  $\pm$  104 vs. PL: 1126  $\pm$  104 s). In this study dietary NO<sub>3</sub>- does not offer an ergogenic benefit, however there was considerable response heterogeneity. Importantly no adverse side effects were reported by any of the subjects. Future research exploring the variation in individual response to dietary NO<sub>3</sub>- and a secondary evaluation of the observed absent submaximal VO<sub>2</sub> response in a trained triathlete population would progress the literature. Lansley KE, Winyard PG, Bailey SJ, Vanhatalo A, Wilkerson DP, Blackwell JR, Gilchrist M, Benjamin N and Jones AM. (2011b). *Med Sci Sports Exerc*, 43 (6), 1125-1131.

## THE RELATIONSHIP BETWEEN LACTATE THRESHOLD AND LACTATE DEHYDROGENASE ACCORDING TO MCT1 GENETIC POLYMORPHISM

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Lactate transport and Lactate dehydrogenase activity seem to have a triphasic nature. The relationship among them are still rather complex and require a framework for their analysis. Both lactate influx into or efflux out of muscles depend on the required balance between oxidative metabolism and glycolysis. During exercise (> 80% of VO<sub>2</sub> max) the rate of glycolysis increases several fold and causes a progressive accumulation of lactate in muscle and blood reach to higher steady state levels until fatigue ensues. Therefore, we performed this study to analyze any relationship between lactate Threshold (LT) accumulation and Lactate dehydrogenase (LDH) on one side and MCT1 gene polymorphism on the other side. Three different tests were carried out prior to and after a training period of 12 weeks. The first two test consisted of 5 min running at five different velocities (9 km/h, 10.8 km/h, 12.6 km/h, 14.4 km/h) respectively. LT and LDH were measured immediately after each exercise by Spectrophotometer and Accusport devices. Genomic DNA were extracted from whole blood samples drawn using commercially available kits by High Resolution Melts Strategy. The quantitative PCRs were performed using the appropriate QPCR mix and Thermal Cycler machine. Two polymorphism were found; AA and, TT genotypes in 2 cases (18.2%) and 9 cases (81.8%) respectively. Before the training period there is no difference between groups in LT and LDH values. After the training

period the mean LT and LDH values for TT genotypes were significantly higher than those in AA genotypes (with a significant  $P=0.05$ ) (1.85 mM/L, 301.5 IU/L) and (6.51 mM/L, 346.11 IU/L) for the AA, TT genotypes respectively. The higher accumulation for LT and LDH observed in TT genotypes is not dependent on the type of effort but could be caused by increase in NADH/NAD caused by a reduced rate of oxidative phosphorylation from inadequate O<sub>2</sub> levels, with a consequence of impaired function of MCT1, which would lead to impaired lactate transporter into the less active muscle cells for oxidation, thus increasing blood lactate concentration that could explain the increased muscle fatigue.

### **LACK OF ANDROGENS ENHANCES ENDURANCE TRAINING-INDUCED ADAPTATIONS: POSSIBLE INHIBITORY ROLE OF ANDROGENS ON ENDURANCE**

Hamasaki, M., Okamoto, M., Koshiro, I., Lee, M., Soya, H.

*University of Tsukuba*

Introduction High-volume exercise training such as marathons leads to hypogonadism, or low gonadal hormone levels in the blood (Cumming et al, 1989). However, the physiological significance of this and its influences on performance are unclear, especially in male endurance athletes. Intriguingly, intramuscular injections of anabolic steroids into rats caused inhibition of exercise-induced angiogenesis in the soleus muscle (Soares et al, 1991). Additionally, in orchidectomized (ORX) rats, the citrate synthase (CS) activity of the soleus increased with 2 weeks of treadmill running (unpublished data). This leads the hypothesis that a low blood androgen level in male endurance athletes is a compensatory action to enhance endurance performance, although this has yet to be determined. To address this issue, we examined how adaptive changes with endurance training would alter in ORX rats. Methods Twenty-nine male Wistar rats (12 weeks old) were divided into two groups: (1) the sham group, in which a skin incision was made and sutured ( $n=14$ ), and (2) the ORX group, in which the rats were submitted to a bilateral orchidectomy ( $n=15$ ). After the surgery and recovery period, all rats trained for 2 weeks at treadmill running (30 min/day). After 2 weeks of running training, seven rats from each group were anaesthetized to evaluate the effects of orchidectomy on muscle adaptation to exercise. The endurance of the remaining rats was measured using a treadmill that analyzes expired gas during exercise. They ran to fatigue at 20 m/min<sup>-1</sup> with no incline. Total time to fatigue (TTF), running economy (RE) and heat production (HP) during running, which are considered indices of endurance performance, were measured. Blood was taken from the heart to determine plasma testosterone or free fatty acid (FFA) concentration, and tissues were collected rapidly from the seminal vesicle, prostate, and soleus (SOL) and plantaris (PL) muscles. Results and Discussion The ORX group had a lower plasma testosterone levels, seminal vesicle and prostate, indicating that the ORX group had appropriately removed testes. After 2 weeks of running training, there were no significant differences in plasma FFA levels or SOL and PL glycogen levels between ORX and sham groups. However, CS activity of the SOL, which are accounted for slow-switch-muscle of 90% and makes a major contribution to endurance performance, significantly increased in the ORX group. TTF also increased, while HP decreased in the ORX group; there were no effects on RE. Thus, ORX enhances endurance performance, probably by minimizing net energy loss, suggesting a possible inhibitory role of androgens in the development of endurance training-induced adaptation in male endurance athletes. Reference Cumming DC, Wheeler GD, McCol EM. (1989). *Sports Med*, 7, 1-17. Tagarakis CV, Bloch W, Hartmann G, Hollmann W, Addicks K. (2000). *Med Sci Sports Exerc*, 32, 946-953.

## **14:00 - 15:00**

### **Mini-Orals**

#### **PP-PM57 Sports Medicine [SM] 1**

### **EXOGENOUS SUBSTANCES USE : TENDANCIES IN TUNISIAN PROFESSIONAL FOOTBALL**

Kouki Chaouachi, H.

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Medical frame has an essential role in the athlete life particularly in team sports where the effect of the group can turn out sometimes more important with regard to the use of all types of exogenous substances (ES). For that purpose, this study examined the tendencies of the ES use among professional Tunisian football players of first (L1) and second league (L2) throughout quantitative and qualitative analysis of FIFA 01-forms recommended to list every match the ES declared taken by each player. In Tunisian professional football with its two levels, during the season 2009-2010, the general rate of ES use was 0.797/player/match. In spite of an aspect rather close of the fluctuation curves during the season, this rate present a highly significant disproportion between L1 and L2 (0.955 vs. 0.533 with no significant difference between the two competition phases either in L1 or in L2. In 2009-2010, qualitative analysis of ES administrations in both leagues demonstrated that vitamins and dietary supplements are the most administered (36.6 %) followed by anti-inflammatory drugs in particular antirheumatics, analgesics, myorelaxants and antibiotics. Crossed comparisons showed that this classification is not significantly affected either as per league (L1 or L2) or as per competition phase. However, the use rates of these classes are significantly higher in L1 than in L2 apart from analgesics. This study raised an ES use rate quite high in professional national championship even it remains, by far fewer than during the National Cup final match (2SE/player). Furthermore, it was noticed that the practice of massive ES administrations to the whole team is very widespread particularly for dietary supplements and vitamins. Moreover, very rare are the teams whose 01-form is blank and the football players with zero ES/match vs. a high number of players using more than 3ES/match. The major recommendation standing out from this study is the imminent need to rationalize medication in Tunisian professional football to avoid players any potential risk of doping (corticoids, morphinic analgesics) or health (antirheumatics). Medical framers will have to privilege therapies with minor risk like homeopathy to avoid the massive and repetitive ES administrations; even dietary supplements mustn't be presented in 'open-buffer' mode but rather tightened to the real sanitary and nutritional needs of every player who has to help by rejecting auto therapy and prescribed ES overdose.

## **SKELETAL MUSCLE CAPILLARY DENSITY AND MICROVASCULAR FUNCTION ARE COMPROMISED WITH AGING AND TYPE 2 DIABETES**

Groen, B., Hamer, H., van Kranenburg, J., Frijns, D., Vink, H., van Loon, L.  
*Maastricht University*

Departments of (1) Human Movement Sciences, NUTRIM School for Nutrition, Toxicology and Metabolism and (2) Physiology, CARIM School for cardiovascular disease, Maastricht University Medical Centre+ (MUMC+), The Netherlands. Introduction Adequate muscle perfusion is a requirement for the proper maintenance of skeletal muscle mass. Impairments in microvascular structure and/or function with aging and type 2 diabetes have been associated with the progressive loss of skeletal muscle mass. The objective of this study was to compare muscle fibre type specific capillary density and endothelial function (i.e. endothelial glycocalyx) between healthy young males, healthy older men, and age-matched older type 2 diabetes patients. Methods 15 healthy young men (24±1 y), 15 healthy older men (70±2 y), and 15 type 2 diabetes patients (69±1 y) were selected to participate in the present study. Whole-body insulin sensitivity (oral glucose tolerance test), muscle fibre type specific capillary density (muscle biopsy), sublingual microvascular density and endothelial thickness (sidestream darkfield imaging) were assessed to evaluate the impact of aging and type 2 diabetes on microvascular structure and function. Results Whole body insulin sensitivity was significantly lower at a more advanced age, with lowest values reported in the type 2 diabetic patients (OGIS: 443±13, 364±14, 291±10 in the young, older and older type 2 diabetic group, respectively; P<0.05). In line, skeletal mixed muscle capillary-to-fibre-ratio was much lower in the older and older type 2 diabetic patients when compared with the young (1.85±0.07, 1.55±0.06 and 1.41±0.10 in the young, older and older type 2 diabetic group, respectively; P<0.05). Sidestream darkfield imaging showed a significantly greater glycocalyx thickness in the type 2 diabetic patients compared with the young (1.89±0.07, 2.06±0.07, 2.26±0.12 µm in the young, older, and older type 2 diabetic group, respectively; P<0.05). Discussion Skeletal muscle capillary density is reduced with aging and type 2 diabetes and accompanied by a greater endothelial glycocalyx thickness, which is representative of a compromised functional capacity of the microvasculature. Skeletal muscle characteristics, capillary density, and microvascular function are compromised with aging and type 2 diabetes.

## **ANTHROPOMETRY AND LIFESTYLE CHARACTERISTICS OF ENGLISH COMMUNITY LEVEL RUGBY UNION PLAYERS**

Perkin, O.J., Roberts, S., Trewartha, G., England, M., Stokes, K.A.  
*University of Bath*

Introduction English community level rugby union represents the largest rugby playing population globally; however descriptive information for this group is sparse. This study provides basic anthropometric and lifestyle data from community level rugby players, with a comparison of these characteristics with the general public and across playing levels. Methods Medical staff at 102 rugby clubs disseminated self-report questionnaires to all 1st team squad players at the start of the 2012/13 season. Information was collected on height, body mass, age, smoking and drinking (AUDIT-C) status. Playing levels were divided into three groups for analysis: group A (RFU levels 3 and 4; semi-professional), group B (RFU levels 5 and 6; amateur), and group C (RFU levels 7 to 9; recreational). Anthropometric data were analysed by one-way ANOVA and Bonferroni post hoc with significance accepted at p<0.05. Results Data from 715 rugby players (Group A; 111, B; 249, C; 355) who completed the questionnaire were analysed, representing 39 clubs. Mean values were reported for height [mean (SD) 182 (7) cm], mass [94.1 (13.3) kg], BMI [28.3 (3.6) kg/m<sup>2</sup>], and age [25.2 (5.2) years]. No between group differences were reported in height. Group A and B reported greater mass than C; 98.0 (13.7) and 95.0 (12.7) vs. 92.3 (13.3) kg respectively. Group A reported higher BMI than C; 29.1 (3.3) vs. 27.9 (3.8) kg/m<sup>2</sup>, with group B not differing significantly from either. Group C reported being older than B [25.7 (5.9) vs. 24.3 (4.23) years]. 85% of players AUDIT-C scores indicated 'higher risk drinking habits', whilst 10% of players reported current regular smoking; 2, 8, and 14% for groups A, B, and C respectively. Discussion Community level rugby players who completed a lifestyle questionnaire reported greater height and mass than the age-matched (16-44 years) male general public in England (182 vs. 177cm, 94.1 vs. 81.3 kg, 28.3 vs. 25.9 kg/m<sup>2</sup>) (Health Survey for England (HSE 2011)). Higher level players reported greater body mass, which may reflect more focus on physical conditioning and benefits of greater body mass in the contact elements of rugby. Whilst current regular cigarette smoking was 13% lower than the 23% observed in the HSE (2011), the amount of AUDIT-C scores >5 may indicate increased risk of alcohol related health contraindications within community level rugby players. The self-report nature of the questionnaires may have introduced a bias in the results as may playing position bias in the sample. Even so, these data suggest that community level rugby players' physical characteristics and smoking habits are not typical of the general public. References Sutton (2012). Health Survey for England 2011 Vol1:Chapter10 Acknowledgement Funded by the Rugby Football Union

## **THE EPIDEMIOLOGY OF CONCUSSION IN ELITE RUGBY UNION PLAYERS: AN 8-SEASON REVIEW**

Cross, M.J., Trewartha, G., Williams, S., Kemp, S.P.T., Stokes, K.A.  
*University of Bath*

INTRODUCTION Estimates suggest that 1.6-3.8 million sports-related concussions occur annually (Langlois et al., 2006). Within the most recent season of the English rugby union Premiership, concussion was reported as the most common time loss injury from matches. Loss of consciousness (LOC) may only occur in 10% of concussions (Harmon et al., 2013) often making concussion difficult to diagnose. Repeated exposure to head contacts and recurrent concussive events are of particular concern due to the possible risk of long-term cognitive impairment. METHODS This study was based on data collected by the RFU English Professional Rugby Union Injury Surveillance Project (n=1752 participants) from 2002 - 2011. Medical staff at each club reported injury episodes weekly using an injury report form that detailed specific fields about each injury and a final diagnosis using the Orchard sports injury classification system. Following a concussion, athletes were monitored clinically according to each individual clubs' best practice guidelines. RESULTS A total of 379 concussions were recorded. Of these 95% occurred in match play and 5% occurred in training. The overall incidence of match concussions was 4.4 injuries/1000 player hours (95% CI 4.0 to 4.9). The mean severity of a concussion across the time period was 12 days (95% CI 10 to 15) and carried a median severity of 8 days. 7% of concussions were severe (>28 days absence) with 43% resolving within 7 days. The most common injury causations were player-on-player collisions (18%) and front on tackling (15%). 9% of concussions were classified as being a recurrent injury, with recurrent concussions resulting in an average severity of 15 days (95% CI 9 to 21). DISCUSSION The incidence rate and severity observed for concussions is in keeping with previous studies that have used a similar methodology within rugby union. Although this incidence rate is similar to that of other contact sports, the magnitude of these figures are still cause for concern and emphasise the importance of continued research into the potential risk factors for concussion. 35% of concussed players returned to full training/match play more quickly than the recommended International Rugby Board (IRB) guideline of 6 days. This highlights a need for a

clearer understanding and implementation of the graduated return to play protocols post concussive injury in professional rugby union. REFERENCES Harmon K, Drezner J, Gammons M, Guskiewicz K, Halstead M, Herring S, Kutcher J, Pana A, Putukin M, Roberts W. (2013). *Br J Sports Med* 47, 15-26 Langlois J, Rutland-Brown W, Wald M. (2006). *J Head Trauma Rehabil* 21, 375-378. ACKNOWLEDGEMENT Funded by the Rugby Football Union

### LOW VOLUME HIGH INTENSITY INTERVAL AND STEADY STATE EXERCISE BOUTS ELICIT SIMILAR ALTERATIONS IN PLASMA MARKERS OF OXIDATIVE STRESS

Wadley, A.J., Fisher, J.P., Chen, Y.W., Aldred, S.

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**Introduction** The use of low volume, high intensity interval training (LV-HIIT) has attracted significant recent attention due to the diverse metabolic and physiological benefits it confers, but with a marked reduction in the required time commitment and energy cost in comparison to traditional steady state exercise. Acute increases in oxidative stress are thought to be essential in mediating post-exercise adaptations, however to date a direct comparison of the oxidative stress response to LV-HIIT and steady state exercise has not been made. This study aimed to assess the magnitude of acute oxidative change following a single bout of LV-HIIT, and compare this to two steady state exercise bouts of differing intensity. **Methods** Untrained healthy males ( $n=10$ , mean  $\pm$  SD: age  $22 \pm 3$  yrs; body mass index  $24.0 \pm 3.1$  kg/m<sup>2</sup>; maximal oxygen consumption  $42.7 \pm 5.0$  ml/kg/min-1) undertook two energy-matched steady state exercise bouts (moderate intensity: 27 min, 60% VO<sub>2</sub>MAX (MOD) and high intensity: 20 min, 80% VO<sub>2</sub>MAX (HIGH)) and a bout of LV-HIIT (10\*1 minute 90% VO<sub>2</sub>MAX intervals, interspersed with 1 minute intervals at 40% VO<sub>2</sub>MAX) on separate days. Blood samples were taken before (base), 1 minute prior to the cessation of exercise (ex) and 30 minutes following exercise. Oxidative stress was assessed by evaluation of plasma markers of protein carbonylation (PC), lipid hydroperoxides (LOOH) and total antioxidant capacity measured by ferric reducing ability of plasma (FRAP). Total peripheral blood lymphocytes (LYM) were also assessed. **Results** LYM increased during all exercise bouts ( $p < 0.05$ ), with HIGH (+140%) eliciting a significantly greater increase than both MOD (+41%) and LV-HIIT (+99%), and LV-HIIT being significantly higher than MOD. Markers of oxidative stress were significantly increased in all exercise bouts, but the magnitude of this response was not different between bouts. Increases in total antioxidant capacity during LV-HIIT (base  $953.0 \pm 171.1$  vs. ex  $1029.4 \pm 168.3$   $\mu$ M) were more similar to HIGH (base  $938 \pm 165$  vs. ex  $1031 \pm 152$ ) than MOD (base  $914 \pm 153$  vs. ex  $914 \pm 157$ ). **Discussion** These data indicate that despite a single bout of LV-HIIT eliciting a significantly greater response in lymphocytosis than MOD, LV-HIIT is not different to steady state exercise when assessing plasma markers of oxidative stress.

### INTERLEUKIN-6 AND INSULIN SENSITIVITY RESPONSES IN OBESE MEN DURING TRAINING AND DETRAINING

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**Introduction:** Obesity is associated with insulin resistance. Adipocytes release a variety of adipocytokines including interleukin-6 (IL-6). This study aimed to investigate to responses of IL-6 and insulin resistance in healthy middle-aged obese men after exercise training and detraining. **Methods:** Thirty-four healthy obese men were selected on a random basis for non-linear resistance (non-RT,  $n=12$ ), aerobic interval training (AIT,  $n= 12$ ) and a control group ( $n= 10$ ). At baseline, after 12-week of training and after 4-week of detraining, Blood samples were taken in fasting state from all subjects. The experimental groups performed three weekly sessions for 12 weeks, followed by a 4-week detraining period. Non-RT consisted of weight training at five different intensities with emphasis on muscular endurance. AIT consisted of running on a treadmill, four times 4 min at 80-90% of maximal heart rate, with a 3 min jog in between. **Results:** Serum IL-6 did not change significantly after 12 weeks of non-RT and AIT. However, after 4 weeks of detraining, a significant increase was found in this cytokine for the experimental groups. Both Non-RT and AIT resulted in a significant decrease in the insulin resistance. However, these improvements did not return into baseline level after detraining. The body fat percentage, waist circumference and VO<sub>2</sub>max were improved significantly after training and returned to baseline level after detraining. There were no significant correlations between serum IL-6 and body fat percentage, waist circumference, insulin resistance and VO<sub>2</sub>max at baseline, similarly alterations in responses to training and detraining were not significantly correlated. **Discussion:** Non-RT and AIT caused an improvement in insulin sensitivity in healthy obese men, but this improvement was not accompanied by decreased in IL-6. After exercise training, IL-6 remained unchanged, is similar to finding reported by previous studies (Donges et al., 2010; Libardi et al., 2012). Moreover, baseline IL-6 levels was similar to those observed in healthy subjects. Interestingly, serum IL-6 levels increased significantly in the non-RT (2.95 to 6.90 pg.mL<sup>-1</sup>) and AIT (2.65 to 6.50 pg.mL<sup>-1</sup>) groups after 4-week of detraining. Subcutaneous adipose tissue produces IL-6 at rest. There was considerable drop in glucose concentrations during the detraining period in experimental groups. The possible mechanism is that, increased IL-6 may be due to a sudden increase in body fat percentage and waist circumference and substantial drop in serum glucose. It is suggested that the regular exercise training should not be abruptly cut in active obese men. **References:** Donges CE, Duffield R, Drinkwater EJ. (2010). *Med Sci Sports Exerc*, 42(2), 304-313. Libardi CA, De Souza GV, Cavaglieri CR, Madruga VA, Chacon-Mikahil MP. (2012). *Med Sci Sports Exerc*, 44, 50-56.

### METABOLOMICS OF SALIVARY FATIGUE MARKERS AFTER 3 CONSECUTIVE DAYS OF SOCCER GAME IN MALE SOCCER PLAYERS

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**Introduction** Strenuous and consecutive exercise leads to fatigue symptoms and performance decline in athletes. Metabolomics is a comprehensive method to assess metabolite that involves the measurements of the overall metabolic signature of biological samples. **Purpose** The aim of this study was to examine of novel salivary fatigue markers by metabolomics after short consecutive days of game in soccer players. **Methods** One hundred twenty-two male soccer players participated in 3 consecutive days of soccer game program. To detect fatigued athletes, we measured indices of traditional fatigue symptoms, i.e., heart rate (HR), body weight (BW) and psychological status, before and after program, and setting the cut-off value as follows: increase in awakening HR (5 beats/min) (1), decrease in BW (2.25 kg) (2), and increase in the fatigue score (5 score) and decrease in the vigor score (5 score) in psychological test (1). Finally, we detected 37 fatigued players and their saliva was analyzed using metabolomics. **Results** Metabolomics identified 144 metabolites from the saliva of fatigued players, and some metabolites were significantly changed after the soccer game program. Interestingly, metabolites

that has been confirmed significant differences were all increased in after program ( $p < 0.001$ ). The identified metabolites were including 3-methylhistidine (3-MHis), glucose 1 and 6-phosphate (G-1-P, G-6-P), taurine, alanine (Ala) and branched-chain amino acids (valine, isoleucine, leucine: BCAA) and aromatic amino acids (phenylalanine, tyrosine, tryptophan: AAA). Discussion To our knowledge, this is the first study to identify salivary fatigue markers in soccer players after short consecutive game program. Activating protein broke down in the body, the 3M-His increases in the blood (3). Similarly, it has been reported that taurine is released in the blood from muscles during exercise (4). Moreover, G-1-P, G-6-P and Ala play an important role of glucose metabolism, and BCAA and AAA were precursors of intermediate metabolites of the TCA cycle. We inferred that increasing 3-MHis and taurine were result of exercise loads, and G-1-P, G-6-P, Ala, BCAA and AAA were increased in order to recovery the physiological conditions. Conclusion We concluded that some soccer players develop fatigue symptoms after short consecutive days of soccer game and energy related metabolites were increased in saliva in fatigued athletes. We propose that the detected salivary metabolites may be new fatigue markers in athletes. References 1. Koutedakis et al. (1990). *Br J Sports Med.* 24(4):248-52. 2. Budgett. (1998). *Br J Sports Med.* 32(2):107-10. 3. Nagasawa et al. (1998). *Biosci Biotechnol Biochem.* 62(10):1932-7. 4. Cuisinier et al. (2002). *Eur J Appl Physiol.* 87(6):489-95.

### DIFFERENT INDIVIDUAL RESPONSES OF THE HYPOTHALAMIC-PITUITARY GONADAL AXIS AFTER INTRANASAL LH-RH APPLICATION IN HEALTHY MEN

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1Department of Sports Medicine and Sports Nutrition, Faculty of Sport Science, Ruhr-University Bochum 2Center for Preventive Doping Research and Institute of Biochemistry, German Sport University Cologne Introduction During the last years the misuse of intranasal luteinizing hormone-releasing hormone (LH-RH) in elite sports has frequently been reported and is not detectable in anti-doping analysis so far. It is not clear how the application of external LH-RH influences the integrity of the internal hypothalamo-pituitary-gonadal axis (HPGA) in healthy adults. One aim of the study was to analyse the hormonal response of the HPGA after intranasal LH-RH application in healthy men. Methods 10 healthy moderately trained male students (22.8±1.7 yrs, 179.6±6.0 cm, 77.6±7.0 kg) were investigated 2 days before (d-2) a 7 day-period of intranasal LH-RH application (every 1.5 hrs from 7am-10pm (in total 4.4 mg/day)), as well as during the 1st (d1) and 7th (d7) day of intranasal LH-RH application. On these days, we analysed serum concentrations of total testosterone (T), free testosterone (fT), luteinizing hormone (LH) and follicle stimulating hormone (FSH) in early morning blood samples. Results T increased during the intranasal LH-RH application period from d-2 to d1 and d7 ( $p < 0.05$  and  $p = 0.08$ ; 5.5±2.1, 7.4±2.5, 9.2±3.8 ng/ml, respectively). Inter-individually, the difference of T varied between 5% and 113% (mean 37%) for d1 towards d-2, and between -6% and 294% (mean 78%) for d7 towards d-2. fT remained unchanged on d1 and increased significantly on d7 ( $p < 0.01$ ); 10.6±3.2, 14.1±6.8, 16.3±5.8 pg/ml, respectively). Inter-individual increase of fT differed between 12% and 107% (mean: 56%). LH increased from d-2 to d1 and d7 ( $p < 0.05$  and  $p = 0.09$ ; 5.1±2.5, 19.2±11.5, 8.3±2.4, mU/ml, respectively). Inter-individually the difference of LH varied between 16% and 664% (mean 313%) on d1 towards d-2, and between -21% and 246% (mean 93%) for d7 towards d-2, respectively. FSH remained unchanged over time in the whole group (5.1±7.0, 8.6±11.9, 4.4±4.5 mU/ml, respectively) and showed remarkable inter-individual variations (d1: increase between 5% and 132% (mean 68%); d7: decline or increase of -33% and 59% (mean 4%), respectively). Discussion Before the study, the effect of intranasal LH-RH application on endogenous hormone serum concentrations in healthy young men was unclear. The results of the study showed large variations in the individual reaction on exogenous LH-RH administration. The observed effects suppose the existence of responders and non-responders. In context of routine doping controls the results favor individual interpretation of hormone values and individual longitudinal data like a blood passport for athletes. Acknowledgement This project has been carried out with the support of WADA.

### ENTRY PHASE ALIGNMENT IN MEN'S BACKWARD DIVE PIKE <2018> FROM 3 M SPRINGBOARD DIVES

Takaya, N., Kaji, K., Yoshiro, S., Takamichi, N.

*Health Science University*

During competitive diving events, divers jump up from 1 - 3 m springboards or 5 - 10 m platforms and dive into the water. The impact forces are very large in the water entry phase, and therefore, the divers experience a lot of physical stress. Our previous study showed that there was high prevalence of low back pain (LBP) in elite junior divers and shoulder flexibility and age were related to low back pain among the male junior divers. In this study, we aimed to investigate the influence of the shoulder angle on the entry alignment and compare the differences in entry phase alignment between the divers in the LBP divers groups and no-LBP divers groups. We included 13 male elite junior Japanese divers. The entry phase was filmed laterally by using high-speed camera (shutter speed: 1 / 200 seconds). The shoulder and trunk, hip angles data for the entry phase (5 frames) were derived from the digitized film. The LBP experienced by divers were assessed via questionnaires during national training camps. The relevance of the shoulder, trunk, and hip angles was examined using the Pearson product-moment correlation coefficient. We divided the divers in 2 groups on the basis of LBP status. An intergroup comparison was carried out using Mann-Whitney's U test on the basis of entry phase alignment. Negative correlation ( $r = -0.623$ ) was observed in the shoulder flexion angle and trunk extension angle for the entry phase. Four of 13 male divers experienced LBP. The trunk angle showed a significant difference between the LBP groups (210.4 ± 5.7°) and no-LBP groups (199.9 ± 9.0°). Our results suggested that shoulder flexibility is important to prevent LBP in the elite male junior divers, because divers require full shoulder flexion in the water entry phase. Limited shoulder flexibility could cause lumbar hyperextension when adjusting the angle of water entry. The major findings of this study were as follows: (1) shoulder flexion angle was related to trunk extension angle for the entry phase; and (2) the LBP group has a larger trunk extension angle than the no-LBP groups.

### TOE DEFORMITY, PHYSICAL PERFORMANCE AND POSTURAL SWAY IN OLDER ADULTS USING A 3D FOOT SCANNER

Saghazadeh, M., Tsunoda, K., Kitano, N., Okura, T.

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Introduction Hallux valgus (HV), a lateral deviation of the big toe away from the midline of the body, is toe deformity prevalent in older adults which contributes to falls in this age group (Mickle et al., 2009). However, toe deformities have been generally poorly defined in balance and physical performance studies and are often coded as a single variable (i.e. present or absent) or clustered together with other pathologies and labeled 'lower extremity problems' (Menz and Lord, 1999). Therefore, the purpose of this study was to determine whether the degree of HV correlates with physical performance and postural sway in older adults using a 3D foot scanner. Methods This

cross-sectional study included 259 community-dwelling older adults ( $74.2 \pm 5.3$  years) recruited in Kasama City, Japan. Physical performance was assessed using: (1) timed-up-and-go (TUG), (2) standing time from long sitting position, (3) habitual walk and (4) choice reaction time. Postural sway variables were measured by force plate. In this study, right foot HV was measured by a 3D foot scanner machine in sitting and standing positions. Results After adjusting for potential confounders, Pearson's correlation analysis revealed significant correlations between HV and all physical performance measures in woman in both sitting and standing positions, respectively [(1:  $r = 0.258, 0.212$ ), (2:  $r = 0.251, 0.276$ ), (3:  $r = 0.259, 0.216$ ), (4:  $r = 0.196, 0.189$ )]. However, in men, HV correlated significantly only with habitual walk ( $r = 0.181, 0.171$ ). Absolute X distance ( $r = 0.220$ , sit;  $0.189$ , stand) and area ( $r = 0.213$  just sitting) from postural sway items correlated significantly with HV in women in both sitting and standing positions ( $P < 0.05$ ). Discussion Our results indicate that the degree of HV is an important determinant of physical performance and postural sway in older people, especially women. These results possibly occurred because toe deformities alter the weight bearing function of the toes, and, consequently, individuals cannot effectively exert pressure on the ground. Therefore, reduced sensory input from a deformed toe may lead to reduced mechanical stability, which, in turn, affects stability during the weight bearing and push phases of gait (Mickle et al., 2009). Further research is required to clarify whether therapeutic interventions by foot care specialists may improve balance in older people and decrease risk of falls. References MENZ, H. B. & LORD, S. R. (1999) Foot problems, Functional impairment, and falls in older people. *J AM Podiatr Med Assoc*, 89, 458-467. MICKLE, K. J., MUNRO, B. J., LORD, S. R., MENZ, H. B. & STEELE, J. R. (2009) Toe weakness and deformity increase the risk of falls in older people. *Clinical Biomechanics*, 24, 787-791.

### IMPROVING POSTURAL CONTROL IN RESPONSE TO A 4-WEEK BALANCE TRAINING WITH PARTIAL WEIGHT-BEARING

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Introduction Balance training (BAL) improves postural skills, reduces the incidence of limb injuries and, as a consequence, is successfully implemented in therapy as a countermeasure against many postural dysfunctions (Taube et al. 2008). It is well known that improved postural control in response to BAL is associated with decreased cocontraction of antagonist muscles concomitant with a reduction in spinal excitability (Taube et al. 2008, Nagai et al. 2012). In patients suffering from motor impairments or reduced mobility, BAL with partial weight-bearing (PWB) might be the only approach for therapy. However, PWB during BAL must not necessarily address similar functional and neuromuscular adaptations. Therefore, this study aims to compare the effects of a 4-week BAL intervention with PWB on postural control with BAL under full bodyweight (BW). Methods 32 subjects were randomly assigned to a BT group (full BW) or a BTP group (PWB equal to 40% of the BW). The intervention consisted of a supervised visual feedback-based BAL that addressed dynamic stabilization in mono- and bipedal stance. PWB was applied by means of a harness attached to a ceiling-mounted height-adjustable system. Before and after training, centre of pressure (COP) displacement and electromyographic activity of the soleus (SOL), gastrocnemius medialis (GM), tibialis anterior (TA) and peroneus longus (PER) were monitored during monopodal stance on an instable surface. Cocontraction index (CCI) of SOL and TA was calculated. Soleus H-reflexes were elicited to evaluate changes in the excitability of the spinal reflex circuitry. Results The study revealed three main results: (i) for both groups, the COP displacement was reduced (BTP  $-6 \pm 13\%$   $p < 0.05$ ; BT  $-10 \pm 15\%$   $p < 0.05$ ) after the intervention. This reduction in COP displacement was accompanied by (ii) a decreased CCI of SOL and TA (BTP  $-20 \pm 40\%$   $p < 0.05$ ; BT  $-34 \pm 35\%$   $p = 0.07$ ) and (iii) a decrease in H-Reflex sensitivity (BTP  $-10 \pm 28\%$   $p < 0.05$ ; BT  $-11 \pm 48\%$   $p < 0.05$ ). GM and PER remained unchanged. Discussion We found that BAL with PWB led to a reduced COP displacement indicating an improvement in stance stability. This functional adaptation is accompanied by a decreased coactivation of the antagonist muscles TA and SOL and a reduced spinal excitability of the SOL motoneuron-pool. These aspects point toward fundamental changes regarding postural control strategies generally known from regular BAL (Taube et al. 2008). Based on these results, BAL with PWB is suggested to be an appropriate alternative especially for patients with motor dysfunctions or after surgery unable to conduct BAL under full body load. References Nagai K, Yamada M, Tanaka B, Uemura K, Mori S, Aoyama T, Ichihashi N, Tsuboyama T.(2012). *Gerontol A Biol Sci Med Sci*,67(8),882–889 Taube W, Gruber M, Gollhofer A. (2008). *ActaPhysiol*,193,101–116

### STABILITY OF CROSS-SECTIONAL RELATIONSHIPS BETWEEN CHANGES IN BIOCHEMICAL AND HEMATOLOGICAL MARKERS OVER A SOCCER HALF-SEASON

Patras, K., Sargiotis, D., Siaravas, S., Giannitopoulos, T., Evaggelou, A., Georgoulis, A.D.

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INTRODUCTION: Monitoring of selected biochemical/haematological variables is used in professional soccer to evaluate the health status/training process [1]. Furthermore identifying relationships between variables may be indicative of a common stress factor [2]. However in order to determine causative relationships, longitudinal changes must be investigated [3]. The present study examined whether interrelationships between biochemical and hematological variables change over the course of two consecutive mesocycles comprising the first half of the season. METHODS: Twenty-three professional soccer outfield players participated in the study. Blood samples were collected before the first competitive game (September), at the end of the first competitive mesocycle (November) and at the end of the second competitive mesocycle (January). Samples were analyzed for haematocrit (HCT), haemoglobin (HGB), aspartate aminotransferase (AST), alanine aminotransferase (ALT), phosphocreatine kinase (CPK), ferritin (FER), creatinine (CRE) and magnesium (Mg). Pearson correlations ( $r$ ) were calculated to assess the interrelationships between the variables [4]. Relationships ( $r \pm 90\%$  CI) were classified using a magnitude-based approach [4] and classified as practically important where there was a  $\geq 75\%$  likelihood of the correlation exceeding the smallest practically important (0.1) value using an Excel spreadsheet [5]. RESULTS: AST and CPK showed very large correlations (0.76-0.87) at every time period. All other variables showed cross-sectional relationships that varied significantly in magnitude over time. DISCUSSION: With the exception of CPK and AST all other variables showed relationships that varied with time and thus it is questionable whether they have causative relationship [3]. CPK changes had very strong relationship to AST changes that remained stable over the course of a half-season in professional soccer. The stability of the magnitude of the cross-sectional correlations over time indicates that these biochemical markers have similar rates of change. REFERENCES 1. Meyer T, Meister S. *Int J Sports Med*, 32: 875-81, 2011. 2. Viru A, Viru M. *Biochemical monitoring of training*, 2001. 3. Cronin J, et al. *Strength Cond J* 29: 86–95, 2007. 4. Batterham AM, Hopkins WG. *Int J Sports Physiol Perf*, 1: 50-57, 2006. 5. Hopkins, WG. Available from: <http://newstats.org/xcl.xls>.

14:00 - 15:00

## Mini-Orals

## PP-PM79 Training and Testing [TT] 14

**OXYGEN CONSUMPTION OF MILITARY TASKS DURING FIELD EXERCISES**

Pihlainen, K., Santtila, M., Häkkinen, K., Kyröläinen, H.

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**Introduction** Military operations consist of physically demanding tasks which typically are load carriage, digging and lifting loads (Sharp et al 1998, Knapik et al 2004). To avoid accumulation of fatigue, it is important to know the absolute and relative energy expenditure of soldiers during such tasks. Several studies have investigated physiological responses of military tasks in laboratory settings while very limited information is available of field conditions (Larsen et al 2011). Therefore, the purpose of the present study was to measure oxygen consumption (VO<sub>2</sub>) during military tasks in field circumstances. Following tasks of army soldiers were monitored: unloaded (M1) and loaded (M2) marching, artillery field preparation (AFP) and digging in defensive positions (D). **Methods** Subjects were 17 voluntary male conscripts (19.4±1.1 years, 179.3±7.3 cm, and 72.9±7.7 kg). Initial aerobic capacity (VO<sub>2</sub>max) was directly measured five weeks before the field exercise by using an incremental treadmill. Additional weight of 5.4 kg was carried during M1, AFP and D and 24.4 kg during M2. Direct VO<sub>2</sub> was measured by portable oxygen spirometers (Oxycon Mobile, CareFusion, San Diego, CA, USA and MetaMax, Cortex, Leipzig, Germany). Relative work intensity was individually determined by dividing VO<sub>2</sub> of each field task by initial VO<sub>2</sub>max. **Results** The initial mean VO<sub>2</sub>max of the subjects was 47.3±4.5 ml/kg/min. The mean VO<sub>2</sub> of M1 (n=8) was 19.9±2.7 ml/kg/min which refers to 43±9 % of VO<sub>2</sub>max of the subjects. Oxygen consumption of M2 (n=8) was 22.6±3.4 (48±9%), AFP (n=5) 17.9±3.0 (38±6%) and D (n=5) 24.0±4.4 ml/kg/min (50±9% VO<sub>2</sub>max), respectively. **Discussion** The direct VO<sub>2</sub> values measured in field tasks are in line with the previous findings of laboratory studies. The mean work intensity of soldiers in measured military tasks was close to 50% of their maximal aerobic capacity. This level has been suggested to be maximum limit of intensity for sustained work (Epstein et al 1988). Based on the present study, the minimum requirement of VO<sub>2</sub>max for the army soldiers seems to be 45.0-50.0 ml/kg/min. More studies are needed with direct measurements during military tasks in field conditions in order to reliably define the physical requirements for soldiers of different army branches. **References** Sharp MA, Knapik JJ, Walker LA, Burrell L, Frykman PN, Darakij SS, Lester ME, Marin RE (2008). *Med Sci Sports Exerc.* 40:1687-92. Knapik JJ, Reynolds KL, Harman E (2004). *Mil Med.* 169:45-56. Larsen B, Netto K, Aisbett B (2011). *Mil Med.* 176: 1265-1273. Epstein Y, Rosenblum J, Burstein R, Sawka M.N (1988). *Eur J Appl Physiol.* 57:243-27.

**FIXED CONCENTRATION LACTATE TESTS IN RUNNERS: WHAT IS THE IDEAL SPEED TO START?**

Dantas, J.1,2, Doria, C.1, Rossi, H.3, Rosa, G.3, Pietrangelo, T.1, Fano'-Illuc, G.1

1: *Gabriele d'Annunzio University (Chieti, Italy)*, 2: *State University of Londrina (Londrina, Brazil)*, 3: *Marathon Sport Medical Center (Brescia, Italy)*.

**Introduction** Fixed concentration lactate (LAC) tests are widely used to determine intensity parameters (e.g., heart rate (HR) or speed) for runners in order to prescribe and to control training workload. However, speed to begin the tests is chosen arbitrarily because lack a scientific support to this choice. Therefore, the aim of this study was to determine the ideal initial speed for LAC tests in runners. **Methods** Retrospective data from our laboratory concerning amateur runners (n=102) were used in this study. All volunteers, which have given their written informed consent had experienced at least of one competition (10 km to marathon races) and their average speed performed in the last race (AVS) were reported. All volunteers enrolled had undergone to a standard test<sup>1</sup> on treadmill in order to determine intensity parameters at LAC of 2 and 4 mmol (stages duration= 4 min; pauses=1 min; speed increment=1.5 km.h<sup>-1</sup>/stage). The criterion to stop the test was the achievement of a LAC ≥ 4 mmol. LAC, HR and speed were recorded in every stage and were shown as percent of maximal predicted HR<sub>2</sub> (%HRMAX= 211 - 0.64\*age) and percent of AVS (%AVS), respectively. For the aim of this study, 1st and 2nd stage data were analyzed. Descriptive statistical (mean, SD and CI95%) was used to show all data. **Results** For all volunteers the LAC values were < 2 mmol after the 1st stage (1.1 ±0.2; CI95%= 0.6 to 1.5 mmol). The mean of speed of the 1st stage was 69.1 ±4.2 (CI95%= 60.9 to 77.3) %AVS. After the 1st stage, 85 from 102 (83.3%) of the volunteers showed LAC ≤ 1 mmol (speed= 68.8 %AVS; HR= 71.4 %HRMAX) and other 17 volunteers showed LAC > 1 and < 2 mmol (speed= 70.7 %AVS; HR= 76.7 %HRMAX). The mean of speed for the 2nd stage was 80.1 ±4.8 (CI95%= 70.6 to 89.6) %AVS. HR values were 72.3 ±6.1 (CI95%= 60.2 to 84.3) and 79.0 ±5.9 (CI95%= 67.4 to 90.5) %HRMAX for the 1st and 2nd stage, respectively. After the 2nd stage, 17 volunteers had LAC ≤ 1 mmol (speed = 77.5 %AVS; HR= 76.1 %HRMAX), 73 had LAC between >1 and < 2 mmol (speed= 80.2 %AVS; HR= 78.9 %HRMAX), and 12 had LAC ≥ 2 mmol (speed= 82.9 %AVS; HR= 83.3 %HRMAX). **Conclusion** In according the data, the option for the nearest speed of 70 %AVS seems to be the ideal and secure speed to start LAC tests in runners. **References** 1. Kindermann W, et al. The significance of the aerobic-anaerobic transition for the determination of work load intensities during endurance training. *Eur J Appl Physiol Occup Physiol.* Sep 1979;42(1):25-34. 2. Nes BM, et al. Age-predicted maximal heart rate in healthy subjects: The HUNT Fitness Study. *Scand J Med Sci Sports.* Feb 29 2012.

**THE RELIABILITY OF 200 AND 1000 METER ALL OUT TESTS ON DANSPRINT PADDLING ERGOMETER.**

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*Bergen University og College*

**Introduction** The Dansprint paddling ergometer (Dansprint, Denmark) is used by most Norwegian flat water kayakers, both in their common "off water" training, and in performance testing. In this study we examined the reproducibility of tests of 200 meter and 1000 meter, with the aim of evaluating the ergometers reliability. **Methods** 8 highly trained male and female national level flat water kayakers, aged 17- 25 yrs., participated in this experiment. The subjects were tested on 3 separate days with 3 days between. Both distances were performed on the same day with a two hour of rest in between. The subjects were instructed to keep a diet and activity log 24 hrs before the first test, and this was then used as a template for all the tests. The subjects were instructed to give maximal effort in each test. All the tests were performed on the same ergometer (Dansprint, Denmark) and in "pre-season". The software Dansprint analyzer (Dansprint, Denmark) was used to evaluate each test regard to paddling frequency, wattage, velocity, and time. Accumulated VO<sub>2</sub> was measured

during all tests, and a blood sample was taken one minute after the tests for lactate measures. Heart rate was measured using a Polar RS 800 CX, (Kempele, Finland) during the testes. Oxygen consumption was measured using a Jaeger Oxycon Pro in mixing chamber mode (Jaeger, Germany), and lactate was measured using a Lactate Scout (Biosen, Germany) device. Results In the 200 m tests, the paddling time improved significantly from test 1 to test 2 ( $p < 0.05$ ), but not from test 2 to test 3. On the 1000m tests, the times improved significantly on every test ( $p < 0.05$ ) Conclusion 200m testes can be performed on the ergometer, if sufficient pre-tests to elucidate learning effect are performed. There is need for more than 3 learning sessions in the ergometer before testing 1000m.

### COMPARISON OF PULL DOWN STRENGTH BETWEEN RECREATIONAL AND EXPERTS CLIMBERS

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**Introduction** The importance of muscular strength in sport climbing has been investigated, mainly through handgrip strength<sup>1,2,3</sup>. However there are no studies that evaluate muscle strength in specific pull down climbing movement (shoulder abduction accompanied by elbow flexion). This study evaluated muscle strength in recreational (RC) and experts climbers (EC) in a specific movement of the climbing (pull down). Our hypothesis is that EC have greater strength than RC. **Methods** Seventeen climbers were selected for this study, 8 EC (minimal climbing level: 8A/Fr in last year) and 9 RC. Each subject performed three maximum isometric contractions (Biodex System 4 Pro, Medical Systems, USA) using their dominant member in the motion of pull down (at 90° of elbow flexion and 135° of shoulder abduction), with a 3 minutes rest interval between attempts. The peak torque generated was computed and compared between groups by an independent T-Test. **Results** The EC demonstrated greater ( $p < 0.008$ ) pull down strength ( $213.81 \pm 25.89$  Nm) than the RC ( $171.41 \pm 31.27$  Nm). Also, the pull down strength relative to body mass was higher ( $p < 0.005$ ) for EC ( $2.48 \pm 0.50$  Nm/kg) compared to RC ( $3.33 \pm 0.59$  Nm/kg). **Discussion** Previous study showed that handgrip strength is higher for EC than RC<sup>2</sup>. The present study demonstrated that the EC had higher levels of strength also when a specific pull down climbing movement is performed. Thus, the present study suggests that upper body strength is an important factor for the determination of climbing level and performance. **Conclusion** It is concluded that EC elicits higher levels of strength than RC in specific pull down climbing movement; therefore it is important to include this specific training in climbing training. **Reference** 1- Mermier et. Al. *British Journal of Sports Medicine*, 34, 359-66, 2000. 2- Giles et. Al. *Sports Med*, 36, 529-45, 2006. 3- España-Romero et. al. *Eur J Appl Physiol*, 107, 517-25, 2009.

### PACING IN ISOLATED AND NON-ISOLATED SPORTS – INFLUENCE OF COMPETITORS

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**Introduction** Most analyses of pacing pattern (PP) in endurance sports distinguish between events with reference to the metabolic demand due to the time of completion (e.g. short-, middle- and long distance events) (Abbiss & Laursen, 2008). Hence, it could be suspected that PP is similar in events of the same duration independent of the sport. However, in some sports athletes are more isolated from their competitors than in others, assuming less tactical influences. The aim of this study was to compare PP in middle-distance events with similar duration in a non-isolated (running; RUN) and a more isolated sport (swimming; SWIM). **Methods** Finals of the London Olympic Games of the following events were compared: 1500m RUN ( $n=12$ ) vs. 400m SWIM ( $n=8$ ), 800m RUN ( $n=8$ ) vs. 200m SWIM ( $n=8$ ) and 5000m RUN ( $n=15$ ) vs. 1500m SWIM ( $n=8$ ). Altogether 59 male athletes were included in the analysis. Split times (ST) were accessed via the websites iaaf.org and swimrankings.net. For 800m RUN, ST were available every 200m, for 1500m and 5000m RUN every 400m. In SWIM events 50m ST were chosen for 200m, and 100m ST for 400m and 1500m to ensure similar numbers of ST for both sports. PP is expressed in relation to mean velocity for all calculations. Furthermore, differences between ST (m/s) were calculated in percent of the preceding ST. Repeated-measures ANOVAs were used to analyse for differences between SWIM and RUN. The post-hoc Scheffé-Test was carried out to determine ST differences within one race. **Results** PP was significantly different between sports in all events ( $p > 0.001$ ). SWIM showed an even PP in 1500m and 400m ( $p > 0.99$ ), whereas in 5000m and 1500m RUN the second half was significantly faster than the first one ( $p < 0.001$ , increase:  $+0.64 \pm 0.34$  m/s). In 200m SWIM and 800m RUN the first half was significantly faster than the second in both sports ( $p < 0.02$ ), with a higher decrease in velocity in RUN (decrease: -5.7 and -8.4%, respectively). Regarding ST differences 1500m and 400m SWIM splits were constant over the whole race ( $p > 0.06$ , mean ST difference:  $0.50 \pm 1.8\%$ ; MIN: 0.004%; MAX: 5.56%). In 5000m and 1500m RUN ST differences varied stronger over the whole event ( $p < 0.001$ , mean ST difference:  $1.71 \pm 4.67\%$ ; MIN: 0.83%; MAX: 12.2%). **Discussion** Even though overall performance time was similar in the analyzed running and swimming events, PP was different between sports in all distances. Although swimmers display a consistent profile, the ability of runners to do so seems to be „impaired“ by tactical factors associated with the more direct presence of competitors. **References** Abbiss C, Laursen PB (2008) *Sports Med*, 38, 293-252

### THE 10-WEEK SOCCER TRAINING EFFECTS ON MUSCLE POWER AND CREATINE KINASE CONCENTRATION.

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**Introduction** Evaluate how the content training distribution influences in the muscle soreness Creatine Kinase's concentration (CK) and muscular performance is an important tool in the training. This work aims to assess the 10-week effects of training and its relationship in the muscular power performance and CK in U19 soccer players. **Methods** 13 athletes of U19 participated in this study,  $18,40 \pm 0,88$  years,  $179,52 \pm 6,96$  cm,  $73,70 \pm 7,89$  kg. The study was approved by the Research Ethics Committee under the protocol 596/2011. Forty-nine training sessions were analysed in 11 matches along 10 weeks. We evaluated the athletes in two moments, at the beginning (M1) and at the end of the 10 weeks (M2). The jump height (CMJ) was measured according to Bosco et al. (1983) protocol and the CK activity was determined by UV Espectrofotometer (Biospectro, SP-220, Brazil) with the athletes were fasted. The content training followed the proceedings described by Proia et al., (2012). The CMJ data was analysed by the Student t-test while the CK concentration was analysed by the Wilcoxon test. The  $\alpha$  was fixed in 5%. **Results** In the analysed period there was an anaerobic lactic capacity predominance (1140 min), strength training (1090 min) and official matches (935 min). No significant changes were verified in the CMJ values ( $53,70 \pm 9,60$  cm to  $55,61 \pm 9,14$  cm) but the CK change from M1 to M2 ( $64,20 \pm 85,45\%$ ,  $p = 0,0429$ ). **Discussion** The training organization in the evaluated period and the quantity of matches could have affected the found results because the lower body power can be reached its approximated maximal values characteristic of the period (Verkhoshansky, Stiff, 2010) as well as the CK improvement after M2 (Ispirlidis et al., 2008). **References** Bosco, C., Luhtanen, P., Komi, P.V. (1983). *Eur J Appl Physiol*, 50(2), 273-282. Ispirlidis, I., Fatouros, I.G., Jamurtas, A.Z.,

Nikolaidis, M.G., Michailidis, I., Douroudos, I. et al (2008). Clin J Sport Med, 18(5), 423-431. Proia, P., Bianco, A., Schiera, G., Saladino, P., Pomara, F., Petrucci, M., et al (2011). J Sports Med Phys Fitness, 52(1), 102-106. Verkhoshansky, Y., Siff, M.C., (2010) Supertraining, 6ed.

### RELIABILITY OF MUSCLE RESPONSE MEASUREMENTS WITHIN DIFFERENT ELECTRICAL STIMULATION INTENSITIES USING TENSIO MYOGRAPHY

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**Introduction** In the last few years, different methods, techniques and devices have been used to evaluate neuromuscular function in rehabilitation and sports training settings. Recently, a non-invasive method, tensiomyography (TMG), which allows the contractile properties assessment from radial muscle belly displacement just after a single electrical stimulation, has been introduced. Although the reliability of TMG was already reported (Simunic, 2012), to the best of our knowledge, it is unclear its reliability from submaximal electrical stimulus. Therefore, the aim of this study was to analyze TMG reliability within maximal and submaximal electrical stimulus. **Method** 20 male sport students were tested two times over one week period. TMG measurements were conducted using a specific electrical stimulator (TMG-S2), TMG-OK 3.0 software, as well as a displacement sensor tip with prefixed tension, which was positioned at 90 degrees to the muscle belly. Muscles analyzed were rectus femoris (RF), biceps femoris (BF) and gastrocnemius lateralis (GL) left and right sides, after a single 1 ms maximal or either a submaximal electrical stimulation (40mA). Maximal electrical stimulation was found through step increase of 20mA. Time contraction (Tc), determined from 10% to 90% of the maximal response, delay time (Td), determined from onset of electrical stimulus to 10% of maximal response, maximal radial muscle displacement (D), sustain time (Ts), determined as time between 50% of maximal response during muscle contraction and relaxation and relaxation time (Tr), determined from time of fall from 90% to 50% of the maximal response (Krijaz et al., 2008), were analyzed. Absolute reliability was assessed by the standard error of measurement (SEM) whereas the relative reliability by the intraclass correlation coefficient (ICC). **Results** The highest significant values ( $p < 0.01$ ) for TMG reliability were reported in maximal electrical stimulation (ICC=0.85-0.94; 0.83-0.91; 0.55-0.92; 0.67-0.88; 0.91-0.94) for Tc, Td, Tr, Dm and Ts respectively, in all muscles. Regarding submaximal electrical stimulation, Dm, Tc and Td also showed significant ( $p < 0.01$ ) high scores (ICC=0.91-0.94; 0.76-0.92; 0.70-0.92) in different muscles respectively. **Discussion** Maximal electrical stimulus have demonstrated high reliability. Submaximal values indicated a lower reliability for some parameters. In some muscles, under submaximal stimulus, Tr and Ts have not been repeatable. TMG may be considered as a reliable method to evaluate contractile properties within maximal and submaximal electrical stimulus. **References** Simunic, (2012). J Electromyogr Kinesiol, 22(4), 527-30. Krizaj et al., (2008). J Electromyogr Kinesiol, 18(4), 645-51.

### CARDIODRIFT: A FACTOR TO BE CONSIDERED IN TARGET HEART RATE DURING RECREATIONAL RUNNING

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**Introduction** Recreational running is one of the most common physical activities for an increasing number of people with different standards (i.e., social backgrounds). Among recreational runners, the use of heart rate (HR) monitors is a typical method to quantify the training load, easy to handle and also praised by the sport industry. Coaches and exercise physiologists recommend the use of different HR formulas, although these formulas do not take into account the Cardiodrift (CD). CD is a term used to describe the increase of the HR during aerobic exercise, which can be related to a reduced stroke volume, an increased core temperature and dehydration. During recreational running one can obtain a constant HR but has to reduce the running speed in order to achieve this. Yet from a practical point of view maintaining a constant speed should be the aim of the training. Therefore, the aim of the study was to develop a HR-Formula, which takes into account the CD. **Methods** 135 recreational runners (i.e., men and women) (age:  $40.0 \pm 13.4$  yrs; height:  $173.4 \pm 9.1$  cm; body mass:  $68.3 \pm 11.1$  kg) participated in a matched crossover study. On three experimental days separated by one week, the athletes completed three 45 min runs, with a constant velocity corresponding to 85, 90 and 95% of the 4 mmol/l threshold (v4). HR formulas were developed for each running velocity, related to gender, age and performance, using the coefficient of determination ( $R^2$ ). **Results** Results showed a significant increase in HR from 15 to 45 min of running duration in all intensities in both, men and women and independent from age and performance ( $p < 0.01$ ). The absolute HR showed no differences regarding the performance level of runners, but was significantly higher in women and in younger runners. There was no relationship between HR and blood lactate, age or performance level. Blood lactate remained stable at 95% v4 and decreased significantly ( $p < 0.01$ ) at 85 and 90% v4. **Discussion** HR monitors are a useful way to monitor the training load, although the CD should be taken into account. In the present study we developed a formula, which takes into account the natural increase of the HR while running and made a table, which predicts the training target HR. The formula presented here would be useful for the HR monitor manufacturers, as they could integrate it into their watches next to the determinants of age, gender and intensity. **References** Coyle, E.F., Boa, F.G. & Gaze, D.C. (2001). Exerc Sport Sci Rev, 29, 92-99.

### TEST-RETEST RELIABILITY OF A FIELD-BASED FITNESS TEST BATTERY USED IN AUSTRIAN YOUTH SOCCER

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**INTRODUCTION** Fitness tests are implemented in youth soccer to determine current fitness levels, to identify and select talented players, and to monitor players' development (Stratton et al., 2004). However, especially in well-trained athletes, there is a lack of "quality control" of fitness tests (Hopkins et al., 1999). The purpose of this study was to determine relative and absolute reliability of a field-based fitness test battery performed by elite Austrian soccer players from the age of 11 to 18 years. **METHOD** Forty-one elite male youth soccer academy players (age  $15.7 \pm 0.7$  yrs, body size  $1.75 \pm 0.08$  m, weight  $63.7 \pm 9.9$  kg) conducted a battery of 10 fitness tests on two separate occasions 7 days apart: 20 m straight-line sprint (with 5 and 10 m split times); 5 x 10 m shuttle sprint (SS); hurdles agility run (HAR); reaction test (RT); foot tapping (FT); 20 m multi-stage endurance run (ER); counter movement jump (CMJ); 40 cm drop jump (DJ); 2 kg standing overhead medicine ball throw (MBT); and sit-and-reach test (SR). All players passed through a familiarisation session on a separate occasion. Paired t-tests were calculated to detect systematic changes in the mean. Intraclass correlation coefficient, ICC (2, 1), was used to assess relative reliability. Since all data proved to be homoscedastic, absolute reliability was quantified by standard error of measurement, SEM (Atkinson and Nevill, 1998). **RESULTS** A significant ( $p < .01$ ) systematic bias was detected in 5, 10, and 20 m, RT, ER, and SR, indicating increased (RT, ER, SR) and decreased (5, 10, 20 m) retest performances. Moderate to high ICC values of .81-.97 were found in 20 m (mean  $\pm$  SEM:  $3.20 \pm 0.04$  s); SS ( $11.75 \pm 0.14$  s); FT ( $13.1 \pm 0.3$  Hz); ER ( $11.6 \pm 0.2$  km/h); MBT ( $9.3 \pm 0.4$  m); and SR ( $7 \pm 1$  cm). While CMJ ( $36.2 \pm 2.4$

cm); DJ coefficient ( $6.7 \pm 0.8$ ); 10 m ( $1.86 \pm 0.02$  s); and HAR ( $11.77 \pm 0.24$  s) displayed acceptable ICC scores of .74-.79., values for 5 m ( $1.09 \pm 0.03$  s), .56, and RT ( $642 \pm 40$  ms), .48, were classified as low. CONCLUSION The systematic bias detected in RT, ER and SR might be attributed to learning effects. Additional familiarisation trials would be preferable (Atkinson and Nevill, 1998). Most of the current tests displayed acceptable to high relative reliability for this homogenous group of players. Furthermore, small within-subject variations throughout all tests, quantified by low SEM, pointed out that the test battery was a reliable tool for fitness assessment in youth soccer. Therefore, applying these tests in talent identification and development settings seems to be appropriate for fitness evaluation. REFERENCES Atkinson G, Nevill AM. (1998). *Sports Med*, 26 (4), 217-238. Hopkins WG, Hawley JA, Burke LM. (1999). *Med Sci Sports Exerc*, 31 (3), 472-485. Stratton G, Reilly T, Williams AM, Richardson D. (2004). *Youth soccer. From science to performance*. Routledge, London.

### EFFECTS OF HIGH-INTENSITY CIRCUIT TRAINING ON BLOOD PRESSURE, LIPOPROTEINS AND TRIGLYCERIDES IN MIDDLE AGED OVERWEIGHT MEN

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**Introduction** High intensity circuit training have showed to be able to improve body composition, physical fitness and health-related factors in older individuals 1,2 The aim of this study was to determine the physiological effects of an high-intensity circuit training (HICT) on several cardiovascular disease risk factors in healthy, overweight middle-aged subjects, and to compare the effects of HICT to traditional endurance training (ET) and low-intensity circuit training (LICT). **Methods** 30 subjects (ages 50-65 yr, BMI  $29.8 \pm 0.9$ ) were randomly assigned to one of the three exercise treatment groups: HICT, LICT and ET. The three groups exercised three times per week, for 12 weeks. HICT consists in 7 min on cycloergometer performed with HIT technique (30 sec at 85% of VO<sub>2</sub>max and 3 min and 30 sec at 50% of VO<sub>2</sub>max repeated for two times) and resistance training (RT) exercises (latissimus dorsi pull-downs, pectoral machine, lateral shoulder raise; horizontal leg press) performed with HIRT technique<sup>3</sup>, all circuit was repeated two times (with 7 min of HIT at the end). LICT consist in the same circuit but with cycloergometer performed at 65% of VO<sub>2</sub>max and RT performed with 3 sets for 15 repetitions. ET consisted in 60 min at cycloergometer performed at 65% of VO<sub>2</sub>max. Pre- and post-training, participants underwent to anthropometric and blood pressure measurements: BW (body weight), FM (fat mass), WLC (waist line circumference), DBP and SBP (diastolic and systolic). Moreover some blood parameters were checked pre and post training: CHOLt (total cholesterol), LDL (low density lipoprotein-cholesterol), HDL (high density lipoprotein-cholesterol), TG (triglycerides). Before and after training also LAb100w (blood lactate produced at 100 Watt during submaximal test) and VO<sub>2</sub>max were determined. **Results** Compared to other groups, CHIT showed significantly higher reductions in BW, FM, WLC, DBP, CHOLt, TG and LAb100w and significantly greater increases in high density HDL and VO<sub>2</sub>max whilst HDL increased in similar manner in all groups. CLT resulted in the greatest reduction in SBP. **Discussion** Our findings indicate that high-intensity circuit training is more effective in improving some cardiovascular disease risk factors and physical performance than endurance training alone or lower intensity circuit training. **References** 1 Paoli A. *J Sports Med Phys Fitness*. 2010 Mar;50(1):43-51 2 Romero-Arenas S. *Exp Gerontol*. 2013 Jan 23. pii: S0531-5565(13)00013-2 3 Paoli A. *J Transl Med*. 2012 Nov 24;10:237

### WHOLE-BODY CRYOTHERAPY <-110 °C> IMPROVES ECCENTRIC MUSCLE PERFORMANCE RECOVERY AFTER HIGH-INTENSITY EXERCISE

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**Introduction** Whole-body cryotherapy (WBC) refers to brief exposure to extremely cold air (around -110 °C) in a temperature-controlled chamber. WBC has gained wide acceptance as a procedure to improve neuromuscular performance (Banfi et al., 2009). Furthermore, athletes of various sports, such as swimming, athletics, judo, jiu-jitsu, among others, frequently compete or train more than once in the same day. Thus, one session of WBC may help these athletes maintain their performance between matches. However, controlled studies on the effects of WBC between high-intensity exercise on neuromuscular recovery are lacking. Therefore, the aim of this study was to evaluate the effects of a single WBC bout on strength recovery between-training sessions. **Methods** Twelve young men ( $23.9 \pm 5.9$  yrs) were randomly exposed to two different conditions separated by 7 days: 1) WBC (Subjects were exposed to 3 min of WBC at -110 °C); 2) Control (CON). All subjects performed two knee extension training sessions: 1) before each condition and 2) 30 min after. The training consisted of 6 sets of 10 repetitions at 60°.s<sup>-1</sup> for concentric (CC) actions and 180.s<sup>-1</sup> for eccentric (EC) actions. **Results** CC Peak torque (PT) decreased significantly ( $p < 0.05$ ) after WBC (9.4%) and CON (7.5%) training sessions. Total work (TW) also decreased after WBC (6.5%) and CON (5.2%). There was no significant difference ( $p > 0.05$ ) between conditions in PT or TW. Additionally, EC PT decreased significantly ( $p < 0.05$ ) after WBC (5.6%) and CON (16.0%) training sessions. EC TW also decreased after WBC (2.0%) and CON (11.6%). However, the decrease in EC PT and TW were significantly ( $p < 0.05$ ) less after the WBC when compared to the CON condition. **Discussion** The main finding of the present study was that WBC may improve EC recovery after a bout of high-intensity exercise. EC muscle actions are stronger and have less energy cost because it also involves passive tension from the elastic properties of the muscle, not just active tension from cross-bridge cycling. In addition, Herzog et al. (2008) adds that there is an increase in the stiffness of the titin protein during eccentric actions. Increases in muscle-tendon stiffness resulting from exposure to cold have been well documented (García-Manso et al., 2011). Thus, the improvement in EC performance in the present study may be due to increases in muscle-tendon stiffness associated with WBC (-110 °C). **In conclusion**, the present study showed that WBC may be used after exercise to enhance between-training session recovery of EC muscle performance. **References** Banfi G, Melegati G, Barassi A, et al. (2009). *J Sci Med Sport* 12, 609-610 Herzog W, Leonard TR, Joumaa V, et al. (2008). *J Applied Biomech*, 24, 1-13. García-Manso JM, Rodríguez-Matoso D, Rodríguez-Ruiz D, et al. (2011). *Am J Phys Med Rehabil*, 90(5), 356-63. Financial support: FAPEMIG, CAPES and FAPDF

### ADDING WHOLE BODY VIBRATION TO PRE CONDITIONING EXERCISE IMPROVES ON-ICE SPRINT PERFORMANCE IN ICE HOCKEY PLAYERS

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**Introduction** Training methods to acutely enhance sprint performance and thus impose a greater training stimulus may be of great value to ice hockey players. Post activation potentiation (PAP) exercises with added whole-body vibration (WBV) have been suggested to be a potential way to acutely improve sprint performance. We have recently shown that adding WBV with a vibration frequency of 50 Hz to

body-loaded half-squats improves subsequent 40 m sprint performance in soccer players (3). However, not all studies do find a significant effect of adding WBV (1, 2). The aim of the present study is to investigate the effect of adding WBV to body-loaded half-squats, performed as preconditioning activity to on ice-sprint in ice-hockey players. Method Fifteen male junior elite level ice hockey players participated in the study. Four separate test sessions were performed, wherein each session included a standardized warm-up followed by one of the following preconditioning exercises; 30 s of half-squats without WBV, or 30 s of half-squats with WBV at 50 Hz. A 40 m sprint was performed one minute after the preconditioning exercise with intermediate timing after 10 m and 20 m. For each subject, both protocols were repeated twice on separate days in a randomized order and the best 40 m time was used for statistical analysis. Perceived wellbeing in the legs was measured before warm-up, after warm-up and after the preconditioning activity (method presented in ref. 4). Results Performing preconditioning exercise with WBV at 50 Hz resulted in superior 10, 20, and 40 m sprint performance compared to preconditioning exercise without WBV ( $1.88 \pm 0.10$  vs.  $1.84 \pm 0.10$  s,  $3.17 \pm 0.13$  vs.  $3.14 \pm 0.13$  s, and  $5.53 \pm 0.15$  vs.  $5.39 \pm 0.2$  s, respectively; all  $p < 0.05$ ). There was no difference in perceived wellbeing in the legs between the testing mode before and after warm-up. However, after preconditioning activity with WBV the players felt better in their legs than after precondition activity without WBV ( $p < 0.05$ ). Discussion The overall finding was that preconditioning exercise performed with WBV at 50 Hz seems to have a positive effect on on-ice sprint performance in junior elite level ice hockey players. Performing PAP exercises with WBV at the right frequency (50 Hz) during warm-up sessions may improve sprint performance and thus improve the quality of sprint training. A part of this effect may be related to the observed improvement in perceived wellbeing of the legs after WBV. References 1. Bullock et al., JSCR, 2008; 22:1371-74 2. Guggenheimer et al., JSCR, 2009; 23:1135-39 3. Rønnestad & Ellefsen, JSCR, 2011;25:3306-10 4. Rønnestad et al. SJMSS, 2012; doi: 10.1111/j.1600-0838.2012.01485.x.

### VARIATION OF MUSCLE BALANCE AND ISOKINETIC PEAK TORQUE DURING PRESEASON SOCCER PLAYERS OF U-19 CUP.

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Introduction: In the scope of sports training the control of the internal load is connected to the fact that adaptations occurring in the body of the athletes are linked to intensity and magnitude, seeking to ensure that the athlete will increase their performance (Issurin, 2010). Objective: The objective of this study was to analyze the variation of muscle balance flexors and extensors of the knee and the peak torque of these muscles along the preseason training in soccer players in the under-19 category. Methodology: 13 subjects belonging to the under-19 team of Desportivo Brasil, in a preparatory stage to Sao Paulo Juniors Cup 2013, participated in 10 weeks of training and conducted two evaluations at the beginning (M1) and at the end (M2) of the preparatory phase. The peak torque (PT) and the ratio between agonist and antagonist (RFE), both members were obtained using a Biodex System 4 @ isokinetic dynamometer, in a series of five repetitions concentric of  $60^\circ/s$ . For the statistical analysis was used initially normality test of Shapiro-Wilk, and then, Wilcoxon test for paired comparison. The study was approved by the Research Ethics Committee under the protocol 596/2011. Results: The PT in the knee extensor muscles was lower in M2 with respect to M1, showing significant difference ( $p \leq 0.05$ ) in both states. For the knee flexor muscles in both members there was no difference ( $p > 0.05$ ). RFE was lower in M1 compared to M2, and the comparison between moments does not have a significant difference ( $p > 0.05$ ). Discussion: The results indicate the existence of changes in the magnitude of RFE, but within the normal range and maintaining proportionality between members throughout the preparatory period, as well as a significant decrease in the extensor PT, featuring a decrease in the ability to generate force of the quadriceps muscles. References Aquino, C.F; Vaz, D.V.; Brício, R.S.; Silva, P.L.P; Ocarino, J.M.; Fonseca, S.T. R. Bras. Ci e Mov. 2007, 15(1): 93 -100. Brink, M. S., E. Nederhof, C. Visscher, S. L. Schmikli e K. A. J Strength Cond Res, v.24, n.3, Mar, p.597-603. 2010. Croisier, J.L.; Reveillon, V.; Ferret, J.M.; Cotte, T.; Genty, M.; Popovich, N.; Mohity Filho, Faryniuk, J.E.; Ganteaume, S; Crielaard, J.M. Isokinetics and Exercise Science.2003. Goulart, Luiz Fernando; Dias, Raphael M. R.; Altimari, Leandro R. Rev Bras Med Esporte – Vol 14. N° 1 – Jan/Fev. 2008. Issurin, V. B. Sports Med, v.40, n.3, Mar 1, p.189-206. 2010. Terreri, Antonio Sergio A.P.; Greve, Júlia M.D.; Amatuzzi, Marco M. Rev Bras Med Esporte – Vol 7. n 5 – Set/Out. 2001. Zabka, Felipe F.; Valente, Henrique G.; Pacheco, Adriana M. Rev Bras Med Esporte – Vol 17. n 3 – Mai/Jun. 2011.

### EFFECTS OF STRENGTHENING-AEROBIC COMBINATION EXERCISE AND RHYTHMIC EXERCISE ON SUBJECTIVE PAIN & PHYSICAL FITNESS IN KOREAN SENIOR FEMALES

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INTRODUCTION The purpose of this study was to investigate the effects of strengthening-aerobic combination exercise and rhythmic exercise on subjective pain and physical fitness in senior females. METHODS The physical fitness were measured by Senior fitness test(Rikli & Jones, 2001). The subjects were classified into groups with strengthening-aerobic combination group(SAG), rhythmic exercise group(RG), and control group(CG). There were senior females of  $72.4 \pm 5.5$  years, total 29 persons. The SAG included bicycling for aerobic exercise as well as wrist and ankle weight sandbag for strengthening exercise. The program for SAG was performed 60 min/day, 2-3 times/week for 8 weeks. The RG executed 70 min/day rhythmic program, 2 times/week for 8 weeks. Rhythmic program were include 'Gustaf's Skool, Circassian Circle, Nigino shell Yoshi, I'm Busted, Goodnight waltz, Laringka, Jenka'. Data were analyzed with paired t-test, independent t-test and two-way ANOVA for repeated measures by SPSSWIN program. This study was modified from the raw data of Lee, Kang, & Kim(2013). RESULTS The results were as follows; The SACG were significantly improved on cardio-respiratory fitness and upper muscular strength(left grip strength). The RG were significantly improved on lower muscular endurance, upper right flexibility, resting HR, & DBP. In subjective pain, the SACG had a positive effects on back pain. Both groups showed improvements in the other categories of subjective pain even though the improvements didn't show reach statistical significance. CONCLUSION Both strengthening-aerobic combination exercise and rhythmic exercise were effective program for senior female, and the rhythmic exercise was more effective than the combination exercise for improving the physical fitness of senior females. This study recommend that the development of rhythmic exercise and combine exercise program should be the useful program for Korean senior females. Reference Lee, B.K., Kang, H.J., & Kim, S.B. (2013). The effects of rhythmic exercise and strengthening-aerobic exercise on physical fitness and MVAS in older females. Unpublished study. Rikli, R.E., & Jones, C.J. (2001). Senior fitness test manual. Human Kinetics.

14:00 - 15:00

## Mini-Orals

## PP-BN02 Biomechanics [BM] 2

**COMPARISON BETWEEN GRAB START AND TRACK START IN COMPETITIVE SWIMMING START: ABOUT IMPULSE DURING A MOVEMENT ON THE STARTING BLOCK**

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Comparison between Grab start and Track start in Competitive Swimming Start: About impulse during a movement on the starting block Sakai, S.1, Takeda, T. 2, Tsubakimoto, T. 1, Takagi, H. 1 1: University of Tsukuba ( Japan ), 2:University of Waseda ( Japan ) Introduction Recently, Grab start and Track start have been mainly used in swimming competitions. The take-off velocity from the starting block is caused by acting a force on the block by hands and feet. Thus a characteristic of start technique must be clarified by measuring the force acting on the block. Although several measurements of the force acting on the starting block have been done, there was no report which measured forces exerted through hands or feet separately. A degree of contribution by hands and feet for acquiring the take-off velocity has not been clarified yet. Therefore, the purpose of this study was to compare between Grab start and Track start focusing on impulse during a movement on the starting block by measuring forces exerted by hands or feet separately Method We made a new starting block with built-in biaxial (horizontal and vertical) force gauges which consisted of hand-, front-foot-, rear-foot-part. The horizontal/vertical component of take-off velocity was calculated as each component of impulse during a movement on the starting block divided by subject's weight. A degree of contribution by hands or feet was estimated by means of comparing impulse exerted through hands or feet. Results and Discussion In Grab start, although large positive horizontal reaction force by feet was observed, negative reaction force by hands was measured. This negative force was necessary to attract a body with the starting block until the body moving fore-and-downward so that the take-off angle came to negative. In addition, the negative vertical reaction forces by hands and the positive vertical reaction force by feet were observed. However, a total of reaction force by hands and feet was slightly larger than the reaction force correspond to the weight of the subjects. Therefore, a function of vertical reaction force seemed to mainly support the body weight while moving on the starting block. In Track start, the positive horizontal reaction force was measured by all of hands, front foot and rear foot. Moreover, a degree of contribution to take-off horizontal velocity by the rear foot was the biggest, and accounted for 65% of the total force. For the vertical reaction force, the negative force by hands and the positive force by feet were observed. However unlike Grab start, the front foot mainly supported the body weight, and a couple of forces by hands and rear foot acted in an opposite direction. Therefore, Track start was able to incline a body forward quicker than Grab start. Reference Takeda T, Nomura T. (2006). Portuguese J Sports Sci, 102-105. Maglischo E.W. (2003) : Swimming fastest : 265-278. Human Kinetics.

**THE EFFECT OF HEAD UP MOTION ON HAND DISPLACEMENT IN FRONT CRAWL BY LIFESAVER.**

Hara, R., Gando, Y., Muraoka, I.

*Waseda University*

Introduction Lifesaver and open water swimmer do head up motion during swimming at ocean. Some researches of head up swimming with water polo players were reported ( Karla, 2012 ; Dopsaj, 2007 ). Lifesaver and open water swimmer are swimming with moving up and down of the head, which is different from head up swimming of water polo player. No studies were focused on head up swimming of lifesaver. Therefore, the aim of the present study was to examine the effect of head up motion on hand displacement in front crawl by lifesaver. Methods Ten surf lifesavers provided written informed consent to participate in the study. Each swimmer performed four swim trials ( two front crawls and two head up swimings ) in 50m swimming pool. Each trial was swum at 80% of their each best performance velocity which were kept by a pacemaker. Two underwater video cameras were used to capture the right and left hands in two strokes at 200Hz. A digitizing system was used to manually digitize the third fingertip. The direct liner transformation method was used to obtain the three dimensional coordinates of landmark. Duration of the stroke, stroke length ( SL ), hand displacement were measured on left and right hands, respectively. Results All subjects did the head up motion after the entering of the right hand into the water. On right hand, head up swimming had significantly shorter stroke length than front crawl ( head up swimming :  $2.15 \pm 0.15$  m, front crawl :  $2.35 \pm 0.15$  m ). On left hand, head up swimming had significantly shorter maximum forward displacement than front crawl ( head up swimming :  $0.62 \pm 0.15$  m, front crawl :  $0.95 \pm 0.32$  m ). Discussion Maglischo ( 2003 ) said that swimmers should try to remain the horizontal components as possible to the water surface for reducing the drag and head up motion disturb the horizontal swimming form and increase drag force. In this study, head up swimming showed shorter stroke length than front crawl on right hand. This result indicates that head up swimming increased drag force and it would make shorter stroke length than front crawl. On left hand, head up swimming showed shorter maximum forward displacement than front crawl. These findings indicate that after the entering of the left hand into the water, left hand catches the water immediately and begins the propulsive phase during head up swimming. References Karla DJ, Pedro F, Kelly DJ, Filipa P, Paulo VB, Leandro M, Ricardo JF. (2012). J Sports Sci, 30(7), 715-723. Dopsaj M, Madic D, Okicic T. (2007). Physical Education and Sport, 5, 109-120. Maglischo EW. (2003). Swimming fastest, 49-57. Human Kinetics, Champaign.

**EFFECTS OF SLIP-INDUCED CHANGES IN ANKLE MOVEMENT ON MUSCLE ACTIVITY AND GROUND REACTION FORCES DURING RUNNING ACCELERATION**

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Introduction Ground contact in running is always linked to a minimum amount of slipping, e.g., during the early contact phase when horizontal forces are high compared to vertical forces. Studies have shown altered muscular activation when expecting slips [2-4]. It is not known what the mechanical effect of such slip episodes are on joint loading or performance. The aim of the present study was to examine the effect of changes in ankle movement on ankle joint loading, muscle activity, and ground reaction forces during linear acceleration. Methods Four young, healthy subjects were investigated while their run was perturbed by a moving force plate. GRF data were sampled

at 1000 Hz and corrected for inertia effects from platform movement. Eight pairs of bipolar surface electromyography (EMG) electrodes were used to record the activity of the thigh and leg: rectus femoris (RF), biceps femoris (BF), vastus medialis (VM), Tibialis anterior (TA), vastus lateralis (VL), soleus (SO), gastrocnemius lateralis (GL) and gastrocnemius medialis (GM) on the perturbed limb (biovision, Germany, 2000 Hz). Kinematic data of 45 reflective markers placed on anatomical landmarks were collected with an 8-camera motion capture system (Qualisys AB, Gothenburg, Sweden, 250 Hz). Three slipping conditions were compared: No movement (control), slip of 4 and 6 cm posteriorly. Subjects performed sprint starts from a standing position with the 4th step on the platform. Results The kinematic data were applied to a full-body model in C-motion and the center of mass position extracted. Only the largest slip amplitude resulted in a notable change in center of mass trajectory or angle of GRF vector direction, while ankle movement was changed systematically, showing a greater range of movement during contact. Only marginal differences were observed with a trend for increased gastrocnemius activity for the 6 cm slip. No significant differences were found for the horizontal force component for these subjects. Further testing is under way to consolidate these findings. Conclusion Ankle movement during the acceleration phase of running did not alter ground contact mechanics substantially. However, at larger amplitudes alterations in muscle activity were observed. Future research should focus on the functional implications of micro movements on injury risk and performance including the timing of slipping. Reference 1. A. J. Chambers, R. Cham, 2007. *Gait & Posture* 25 (2007) 565–572. 2. M.S. REDFERN, R. CHAM, K. GIELO-PERCZAK, R.G. NQVIST, C. POWERS, 2001. *ERGONOMICS*, VOL. 44, NO. 13, 1138 ± 1166. 3. D.S. MARIGOLD, A.E. PATLA, 2001. *Neurophysiology* 88: 339–353, 2002; 10.1152/jn.00691. 4. J-Y. You, Y-L. Chou, C-J. Lin, F-C. Su, 2001. *clinical biomechanics*, 16- 167-173.

## USING BALL RESIN MAY AFFECT HANDBALL THROWING PERFORMANCE

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**Introduction** In order to increase ball control ability, it is common for handball players to put ball resin on hands or fingers during competition. However, its effects on throwing movements, ball velocity, and accuracy are not clear. The purpose of the study was to investigate the effects of using ball resin on handball throwing performance. **Methods** Ten male handball players with right hand dominance (age: 21.9±1.3 years, height: 176.9±3.0 cm, weight: 76.6±7.6 kg, experience: 11.3±2.2 years) were recruited from Division I college handball teams in Taiwan. Each player performed cross-over step throw from a distance of 7 meters to hit 3 targets of the goal (center, left upper corner, right upper corner). Each target was made by a piece of cloth with an area of 0.5m\*0.5m. Five shoots were conducted for each target with and without a certain amount of resin evenly placed all over the handball. Throwing movements including throwing arm, trunk, pelvic, and pivot leg movement were recorded using a 3D electromagnetic motion analysis system at 240 Hz. Ball velocity was recorded with a sports radar gun. A ball that hit any area of the target and passed the goal line inside the goal was considered score. Throwing accuracy for each target was determined by the scoring rate of each target. Paired t-tests were performed to compare differences in results for all assessments with and without using handball resin. **Results** Ball velocity was significantly increased with ball resin while throwing towards center (21.86±1.67 vs. 22.80±1.80 m/s, p=0.003) and left upper corner (21.65±1.41 vs. 22.71±1.66 m/s, p=0.016) target. However, throwing accuracy was only significantly decreased while throwing towards right upper corner target with ball resin (1.00±0.00 vs. 0.88±0.13, p=0.015). While throwing towards center target with ball resin, maximum shoulder external rotation velocity, maximum hip flexion angle, maximum trunk flexion velocity, and maximum wrist flexion velocity were increased. While throwing towards left upper corner target with ball resin, only maximum shoulder external rotation velocity was increased. While throwing towards right upper corner target with ball resin, maximum elbow flexion angle was decreased and maximum hip flexion angle was increased. Throwing movement time was not significantly increased while throwing towards any target with ball resin. **Discussion** Throwing with ball resin may increase ball velocity that may contribute to score. However, this situation may potentially decrease throwing accuracy while throwing towards right upper corner of the goal, although the number of our throws may not enough for the accuracy test. Several changes in biomechanical throwing movements were observed while throwing towards different targets with ball resin. Whether these movement changes significantly affect the results of this study needs further investigation.

## OPTIMAL CYCLING TIME TRIAL POSITION MODELS

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**Introduction** The aerodynamic drag of a cyclist in time trial (TT) position is strongly influenced by the torso angle (Underwood et al. 2011). To minimize drag, cyclists lower their torso angle. Along with the drag the cyclists' peak power output decreases. There should be a trade-off between the loss in power output and drag as function of cycling velocity. This hypothesis is supported by the energy expenditure which is a function of the workload divided by the gross efficiency. The workload to overcome drag decreases with smaller torso angles, while the GE decreases accordingly. Previous literature suggested that the aerodynamic losses outweigh the loss in power output (Lukes et al. 2005). However, these statements are only valid for elite TT cycling velocities, e.g. > 45 km/h. To our best knowledge, there is no published prediction at which speed the aerodynamic power loss starts to dominate. Therefore the aim of this study is to predict the optimal TT cycling position as a function of a wide range of velocities. **Methods** Two models were developed to determine the optimal torso angle of TT cyclists: a power output model and a metabolic efficiency model. The power output model predicts the optimal cycling position by maximizing the peak power output minus the power losses due to drag and roll resistance. The metabolic efficiency model minimizes the required cycling energy. Model input parameters were experimentally collected of 19 trained competitive time trial cyclists. The main input variables were the power output, frontal area and gross efficiency of the cyclists in different torso angle positions (0,8,16,24°). The optimal cycling torso angle was predicted for speeds between 18-50km/h. **Results and discussion** It has been demonstrated that for both models, the optimal torso angle is dependent on the cycling velocity. The torso angle showed a sigmoid-like shape, with decreasing torso angles at increasing velocities. The power output model curve was shifted to a higher velocity, which could be explained by the different approach of the models. The aerodynamic losses outweighed the power losses for velocities above 45km/h, which goes in line with the literature. For cycling velocities below 30km/h the power loss and gross efficiency due to position change were dominant. Furthermore, it is shown that a fully horizontal torso is not optimal. Finally, it is suggested that despite some limitations, the models give valuable information about the optimal TT cycling position at different speeds. This study showed it is beneficial to ride in a more upright TT position when velocities are below 30km/h. **References** Lukes R, Chin S, Haake S (2005). *Sports Eng.*, 8(2): 59-74. Underwood L, Schumacher J, Burette-Pommay J, Jermy M (2011). *Sports Eng.*, 14(2): 147-154.

## ESTIMATION OF THE FLUID FORCES AROUND A FOOT BY A PRESSURE DISTRIBUTION ANALYSIS DURING BREAST-STROKE KICKING

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**Introduction** The propulsive force produced by a swimmer is one of the key factors determining swimming velocity in human swimming. In breaststroke, the propulsive force produced by lower limb's motion was larger than the propulsive force by upper limb's motion. If the methodology to predict the fluid force acting on the foot is established it could be a useful information to improve swimming performance. Therefore, the purpose of this study was to investigate a validity and a reproducibility of a methodology to estimate the fluid forces acting on a foot by the pressure distribution analysis using a robotic leg which can reproduce human's breaststroke kicking motion. **Method** The robotic leg which mounted the foot model performed a breaststroke kicking motion at three motion ranges and two motion speeds. The robotic leg was fixed above the water channel with a three-dimensional dynamometer, and eight pressure sensors were attached to the foot model. The fluid force acting on the foot model was clarified by two methods which used a dynamometer ( "F<sub>dynam</sub>" ) and used pressure sensors ( "F<sub>press</sub>" ). In the present study, we calculated the intra-class correlation coefficients ( ICCs ) of F<sub>press</sub> within and between trials to investigate the reproducibility and the correlation values between F<sub>dynam</sub> and F<sub>press</sub> to investigate the validity. **Results** The ICCs within trials were 0.993 and 0.984 for maximum of F<sub>press</sub> and impulse of F<sub>press</sub>, respectively. And the ICCs between trials were 0.992 and 0.982 for maximum of F<sub>press</sub> and impulse of F<sub>press</sub> respectively. The maximum of F<sub>press</sub> showed significant correlations between the maximum of F<sub>dynam</sub> (  $r = 0.888$  ) and between the impulse of F<sub>dynam</sub> (  $r = 0.820$  ). And the impulse of F<sub>press</sub> showed significant correlations between the maximum of F<sub>dynam</sub> (  $r = 0.870$  ) and between the impulse of F<sub>dynam</sub> (  $r = 0.881$  ). **Discussion** As significant ICCs values and significant correlations were observed, a validity and a reproducibility of the methodology to estimate the fluid force around a foot were accepted. Therefore, the methodology to estimate the fluid force around a foot could apply for hydrodynamic investigation of breaststroke kicking technique, and could get objective and consecutive information during a whole of kicking motion. If the methodology will be applied to the swimming training, swimmers could check their training effects or their conditions. **References** Takagi H, Wilson B. ( 1999 ). *Biomechanics and Medicine in Swimming VIII*, 101-106. Kudo S, Yanai T, Wilson B, Takagi H, Ross Vennell R. ( 2008 ). *Journal of Biomechanics*, 41, 1131-1136. Marinho D, Reis V, Alves F, Vilas-Boas J, Machado L, Silva A, Rouboua A. ( 2009 ). *Journal of Applied Biomechanics*, 25, 253-257

## CONTRIBUTION TO PROPULSION OF KICKING IN FRONT CRAWL SWIMMING

Ichikawa, H., Tahara, R., Taba, S., Taguchi, M.

Fukuoka University

**Introduction** It was supposed that the faster the swimming velocity was, the more difficult the kicking motion in front crawl swimming accelerated water backward and produced propulsive force. The aim of this study was to investigate the propulsive force of kicking and clarify how the kicking contributed to the propulsion in front crawl swimming. **Methods** A male well-trained swimmer (age: 22.0 yrs., best record of 50m Fr.: 24.9sec) participated two experiments as a subject. The first experiment was to measure the velocity in front crawl swimming with maximal effort. In second experiment, the swimmer was towed by the towing system, which could measure towing tension and velocity, in two conditions such as gliding posture and kicking trial with five different velocities from 1.2 to 2.3m/s. The swimming acceleration was measured using a wireless logger system with inertial sensors attached on swimmer's low back. Based on our model of dynamics in swimming direction, the kicking propulsive force "F<sub>p</sub>" was calculated as "F<sub>p</sub> = m a - F<sub>t</sub> - F<sub>d</sub>", where "m" and "a" were swimmer's mass and swimming acceleration, "F<sub>t</sub>" and "F<sub>d</sub>" were the towing tension and passive drag of whole body, respectively. The passive drag was calculated by the towing velocity in the kicking trials and the coefficient of drag derived from the towing tension in the gliding posture trials. **Results** The mean velocities in the kicking trials were 1.26, 1.51, 1.82, 2.05 and 2.29m/s, respectively. The 4th and 5th trials were faster than the mean velocity in front crawl swimming with maximal effort 1.96m/s. The mean propulsive forces of kicking were -59.4, -83.5, -104.5, -234.4 and -228.3N, respectively. It was observed that the maximal propulsive forces of kicking were positive values in all kicking trials. **Discussion** The observed positive propulsive forces in the faster trials showed that the kicking motion would be able to produce propulsive force even in fast swimming. However, the mean propulsive forces were negative in all trials. It was suggested that the whole motion of kicking would produce resistance and be one of the factors to deceleration. The results cannot explain the advantage of kicking in swimming performance, which the swimming with kicking is faster than without kicking. The reasons would include that our dynamic model was taken account of swimming direction only. The kicking motion would produce the vertical hydrodynamic force and keep the whole body horizontal (Yanai, 2001), so the vertical force would contribute to decrease the resistance of whole body "F<sub>d</sub>". It was suggested that the advantage of the vertical force of kicking would exceed the disadvantage of the resistance in swimming direction, so the kicking would contribute to swim faster in front crawl swimming. **References** Yanai, T., (2001). *Journal of Biomechanics*, 24, 235-243

## CHANGES OF PHYSIOLOGICAL TREMOR AFTER MAXIMUM INTENSITY EFFORT IN MALE AND FEMALE YOUNG SWIMMERS

Mazur-Rozycka, J.1, Gajewski, J.1,2, Zmijewski, P.1, Rozycki, S.2, Busko, K.1,2, Michalski, R.1

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**Introduction** It was demonstrated that the maximum amplitude of the exercise-induced tremor occurred with some delay in relation to the physical effort performed (Gajewski, 2006). The aim of this study was to determine the changes of postural physiological tremor following maximum intensity effort performed on arm ergometer by young male and female swimmers. **Methods** Ten female (age 15.0±0.9 years, body mass 58.9±6.3 kg, body height 171.6±6.5 cm and training experience 6.2±1.6 years) and nine male (age 14.8±0.5 years, body mass 67.3±6.4 kg, body height 180.6±7.2 cm and training experience 6.4±1.8 years) young swimmers served as a subjects in the study. Hand tremor was measured accelerometrically in a sitting position before the 30-second anaerobic test on arm ergometer and then 5, 15 and 30 minutes post-test. An accelerometer was placed on one-kilogram load held as motionless as possible on the subject's hand (forearm in horizontal position, back and elbow supported). The 32-second course of acceleration was recorded (200 Hz sampling frequency) for each subject. Power spectrum density function was estimated using the fast Fourier transform procedure. Mean log-powers in 1 to 5 Hz (L1-5) and 10 to 20 Hz ranges (L10-20) were extracted for further analysis. The mixed-design ANOVA (fixed effect: gender) was employed to detect differences between subsequent measurements. **Results** Low-frequency tremor log-amplitude (L1-5) increased (repeated factor:  $p < 0.001$ ) from -7.96±0.45 to -7.33±0.58 and from -6.85±0.53 to -6.29±0.59 in women and men, respectively (gender:  $p < 0.001$ ) 5 minute

post-test. High-frequency tremor log-amplitude (L10-20) increased from  $-8.26 \pm 0.87$  pre-exercise to  $-7.88 \pm 0.81$  5 minutes post-exercise ( $p < 0.01$ ). No effect of gender was found. The post-hoc comparison showed that the highest tremor log-amplitude (L10-20) occurred 5 minutes post-exercise. Recovery from increased tremor took 30 minutes. Discussion The study confirmed a previously reported significant increase of tremor amplitude after physical effort (Gajewski, 2006). Tremor spectra measured in young female and male swimmers differed only in low-frequencies. The increased tremor amplitude was observed even 30 minute post-exercise. Exercise-induced changes in tremor were similar in males and females. Just as we thought, the increased tremor following fatigue appeared 5 minutes after completion of exercise. Such changes in tremor after exercise may be result of temporary disorders of control mechanisms in the nervous system. Acknowledgements The study was supported by Ministry of Science and Higher Education No. NRSA1 001051 References Gajewski J. (2006). *Acta Bioeng Biomech* 8:103-110.

### **INTRACYCLIC ACCELERATION VARIATIONS ASSESSMENT IN ELITE LONG DISTANCE SWIMMERS WITH AN ACCELEROMETER DEVICE**

Company Badia, G.

*barcelona university*

**INTRODUCTION** The aim of an efficient swimming, especially important for endurance swimmers, is to keep the momentum as constant as possible in order to maximize its economy avoiding the increase of energy required to overcome the water resistance in every acceleration (Colwin, 1992). The study of the intracyclic variation of the horizontal velocity of center of mass is being used to determine this parameter, and results show that high level swimmers make biomechanical adaptations to maintain low velocity fluctuations (Seifert et al., 2010). The aim of this study is to use an accelerometer, a very small and unobstructive device which allows to obtain an easily and accurate quantification of the intracyclic acceleration variations (Callaway, Cobb, & Jones, 2009), to determine this parameter and the associate changes with increasing submaximal velocities. **METHODS** As a preliminary study, two elite endurance swimmers were monitored at three different competitive paces (85%, 90% and 95% 1500m pace) during 500m using a triaxial accelerometer device situated in the sacrum. **RESULTS** Raw graph data define a specific profile for each swimmer regardless of the pace. Statistically, both swimmers show significant differences ( $p < 0.05$ ) in nearly all the descriptive acceleration parameters (mean, SD, max, min, rang) and with the stroke parameters (stroke length and stroke frequency) in the 3 intensities. They also have significant correlation ( $p < 0.05$ ) of all these variables with the changing velocity except for the stroke length. **DISCUSSION** The obtained data shows that monitoring swimming with an accelerometer define a specific graphic profile for each swimmer, resulting from the individual technical adaptations to drag and force generation, and it also allows to determine directly its accelerometer and stroke characteristics. With them, we can assess its usual values and their changes with increasing speed. So, this device can be used to control regularly swimmers training and their adaptation to changing constraints in different tasks. **REFERENCES** Callaway, A. J., Cobb, J. E., & Jones, I. (2009). A Comparison of Video and Accelerometer Based Approaches Applied to Performance Monitoring in Swimming. *International Journal of Sports Science & Coaching*, 4(1), 139-153. Colwin, C. M. (1992). *Swimming into the XXI century*. Champaign (Illinois): Ed. Leisure Press. Seifert, L., Komar, J., Lepretre, P. M., Lemaître, F., Chavallard, F., Alberty, M., . . . Hellard, P. (2010). Swim Specialty Affects Energy Cost and Motor Organization. *International Journal of Sports Medicine*, 31(9), 624-630.

### **ELECTROMYOGRAPHIC ANALYSIS OF MUSCLE RECRUITMENT PATTERNS ON STATIONARY AND SLIDING ROWING ERGOMETERS**

Osborne, M., Pritchard-Peschek, K., Manning, J.

*Queensland Academy of Sport*

**Introduction** To better replicate on-water rowing movements, the addition of slide rails allows the mass of the ergometer to move beneath the rower during the recovery phase of the stroke. Although the general patterns of muscle recruitment during the stroke cycle of stationary ergometry have been identified<sup>1-2</sup>, little information exists on the differences in technique, and thus muscle recruitment patterns between stationary and sliding ergometer rowing. The purpose of the present study was to identify potential differences in rowing technique between stationary (STAT) and sliding (SLIDE) ergometers by determining the sequence of muscle recruitment patterns. **Methods** Seven elite U23 male heavyweight rowers completed two 2000 m trials on either a stationary or sliding Concept II ergometer, followed by two 60 s trials in each condition at the same respective speeds and stroke rates to determine muscle recruitment patterns using electromyographic (EMG) activity. **Results** There was no difference in 2000 m performance between trials (STAT:  $6:12.7 \pm 5.3$  s;  $432.7$  W vs. SLIDE:  $6:13.9 \pm 4.2$  s;  $428.5$  W;  $P > 0.05$ ), although stroke rate was higher in the SLIDE ( $36.5 \pm 4.0$  strokes-min<sup>-1</sup>) compared to the STAT trial ( $29.7 \pm 1.7$  strokes-min<sup>-1</sup>;  $P > 0.05$ ). Biceps femoris, trapezius and latissimus dorsi were recruited earlier in the recovery phase of the SLIDE compared to the STAT trial ( $P < 0.05$ ). **Discussion** Differences exist between STAT and SLIDE ergometry during the recovery phase, possibly in an attempt to control the rower and ergometer's momentum when approaching the catch position. Technique is therefore different between rowing modes, and coaches may need to modify technical instructions to rowers accordingly. **References** 1. Lamb, D.H. (1989). *Am J Sports Med*, 17, 367-373. 2. Rodriguez, R.J., Rodriguez, R.P., Cook, S.D., Sandborn, P.M. (1990). *J Sports Med Phys Fit*, 30, 103-108.

### **BODY STABILITY IN THE VERTICAL POSITION AND THE KINEMATIC PARAMETERS OF UPPER LIMB MOVEMENT IN SYNCHRONIZED SWIMMING**

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**Introduction** The aim of this study was to investigate dependences between the kinematic parameters of upper limb movement during support scull and a swimmer's body stability in the vertical position. In addition, this paper also proposes an objective criterion for the division of the exhibited upper limb movements in terms of movement cycles and phases. **Methods** Twelve position markers were placed on the pubic symphysis, head and middle finger and at the transverse axes of selected upper limb joints. The entire movement was filmed by cameras placed in watertight housings. The following parameters were calculated: the time of the entire scull cycle; the time of the first and second phase of the scull cycle; the flexion and extension angle of the elbow and wrist joint; the flexion; the adduction and abduction angle of the shoulder joint; the adduction and abduction angle of the forearm to/from the trunk; the ranges of movement of the wrist, elbow and shoulder joints; the range of movement of forearm adduction towards the trunk; and the range of movement of shoulder adduction towards the trunk. **Results** The head marker was characterized by a significantly larger range of movement in the forwards-backwards and right-left directions than the pubic symphysis. Statistical analysis indicated that a significant difference exists

between the sculling angle and the elbow joint angle not only in the angles themselves but also for the ranges of movement. When analyzing the angles as well as the ranges of movement created by these joints, it can be found that the largest movement range is exhibited in the adduction movement made by the forearm. Statistical analysis found that the first phase (the shoulder movement in the lateral direction) is significantly shorter than the second phase (the shoulder movement in the medial direction). Discussion A comparison of the time of the sculling movements found that the support scull cycle times were similar to the ones reported in the studies by Hall (1995), Rostkowska et al. (2005) and Homma and Homma (2008). The results of this study found that the time of the movement cycles had little variability in the group of examined swimmers. The scull angles proposed in the study can constitute a criterion for dividing the upper limb movement of support scull into phases. It was found that the ability to maintain body stability by swimmers in the vertical position is dependent upon the range of movement by the elbow and wrist joints. Homma and Homma (2008) presented an analysis of the exhibited angular movements by measuring the minimum, maximum and ranges of movement of the elbow. Their study was found to confirm the results found in this study on the flexion of the wrist joint. References Hall, S.J. (1995). Proceedings of the XIIIth International Symposium on Biomechanics in Sports, 44-47. Homma, M. & Homma, M. (2008). Proceedings of the 1st International Scientific Conference of Aquatic Space Activities, 110-115 Rostkowska, E., Habiera, M., & Antosiak-Cyrak K. (2005). Human Kinetics, 14, 51-66.

### COMPARATIVE ANALYSIS OF THE REACTION TIME FOR HIGH LEVEL SPRINTERS AND HURLERS IN THE YOUTH, JUNIOR AND ABSOLUTE CATEGORIES

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1: UVic-GREAF (Vic, Spain), 2: UB (Barcelona, Spain), 3: INEFC-SSRG UB (Barcelona, Spain)

**Introduction** At the sprint start, reaction time (RT) is the interval between the presentation of an eliciting stimulus (sound of gun) and the initiation of the subject's response. It has been proven that RT has no influence whatsoever over the final results obtained in a sprinting race; RT is neither a determining variable in sprints up to 10 m; and nor are there any major differences between men and women at the main competitions (López, 2006). **Methods** Purpose: To analyse if there are any significant differences between RT in high level young sprinters from the Youth and Junior categories and high level Absolute athletes. We have analysed the final rounds at the IAAF World Championships Daegu 2011, Moncton 2010 and Lille 2011 (Absolute, Junior and Youth categories, respectively). For the 100 m and 200 m events, the variables compared were the official time to finish line and RT. For 110 m hurdles and the 100 m hurdles, only the RT was studied. Results When comparing each one of the events from the 3 categories as a whole, we observed that there were statistically significant differences ( $p < 0.01$ ) between the average times to finish line in the 100 m and 200 m for both men and women. When comparing RT, we observed that there were no statistically significant differences ( $p < 0.05$ ) between the 3 categories in the men's and women's 100 m and 200 m and the 110 m hurdles. There were, however, statistically significant differences ( $p < 0.05$ ) in the 100 m hurdles. When studying the RT of the 6 races analysed, no statistically significant differences were found, which means that the previous results were corroborated. For further contrasting purposes, the championships were compared in pairs. For the men's 100 m, there were statistically significant differences ( $p < 0.05$ ) between all the categories in times to finish line but none in RT. In the women's 100 m and the men's and women's 200 m, there were also statistically significant differences ( $p < 0.01$ ) between the Absolute category and the Junior and Youth categories in the average times to finish line, but not between these two. There were no statistically significant differences in RT between any of the categories in the men's and women's 100 m and 200 m, and the men's 110 m hurdles. Discussion The results obtained corroborate that RT values for Youth, Junior and Adult sprinters are thus very similar. Nevertheless, when observing displacement velocity, formulated as time to finish line, the results obtained in the aforementioned categories vary, since many other aspects influence this value, i.e. strength, speed resistance and technical skill. References López JL (2006). Doctoral Thesis, University of Barcelona.

14:00 - 15:00

### Mini-Orals

#### PP-BN04 Biomechanics [BM] 4

### GENDER DIFFERENCE DURING DEFENSIVE CUTTING ACTION: THREE DIMENSIONAL MOTION RECONSTRUCTIONS FROM VIDEO SEQUENCES

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**Introduction** Defensive performance is one of the very important factors for success in the modern football games. Recently, defensive cutting actions in male in football game situations have been analyzed (Sasaki et al., 2013); however, female's cutting actions were unknown. The purposes of this study were to analyze female's defensive movements in game situations and to determine the difference between male and female athletes. **Methods** Seven defensive scenes (4 males and 3 females) in which a subject was responding to an offender's dribble attacking were analyzed using a model-based image-matching technique. We calculated centre of mass height, and trunk, hip and knee kinematics during defensive cutting actions. A relative centre of mass heights was expressed as a ratio of each participant's height. Each parameter was checked at the point of initial foot contact (IC), the point of the lowest centre of mass height (COM low), and the point of foot off (FO). Results Females (mean (SD): 3.3 (1.4) cm) had bigger change in centre of mass height between IC and COM low compared with males (6.9 (1.0) cm). A relative centre of mass heights at IC in females (0.39 (0.03) cm/m) were higher than those in males (0.44 (0.02) cm/m). Furthermore, trunk and hip flexion angles at IC in females (38 (4) deg.; 19 (15) deg.) tended to be smaller than those in males (64 (15) deg.; 47 (13) deg.). Discussion Compared with males, in football games which is not lab-setting, females contacted to ground in higher centre of mass point and displayed a bigger change in centre of mass height between IC and COM low. This could be a reason that females showed the posture of smaller trunk and hip flexion angles at IC. A small displacement and low centre of mass gravity would be beneficial in agility skill (Bradshaw et al., 2011). Females demonstrated a low trunk forward inclination angle (Nagano et al., 2011) and less hip flexion angles (McLean et al., 2004) compared with males during cutting manoeuvres. These findings from lab-setting trials support our findings from the present field play study. Therefore, coaches for female athletes should check the posture at the moment of initial foot contact during defensive cutting actions. References Sasaki S, Koga H, Krosshaug T, Sakurai T, Fukubayashi T. (2013). Gazz Med Ital. in press. Bradshaw RJ, Young WB, Russell A, Burge P. (2011). J Sci Med Sport. 14(1), 65-69. Nagano Y,

Ida H, Akai M, Fukubayashi T. (2011). *J Sports Sci.* 29(14), 1525-1534. McLean SG, Lipfert SW, van den Bogert AJ. (2004). *Med Sci Sports Exerc.* 36(6), 1008-1016.

### A CASE STUDY OF EXTERNAL KINETICS FOLLOWING THE SPRINT START IN A UNILATERAL TRANSTIBIAL AMPUTEE

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1: *Cardiff Metropolitan University (UK)*, 2: *University of Southampton (UK)*, 3: *Sport Wales, (Cardiff, UK)*, 4: *German Sport University (Cologne, Germany)*

Introduction Stance limb force production is vital to sprint running performance. Previous studies of maximum velocity sprinting have shown both single- and double-leg amputees generate lower vertical ground reaction force (GRF) than the intact limb or healthy controls (Brüggemann et al., 2008; Weyand et al., 2009; Grabowski et al., 2010), which may be related to reduced capability. Able bodied athletes create higher vertical GRF in the first than second step of a maximal sprint (Salo et al., 2005). To the authors' knowledge there is no previously published data of sprint start GRFs in amputee athletes. The aim of this study was to describe the external kinetics in the first two steps of a maximal sprint in order to gain a greater understanding of amputee sprint performance. Methods One T44 athlete (100 m PB 12.74 s, mass 88.0 kg) performed seven maximal 20 m sprints from blocks. Force plates (1000 Hz) captured the first two stance phases after the blocks (first: blade, second: intact limb). Temporal and kinetic data were used to calculate discrete GRF values and impulse via the trapezium rule. Change in velocity was calculated by dividing impulse by mass. Mean and standard deviation were calculated across all trials. Results Mean peak vertical GRF was  $1222 \pm 131$  N in the first and  $1787 \pm 132$  N in the second stance. Net horizontal and vertical impulses were  $68.8 \pm 17.4$  and  $-10.0 \pm 22.1$  Ns in the first and  $74.8 \pm 3.2$  and  $68.2 \pm 20.9$  Ns in the second stance respectively, equating to horizontal and vertical velocity changes of  $0.81 \pm 0.21$  and  $-0.12 \pm 0.26$  m/s in the first and  $0.88 \pm 0.04$  and  $0.74 \pm 0.25$  m/s in the second stance. Vertical impulse and velocity change in the first stance were negative in six trials. All other values were positive. Discussion Reduced vertical GRF production in the first, bladed stance compared to second, intact limb stance conflicted with previous able bodied start data (Salo et al., 2005), but matched patterns in amputees at maximum velocity (Grabowski et al., 2010). Vertical force impairment in the first stance was such that the athlete was unable to raise their mass centre during contact. Horizontal impulses were lower in the first stance than the second, further suggesting reduced force producing capabilities due to the blade. References Brüggemann G-P, Arampatzis A, Emrich F, Potthast W. (2008). *Sports Tech.*, 1, 220-227. Grabowski AM, McGowan CP, McDermott WJ, Beale MT, Kram R, Herr HM. (2010). *Biol. Lett.* 6, 201-204. Salo AIT, Keränen T, Viitasalo JT. (2005). *Proceedings 23rd ISBS Conference.* 313-317. Weyand PG, Bundle MW, McGowan CP, Grabowski A, Brown MB, Kram R, Herr H. (2009). *J Appl. Physiol.* 107, 903-911.

### A RELIABILITY ANALYSIS OF KINETIC AND TEMPORAL VARIABLES RELATING TO VERTICAL JUMP PERFORMANCE

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Introduction: A typical kinetic analysis of countermovement jump performance (CMJ) usually involves the calculation of performance variables such as jump height, power & velocity. However further levels of analysis can offer advanced variables which may reveal important information about mechanical mechanisms underlying performance changes (Cormie et al. 2009) providing these advanced variables exhibit satisfactory between-session reproducibility. Hence, this study aimed a) to identify new mechanical variables associated with CMJ performance and b) to quantify their reproducibility using a range of reliability statistics. Methods: Seven males ( $23.6 \pm 2.7$  years) accustomed with jumping activities completed 2 identical testing sessions separated by 48 hrs. The sessions comprised a dynamic warm-up, 2 practice & 3 maximal CMJ's performed on a force plate (1000Hz). Jump height (JH) was calculated via the take-off velocity method & 68 other variables were derived from the force-time curves. Pearson correlation coefficients were calculated to determine associations with JH. Three methods for assessing reliability were also used after the data were assessed for heteroscedasticity: 95% Limits of Agreement (LOA), Coefficient of Variation (CV) & Intraclass Correlation Coefficient [(3,1) consistency]. Results: Out of the 68 variables analysed, 25 correlated significantly with JH ( $p \leq 0.05$ ). Although 11 of these variables (e.g. power & velocity) were derived from the initial level of analysis, 14 of the advanced variables also displayed significant correlations. 51 of the 68 variables showed acceptable levels of reproducibility, these were derived from the initial & advanced levels of analysis. A key variable such as the duration from peak velocity to take-off was particularly indicative of the overall trend demonstrating a CV of 1.97%, a random error of 6.23% and LOA of  $0.00 \pm 0.002$  s. The remaining 17 variables showed high levels of variability (random error >20%), these were mainly related to the duration & slope characteristics of certain key phases (e.g. passive unloading). Discussion: Even though commonly used variables (e.g. power) do not offer advanced mechanical information, they still provide reliable details about CMJ performance. It is clear that more in depth bio-mechanical information can be gained from multiple levels of analysis; however, the resulting variables do not all display adequate stability for use during consecutive sessions. Whilst it may be worthwhile to conduct a comprehensive analysis of the CMJ to understand how certain interventions bring about changes in performance, the present findings highlight the need to consider a range of reliability statistics before interpreting such findings. References: Cormie, P. et al. (2009) *J Strength Cond Res* 23(1): 177-186.

### THE RELATIONSHIP BETWEEN PLAYER TECHNIQUE AND FORCES GENERATED IN RUGBY SCRUMMAGING

Churchill, S.M., Preatoni, E., Stokes, K.A., England, M., Trewartha, G.

*University of Bath*

Introduction The scrum is integral to the game of rugby union. Although the International Rugby Board (IRB) laws state that players must not "charge" at each other and that players should remain stationary until the ball has been thrown into the scrum (IRB, 2013), modern scrummaging often endeavours to achieve a high-impact engagement. Little is known about how player technique influences the forces experienced at impact and how these forces may then influence the forces produced during the sustained push phase of scrummaging. Therefore, our aim was to understand the relationships between player kinematics, engagement forces, and forces during the sustained push phase. Methods Twelve elite professional rugby union forward packs performed up to four scrummaging trials against a scrum machine and one trial was selected for analysis. The scrum machine (Dictator, Rhino Rugby, UK), was instrumented with a bespoke three-dimensional force measurement system (Preatoni et al., 2012). Player kinematics were obtained by manual digitisation of multiple two-dimensional 50 Hz video sequences as described by Preatoni et al. (2012) and parameters recorded at movement onset (@onset), at engagement with the machine (@engage), and during the sustained push phase. Vertical and compression forces were recorded throughout each scrum and peak and average values extracted during both the initial engagement phase and sustained phase. Pearson correlations were used to determine associations between player technique and performance. Results and Discussion The further

the front row was from the scrum machine @onset, the greater the velocity of the front row @engage ( $r=0.790$ ,  $p=0.002$ ). A high velocity of the front row @engage was associated with greater peak compression force, although this was not significant ( $r=0.434$ ,  $p=0.158$ ). However, a higher peak compression force was only weakly correlated with a greater compression force during the sustained push ( $r=0.190$ ,  $p=0.554$ ), indicating that a large "hit" at engagement did not result in better generation of force during the sustained push phase. Therefore, there was little "carry-over" effect from a large hit at engagement. Furthermore, larger peak compression forces were associated with greater peak downward forces ( $r=0.530$ ,  $p=0.076$ ). These results suggest that employment of an aggressive engagement technique which strives to achieve a high-impact engagement may not contribute to better sustained scrum performance, and the accompanying large downward forces may increase the risk of scrum collapse, which disrupts play and is potentially injurious. References IRB (2013). Laws of the Game. International Rugby Board, Dublin. Preatoni E et al. (2012). P I Mech Eng P - J Sports Eng Tech, 226(3/4), 266-273. Acknowledgement Funded by the International Rugby Board

## GROUND REACTION FORCES OF WORLD CLASS RACE WALKERS

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Introduction Race walking is an abnormal form of gait where no visible loss of contact with the ground is permitted and the knee must be straightened from heel strike until the 'vertical upright position' (IAAF rule 230.1). The absence of knee flexion during early stance does not occur in normal walking (Levine et al., 2012) and might therefore have an effect on ground reaction force (GRF) patterns. Little research has been carried out on GRFs in race walking despite the value of kinetic data in analysing this unique form of gait. The aim of this study was to measure and describe typical ground reaction force patterns of world-class race walkers. Methods Sixteen international race walkers performed multiple trials at their season's best pace in a laboratory setting. The group consisted of nine men (stature: 1.79 m ( $\pm$  0.05); mass: 68.0 kg ( $\pm$  6.8)) and seven women (stature: 1.67 m ( $\pm$  0.05); mass: 55.8 kg ( $\pm$  3.9)). Each athlete race walked along a 45 m indoor track at a speed equivalent to their season's best time for 20 km or 50 km. Ground reaction forces (Kistler, Winterthur) were recorded of the contact phases of both legs within the same trial (1000 Hz). Athletes completed at least ten trials each and the three closest to the target time were analysed for kinetic variables provided there was no evidence of targeting by the walker. Results In the vertical direction, a distinct impact peak was identified in the GRF traces of 13 of the 16 participants. In all those traces with an impact peak, the impact peak value was smaller than the loading peak ( $p < 0.001$ ). The loading peak force was also greater than the midstance force and the push-off peak force ( $p < 0.001$ ), but these two final vertical peaks were not different from each other. In the anteroposterior direction, a brief anterior impulse beginning at initial contact and lasting 17 ms ( $\pm$  6) was identified in the traces of all but one participant. The following braking phase lasted 41.1% ( $\pm$  5.9) of total stance time. In the mediolateral direction, there was a pattern of medially directed forces from 28.7% ( $\pm$  5.1) to 62.3% ( $\pm$  5.2) of total stance time, after which laterally directed forces were observed until toe-off. Discussion Although the GRFs of elite race walkers were similar to normal walking, there were some distinct differences. The final vertical push-off peak was much flatter, possibly due to the need to fully extend the knee until midstance, and to prevent vertical lift and subsequent loss of visible contact. The medially directed forces during midstance appeared to occur due to contralateral pelvic tilt which is itself a response to the fully extended knee, while the final lateral forces acted to return the pelvis to a neutral position prior to the next step. References Levine D, Richards J, Whittle MW (2012). Whittle's Gait Analysis (5th ed.). Edinburgh, Churchill Livingstone.

## THE RELATIONSHIP BETWEEN FOOT ALIGNMENT AND HIND-FOOT KINEMATICS DURING WALKING.

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Introduction Variations of foot alignment, such as low arch or high arch are thought to be an intrinsic risk factor because of kinematic changes of the lower extremity [1]. The purpose of this study was to examine the relationship between static foot alignment and the hind-foot kinematics during walking. Methods Seven healthy male subjects participated in this study. IRB approved informed consent was obtained from all subjects. All subjects performed one gait-cycle task on their right foot in the test area. Each trial was recorded using lateral fluoroscopy at a rate of 60 Hz. Radiographic images of the subjects' feet were obtained under static conditions with and without weight bearing for measuring static foot alignment. In addition, CT scans from 15cm proximal to the lateral malleolus to the plantar surface were obtained for each foot/ankle using with a slice thickness of 0.4 mm. In vivo three dimensional bone positions during walking were determined using 3D-2D model-image registration techniques [2] with bone models, that were developed from CT data, and single plane fluoroscopic images between the time of heel contact and toe off. Pearson product-moment correlation coefficients were used to determine the relation between static foot alignment and hind-foot kinematics during walking. Results The primary talocrural joint motion during stance phase was in sagittal plane. All subjects experience talocrural plantar flexion from footstrike to approximately the first half stance phase, while they experienced dorsiflexion during the last half of stance phase. Subtalar joint motion was complex with significant calcaneal dorsiflexion, eversion and external rotation throughout stance phase. For the relationship between static foot alignment and the talocrural and subtalar joints, increasing the calcaneal pitch angles both with and without weight bearing conditions were positively associated with increased range of motion of the talocrural and the subtalar joints during stance phase. Decreasing navicular height tended to be associated with increased range of talocrural joint motion during stance phase. Discussion Hind foot function is critical to ambulation, yet our knowledge of hind foot kinematics during locomotion is limited. These results indicate that the static measurement obtained radiographic image has possibility to predict range of talocrural and subtalar joint motion during walking. References [1]. Kaufman, KR., et al. 1999. [2]. Banks SA., et al 2003

## SEX DIFFERENCES IN LANDING KINEMATICS DURING JUMPING EXERCISE

Daniuseviciute, L., Brazaitis, M., Linonis, V.

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The aim of the study was to evaluate sex differences in landing from a jump in relation to lower extremity landing kinematics. Healthy and physical active females ( $n=10$ ) with normal menstrual cycle and healthy and physically active males ( $n = 10$ ) whom age 19-23 years participated in the study. All the subjects were physically active, but did not take part in any formal physical exercise or sport program. After 10-15 min of not-intensive warming-up (slow pedaling velogometer, with the heart rate of 120-130 b / min) 100 drop jumps were started on vertical jump force plate (New Test, Finland). Subjects were standing on 75 cm stage, then stretched the right leg forward and made drop jumps on vertical jump force plate. Before jumping the electrodes and telescopic end-blokes were attached and scoreless

values were set. Jumping height (H), EMG signal and angles of electrogoniometer were measured of every drop jump. During one drop jump EMG of vastus lateralis, biceps femoris, peak values of hip, knee and ankle angles were calculated. When participant got to braking phase (beginning of drop jump to the peak knee joint angle), was named as phase T 1; push-off phase (peak knee joint angle to the end of jump), was named T 2 phase. EMG values were analyzed by RMS (root mean square). The fatigue index of H in males was  $3.44 \pm 0.042\%$ , and females  $4.62 \pm 0.041$ . There was reverse significant relationship between changes in females EMG vastus lateralis (T2 phase) and peak knee angle ( $r = -0.75$ ,  $P < 0.05$ ), also peak hip angle ( $r = -0.81$ ,  $P < 0.05$ ) during last ten drop jumps. There was reverse significant relationship between changes in males EMG vastus lateralis (T2 phase) and peak knee angle ( $r = -0.73$ ,  $P < 0.05$ ), also peak hip angle ( $r = -0.78$ ,  $P < 0.05$ ) during last ten drop jumps. We found reverse significant relationship between changes in females EMG biceps femoris (T2 phase) and peak knee angle ( $r = -0.77$ ,  $P < 0.05$ ), also between peak hip angle ( $r = -0.83$ ,  $P < 0.05$ ) during last ten drop jumps. There was reverse significant relationship between changes in males EMG biceps femoris (T2 phase) and peak knee angle ( $r = -0.7$ ,  $P < 0.05$ ), also between peak hip angle ( $r = -0.78$ ,  $P < 0.05$ ) during last ten drop jumps. Women demonstrated lower peak hip, knee joint angles and lower EMG values in T2 phase when landing from a drop jump. Furthermore, correlations between H, EMG fatigue indexes and landing kinematics were generally larger for women than men. insert authors here

#### VALIDATION OF AN INERTIAL SENSOR AGAINST OPTOELECTRONIC MOTION CAPTURE UNDER DYNAMIC CONDITIONS

Kiani-Dehkordi, K.1, Lees, A.1, Butler, P.B.2, Barton, J.G.1

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**Introduction** Capturing 3D kinematics has been used widely in both clinical and biomechanical environments based on the detection of reflected infrared or visible light within a laboratory, for example with the Oqus system (Qualisys, Gothenburg, Sweden). To quantify the effects of an intervention on segmental movement, access to a valid tool usable both inside and outside of the laboratory is required. Therefore the aim of this study was to examine the validity of the XSens MTx inertial sensor unit against the Oqus motion capture system under dynamic conditions. **Methods** A combination of the Oqus motion analysis system, the XSens inertial sensor unit and the Targeted Training Equipment (TTE) were used. The TTE has an unstable rocking base that has been modified so that it can be released producing the same amplitude and frequency of movement for each trial. The Oqus system recorded the XYZ coordinates of four markers which were used to calculate the TTE object's tilt angle using Visual3D (C-Motion, Germantown, USA). The XSens attached to the TTE was used to capture the tilt angle simultaneously derived from the full algorithm and also from integrated angular velocity. The Root Mean Square Differences (RMSD) between the Oqus and XSens angle profiles were then calculated in MS Excel. **Results** A significant association was found between the Oqus and Xsens systems ( $p < 0.05$ ). The RMSD between the Oqus angle and XSens full algorithm angle was  $0.24 \pm 0.08^\circ$  and the RMSD between the Oqus angle and XSens angle derived from angular velocity was  $0.46 \pm 0.16^\circ$ . Under the dynamic condition of rocking the TTE over  $12^\circ$  both modes of angular calculations produced less than  $1^\circ$  error as compared to the Oqus system. **Discussion** The XSens inertial sensor unit produced a similar output to the Oqus system with a small error of less than  $1^\circ$ . A particular advantage of the XSens method of calculating tilt angle is that it is not constrained to be used in a laboratory. This makes it possible to test movement responses in clinical environments or even at home. One potential problem with angles derived from angular velocity is the signal drift which is a typical limitation for this type of measurement. Another limitation of the XSens sensor is that its full algorithm is affected by ferromagnetic materials but this effect can be eliminated by keeping a distance from such materials. McGinley et al. (2009) reported that a common clinical assessment error of  $2^\circ$  or less is acceptable. Thus, the XSens MTx sensor is a valid tool for recording angular movement under dynamic conditions. **References** MCGINLEY, J. L., BAKER, R., et al. 2009. Gait Posture 29, 360–369. Do not insert authors here

#### EFFECTS OF STRENGTH OF SHOULDER INTERNAL ROTATORS ON THE COMPETITION RESULTS IN ARMWRESTLING

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**Introduction** Technique and strength are the greatest contributing factors to winning an arm wrestling (AW) match (Hong, et al., 2011). We tried to find the relationship between strength of shoulder internal rotation and results of AW. This study would, by biomechanical analysis, evaluate the hypothesis that shoulder internal rotators play an important role on normal males in AW match. **Methods** Totally sixty healthy male volunteers who neither have any surgery experience on limbs nor any injury on limbs in last six months were recruited in this study. Thirty athletes were classified as training group; the others were classified as normal group. Winning or losing a match was determined by the rules of WAF (World Arm Wrestling Competition Federation) and World of Armwrestling. The dynamometer of maximum strength was measured with Biodex system (Biodex System 4 Pro, New York, USA). Strength of shoulder internal rotation of all participants should be tested. All subjects were tested before the AW experiment in order to evaluate their shoulder internal rotation force. **Results** Most subjects had maximum strength in eccentric contraction and lower speed ( $45^\circ/\text{sec}$ ). Comparison of detail of strength at different velocities and types of muscle contraction between winner and loser was conducted. The strength of shoulder internal rotation at angular velocity of  $45^\circ/\text{sec}$  ( $p = .001$  in eccentric contraction;  $P = .004$  in concentric contraction) and  $60^\circ/\text{sec}$  ( $P = .032$  in eccentric contraction;  $P = .041$  in concentric contraction) indicated significant differences between winner and loser in overall. **Discussion** Most subjects had maximum strength in eccentric contraction and at slower angular velocity, which indicated that participants had performed maximum strength on dynamometer. Nevertheless, the training subjects' greater strength in larger angular velocity might attribute to the specific characteristics of the sport they played (Bompa, 1999). The strength of arm shoulder internal rotation observed suggested that winner had greater torque values (Newton meter; N-M) than loser. The peak torque values were significantly higher in winner than loser overall in normal group, but not in training group. Winners had no greater peak torque than losers in training group for the following reasons: 1) Some winners of the training group had better technique than winners of normal group, hence they could win even though they had weaker strength than loser. Losers could have greater strength but just used the shoulder internal rotation, which resulted in failure. 2) It's been described that two of ten pairs reversed the situation because the winner did not use full force on dynamometer. 3) It's been presented that two losers of ten pairs did not use full force to content during match. **References** Hong MK, Lin CY, Liao YS, Hong CK, Wang LH. (2011). ISBS 2011, (Supl. 2), 267-270. Bompa TO, (1999). Periodization: theory and methodology of training (4th ed.). Champaign, IL: Human Kinetics.

## LINEAR AND ANGULAR KINEMATICS DURING SWIMMING AT ANAEROBIC THRESHOLD

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**Introduction** The anaerobic threshold (AnT) is a frequently used parameter to assess swimming aerobic performance, but the proper incremental protocol step lengths for its determination is still a controversial issue. Fernandes et al. (2011) concluded that short step lengths (i.e. 200m) are valid for AnT assessment, but it remains questionable if swimmer's kinematics is affected by the step duration. We aimed to compare the front crawl linear and angular kinematics at the AnT intensity in three variants of a swimming incremental protocol. **Methods** 8 national level swimmers (21.2±2.2yrs, 1.80±0.06m and 74.1±4.3kg), performed 3 variants of a front crawl incremental protocol (7x200-300-400m) until exhaustion (increments of 0.05m/s, 30s intervals and 48h between protocols). The individual AnT was assessed using the blood lactate vs. velocity curve modelling method. 2 cameras (above and below water surface in the sagittal plane) recorded 2 stroke cycles in each penultimate lap of the step at AnT. Velocity (v), stroke frequency (SF), stroke length (SL), maximal finger depth (MF), backward displacement of the hand (BD), absolute trunk inclination (TI) and hip's intracycle velocity variation (IVV) were calculated. Friedman's test was used to compare protocol variants ( $p \leq 0.05$ ). Results Linear and angular parameters showed similar behaviour at AnT for 7x200-300-400m, respectively: (i) v: 1.26±0.20, 1.22±0.22 and 1.26±0.27m.s<sup>-1</sup>; (ii) SF: 0.49±0.08, 0.43±0.03 and 0.50±0.07Hz; (iii) SL: 2.57±0.35, 2.62±0.35 and 2.66±0.24m; (iv) MF: 0.69±0.07, 0.67±0.08 and 0.66±0.03m; (v) BD: 0.60±0.11, 0.57±0.13 and 0.59±0.13m; (vi) TI: 7.88±4.87, 8.31±4.27 and 9.84±6.62°; IVV: 0.21±0.09, 0.19±0.07 and 0.21±0.05. **Discussion** The different step lengths did not affect the linear and angular kinematics at AnT intensity. V, SF and SL followed the trend as described before for the 200m protocol: (i) at AnT, v and SF begin to increase, while SL slight decreases (Fernandes et al. 2011); (ii) at the same velocity presented in this study, some estimators suggest a change in IVV and TI (Zamparo et al. 2009). Aiming to collect reliable and valid data with low impact (i.e. at shorter time) in swimmers' activities, the current data suggest that the 200m step length is a suitable option to be used in incremental intermittent protocols to AnT assessment. Future studies are required to determine the kinematic and coordinative behaviours throughout an overall incremental swimming protocol. **References** Fernandes R et al. (2011). *Int J Sports Med*, 33. Zamparo P et al. (2009). *Eur J Appl Physiol*, 106. **Acknowledgements** CAPES 5431-10-7/2011, PTDC/DES/101224/2008 (FCOMP-01-0124-FEDER-009577) and Fundación Séneca 1873/EE/12. Do not insert authors here

## HIP-KNEE COORDINATION AND SNATCH PERFORMANCE FOR A NOVICE WEIGHTLIFTER

Ho, K., Lorenzen, C., Wilson, C., Williams, M., Saunders, J.

*Australian Catholic University*

**Introduction** Body positions at specified phases of the snatch have been used to assess technique. The positions adopted, both at the set-up and termination of the second-pull have been identified as markers of technical competence. Yet, it is how the weightlifter transitions from set-up to finish that may be the key to performance. Joint coordination during the snatch has not been investigated in depth. The few studies that explored 'timing', have focused attention on the duration of each phase or concentrated on describing the presence of the double knee bend and its benefit to performance. The aim of this study was to explore coordination through the timing of peak lower limb joint extensions, during the snatch for a novice weightlifter. It was anticipated that a joint coordination sequence that differentiates successful and failed attempts may emerge following data analysis. Such findings would help inform coaching practices. **Methods** A novice weightlifter (age=26years; mass=75kg; stature=171cm; 1RM=90Kg) performed 66 lifts at loads between 88-94%1RM. 3D motion analysis (ViconTM 500Hz) captured the data. Barbell and lower limb joint kinematic variables were normalized to the first peak bar displacement after the second pull. Time to peak joint extension was expressed as a percentage of the normalized lift. Logistic regression was used for statistical analysis. Results Time to peak joint extension occurred at 78.4±2.3% (hip) 78.6±2.4% (knee) and 79.2±2.3% (ankle) for all lifts. No single peak joint extension predicted a successful outcome (hip  $p=0.45$ ; knee  $p=0.67$ ; ankle  $p=0.59$ ); yet, a model including both time to peak hip extension and peak knee extension could predict successful lifts ( $p=0.01$ ; ROC=0.73). In this model, both parameter estimates were significant (hip:  $p=0.01$ ; knee:  $p=0.01$ ) and the size and direction of the relationship was indicated by the odds ratios of 29.41 for hip and 0.04 for time to peak knee extension. **Discussion** Coordination of proximal joints only was found to be significant to the outcome, the probability for success improved when peak hip extension occurred later in the lift and peak knee extension occurred prior to the hip. Effective force production relies on joint coordination in the second pull (Stone et al., 2006). Interaction of the hips and knees develop the force for the vertical jump and is often compared to Olympic weightlifting (Canavan et al, 1996). Our findings are consistent with the suggestion that the stretch-shortening cycle of the knee extensors initiates force production and hip extension continues contributing force in the second pull. **References** Canavan P, Garrett G, Armstrong L. (1996). *J Strength Cond Res*, 10(2), 127-130. Stone M, Pierce K, Sands W, Stone M. (2006). *Strength Cond J*, 28, 50-65.

## 3D KINEMATIC ANALYSIS OF CROATIAN WOMEN HIGH JUMP RECORD – 2,08 M

Bakovic, M., Antekolovic, L.

*Faculty of Kinesiology, University of Zagreb*

**Introduction** Croatian record holder for the women's high jump has been dominant female high jumper in the world for the past several years and she has repeatedly tried to break the world record (2,09m). The aim of this study was to determine kinematic parameters of the her high jump record which is second best jump in the history of women's high jump (2,08m). **Methods** Acquisition of the video recordings necessary for the kinematic analysis was made during IAAF Grand Prix meeting in Zagreb, 31st August 2009. Three digital Sony HDR-HC9E cameras, each with frequency of 50Hz were used. The cameras were recording last two strides of approach, take-off and flight phase. Data analysis was performed according APAS (Ariel Performance Analyses System) protocol standards. Data for the parameters most frequently used in high jump technique studies were calculated. Results Lengths of the strides (penultimate and last) were 233,99 and 208,58cm. Toe to bar distance was 84,00cm. Take off contact time was 0,160sec. Horizontal center of mass (CM) velocities: third last stride (6,89m/s), penultimate stride (7,06m/s), touchdown (6,47m/s) and take off (4,30m/s). Vertical CM velocity at take off was 3,63m/s. CM heights at: touchdown (99,73cm), amortization (106,51cm), take off (130,05cm), maximum CM height (205,54cm) and CM height relative to the bar height (-2,46cm). Knee angle of amortization and angle of take off were 143,31° and 40,17°. **Discussion** Values for the lengths of two last strides of the approach vary greatly due to individual characteristics of jumpers. Some jumpers shorten the last stride to increase the CM height at the beginning of take-off while others lengthen it to lower down CM. Ratio of the lengths of penultimate and last strides changes with the increase of the bar height with tendency to shorten the last stride (Antekolovic et al., 2006). We found that last stride is shorter than the penultimate for 10,85%. Shortening the last stride allows better positioning the take off foot on the

ground, shorter contact time and less decrease of the horizontal speed. Horizontal speed parameters (6,89 and 7,06 m/s) and take off time (0,16sec) are in average range values (6,3-7,5m/s and 0,14-0,18sec) for elite female high jumpers (Dapena, 2000). Take off time is the factor with biggest need for improvement. References Antekolovic Lj, Blazevic I., Mejovsek M., Coh M. (2006). Longitudinal follow-up of kinematic parameters in the high jump – A case study. *New Studies in Athletics*, 21(4), 27-37. Dapena J. (2000). The High Jump. In V. Zatsiorsky (Ed.), *Biomechanics in Sport*, 285-311. Ritzdorf, W., Conrad, A., Loch, M. (1989). Intra-individual comparison of the jumps of Stefka Kostadinova at the II World Championships in Athletics Rome 1987 and the Games of the XXIV Olympiad Seoul 1988. *New Studies in Athletics*, 4, 35-41.

**14:00 - 15:00**

## Mini-Orals

### PP-BN13 Motor Learning [ML] 1

#### ANALYSIS THE TRACKING EYE OF 10 EXPERTS AND 10 NOVICES SAILOR IN A VIRTUAL SIMULATOR.

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*Universidad Católica de San Antonio Murcia*

**Introduction** The visual search strategy is a determining factor in sports where the environmental conditions influenced, like in the case of the sailing. This is due to the influence of the information captured by the sense of sight over decision-making and motor behaviour performed by athletes (Vickers, 2007). The approach we have used aims to describe the visual conduct of experts and novices racer for the previous minute to the start signal. **Methods** The sample was made up by 10 expert and 10 novices sailors, all of them competed on the Optimist Class, in the Region of Murcia (Spain). An automated system of measurement, which integrates the following instruments: a) VSail-Trainer® sail simulator and b) Eye Tracking System®, was used. Research variables were the number of fixations, the location of the fixations and the fixations time on each location made by the competitor. The event was made up by one start of simulated race, with stable conditions of wind, competitor and sea. The simulated race reflected the same conditions as a real start. **Results** The results showed that expert sailors made a greater number of visual fixations than novice sailors. Looking at the distribution of fixations over 16 locations present in the projection of the start of simulated race, we can see that the expert sailors perform a greater number of fixations on the most important locations such as buoys of start, the clock, rivals and telltales among others, while novices sailors performed a greater number of fixations in less relevant locations such as out of screen, others places and boat hull. This also happens with the fixation time because novice sailors spent more time on less relevant localizations. **Discussion** The visual search strategy made by expert sailors is more active than in beginners, because the less experienced sailors tend to make a lower number of visual fixations with a higher fixation time. This is consistent with the theory expounded by Seung-Min Lee (2010) in volleyball, where novice athletes use a less active and more focused on specific localizations visual search strategy, while the expert athlete, uses a more active strategy. **References** Seung-Min. L. (2010). Does your eyes keep on the ball?: The strategy eye movement for volleyball defensive players during spike serve reception. *International Journal of Applied Sports Sciences*, 20(1), 128-137. Vickers, J.N. (2007). Perception, cognition and decision training. *The quiet eye in action*. Champaign: Human Kinetics.

#### GAZE BEHAVIOUR OF ASSISTANT REFEREES DURING THE JUDGING OF OFFSIDE IN FOOTBALL.

Koedijker, J., Schnyder, U., Kredel, R., Hossner, E.J.

*University of Bern*

**Introduction** The offside rule in football is one the most controversial rules in sports due to the relatively high error rate. The occurrence of errors is unsurprising as the task of the assistant referee (AR) is to judge whether an attacker is in offside position at the exact same moment that the ball is played on another part of the field. Sanabria et al. (1998) argued that errors occur because ARs shift their gaze from the attacker with the ball to the second-last defender at the moment of the pass. However, this hypothesis was rejected by studies of Oudejans et al. (2000) and Catteeuw et al. (2009). Unfortunately, methodological limitations (e.g. head-mounted camera rather than eye-tracker), experimental design (e.g. computer experimentation, employment of rather predictable situations) and empirically not completely satisfactory alternatives, make it seems rather premature to discard the gaze shift hypothesis completely. Therefore, the aim of this study was to investigate gaze behaviour of ARs on the field during the judging of offside, to our knowledge, a first attempt to study gaze behaviour of referees in such a dynamic and natural setting. **Methods** Three expert- (FIFA) and 3 near-expert (national level) ARs each judged 36 relatively complex, predetermined attack situations played by the U-21 team of a professional Swiss football club. During the experiment, ARs wore a lightweight, mobile eye tracking device (EyeSeeCam) that was connected to a lap top worn in a backpack to ensure complete mobility. Subsequently analyzed gaze variables are the number of saccades during a complete situation as well as the fixation locations at the moment of the pass. **Results** Results show that on average the experts incorrectly judged 12% of the situations compared to the near-experts who erred in 17% of the situations. First analyses show that ARs, irrespective of expertise and situation type, rarely fixate the passer during the moment of the pass, but focus the offside line well in advance. Interestingly, the experts seemed to make a lower number of saccades over the course of a played situation compared to the near-experts, who appear to shift their gaze more often between the passer and offside line. **Discussion** The current study confirms earlier findings stating that ARs do not shift gaze from the passer to offside line at the moment of the pass. Further, this finding also brings about a new set of relevant questions about how (and how accurate) ARs actually are able to determine the moment of the pass – until now an unaddressed topic in the field. **References** Catteeuw, P, Helsen, W, Gilis, B, Van Roie, E, Wagemans, J (2009). Visual scan patterns and decision-making skills of expert assistant referees in offside situations. *J Sport Exerc Psychol*, 31, 786–797. Oudejans, RRD, Verheijen, R, Bakker, FC, Gerrits, JC, Steinbrückner, M, Beek, PJ (2000). Errors in judging ‘offside’ in football. *Nature*, 404, 33. Sanabria, J, Cenjor, C, Marquez, F, Gutierrez, R, Martinez, D, Prados-Garcia, JL (1998). Oculomotor movements and football’s Law 11. *Lancet*, 351, 268.

## THE EFFECT OF MOTOR SKILL TRAINING AT LOW VERSUS HIGH SPEED IN SOCCER PERFORMANCE

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*Nord Trøndelag University College*

**Introduction** A generalized motor program is an abstract memory representation of a class of movements that share invariant features (Schmidt, 1975). The generalizability of such programs is according to Schmidt (1991) a matter of the variability of the practice building them. The theory states that an acquired motor program can be executed in countless ways and transferred from one set of requirements to another, simply by selecting the optimal values of temporal and spatial parameters of the program (Kwon et al., 2011). The purpose of the study was to explore the effect of training at low versus high speeds, when the test required the players to perform at their maximum. Method 16 male soccer players at level 4 and 5 in the Norwegian league, volunteered for the experiment. The task was receiving the ball, turning and stopping the ball inside a defined square. The subjects were randomly allocated to a low-speed group (LS) training the task at or below their breakdown speed, and a high-speed group (HS) training at or slightly above their individual breakdown speed. The players were tested before and after the training period. A ball projection machine was used to set the speeds of the balls. Results Comparison of the pre and post data showed a significant improvement for both groups in breakdown speed ( $p < 0.05$ ), and interestingly the relative improvement for the HS group were significantly larger compared to the LS group ( $p < 0.05$ ). In the post test there were a significant improvement for the HS group with respect to the time between the first and second touch ( $p < 0.05$ ), as compared to the LS-group. Additionally, there was an increase in time between the first and the last touch controlling the ball for the LS-group ( $p < 0.05$ ). Discussion Indicators for high skill performance in soccer are a short time interval between the first and second touch, and between the first and last touch in controlling the ball. The results indicate that training close to ones breakdown speed is not only beneficial for improving these skill indicators, but also that there is only positive transfer of skills from high to lower speed, and not from low to higher speed. This can be an indication that the generalizability of motor programs works best inside the parameter range, and not so well when the aim of the training is to extend the range of the program. References Kwon, O., Zelaznik, H.N., Chiu, G., & Pizl, Z. (2011). Human motor transfer is determined by the scaling of size and accuracy of movement. *Journal of Motor Behavior*, 1, 15-26. Schmidt, R.A. (1975). A schema theory of discrete motor skill learning. *Psychological Review*, 82, 225-260. Schmidt, R.A. (1975). *Motor Learning and Performance*. Champaign: Human Kinetics Books.

## AMPLIFICATION OF ERROR: A LEARNING STRATEGY TO IMPROVE MOTOR SKILLS

Milanese, C.1, Corte, S.1, Salvetti, L.1, Cavedon, V.1, Agostini, T.2

*1:School of Exercise and Sport Sciences, University of Verona, Italy. 2: Department of Psychology, University of Trieste, Italy*

**Introduction** The correction of technique errors in motor skills represents one of the major issues in motor control and motor learning literature. A good technique is an essential prerequisite in performance improvement and injury reduction. The aim of this study is to test the efficacy of an alternative teaching strategy called Method of Amplification of Error (MAE) and to compare the relative effectiveness of MAE to the traditional direct instruction (DI) and to a no-feedback control condition (C). MAE assumes that amplifying the subject's "main" error in a given motor skill would allow him to better understand what is not-to-be-done, thereby correcting motor errors. Methods Twelve golfers were assigned to one of three groups: DI feedback, MAE feedback and C without feedback, based on their handicap (H), (1 professional, 2 medium H and 1 high H for each group). During the training session each athlete performed 20 swings (7 swings pre-training (T0), 6 swings feedback training and 7 swings post-training (T1)). After a week the athletes performed retention test (T2). Participants used their own driver and wore appropriate golf shoes. The feedback focused on the "main" error diagnosed as the incorrect position of the participant's centre of mass projection. Kinematic outcomes were recorded with a motion analysis system (VICON 1.5.1, 8 cameras, 500Hz), a dedicated software (VICON Workstation 5.2) was also used for digitalization and reconstruction of the marker positions. Nonparametric statistical analysis was performed using SPSS version 16.; the Mann-Whitney test was conducted to assess significant differences between groups at three levels: T0, T1 and T2. Statistical significance was set at  $P \leq 0.05$ . Results At baseline (T0) kinematic outcomes were similar between groups ( $P > 0.05$ ). At T1 and T2 MAE showed a greater improvement ( $p < 0.05$ ) than DI and C for club speed (T1: 4.83%; -2.35%; 0.55%, T2: 6.19%; -1.4%; -0.26%, respectively), as well as for ball speed. In fact, MAE showed higher percentage change values than DI and C at T1 and T2 (4.11%; -6.33%; 1.6%; 9.87%, 0.94%; 1.9%, respectively). The same pattern was found for the duration of the swing phases: MAE showed a significantly decreased of tempo at T1 and T2 from the take away to the late backswing and from the early downswing to the ball contact ( $p < 0.05$ ). Discussion In this study the effect of amplification of error strategy in golfers with different ability levels was evaluated. The present findings suggest that MAE is an effective strategy for correcting the pattern of motion in a short time. Further research is necessary to evaluate the persistence of MAE feedback effects over time and their impact on the learning of other sport tasks.

## INDIVIDUAL AND ENVIRONMENTAL FACTORS ASSOCIATED WITH MOTOR SKILLS IN CHILDREN

Coelho, E., Mourão-Carvalho, I.

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**Introduction:** This study investigates the association among individual characteristics (age, gender and BMI), schoolyard's characteristics (area, type of equipment) and motor skills in childhood. Methods: The sample included 203 children (89 girls and 114 boys) aged 5-6 years ( $5,91 \pm 0,419$ ) of kindergarten. The Gross Motor Development Test second edition (TGMD-2) was applied to assess motor skills, and weight and height to calculate the BMI. Areas of schoolyards kindergarten were calculated using the AutoCAD software and equipment were characterized according four categories: no equipment; playground equipment; sport equipment and playground+sport equipment. Logistic regression was used to estimate the magnitude of association between variables. Results: Children shows four levels of motor competence: very poor 14,3%, poor 13,8%, below average 21,7% and average+above average+superior 50,2%. The results from binary logistic regression, associated age as a risk factor of motor competence (OR= 0,240; 95% CI 0,108-0,536 95%). The characteristics of the schoolyard as the area (OR= 0,282; 95% CI 0,092-0,863) and equipment (OR= 0,147.; 95% CI 0,53-0,410) are preventive factors. Conclusions: Motor skills with age decrease. Larger areas of the schoolyards and a greater variety of equipment are associated with a higher motor competence.

### IS SURROUND INHIBITION REALLY FUNCTIONAL?

Márquez, G., Keller, M., Lundby-Jensen, J., Taube, W.

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**Introduction.** Research investigating activity in the primary motor cortex (M1) has indicated that at the onset of a finger movement, unwanted contractions of adjacent muscles are prevented by inhibiting the cortical areas representing those muscles. This phenomenon is called surround inhibition (SI) [1]. It seems that this mechanism is relevant for the performance of selective finger movements, since an enhanced SI has been shown in professional musicians [2] and a lack of SI was evident in the affected hand of patients with focal hand dystonia [1]. However, SI has never been tested in a functional setting. Therefore, the present study tested the implications of SI during real piano playing, and how SI was affected by the task complexity and the previous experience. **Method.** For this purpose 19 subjects (10 untrained subjects and 9 experienced musicians) were asked to play piano with three different fingers (thumb, index and little finger) of the right hand in two different conditions: playing piano rhythmically with one finger (single finger condition) and with three fingers (three fingers condition). In order to assess SI, Transcranial Magnetic Stimulation (TMS) was applied over the contralateral motor cortex using an intensity that evoked a motor evoked potentials (MEP) in all tested muscles (FDI, APB and ADM). MEPs were elicited during the movement preparation and at the onset of movement execution (phasic phase). SI for the inactive muscles were calculated by the ratio of the MEP size measured during one of the two phases (preparation or phasic) to the MEP size measured during a control condition (resting hand position). The ratio between the MEP size in those muscles that did not participate in the actual finger movement (surround muscles) and the control MEP elicited during a control condition (resting hand position) was taken as indication for the amount of SI. A three way RM-ANOVA was performed with TASK COMPLEXITY (single finger vs. three finger condition), PHASE (preparation vs. phasic) and GROUP (musicians vs. controls) as factors. This analysis was performed for SI of FDI, APB, and ADM. **Results.** Results display a statistically higher SI in the preparation phase than in the phasic phase during the single finger condition for all three muscles. The analysis revealed statistically higher FDI SI for the three finger than for the single finger condition when tested in the phasic phase. However, in the preparation phase, results revealed higher APB SI during the three finger condition than in the single one, and the opposite for the ADM muscle. No significant differences in the SI were found between groups although the piano player demonstrated generally higher SI values. **Discussion.** Our results have shown a task and phase specific modulation of surround inhibition but there was no significant experience related modulation of this neural pathway during a functional task like piano playing. **References.** [1]Beck et al. (2008) *J Neurosci.* 28(41):10363-9 [2] Shin et al. (2012) *Exp Brain Res.* 219(3):403-8;

### AMETROPIA/DEFECTIVE VISION, VISUAL DEFICITS AND MOTOR PERFORMANCE IN SCHOOL SPORTS

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*Ruhr-Universität Bochum*

**Introduction** In childhood and puberty essential physical and school developments take place. Poor eyesight in this phase – which is marked through fast/big changes in motor performance and on physical, psychological and emotional level – represents a handicap, as is known. Concluding, the basic correlation between a good eyesight and a safe, successful engaging in sports activities, as well as a motor development are documented through numerous studies. A database concerning the topic “Defective vision in school and its consequences on motor abilities” does not yet exist. **Methods** Against this background a study at 17 elementary schools and 6 high schools concerning ametropia/defective vision in school sports, together with a simultaneous survey of motor abilities (German motor performance test DMT 6-18; Bös et al., 2009) has been carried out. Participants were tested with 8 tests to assess a complete motor fitness profile involving strength, endurance, coordination (under time pressure and under precision demands) and flexibility. In parallel, various tests to detect ametropia and visual deficits have been carried out (visual acuity test, auto-refraction, stereoacuity and contrast sensitivity test). A total of 1.222 children/teenagers (52.2 % male; 47.8 % female) at the age of 5-18 participated in the test (mean age: 8.9±1.7 years). **Results** A synoptic view of the visual test results showed that 25.4 % of the children were classified (according to how they participated in school sports) as ametropic (needing correction of defective vision). This means, a defective vision has been discovered for the first time in the context of the visual test, or else they participated in school sports without actually needed visual aids, or rather, with insufficient correction. Another 15.1 % of the children had noticeable deficits in the visual performance profile, which is what made the observance of the development of the visual performance soon necessary. The children with defective vision attained significantly worse overall results in the motor performance test than the ones without defective vision (2p<0.05). 38.3 % of the pupils with defective vision achieved results below or far below average in the motor performance test (emmetropic students: 12.1 %). The coordination test “balancing backwards” showed analog results (2p<0.05). **Conclusion** The high rate of ametropia/defective vision and the correlation between eyesight in deficit and weaknesses in motor performance shows that regular visual tests are necessary in order to enable the detection and correction of deficits early. Simple screening tests should be implemented in the everyday school (sports) life. **References** Bös, K. et al. (2009). *Deutscher Motorik-Test 6-18 (DMT 6-18)*. Hamburg: Czwalina.

### MUSCLE RELAXATION OF THE FOOT INDUCES INTRACORTICAL INHIBITION OF THE HAND MUSCLE

Kato, K.1, Nakata, H.2, Nakagawa, K.1, Uchida, Y.2, Kanosue, K.2

*Waseda University*

**Introduction** Muscle relaxation is an important factor to make good performances in sports, but the mechanism has not been well understood. Previous study using fMRI suggested that The primary motor cortex was activated during voluntary muscle relaxation as well as during contraction (Toma et al., 1999). Therefore, muscle relaxation is an active process requiring cortical activation, rather than just the end of muscle contraction. The study on motor control of multilimb motion showed that muscle contraction in one limb influences the muscle activities in other limbs (Baldissera et al., 2002). The objective of this study was to clarify how the relaxation of one muscle influences on corticospinal excitability in other remote muscles by using single-pulse transcranial magnetic stimulation (TMS) (Ex.1). Then, we investigated the contribution of short interval intracortical inhibition (SICI) using double-pulse TMS (Ex.2). **Method** Ten participants voluntarily relaxed their right foot from dorsiflexed position in response to an auditory signal. Single (Ex.1) and double (Ex.2) TMS was given on the hand area of the left primary motor cortex at different timing before and after the onset of relaxation. Motor evoked potentials (MEPs) were recorded from their right extensor. SICI was evaluated from the MEP amplitudes of single and double pulse. **Result** In Ex.1, the MEP amplitudes of the hand muscles increased compared to the resting condition in the period of before relaxation onset of the foot. On the other hand, in the period just after relaxation onset (0ms ~ 100ms), the MEP amplitudes of the hand muscles decreased. In Ex.2, The SICI decreased before the relaxation onset of foot, it increased after the relaxation onset. **Discussion** The corticospinal excitability of hand muscle decreased in response to the relaxation of foot (Ex.1). Moreover, the result of Ex.2 indicated that muscle relaxation of foot increas-

es SIC1 and hence may assist in reducing cortical excitability in hand muscles. Thus, the decrease of MEP observed in Ex.1 was produced in the cortical area. References Toma K et al., *J Neurosci*. 19:3527-3534. 1999 Baldissera F et al., *J Physiol*. 539: 903-911. 2002

### THE INFLUENCE OF CATCH TRIALS ON THE CONSOLIDATION OF MOTOR MEMORY IN FORCE FIELD ADAPTATION TASKS

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**Introduction** In neuroscience it is generally accepted that human motor memory contains neural representations of the physics of the musculoskeletal system ("internal models", Kawato, 1999). Force field studies are an established tool to analyze the characteristics of such internal models (Shadmehr and Mussa-Ivaldi, 1994). Following acquisition, internal models undergo changes over time denoting the consolidation of a motor memory (Robertson et al., 2004). The aim of the study was to investigate whether catch trials during force field learning, on which the force field was turned off suddenly, could also influence the consolidation of motor memory in more complex tasks (higher viscosity, unsupported arm) compared to previous studies (Overduin et al., 2006). **Methods** Forty-six subjects performed 256 center-out movements at a robotic manipulandum in two different velocity-dependent force fields (35 N-s/m). Two control groups learned force field A on day 1 and were retested in the same force field on day 3 (AA). Two test groups additionally learned an interfering force field B on day 2 (ABA). While control and test group 1 performed all trials under force field conditions, for the control and test group 2, 48 catch trials (~19%) were embedded pseudo-randomized within the 256 movements. To quantify performance, for each trial in the force field the enclosed area between the hand trajectory and the straight line joining start and target point was calculated (Caithness et al., 2004). Mean scores of the first and last 16 movements were calculated and compared, whereas catch trials were excluded from the calculation. **Results** The results showed a consolidation of force field A for both control groups. Test groups showed no consolidation of force field A (with catch trials) and even a poorer performance on day 3 (without catch trials). **Discussion** It can be stated that for our experimental set up (higher viscosity, unsupported arm) catch trials did not lead to consolidation of motor memory in terms of memory stabilization from day 1 to day 3, when an interfering force field was learned on day 2. The higher complexity of the task seems to lead to worse consolidation processes. Maybe an increase of trial number would enhance the performance during the adaptation-phase (Diskrell et al., 1992). Further studies should continue concentrating on tasks of different complexity as the consolidation of motor memories needs to be investigated in various settings to be understood sufficiently. **References** Caithness, G, Osu, R, Bays, P, Chase, H, Klassen, J, Kawato, M, Wolpert, DM, Flanagan, JR (2004). *J Neurosci*, 24, 8662-8671. Diskrell, JE, Willis, RP & Copper, C (1992). *J Appl Physiol*, 77, 615-622. Kawato, M (1999). *Cur Opin Neurobiol*, 9, 718-727. Overduin, SA, Richardson, AG, Lane, CE, Bizzi, E, Press, DZ (2006). *J Neurosci*, 26, 11888-11892. Robertson, EM, Pascual-Leone, A, Miall, RC (2004). *Nature Rev Neurosci*, 5, 576-582. Shadmehr, R, Mussa-Ivaldi, F (1994). *J of Neurosci*, 14, 3208-3224.

### LEARNING AN ENERGY-DEMANDING AND BIOMECHANICALLY CONSTRAINED MOTOR SKILL, RACEWALKING: MOVEMENT REORGANIZATION AND CONTRIBUTION OF METABOLIC EFFICIENCY AND SENSORY INFORMATION

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**Introduction** Many studies on motor learning focused on understanding the process of passing from a novice status to increased levels of expertise when learning a complex motor task involving a large number of degrees of freedom. But only a few studies also examined, inspired by the metabolic optimization theory (Sparrow, 1983), energetic and perceived exertion factors in order to establish a link between movement reorganization, metabolic efficiency and perceived exertion (Lay et al., 2002). In doing so, this study investigated how novices learn an energy demanding and biomechanically constrained athletic task like racewalking. The first aim was to examine if movement reorganizes according to some fundamental strategies, proceeding in different stages (Newell, 1985). The second aim was to investigate the link between movement reorganization, metabolic efficiency and perceived exertion. **Methods** Seven participants undertook 7 racewalking learning sessions on a motorized treadmill, with increased velocity as the experiment progressed, in order to reach a goal performance speed of 10 km.h<sup>-1</sup>. Peripheral/central perceived exertion ratings, kinematic (gait parameters; relative phases) and metabolic data (VO<sub>2</sub>; HR) were collected during the 1st, 4th, 6th and 7th session. **Results** Repeated-measures (Learning Session-Speed) ANOVAs on kinematic data showed a proximal-to-distal directional trend in movement reorganization, with significant practice-related changes in pattern coordination and decreased variability. Early movement reorganization occurred at the 1st session ("coordination stage") and progressed until the 4th session ("control stage") to reach a plateau. In contrast, metabolic efficiency and peripheral perceived exertion continued optimizing until the last session. Peripheral perceived exertion presented the highest correlation with the global movement reorganization variables. **Discussion** These results support the existence of an early/immediate reorganization in movement with learning, presented in Newell's (1985) model as the "coordination stage" and in favor of a directional trend, from proximal to distal levels. The optimization trend of metabolic aspects occurred probably concurrently with the control stage. More specifically, it seems that peripheral perceived exertion could be an important factor in refining movement and in minimizing metabolic energy expenditure. **References** 1. Sparrow WA (1983). *J Motor Behavior*, 15, 237-261 2. Lay BS, Sparrow WA, Hughes KM, O'Dwyer NJ (2002). *Hum Mov Sci*, 21, 807-830 3. Newell KM (1985). In R.B. Wilberg & I.M. Franks (Eds), Amsterdam: North-Holland

### VISUAL SEARCH AND ANTICIPATION IN INTERNATIONAL ICE HOCKEY PLAYERS

North, J.S., Saunders, L.M.

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The skill of anticipation is critical to success in sport, where performers must make predictions of what is likely to happen under severe time constraints. This skill is especially important at an elite level where perceptual-cognitive aspects of performance are more likely to discriminate players than physical or physiological characteristics (Williams & Reilly, 2000). The majority of research into anticipation in sport has compared participant groups sampled from opposite ends of the skill continuum (i.e., experts vs. novices). We tested an international ice-hockey squad and conducted within group analyses to investigate if differences in visual search behaviour emerged between the most successful and least successful anticipators within the squad. Participants were presented with dynamic, life-size video sequences that were filmed from a first person perspective and represented a 1 vs. 1 situation that a player may encounter in an ice hockey match. The participants' task was to anticipate what action the opponent would produce next. Initially, the international squad was compared against a novice group to assess construct validity of the test. The international squad were significantly more accurate in

their anticipation decisions than the novice participants. The international squad was then ranked according to their anticipation accuracy with the most accurate and least accurate players selected for further testing. In the second phase of testing, visual search data was recorded from these two players whilst making anticipation decisions. Significant differences emerged in visual search strategy, with the most successful player making more fixations, of a shorter duration, across more features within the display in comparison to the least successful player. The research shows that even within an international squad, significant differences are present with regards perceptual-cognitive skill and contributes to recent findings on the complex and multi-dimensional nature of expertise. The potential value of perceptual-training programmes is highlighted. Reference Williams, A. M., & Reilly, T. (2000). Talent identification and development in soccer. *Journal of Sports Sciences*, 18, 657-667.

**14:00 - 15:00**

## Mini-Orals

### PP-SH01 Misc. topics 1

#### THE INFLUENCE OF SOAP OPERAS IN THE BUILDING OF THE WOMEN'S BODY IN THE 80'S

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**THE INFLUENCE OF SOAP OPERAS IN THE BUILDING OF THE WOMEN'S BODY IN THE 80'S** Introduction This paper is part of a research carried out about the validation process of fitness center gymnastics in the Modern Era, focusing in the 80's decade, in Brazil (Toledo, 2010). Considering the high level of audience of Brazilian soap operas and their trendsetter role, the aim of this research is to bring up data and reflections about their influence (and theirs characters) on the building of the feminine body model, in this decade. Method This research is historical and documental (Gil, 2007), with a qualitative approach when analysing the sources (Arostégui, 1995). Universe: VEJA (from 1980 to 1989), Brazil's highest circulation magazine in the 80's (currently it maintains this position). Randomic sample of 93 VEJA magazine editions, including the supplement VEJA São Paulo (about 30% of the universe). Results and Discussion Through the analysis of VEJA's articles and images it was clear the relationship with the building of a new feminine body, gym and television's celebrity. This building was influenced by the United States of America (Courtine, 1995) and European countries, on behalf of both sportsmanship and a beautiful, dexterous and strong body (Ehrenberg, 1991; Silva, 2001). The most beautiful Brazilian actresses, performing in the soap operas in this time, report in the articles the use of workout to obtain a harmonious, beautiful and successful body. Body building (practice booming in this time), the "Cooper" method and the "Jane Fond Workout" were pointed out as the new body practices they adopted. The articles exalted these new practices and praised the actresses' bodies, raising in the readers what they have still been consuming through the images of the soap operas: the desire of a new body model, lean and with defined muscles, given by workout, in line with the search of excitement (Elias and Dunning, 1992). References Aróstegui J. (1995). La investigación histórica: teoría e método. Crítica. Elias N, Dunning E. (1992). A busca da excitação. Difel. Ehrenberg A. (1991). Le culte de la performance. Hachette Littératures. Gil AC. (2007). Métodos e técnicas de pesquisa social. 5a. ed. Atlas. Revista VEJA [www.veja.com.br](http://www.veja.com.br) Courtine, J J. (1995) Os Stakhanovistas do narcisismo: body building e puritanismo ostentatório na cultura Americana do corpo. In: Sant'Anna, D B. Políticas do Corpo. Estação Liberdade. Silva, A M. (2001) Corpo, Ciência e Mercado – reflexões acerca da gestação de um novo arquétipo de felicidade. Autores Associados. Toledo E. (2010). A legitimação da ginástica de academia na modernidade: um estudo da década de 80. Doctoral dissertation, São Paulo, Brazil: Pontifícia Universidade Católica de São Paulo.

#### THE HISTORICAL PRODUCTION OF THE PHYSICAL EDUCATION COLLEGE OF MATO GROSSO FROM THE DOCUMENTAL ORGANIZATION

Ferreira, T., Moreira, E.C., Toledo, E.

*Universidade Federal de Mato Grosso*

**Introduction** Based on preliminary studies, it is know now, that the records of the history/memory of the Physical Education and of the Sport in the State of Mato Grosso, are found kept in several ways and in different sources, being still inaccessible to the Academic community that intents to work in the area. It's noticeable then, the importance of elaborating and developing studies that rescue and organize the printed documents that contain the history of the Physical Education College of the Federal University of Mato Grosso – FEF/UFMT, making it possible the usage of such information by consulting an organized material. **Methods** The present study is characterized as a descriptive historical research, once it objectives the accomplishment of documental records of the FEF/UFMT. The study adopts a qualitative approach, because there is a comprehension depth of the social phenomenon through the analysis of printed records. (RICHARDSON, 1999). **Results** An information gathering of the first primary sources found was made, amongst selected papers for this study. Among the most relevant, at the moment, there are the teachers' Class Diaries of 1982 and 1991; documents of partnership agreement between the FEF/UFMT and the State of Mato Grosso Culture and Education Bureau, aiming at the execution of combined development project of the institution's levels of Licensure, of 1982; partnership agreement between the FEF/UFMT and the Instituto Euvaldo Lodi, to develop the project: "Diagnose of the Physical Education and Sports of Greater Cuiabá", of 1979; physical ability tests for candidates to the Physical Education course, from 1988 to 1993; records of the first Congresses, Meetings, Symposiums, and Development Courses in the area of Physical Education in Cuiabá, Mato Grosso; letters and complaints from academics dissatisfied with the available pedagogical structure and FEF/UFMT's facilities; teaching plans of the teachers who taught classes at the College from 1980 on, besides printed materials, used in classes as well as evaluations applied by the academics at that time. **Discussion** From de documental gathering accomplished, it was verified that historical elements of the sport were already part of the UFMT even before the creation of the FEF. That verification was possible after the rescuing, organizing, reading and classifying of the documents found, in other words, the files keep important information within a historical, administrative and personal context. The information in such documents need to be preserved for being records of the institutional memory and for their contribution as source for future research, that help the development of the institution. References RICHARDSON, R. J. Pesquisa social: métodos e técnicas. 3. ed. São Paulo: Atlas, 1999.

## FROM FRAGMENTATION TO SYNTHESIS IN SCIENCE

Balagué, N.1, Hristovski, R.2, Torrents, C.3

1: INEFC Barcelona (Spain), 2: Ss. Cyril and Methodius University, Skopje (Rep. of Macedonia), 3: INEFC Lleida (Spain)

**Introduction** In the past two decades progressive advances have been made in explaining and modeling different levels of organized matter through universal dynamical concepts. The aim of this study was to examine the change of linguistic space, i.e. conceptual landscape and profile of scientific fields under the absence and presence of general explanatory principles derived from nonlinear dynamic systems theory (NDST) and statistical physics (SP). Specifically, we aimed to model the conceptual space of science as a self-organizing system, and to emphasize the position of sport science within it. Methods Characteristic general concepts from ten scientific fields (classically seen as quite separate) were treated as linguistic degrees of freedom. The dimension reduction and the analysis were conducted using cluster and hierarchical principal component analysis. Distances  $d$  between science fields were calculated as  $d = 1 - q$ , where  $q$  is the cosine similarity (the overlap order parameter) between the vectors that defined the conceptual spaces of scientific fields. The order parameter  $q$  as a measure of conceptual coherence was projected within the space of the first two principal components. This procedure enabled us to visualize the structure of basins of attraction, i.e. the domains of conceptual coherence, and the saddle points representing the linguistic barriers between scientific fields. Results The absence of NDST-SP interpretative concepts led to growing fragmentation of scientific disciplines; the maximal distance, as a measure of fragmentation, was  $d = 0.78$ , and showed a tendency for growth. However, the presence of NDST-SP explanatory concepts, characteristic over the last two decades, brought about a stabilization of this fragmentation, with maximal distance of  $d = 0.66$ . In particular, the tendency towards fragmentation within the domain of sport science was suppressed. This was evidenced by the decreased value of population entropy, i.e. the dimension of the space spanned by significant principal components. Discussion Whereas separate scientific fields maintain their context-dependent language (distances do not go to zero), general concepts form an embedding explanatory space within which a stabilizing synthetic knowledge becomes feasible. Scientific research may be envisioned as a self-organizing process within linguistic space in which, as a result of cooperative processes between scientific fields, a new hierarchical structure and synthetic world view has emerged (Hristovski, 2012). References 1. Hristovski, R. (2012). Book of accomplished projects at the UKIM (115-122). UKIM Press, Skopje.

## ATHLETES' AND DOPING CONTROL OFFICERS' ON-SITE EXPERIENCES DURING REAL DOPING CONTROLS

Peters, C., Postler, T., Schulz, T., Oberhoffer, R.

Technical University of Munich

**Introduction** During doping controls interpersonal contact and communication between athlete and doping control officer (DCO) may influence the control situation, resulting in a neutral and relaxed or displeasing and uncomfortable atmosphere. Therefore, the aim of the present study was to survey German athletes and DCOs concerning their on-site experiences during doping controls. Methods In a cross sectional survey 115 DCOs received a DIN A4 envelope containing one sealed DIN A5 envelope for the DCO himself and a second sealed one to be handed to the athlete during the next doping control. In a written short-form questionnaire both groups were asked to judge the behavior of their counterpart independently of each other. Facts, personal observations, subjective impressions and individual perceptions with regard to the currently finished doping control were asked. Participation was voluntarily and anonymously and considered issues of privacy and confidentiality. Results 43 high elite athletes (response rate 37.4%) and 54 DCOs (response rate 47%) completed the questionnaires (42 matches). Athletes stated more frequently to be prompted for something than DCOs confirmed to have requested: to draw up the jumper (A: 21/39 vs. DCO: 19/49) or to drop the trousers (A: 27/39 vs. DCO: 16/50). Although some DCOs (12/49) prompted to allow a nonrestrictive view of the urine leaving their body just every second athlete (20/39) stated a careful observation during urinating in reality. Altogether athletes confirmed DCOs working professionally (yes: 42/43; 1 no comment) in collecting urine and/or blood samples. Discussion Significance of the survey is limited (small samples, self-selection in participation, social desirability of answers, etc.). Nevertheless, it provides an informative basis on different perceptions of athletes and DCOs during the same doping control. Overall, DCOs behavior was confirmed to be professional, which is in agreement with results from a Switzerland survey (Lamprecht et al., 2010). However, while DCOs possibly assumed to have reminded only, athletes took this remembrance as a prompt more frequently. In addition to the detailed briefing of DCOs with regard to sampling procedure educational programs should include recommendations for the interaction with athletes more often. References Lamprecht M, Gebert A, Stamm H. (2010) Athletenbefragung 2010: Befragung der Athletinnen und Athleten zu Dopinginformationen und Dopingkontrollen. [http://www.antidoping.ch/files/download/de/101011\\_antidoping\\_kurzfassung\\_athletenbefragung\\_dt.pdf](http://www.antidoping.ch/files/download/de/101011_antidoping_kurzfassung_athletenbefragung_dt.pdf) (assessed 3/2012)

## 'UNDERMINING' OR 'OVERMINING': IS THERE A THIRD WAY IN THE UNIFICATION OF SPORT SCIENCE?

Jonasson, K.

Malmö University

In the announcement for the 18th annual congress of the European College of Sport Science (ECSS), the organizers discuss the benefits and pitfalls of reductionism in the field of sport science. This paper addresses the question of unification of disciplines in 'hyphen sciences' such as sport science. While having the multi- and interdisciplinary organization ECSS as a point of departure, and perhaps as a point of arrival, the presentation concerns different attempts at unifying the study of sport. Epistemological, ontological, and disciplinary endeavors to create a comprehensive system of knowledge of sport will be scrutinized. These varying attempts will be discussed with the concepts 'undermining' and 'overmining' (Harman, 2009). The object-oriented philosopher and speculative realist Graham Harman utilizes these concepts to demonstrate that most attempts at describing reality end up in either undermining, i.e. small reductionist schemes (atoms, cells, etc.), or in overmining, i.e. grandiose determinist structures (nature, capitalism, etc.). Instead of giving oneself up to those two strategies we might, Harman suggests, depart from the "middle kingdom" of objects, actors and heterogeneous networks that the sociologist/anthropologist of science Bruno Latour (1993) has pointed out. The paper thus concludes, contrary to the announcement of the conference – i.e. that "the 2013 ECSS Congress in Barcelona seeks to help sport science make its own leap forward towards an understanding of ourselves not as part of a technical world but as interacting parts of an indivisible whole: nature" –, that sport science mustn't skip the step of the 'technical world' since this, as is argued within science and technology studies, is the intermediary region between different disciplines. HARMAN, G. (2009). Prince of networks: Bruno Latour and metaphysics. Prahan, Vic, Re.press. LATOUR, B. (1993). We have never been modern. Cambridge, Mass, Harvard University Press.

## HOW FAIR IS FAIR PLAY

Plested-Alvarez, M., Casals-Rispau, S., Vallejo-Rendón, G.

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Introduction: We determined some socio-sportive and psico-social concepts that negatively influence the moral, ethical and social concept of 'fair play' that sportspeople and the people around them have. The tracing methods and the analysis done, allowed the elaboration of a conceptual map (Plested, M.C., Giraldo, B.S., 2001) that are discussed in this study. We concluded that in some cases fair play is conceptualized through actions which actually represent unfair play. We propose some cultural and pedagogical sportive ways to solve this social conflict. Methods: A qualitative methodology was applied to terminologically analyze the statements (Budin, 1998). The concept of 'representative virtual psychological space of each implicated' (Sánchez Medina, G. 1987) was applied. Common conceptual units were found across all cases which demonstrate that a social network underlies (un)fair play so that it was analyzed as a social case study. Discussion: Not only in the amateur sport it's easy to find this kind of (un) fair play. "Professional sports may be one of the most misunderstood occupations in the world. The public sees the mansions, the bling, and the fancy cars. What it doesn't feel is the insecurity of a profession that averages just two and a half to four seasons before someone younger, faster or stronger comes along. It doesn't see the scam artists who suck away salaries and it doesn't see the egotism and sense of entitlement that can lead a ... to believe that the rules that govern society do not apply to them" as said in Scandals of the decade. It is necessary to change some sport parameters and structures taking into account the cultural, social and family environments and also of the staff of each of those sportspersons. Results: After tracing the life details of sportspersons, it was systematically found that the specific staff was part of the scene, working under his or her instructions or those of a trainer or a relative. "Doing something hidden or behind their soul mate is nothing to be ashamed of until they are caught". "His team was forced to forfeit its games and his father and coach were banned from [that] League". Some of the specific teaching parameters in sport need to face up some universals like remaining silent in case of psychological, moral, material or physiological damages. Unfortunately, it seems that this is a fixed parameter of those who call themselves 'members of a civilized sport culture'. We want to present some positive ways to solve it. References: Budin, G. (1998): *Wissenschaftskommunikation im Spannungsfeld. Zwischen Globalisierung, Technisierung u. kultureller Diversität*. Plested, M. C., Castrillón, E. R. (2004) *Panorama de la terminologie*. *Íkala*: v.9, n.15, p.289 - 312 Plested, M. C., Giraldo, B. S. (2001) *The Ideal Subject-field Terminology Commission In: 6th Annual Congress of the European College of Sport Germany Scandals of the decade*. Toronto Sun.mht Sánchez, G. (1987) *Tiempo, espacio, psicoanálisis*. Bogotá, Colombia

## PHYSICAL EDUCATION: HUMANITIES/SOCIAL SCIENCES OR BIOLOGICAL SCIENCES?

Chaves, A., Correia, R., Ferraz, O.L., Tani, G.

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Introduction By questioning if Physical Education falls within humanities/social sciences or biological sciences, we face great difficulty in finding answers. It is known that this definition is fundamental to professional training and development courses. According to Silveira e Tani (1996), physical education is still incipient as a field of study and it is difficult to define its identity. This study aims to investigate how Brazilian undergraduate and graduate students identify physical education as an area of study. Methodology A field study was conducted involving 21 subjects: 9 women around the average age of 27.37 years old and 12 men around the average age of 29.84 years old, undergraduate and graduate Physical Education students in public and private educational institutions. It was used a questionnaire with three reflective questions about the field of study of Physical Education. Data was analysed according to the Collective Subject Speech (CSS) by Lefèvre and Lefèvre (2003) and to the rate of answers percentage. Results Regarding the questionnaires, 61% of subjects said Physical Education is characterised as humanities/social sciences as much as biological sciences, for 29% of subjects as biological sciences, for 5% as humanities/social sciences and 5% of them were uncertain about the topic. As far as its specific research area, 38% said it is related to biological area, 24% to humanities/social studies, 19% to both and 19% were not able to define it. When they were asked to reflect about Physical Education as humanities/social sciences and/or biological sciences while elaborating a research project, 43% of subjects said they did not taken it into consideration, 38% said they thought it as biological sciences and 19% as humanities/social sciences. Conclusion It was found that only a minority has been concerned about the academic identity of Physical Education. As the assessment of Physical Education as an area of study has not been undertaken in Brazil, whereas the researchers in this field little address the matter, the fact that graduate students are not concerned with the topic can contribute to the continuity of the uncertainties and ambiguities related to the issue. References LEFÈVRE F.; LEFÈVRE A.M.C. *The collective subject discourse. A new approach to qualitative research*. Caxias do Sul; Educ; 2003. SILVEIRA, S. R.; TANI, G. *Physical Education as a field of knowledge in the School of Physical Education and Sport USP: a study of its history and constitution from its institutional journal*. *Brazilian Journal of Physical Education and Sport*, Sao Paulo, v.22, n.1, p.35-44, Jan / Mar 2008.

## TIME AND SPORT

Hogenova, A.

*Charles University*

Time and Sport Keywords: Time, intentionality, sport, body, Dasein This text discusses the implications of the Aristotelian concept of time for understanding the human body. Aristotle saw time as a number of movements, and thus established the implications which we find today in the phenomenon of "Gestell". Heidegger introduces us to the present, which contains pastness (die Gewesenheit), which penetrates into the future, so we have Dasein which is a temporal schedule in which the present includes the past and the plan of the future. What does this mean for sport? It is necessary to return to the primordial spring of sport, the primeval desire to move, the primitive unity of the human body and soul with the world around that is shown in motion. Then we realize that e.g. business in sport is an added value, we realize that the Olympics have to be an utterly deep and undeniable expression of the reverence to the gods on Mount Olympus. Then we look around with different eyes, phenomenological eyes. The body has a special kind of negation, a special kind of absence, a special kind of privation. It contains everything and yet it contains a fundamental absence. The body is embodied temporally, not in an Aristotelian way, i.e. successively. Science describes succession, successivity; however, it overlooks the processes that occur concurrently, co-existentially, simultaneously How is it possible that we cannot see or understand this miracle of simultaneity? Why is this so? Because we work on Aristotelian time which is difficult to escape from and understand differently. Scientific description of the human body in sport is also only made in Aristotelian time, which we can all realize if we let the question emerge from the concealedness we call obviousness. References Heidegger, M. *Das Ereignis*. Frankfurt am Main: Vittorio Klostermann, 2009. Merleau-Ponty, M. *Phenomenology of Perception*. London: Routledge, 1989. Mc Namee, M., *Doping in Sports*. In: *Sport, Ethics and Philosophy*, 1, Number 3, December 2007.

**DO CHESSPLAYERS HAVE GREATER COGNITIVE SKILLS THAN FOOTBALLPLAYERS?**

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DO CHESSPLAYERS HAVE GREATER COGNITIVE SKILLS THAN FOOTBALLPLAYERS? We are often inclined to argue that the primary skills of chess are cognitive ones like memory, mathematics and analytical planning (Binet 1966). We are also often inclined to argue that the primary skills in football are motor skills like eye-foot coordination, balance, spatial orientation and speed of reaction (Schreiner 2010). Several studies though, argue that what separates expert footballers from intermediates are not motor skills but perceptual and planning skills (Vayens et al. 2007, Savelsbergh et al. 2002). Research on chess players suggest that the expertise of high performance do not rely on excellent memory or high IQ (Bilalić 2007), but on perceptual skills and picking out relevant information (Chase & Simon 1973, de Groot 1978). This is even more so in rapid-, blitz- and bullet chess (Calderwood et al. 1988). It seems that the intuition that sport performance goes on without thought, and hence does not involve cognition, stems from the observation that successful action does not need a pre-reflective or accompanying reflective phase. The same seems to be the case in bullet chess. Does that lead us to claim that bullet chess players play on automation, without cognition, even without consciousness? If we still believe that bullet chess players do indeed perform cognitive, intentional and flexible action, should we not think about football players in the same way? The talk aims to undermine the idea that athletes are mindless, not intelligent or without cognitive skills. On the contrary, even though sport (or chess) performance goes on without declarative thought, perceptual and cognitive skills lie at the very core of successful action. References Binet A. (1966). Mnemonic virtuosity: A study of chess players. *Genetic Psychology*, 74, 127–162. Bilalić M, McLeod P, Gobet F (2007). Does chess need intelligence? — A study with young chess players. *Intelligence* 35, 457–470. Calderwood R, Klein G, Crandall B. (1988). Time pressure, skill, and move quality in chess. *The American Journal of Psychology*, 101, 481-493. de Groot A. (1978). Thought and choice in chess. Mouton, The Hague. Savelsberg G, van der Kamp J, Williams A, Ward P. (2002). Visual search, anticipation and expertise in soccer goalkeepers. *Journal of sport sciences*, 20, 279-287. Schreiner P. (2010). Soccer – perfect ball control. Meyer & Meyer, Maidenhead. Vayens, R., Lenoir, M., Philippaerts, R. & Williams, A. Mechanisms underpinning successful decision making in skilled youth soccer players. *Journal of Motor Behavior*, 39, 395-408, 2007 Do not insert authors here

**ACUTE EFFECT OF AEROBIC EXERCISE LONG TERM ON THE LEVEL OF CENTRAL SEROTONIN IN OLDER WOMEN**

Barros, J.F.1, Lopes, K.M.D.C.2, Browne, R.A.V.1, Elsangedy, H.M.1, Farias Junior, L.F.1, Nunes, R.N.1, Lima, R.M.3, Oliveira, R.J.3

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Introduction Exercise is considered a challenge to homeostasis, since several regulatory mechanisms and adaptation (peripheral and central) are activated during or after practice, as perceived changes in neurotransmitter systems, in particular, in the serotonergic system (Meeusen and Piacentini, 2001). Thus, the aim of this study was to investigate the acute effect of aerobic exercise of long duration on the central serotonin levels in older women. Methods Transversal study in which the sample consisted of 17 elderly women, physically active ( $\geq 6$  months) which were divided into two groups: group undergoing aerobic exercise at anaerobic threshold intensity for 1 hour (EG; n= 9;  $63.0 \pm 2.54$  years old; BMI=  $26.31 \pm 2.22$  kg.m<sup>-2</sup>;  $VO_{2peak}$ =  $21.34 \pm 1.76$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) and control group (CG; n= 8;  $62.62 \pm 4.4$  years old; BMI=  $26.76 \pm 3.29$  kg.m<sup>-2</sup>;  $VO_{2peak}$ =  $20.11 \pm 1.92$  ml.kg<sup>-1</sup>.min<sup>-1</sup>). Blood samples were collected in moments of rest (pre-exercise), immediately post-exercise and 20 minutes after exercise for subsequent comparison of prolactin levels, which has been used as a marker of neuroendocrine activity of serotonin. Results The GE ( $5.14 \pm 1.55$  ng/ml) and CG ( $4.60 \pm 1.39$  ng/ml) did not submit significant change ( $p > 0.05$ ) in prolactin level immediately after exercise (GE=  $5.70 \pm 1.73$  and GC=  $4.53 \pm 1.39$  ng/ml), respectively, and also did not show after 20 minutes of post-exercise recovery (SG=  $5.15$  and BF=  $4.6$  ng/ml), respectively. Discussion The results showed no significant increase in prolactin levels of EG immediately after exercise, which might be explained by lipolysis due to the demand of free fatty acids as an energy substrate causing displacement of tryptophan from the albumin binding sites, producing increase in the levels tryptophan-free and hence increased the precursor of serotonin in the central nervous system (Huffman et al., 2004). Thus, it is assumed that aerobic exercise long-term may cause acute increase in serotonin levels central verified by the prolactin level in elderly women physically active. References Huffman DM, Altena TS, Mawhinney TP and Thomas TR. (2004) Effect of n-3 fatty acids on free tryptophan and exercise fatigue. *Eur J Appl Physiol*, 92(4-5), 584-591. Meeusen R and Piacentini M. (2001) Exercise and neurotransmission: a window to the future? *Eur J Sport Sci*, 1(1), 1-12.

**14:00 - 15:00****Mini-Orals****PP-SH03 Physical Education and Pedagogics [PP] 1****TEACHING INDICATORS RELATED TO THE BODY EXPRESSION BASIC CONTENTS**

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Introduction Interest on Body expression as educational content is growing. Body expression is an educational subject with contents of creative dance, mime and body language. However, studies examining the most significant indicators for teaching this subject are scarce and contradictory. The aim of the present study was to examine which were the most significant indicators of Body expression about Technique, Methodology and Creativity and their association with teaching contents (Body, Space and Rhythm) in undergraduate students of Physical Activity and Sport Sciences. Methods A sample of 79 undergraduate students of Physical Activity and Sport Sciences completed the CUVORE questionnaire (Gil & Coterón, 2012) after attending 30 sessions of Body expression. The importance that they gave to all variables was measured. Data were analysed using SPSS 16.0. We performed a multiple logistic regression analysis (stepwise method) to state how teaching variables (Technique, Methodology and Creativity) might predict the importance given by students to contents. Results The significant results found are described. Methodology ( $t=3.84$ ,  $p<0.01$ ) and Technique ( $t=3.36$ ,  $p<0.01$ ) predicted Body

contents ( $R^2=0.41$ ,  $p<0.01$ ). Likewise only Methodology ( $t=4.89$ ,  $p<0.001$ ) predicted Space contents ( $R^2=0.23$ ,  $p<0.01$ ). Methodology ( $t=2.91$ ,  $p<0.01$ ) and Creativity ( $t=2.49$ ,  $p<0.05$ ) predicted Rhythm contents ( $R^2=0.27$ ,  $p<0.01$ ). Methodology emerged as the main predictor in all contents. Discussion The present study indicates that participants scored Methodology as the most important indicator. These findings provide support for evidence that is important to develop strategies to enhance skill acquisition (Mainwaring et al., 2010). Furthermore, in line with our results Torrents et al. (2008) found in a study with similar sample the relation between Creativity and Rhythm. These results suggest that creativity tasks supported by music might be an appropriate strategy for the better acquisition of rhythmic skills. These findings provide information about the student's perception and suggestions on teacher's pedagogical approaches for the teaching of this subject. References Gil, J., Coterón, J. (2012). EmásF. Revista Digital de Educación Física (14), 106-121. Mainwaring, L. Pysh, C., Krasnow DH. (2010). Journal of Dance Education, 10(1), 14-21. Torrents, C., Castañer, M., Dinusová, M., Anguera, M.T. (2008). Retos, 14, 5-9.

### CHALLENGES FOR A RESEARCH METHODOLOGY OF CIRCUS ACTIVITIES PEDAGOGY IN PHYSICAL EDUCATION

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Introduction The inclusion of circus activities as a physical education subject has consolidated in recent years (HIRT & RAMOS, 2008), tending to increase gradually (PRICE, 2012). After analyzing 257 documents on the area, we observe a large number of reported experiences of teachers who use the circus activities in their classes (ONTAÑÓN, 2012). This scenario reveals the urgency of knowing these experiences, seeking to highlight the achievements and difficulties founded, so others professionals can join in an effective and secure way. This requires developing a specific research methodology in order to know the relevant aspects of these experiences. Methods To determinate best instruments and methods to research in a school environment, we follow the methods proposed by Anguera (1999) and Woods (1996). Additionally, we used four categories of analysis developed by researchers of the "Group of Research in Circus Arts" (CIRCUS) at the University of Campinas (Brazil). Results The most suitable instruments for this work are interview and direct observation (non-participatory and systematized) accompanied by a field diary to register the information related in the categories described below: - Historical and cultural circus context: relations between circus history and culture with the content worked in class. - Pedagogy of circus activities: description of the goal of the classes, the methodology, and other aspects such as the use of the ludic element as a catalyst of learning, standards to select the content, planning, progression and evaluation systems. - Safety culture: information about the security measures used in class. - The teacher and the institution: information about the teacher formation, approaches to the circus and institutional support. Discussion The observations allow us to know the general aspects of the educational project but we try also to identify broader issues (MACRO) and specificities (MICRO) that characterize each of the experiences, and therefore, their potential and limitations. In addition, interviews enable us to experience the data triangulation, which, according to Anguera (1999) will help us to validate subsequent analyzes. References ANGUERA, T. (1999) Observación en la escuela: aplicaciones. Universitat de Barcelona. DUPRAT, R.; GALLARDO, J. (2010) Artes Circenses no âmbito escolar. Unijuí. HIRT, M.; RAMOS, I. (2008) Maximum Middle School Physical Education. Human Kinetics. INVERNÓ, J. (2003) Circo y educación física: otra forma de aprender. INDE. ONTAÑÓN, T.; DUPRAT, R.; BORTOLETO M. (2012) Educação Física e Atividades Circenses: 'O Estado da Arte'. Movimento, v.18 n.2. PRICE, C. (2012) Circus for Schools: Bringing a Circo Arts Dimension to Physical Education. PHEnex Journal 4(1). WOODS, P. (1996) Researching the Art of Teaching: Ethnography for Educational Use. Taylor&Francis.

### TEACHING DANCE: A COMPARTIVE STUDY OF USING PREFERRED LEARNING STYLES IN THE TEACHING OF DANCE BETWEEN ENGLISH AND DANISH DANCE ACADEMIES

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Introduction The art of teaching dance is a dynamic and ever-changing array of perceptions and interpretations, yet often breaks down at the point of transferring the information from the dance teacher to the pupil. A variety of teaching methods have been extensively used; Movement based approach (Marx, 2009) and Student-centred approach (McCarthy-Brown, 2009), yet neither of these methods have addressed utilising preferred learning styles of individual pupils in the teaching delivery, and as such, traditional teaching methods of dance have failed to maximise learning potential. Therefore, this study aimed to investigate how teachers from differing cultures of dance utilised the knowledge of how children learn to better inform their teaching practice. Methods Appropriate ethical clearance was granted from a University before gatekeeper permission was granted to assess the preferred learning styles of school aged pupils ( $n=20$ , mean age 14years), from one Dance Academy school within the United Kingdom and Denmark respectively. Parental permission was also gained for all children to participate, prior to the completion of the Learning Styles Questionnaire for Children (LSQ-C). In addition, two semi-structured interviews were conducted with 3 consenting teachers of dance from each of the participating schools to ascertain a) their current teaching strategies and b) any change in their teaching practice. Results The mean scores of the LSQ-C for all children across the two schools exhibited a non-significant difference. Exploratory factor analysis (EFA) established that teachers of dance between the two sub-cultures follow similar teaching practices. When teaching strategies were compared against using knowledge of individual pupil's preferred learning styles, no difference was evident between the two sub-cultures. Discussion The exploratory analysis led to the initial conclusion that dance teachers deliver their lessons in the manner in which they were originally taught. However, there were variances of teaching strategies when knowledge of their pupils' preferred learning styles were gained, with experienced teachers unwilling to adapt/change their teaching philosophies across both sub-cultures. In contrast, the less experienced teachers were more willing to experiment by altering their teaching practices to suit the individual needs of their pupils with much greater success in pupil learning. Whilst these results support the work of dance teachers who educate children through the practical delivery of movements, it must be stressed, that from this study, by not adapting the lesson to suit the needs of the individual pupil could alienate the eventual learning of children. Therefore, dance teachers need to ensure they select a differentiated delivery strategy to allow all children to learn. References Marx, (2009). Rec & Dance, 80(4), 12-17. McCarthy-Brown, N. (2009). J Dance Ed., (9)4, 20-25.

### TRADITIONAL SPORTING GAMES AND EMOTIONS IN GIRLS AND BOYS

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Introduction The distribution of physical and sporting activities into motor action domains (MAD) provides teachers with a series of anchors around which they can organize motor tasks in physical education (PE) (Parlebas, & Dugas, 1998). Each category of games (or MAD)

produces different types of relationships and, therefore, has different kinds of impacts on players (Oboeuf, Collard, & Gerard, 2008). This study examined the emotions reported by PE students when performing activities in four MAD (psychomotor domain and three socio-motor domains: co-operation, opposition and co-operation/opposition). Methods Participants were 220 students from six secondary schools in the Spanish regions of Catalonia and Valencia: 119 girls (54.09 %) and 101 boys (45.90 %), all twelve years old. The Games and Emotions Scale (GES) (Lavega, March, & Filella, 2013) was applied in order to identify the intensity of the emotions experienced. The 34320 observations were analysed using a model based on generalized estimating equations (GEE), with Gaussian family, identity link function and exchangeable correlation structure. Results The statistical analysis revealed significant differences ( $p < .001$ ) between the experiences of positive and negative emotions, with the highest ratings being given to positive emotions ( $M = 5.94$ ,  $SD = .118$ ). The results also revealed significant differences ( $p < .001$ ) between the psychomotor domain (lowest ratings for positive emotions) and the socio-motor domains. Girls reported significantly more intense emotions ( $p < .001$ ) in all the domains except for opposition games. Discussion Participation in traditional games triggered, above all, pleasant experiences. The reported emotions varied notably between the socio-motor domains and the psychomotor ones, this being consistent with previous literature (Oboeuf et al., 2008). Parlebas and Dugas (1998) similarly found that these two broad families of games trigger very different processes. The present study confirms that socio-motor experiences can make a key contribution to emotional well-being in both male and female students. References Lavega, P., March, J., & Filella, G. (2013). Sports games and emotions. Psychometric properties of the Games and Emotions Scale (GES) and its use in Physical Education. *Revista de investigación educativa*, 31(1), 151-165. Oboeuf, A. Collard, L. & B.Gerard, B. (2008). The game of the seated ball: a sociometric questionnaire substitute?. *Les Cahiers internationaux de psychologie sociale*, 77, 87-100. Parlebas, P., & Dugas, E. (1998). Transfer of learning and motor action domains. *Education Physique et Sportive*, 270, 41-47.

### PHYSICAL EDUCATION AND EMOTIONAL WELL-BEING: THE EMOTION OF JOY IN COOPERATIVE GAMES

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Introduction One of the main contributions of physical education is to improve social and emotional wellness through enjoyable learning (Bisquerra, 2003). The cooperative motor interaction offers great possibilities to promote positive learning based on a pact rules. Participants in a cooperative game must overcome four types of relationships established by the internal logic: relationship with the other participants, with space, with time, with the material (Parlebas, 2001). Bisquerra (2003) highlights the joy as key positive emotion to generate personal and social well-being. This study aimed to identify which aspects are associated with the emotion joy by students to participate in cooperative games with and without victory. Methods A total of 117 university students (INEFC) (Age  $M = 19.6$ ,  $SD = 2.23$ ) participated in this study. Four sessions and twenty games were applied. After each game the students described a comment about the more intensely emotion they felt following the 'Games and Emotions Scale' (Lavega, Filella & March, 2013). We conducted a content analysis of 191 comments to identify units of meaning associated with joy. Results We identified five main arguments to explain the presence of the joy associated with the internal logic of cooperative games: 1) Pact: positive participation in the pact group, 2) Relationship with others: positive motor interaction, 3) Relationship with time 3.1 Dynamic game, 3.2 joyful participation in the competition, winning or losing, 4. Relationship with material: overcoming the difficulty of manipulating an object successfully. Discussion The arguments identified confirm the key role of cooperation to elicit the joy through positive experiences oriented to the emotional well-being (Johnson & Egelard, 1992). Cooperative games behave like a micro-society (Parlebas, 2001) where the protagonists learn to build democratic positive relationships of pact. The comments show the strength of the internal logic of cooperative games to elicit the emotion of joy. References Bisquerra, R. (2003). Educación emocional y competencias básicas para la vida. *RIE*, 21(1), 7-43. Johnson, C., & Engelhard, G. (1992). Gender, academic achievement, and preferences for cooperative, competitive, and individualistic learning. *Journal of Psychology*, 126, 385-392. Lavega, P., March, J., & Filella, G. (2013). Sporting games and emotions. Psychometric properties of the Games and Emotions Scale (GES) and its use in Physical Education. *RIE*, 31(1), 151-165. Parlebas P. (2001). *Juegos, Deporte y Sociedad*. Barcelona: Paidotribo.

### EXPRESSION OF EMOTIONS IN COOPERATIVE GAMES: A GENDER PERSPECTIVE

Serna, J., Lavega, P., Araujo, P., Sáez de Ocariz, U., López, V., Font, R.

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Introduction Although the contribution of cooperation to societal wellbeing has been widely recognized by various disciplines it has received scant attention in the field of physical education. This study examined the relationship between certain key features of the internal logic of cooperative motor games and the emotions reported by female and male participants. Methods Participants were 170 students from four secondary schools in Catalonia: 87 girls (51.18 %) and 83 boys (48.82 %), all twelve years old. After playing two cooperative games (four sessions) the students were immediately given the validated "Games and Emotions Scale" (Lavega, March, & Filella, 2013) and asked to rate the intensity of the different emotions they had experienced. The data (19890 observations) were analysed using a model based on generalized estimating equations (GEE), with Gaussian family, identity link function and exchangeable correlation structure. Results The statistical analysis revealed significant differences ( $p < .001$ ) between the three types of emotions. The highest ratings corresponded to positive emotions ( $M = 6.15$ ,  $SD = .171$ ), followed by ambiguous emotions ( $M = 3.11$ ,  $SD = .184$ ) and, finally, negative emotions ( $M = 1.07$ ,  $SD = .164$ ). There were also significant differences ( $p = .043$ ) between cooperative games with a fixed-role system (single role) and those that allowed a local exchange of roles (games with more than one role). No significant differences were found when comparing the intensity ratings of men and women. Discussion The social nature of cooperative motor games not only encourages but also requires participants (both women and men) to relate positively to one another. Games which allow players to switch roles involve a greater repertoire of motor responses and relationships, thereby exploiting to the maximum the positive interactions which may occur between participants (Green & Rechis, 2006). This research highlights the key role that these games can play in terms of providing a natural environment in which positive emotions can be fostered within a relational context (Salen, & Zimmerman, 2003). References Green, V.A & Rechis, R. (2006). Children's cooperative and competitive interactions in limited resource situations: A literature review. *Applied Developmental Psychology*, 27, 42-59. doi:10.1016/j.appdev.2005.12.002 Lavega, P., March, J., & Filella, G. (2013). Sporting games and emotions. Psychometric properties of the Games and Emotions Scale (GES) and its use in Physical Education. *Revista de investigación educativa*, 31(1), 151-165. Salen, K. & Zimmerman, E. (2003). *Rules of Play, Game Design Fundamentals*. Massachusetts: The MIT Press.

**EMOTIONS IN THE INTROJECTIVE MOTOR TASKS. A GENDER PERSPECTIVE**

Font-Lladó, R.1, Rovira, G.1, López-Ros, V.2, Lavega, P.3

1: UdG-EUSES (Girona, Spain); 2: UdG (Girona, Spain) 3: UdL (Lleida, Spain)

Introduction The introjective motor tasks, specially self-awareness, have a positive effect on personal and social well-being (Kabat-Zinn, 2003). The aims of this study were: (a) identify the emotional experience during cooperative and psychomotor introjective motor tasks in men and women. The research used Lazarus' (1991) model of basic emotions grouped into positive, negative and borderline (in this case, ambiguous). Method A total of N= 86 (69 men, 17 women) first year students of the undergraduate degree of Sports and Exercise Science at EUSES-UdG participated in the study. The Games and Emotions Scale (GES) (Lavega, March & Filella, 2013) was applied in order to identify the intensity of the emotions experienced. The subjects participated in four practical introjective sessions (2 psychomotor tasks without motor interaction and 2 cooperative tasks with playmates; Parlebas, 2001). Results Results showed higher values for the positive emotions than for negative and ambiguous emotions ( $p < .001$ ). Men and women experienced the emotions with the same intensity. However, there does exist significant difference between the intensity of negative emotions experienced by women and those experienced by men. A significantly higher emotional intensity was generated by the cooperative tasks ( $M = 1.06$ ) than in the psychomotor ones ( $M = 0.9$ ,  $p < .001$ ). Both men and women experienced similar intensity whereas in psychomotor, women ( $M = 0.75$ ) experienced emotions with significantly less intensity than men ( $M = 1.05$ ,  $p = 0.25$ ). Discussion During the introjective motor tasks, the intensity of positive emotions was significantly more than negative or ambiguous. The results reveals that introjective motor tasks have a positive effect on personal and social well-being. These findings are consistent with previous literature (Kabat-Zinn, 2003). Cooperative motor tasks elicited more intensity of emotions than psychomotor domain. This suggests that social interaction could have an effect on the intensity of emotions felt. Men experience negative emotions with more intensity, even though the intensity of positive emotions is much the same in men and women. Lavega et al (2013) found similar results . References KABAT-ZINN, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice*, 10, 144-156. LAVEGA, P., MARCH, J. & FILELLA, G. (2013). Juegos deportivos y emociones. Propiedades psicométricas de la escala GES para ser aplicada en la Educación Física y el Deporte. *Revista de Investigación Educativa*, 31(1), 151-165. LAZARUS, R.S. (1991). *Emotion and adaptation*. New York: Oxford University Press. PARLEBAS, P. (2001). *Juegos, Deporte y Sociedad*. Léxico de Praxiología Motriz. Barcelona: Paidotribo.

**ELEMENTARY-SCHOOL PHYSICAL ACTIVITY AND GENDER-RELATED NEEDS**

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This study of the operation of the after-school physical activity and gender analysis of the needs of students to activate the After-school athletic activities were aimed at. To this end, the city, Jeollabuk-J-school and elementary school physical education conducted seven school students in grades 5-6 in 300 people (150 people men, women 150) that is considered bad faith of the seven students, except for 293 people (148 people Male, Women's 145 people), by gender, physical activity needs of the school survey was to collect information, after-school athletic activity is of the operation of seven schools to see the large schools (30 classes or more), teacher name, junggyumohakgyo (20-29 class or higher) teacher name, a small school (less than 20 classes), teacher name, sampling a total of three teachers were in-depth interviews. Information collected SPSS (Ver 15.0) program, causing a chain were analyzed using analytical methods. Analyzed results are as follows: First, the elementary school of the operation of the school physical activity compulsory for the majority of the school is run by a few select On, and plans for setting up students and their parents are trying to cater to the needs of the school's facilities, but circumstances or. Instructor due to supply problems have not been able not meet the requirements. Second, information about after-school physical activity requirements on how and where in the school gymnasium, the school athletic director preferred appeared as a teacher, athletic boys in Home football, table tennis, girls dodgeball, badminton and much preferred. Boys in gym class and other requirements in the appropriate personnel, teachers were required integrity, girls get free time, the auditorium expansion, and after-school hours, abolish MORE demanded a ban.

**AGE GROUP EFFECTS IN POSITIVE OUTCOMES IN FEMALE VOLLEYBALL PLAYERS**

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Introduction During the involvement in sport context the young athletes live experiences that can lead to positive results. The enjoyment is an important factor for adhesion and maintenance in sport (Kimiecik & Harris, 1996). The sport can serve as inhibitor of risk-behaviors, promoter of resilience and pro-social individuals recurring to the developmental assets framework (Benson, 2002). The values acquired through sport participation and reflect in sport attitudes are important due to moral judgment is not isolated from the social context, such as team, and can be transferred for other context (Shields & Bredemeier, 2009) This study pretends to verify the age effects on sources of enjoyment, development assets and sport attitudes of youth female volleyball athletes. Methodology The sample was composed by 326 subjects with ages between 12 and 16 years ( $M = 14.15$ ,  $SD = 1.09$ ). They responded to the Sources of Enjoyment in Youth Sport Questionnaire, Developmental Assets Profile and Sport Attitudes Questionnaire. An ANOVA test was performed. Results It wasn't verified age effects in sport attitudes and developmental assets. Relatively to sources of enjoyment it was verified differences in the affiliation with peers ( $p = .007$ ). The athletes present low levels of cheating and unsportsmanship, and reveal good level of positive factors. Discussion The differences observed could be due to the number of years involved in sport, and the relationship developed with the peers during the maintenance in sport. It seems that Volleyball as norms and rules that lead to low levels of anti-social attitudes in sport. Conclusion The coaches must pay attention the age group needs of the athletes but also to other individual and contextual characteristics to improve the youth development. Benson, P. L. (2002). Adolescent development in social and community context: a program of research. *New directions for youth development*, 95(95), 123-47. doi:10.1002/yd.19 Kimiecik, J. C., & Harris, A. T. (1996). What is enjoyment? A conceptual/definitional analysis with implications for sport and exercise psychology. *Journal of Sport & Exercise Psychology*, 18, 247-263. Shields, D. L., & Bredemeier, B. L. (2009). *True Competition: A guide to pursuing excellence in sport and society*. (D. L. Shields & B. L. Bredemeier, Eds.). Champaign, Illinois: Human Kinetics.

## ENJOYMENT AND POWER REGULATIONS IN PE

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Introduction Research shows that many students stop enjoying physical education (PE) as they grow older. Boys enjoy PE more than girls, and the difference increases with age. (Prochaska, Sallis, Slymen, & McKenzie, 2003). Changes during the transition from primary school to junior high school are often pointed out as the reason why enjoyment in PE decreases. (Andrews & Johansen, 2005). Some research also show that shame during showering and changing before and after lessons leads to less enjoyment in PE, especially for girls (Wabakken, 2010). According to Foucault the society are more regulated than ever, and humans are not so emancipated from power as we think we are. (Markula & Pringle, 2006). The aim of this study was to map female students experience with changes in PE during the transition from primary school to junior high school. Locker room rules and behavior was also explored. Methods Interviews with eight girls from two different 8th grade classes (13-14years old) and observations of four PE lessons were conducted. The interviews were conducted during lessons with one student at a time and had a duration from 10 to 20minutes. The girls were chosen with help from the teacher and with a goal of finding someone who didn't enjoy PE too much. Results All of the interviewed girls enjoy PE. The study found that these girls enjoy PE more in junior high school, than they did in primary school. The teachers behavior and the classmates attitude towards winning were mentioned as reasons for this. The two classes had different locker room behavior; while the girls in one class changed and showered together, the other class showered and changed one or two at a time or alone in the bathroom. Discussion In contrast to a lot of research the study finds that the girls enjoy PE more in 8th grade than during primary school. Discipline and regulation increase from primary school to junior high school through the introduction of grades and more organized lessons. The study also shows signs of more regulation and rules in the locker room. More power and regulation are usually seen as a negative thing, but according to Foucault it can also be something positive. (Markula & Pringle, 2006). The results are further discussed in relation to Foucault and previous studies. References Andrews, T., & Johansen, V. (2005). Gym er det faget jeg hater mest. *Norsk Pedagogisk Tidsskrift*, 89(4), 302-314. Markula, P., & Pringle, R. (2006). Foucault, sport and exercise: power, knowledge and transforming the self. New York: Routledge. Prochaska, J. J., Sallis, J. F., Slymen, D. J., & McKenzie, T. L. (2003). A Longitudinal Study of Children's Enjoyment of Physical Education. *Pediatric Exercise Science*, 15(2), 170-178. Wabakken, T. V. (2010). Et følelsesladet valg - Om prosesser og mekanismer bak ikke-deltakelse i kroppsøving, dusj- og garderobeaktiviteter. Avdeling for allmennvitenskapelige fag. Bø: Høgskolen i Telemark.

## EFFECTS OF DIFFERENTLY ORIENTED PHYSICAL EDUCATION PROGRAMS ON PHYSICAL EDUCATION ENJOYMENT IN ITALIAN HIGH-SCHOOL STUDENTS

Di Michele, R.1, Spiga, F.1, Semprini, G.1, Toselli, S.1, Ceciliani, A.2, Brasili, P.1, Merni, F.1

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Introduction Enjoyment of physical education (PE) is important to develop a positive attitude towards physical activity and sports practice. A variety of physical, psychological, and educational factors have been reported to affect PE class enjoyment, including body mass index (BMI), self-efficacy, perceived competence, and curriculum content (Fairclough, 2003; Barr-Anderson et al., 2008). This study aimed to analyse, in Italian adolescents, the effect of two different physical education programmes on PE enjoyment while considering the moderating effect of BMI, physical performance and selected self-perception variables. Methods 37 Italian high-school students (M:18, F:19), aged 15 to 17 years, participated to two-month PE interventions. A group (M:8, F:10) attended a non-traditional team sports program oriented towards fun and motivation, while another group (M:10, F:9) attended a program focused on individual fitness activities. Before intervention, the BMI, self-efficacy, perceived competence, explosive strength, and aerobic fitness were assessed. A physical activity enjoyment scale (PACES) (Kendzierski and De Carlo, 1991) was administered pre- and post-intervention. Results The mean pre-intervention PACES score was not significantly different between the team sports (61.6, SD:8.1), and the fitness (63.4, SD:7.8) groups. A significant effect PE programs was observed, with a mean score increase of 2.4 (5.9) in the team sports program, and a mean decrease of 2.9 (4.4) in the fitness group. This outcome was similar in boys and girls, and no moderating effect was noticed for physical performance, self-efficacy, and perceived competence. BMI only showed an effect, though limited, with a 1-unit higher BMI associated to a 0.5 lower difference in the PACES score change, for each given group. Discussion The present results show that a highly motivating PE program may increase PE enjoyment in adolescents independently from their perceived competence, self-efficacy and performance level. This emphasizes the usefulness to include, in high-school PE curricula, activities focusing on fun and entertainment rather than on performance enhancement. References Barr-Anderson DJ, Neumark-Sztainer D, Schmitz KH, Ward DS, Conway TL, Pratt C, Baggett CD, Lytle L, Pate RR (2008). *Res Q Exerc Sport*, 79(1), 18-27. Fairclough S (2003). *Eur J Phys Educ*, 8(1), 5-18. Kendzierski D, De Carlo KJ (1991). *J Sport Exerc Psychol*, 13(1), 50-64.

## THE EFFECTS OF FOLK DANCE ACTIVITIES ON STUDENT'S ACADEMIC ACHIEVEMENTS AND SOCIAL HARMONY ABILITIES WHO LIVE IN ORPHANAGES

Aydın, M.1, Korkmaz, I.1, Meric Bingul, B.1, Bulgan, C.2, İra, N.1

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Introduction: In every community, there are many young people and children who need some protection for any reason, such as abandonment, family neglect, socio-economic inability and disintegration of families etc. In such cases, the government has to bear the children's care and education (Tufan and Sokezoglu, 2009). The schools are not enough for children and their future preparation if they are living in orphanages. Sportive and recreational activities not only helpfull to improve their physical, mental and social development but also contribute to develop their academic and social harmony abilities. The aim of this study was to determine the effects of traditional folk dance activities on student's academic achievements and social harmony abilities who live in orphanages. Method: Twenty-four primary school students (12 males and 12 females) were participated to this study voluntarily. All students were lived in Kocaeli Kassel Children Village in Turkey. During their two academic semesters, it was applied Traditional Turkish Folk Dance activities every week. Activities were continued 2 hours and they were 2 days in a week. Students' academic scores and social harmony abilities from last year and also this year were collected and analysed by using SPSS program. The average and frequency values were calculated and also Wilcoxon Signed Test was used for evaluation of the differences between the semesters. Results: In results, students' fall semester scores was found  $3,6125 \pm 0,68987$  and spring semester scores was found  $3,8083 \pm 0,68138$  after the folk dance activities. It was found that significant differences between the semesters of student's academic achievements and also participation of social activities ( $p < 0,05$ ). Conclusion: It is necessary to increase the success of academic achievements as well as to increase their ability to live independently of

children who are in under protection (Cetin, 2008). Gilman et al, (2004) were found that activities in out of the school were effected positively to mental health of children who had academic failures and communication problems (Erkan and Safoz, 2009). In this study, it was found that significant differences in academic achievements of children before and after the activities ( $p < 0,05$ ). We believe that these differences were due to the increase of students' self-expression, socialization and more concentration to their courses. In social harmony abilities, it was found a significant difference in participation of social activities ( $p < 0,05$ ) but it were not found differences in other social abilities. It shows that folk dance activities were increased students' willingness to participate to activities. References: Cetin, H., (2008), Journal of Firat Sağlık Hizmetleri, Cilt:3, Sayı:9 Erkan, Saföz. (2009). <http://oc.eab.org.tr/egtconf/pdfkitap/pdf/419.pdf>. Tufan, S., Sokezoglu, D,(2009). 8. National Music Education Symposium, 23–25 Sept., Omu, Samsun, Turkey.

### **A STUDY ABOUT THE DEVELOPMENT AND APPLICATION OF THE WORKBOOK FOR FOSTERING PUPIL'S CREATIVITY AND CHARACTER IN ELEMENTARY SCHOOL PHYSICAL EDUCATION**

Shin, K.

*Jeonju National University of Education*

**Introduction** The curricular change in Korea has been approached by top-down innovation (Jewett, Bain, & Ennis, 1995) which is developed by experts outside the school. Recently the ministry of education emphasized creativity and character as the critical contents in the school curriculum including physical education according to the 2009 revised physical education curriculum. Although the interest and endeavours of developing creativity and character have already existed, few studies of the exact concepts and properties of these qualities have been conducted especially in the elementary school physical education. Therefore the aim of this study was to develop the workbook and to confirm its application effect on pupil's creativity and character by using qualitative method. **Methods** This study focused on developing the workbook for fostering creativity and character. First of all, the notions of them were investigated through literature inquiry, and then the workbook was designed after eliciting the elements related with creativity and character from the textbooks of physical education. The effect of applying workbook in physical education class was investigated by using qualitative method with two elementary teachers. They participated in this study as the practitioner of the workbook. Thus data were collected through observation and interview. They were analyzed using domain analysis and taxonomic analysis which were presented by Spradley(1979). Trustworthiness of data analysis was established by using a member-checking procedure and peer debriefing throughout the research process. **Results & Discussion** Craft(2001) found out that creativity can be developed through systematic education and training. Berkowitz(2002) emphasized the necessity of character education for preventing youth violence. Based on these propositions, two workbooks were developed separately. One was for creativity, the other was for character. Creativity can be developed through participation in the cognitive activities of games. The workbook for developing creativity emphasized the scientific principles of materials, knowledge about the contexts of games through participation in game modifying, and understanding the game properties. The workbook for developing character influenced by the 2009 revised physical education curriculum which emphasize various virtues involved in physical activities such as fair play, team work, and understanding others. As a result of testing both teachers and their students, all of them agreed with the effectiveness of the workbook for developing creativity and character. Participants also presented kind of suggestions and information about making and applying the workbook.

**14:00 - 15:00**

### **Mini-Orals**

#### **PP-SH17 Sociology [SO] 1**

### **COMPARATIVE ANALYSIS OF TV VIEWING IN WEEKDAYS AND WEEKEND DAYS IN FUNCTION OF SOCIO DEMOGRAPHIC FACTORS AND PHYSICAL ACTIVITY.**

Abarca-Sos, A., García-González, L., Aibar, A., Murillo, B., Julián, J.A.

*UNIVERSITY OF ZARAGOZA*

**Introduction** The decrease of physical activity (PA) in adolescence has been commonly associated with the increase of sedentary behaviors (SB) (Marshall, et al., 2004), but the link between these variables and their influence factors are undefined (Pate, et al., 2011). **Methods** A representative sample of adolescent of Aragon region (Spain) participated in this study: 1609 adolescents (14,45  $\pm$  1,27 years; 879 boys and 730 girls). Studied variables were: PA, TV viewing in weekdays and weekend days, father and mother professional level and environment. The University of Zaragoza (Spain) provided ethical approval for this research. Two hierarchical linear regressions were conducted to analyze influence factors of TV viewing in weekdays and weekend days following the procedures of another study in Spanish adolescents (Devís-Devís, et al., 2009). **Results** Results showed significant relations between TV viewing in weekdays and gender ( $\beta = -0,060$ ,  $p < ,05$ ), type of school ( $\beta = ,081$ ,  $p < ,01$ ), professional level of father ( $\beta = ,087$ ,  $p < ,01$ ) and PA ( $\beta = -0,075$ ,  $p < ,05$ ). However, significant and negative relations were found between weekend days and gender ( $\beta = -0,060$   $p < ,05$ ) and age ( $\beta = -0,082$   $p < ,01$ ), and positive for type of school ( $\beta = ,072$   $p < ,05$ ). **Discussion** Boys and adolescents in public schools spent more time watching TV both type of days, similarly to a study developed in Spain (Devís-Devís, et al., 2009). In contrast, it can be observed that TV viewing is associated to different variables in function of the type of day: PA is inversely related to TV viewing in week days, age emerged as the strongest predictor in weekend days and father professional level was not related with TV viewing in weekend days. The weekend day organization is freest than week days one and, consequently, adolescents have more autonomy (Pate, et al., 2011). Finally, PA in weekdays displaces SB because free time is fewer in comparison to weekend days (Te Velde, et al., 2007). **References** Devís-Devís J, Peiró-Velert C, Beltrán-Carrillo VJ, et al. Brief report: Association between socio-demographic factors, screen media usage and physical activity by type of day in Spanish adolescents, Journal of Adolescence 2012; 35(1): 213-218. Marshall SJ, Biddle SJH, Gorely T, et al. Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. Int J Obes 2004; 28:1238–46. Pate RR, Mitchell JA, Byun W, Dowda M. Sedentary behaviour in youth. Br J Sports Med 2011; 45(11): 906-13 Te Velde SJ, De Bourdeaudhuij I, Thorsdottir I, et al. Patterns in sedentary and exercise behaviors and associations with overweight in 9–14-year-old boys and girls - a cross-sectional study. BMC Public Health, 2007; 7(16).

## SWEDISH ELITE SPORT AT A CROSSROADS? SOME RESULTS FROM A STUDY OF GOVERNMENT SUPPORT FOR ELITE SPORT

Norberg, J.

*Idrottsvetenskap*

**Introduction** In 2011, the Swedish government commissioned The Swedish National Centre for Research in Sports (CIF) to examine the structure and impact of government support for elite sport. A study was conducted in collaboration with several research groups under the guidance of Johan R Norberg, researcher at CIF. The result was reported back to the government in May 2012. **Methods** CIF:s survey begins with a comprehensive analysis of the Swedish elite sport system, based on quantitative data relating to sports federations' economy, scope and results at international championships. Thereafter follows a qualitative study concerning the current state of Swedish elite sport, based on interviews with athletes, coaches and sports managers in eight strategically selected sports. Thus, the report also includes a review of international tendencies in elite sport support, a survey of programs for coaching development in Swedish sports and an analysis of sports policy implications of the Swedish government's increased support for elite sport. **Theoretically**, the survey takes its starting point in current research on increased competition in international elite sport (De Bosscher et al 2008, Houlihan & Green 2008). **Results** The study shows that Swedish elite sport has always had a relatively marginal position – at least on a political level (Bergsgard & Norberg 2010). Government support for sport has mainly come in the shape of subsidies to sports facilities, grants to youth sport activities and economic support to the administration of the national sporting federations, while targeted investments in elite sports been few. Furthermore, such investments have had an ambivalent position, viewed as somewhat inappropriate in a social democratic welfare regime based on ideals of breadth and equality rather than elitism and ranking. Thus, the Swedish sports model differs from many comparable countries with a strong focus on "sports for all" rather than elite sport. This is reflected in the organization and conditions of Swedish elite sports. One one hand, local clubs and publicly financed facilities have created good opportunities for young people to try out different sports and develop their skills. One the other hand, there have been few public subsidies to help athletes to take the final step from promising talent to the international elite. **Discussion** In recent years, the Swedish government has taken steps to strengthen the international competitiveness of Swedish sport. This raises the question whether Sweden is about to join "the Global Sporting Arms Race" or if the Swedish government's support for sports will continue to focus mainly on sports-for-all, voluntarism and youth sports. **References** Bergsgard, N. & J. R Norberg (2010) "Sports policy and politics – the Scandinavian way", in *Sport in Society*, Vol 13 De Bosscher et al (2008). *The Global Sporting Arms Race*, Oxford: Meyer & Meyer Sport Houlihan, B. & Green, M. (2008). *Comparative Elite Sport Development*. Oxford: Elsevier

## THE ACADEMIZATION PROCESS IN SWEDEN

Wirén Aakesson, J.

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**Introduction** Sport research within social science, and sport science (sport studies) education at an academic level are relatively new phenomenon's in Sweden. Research started in the 1970s and before the 2000s there were only a few academic sport educations. Today, research and education are comprehensive and diversified. Also, the sport labor market has been expanding and changing, with more employment opportunities, on the one hand, and a smaller proportion of these being qualified jobs, on the other. The study deals with the Sport Academization process. The purpose is to attain extended knowledge and a deeper understanding of higher sport science education and its relationship to sport research, and the sport labor market - from a perspective of knowledge. **The research questions** are: What knowledge is produced within social science sport research, what knowledge is mediated through higher sport education, and what knowledge is demanded in the sport labor market? How does the production, mediation and demand for academic sport knowledge relate to each other? Do they differ, and if so, in what ways and why? **Four theoretical concepts** are particularly central in the study: knowledge (Berger & Luckmann 1966), paradigm (Kuhn 1962), discourse and institution (Foucault 2008). Bauman's theories about social processes and discourses of different eras are also central (Bauman 1998). **Methods** The empirical material consists mainly of various documents, such as: dissertations, journal articles, educational curriculums, job listings, and various statistical materials. The documents have been analyzed quantitatively, with statistical analysis, and qualitatively, through discourse analysis. **Results** The study shows that there are discrepancies between produced, mediated and demanded knowledge. The largest proportion of research has been produced within the fields of pedagogy, psychology and history. At the same time, almost half of the educations are within Sport Management. Also, preliminary results show that the demand for knowledge on the labor market is mainly expressed through demands of practical knowledge, i.e. knowing how to do things, rather than having knowledge and understanding about things. **Discussion** The main interpretation of observed differences is that research, education and labor market is based on different contemporary logics (ideas and ideals). The differences between mentioned knowledge entities highlights important questions about whether and how research, education and the labor market within sport should be governed. **References** Bauman, Zygmunt (1998). *Work, consumerism and the new poor*. Buckingham: Open University Press Kuhn, Thomas S. (1962). *The structure of scientific revolutions*. Chicago: Univ. of Chicago Pr. Berger, Peter L. & Luckmann, Thomas (1966). *The social construction of reality*. London: Penguin Foucault, Michel (2008). *Diskursernas kamp*. Eslöv: Symposion

## QUALITY OF LIFE RESEARCH IN FUTSAL PLAYERS

Santos, A.

*University of São Paulo*

**INTRODUCTION:** Studies on quality of life has been used to indicate the well-being of individuals and groups, as well as identify areas of intervention that can improve people's lives. There are few studies that investigate athletes quality of life and therefore, the use of information in this area has taken little advantage in creating strategies for broad development of athletes. The knowledge in this area can help define a training framework that supports the performance and development of the futsal players. **OBJECTIVE:** The aim is to examine the quality of life in futsal players through a descriptive study. **SUBJECT & METHOD:** The sample comprised 37 participants, 28 men and nine women. They had over 18 years with mean age 21,9 years (SD=3,9). The athletes were affiliated to the futsal federation and took part in formal tournaments. The Quality of Life Index is a generic instrument that characterizes and estimates quality of life in terms of importance-weighted life satisfaction using a specific technique that results in values with the possible range from 0,0 to 30,0 (Ferrans & Powers, 1985; Kimura, 1999). **RESULTS:** The sample presented total QLI 23,9 (SD=3,2) with the minimum of 15,3 and maximum of 29,3. The domains and some factors are as follows: (A) health and functioning domain (24;SD=3) which includes factors like pain (17;SD=7) and sex

life (27;SD=4); (B) socioeconomic domain (16;SD=3) which includes factors like friends (26;SD=4) and financial needs (19;SD=8); (C) psychological and spiritual domain (25;SD=3) which includes factors like faith in God (28;SD=3) and achievement of personal goals (23;SD=5); (D) family domain (22;SD=5) which includes factors like family health (24;SD=6) and children (28;SD=4). **DISCUSSION:** The lowest value was found in the socioeconomic field. The conditions for training and competition should contemplate a career and retirement plan to ensure properly the welfare of athletes. The highest values are in the psychological and spiritual domain. Coaches should recognize the importance to these aspects in promoting the emotional stability of the players (Woods, 2011). These results can help managers and coaches to take decisions that contribute to the performance, based upon the concept of integral human development, both inside and outside the sport scene. **REFERENCES** Ferrans CE, Powers MJ. Quality of Life Index: development and psychometric properties. *Adv Nurs Sci*. 1985; 8(1), 15-24. Kimura M. Translation into Portuguese and validation of the Quality of Life Index, Ferrans and Powers. São Paulo: University of São Paulo, [1999]. Woods R. B. 2011. Social issues in sport. Champaign, IL. Kumankinets.

### **NORWEGIAN PROFESSIONAL FOOTBALL PLAYERS PERCEPTION OF HIGHER EDUCATION, AND THE IMPORTANCE OF FOOTBALL CULTURE.**

Ødegård, A.

*University of Science and Technology (NTNU)*

**Introduction** The combination of professional football and higher education has been of interest for researchers for many years, but has become even more relevant the last decade do a unstable labour-marked (McGillivray, Fearn, & McIntosh, 2005; McGillivray & McIntosh, 2006). Using Pierre Bourdieu's (1990; 1992) theory of field and capital, this study aims to identify Norwegian professional football players attitude towards higher education. The study will also seek to understand how the football culture, that exist within teams, affect the combination of football and higher education. **Methods** The study will use data generated from in-depth qualitative interviews with 10 professional Norwegian male footballers, witch can be classified as established professionals (19-23 years old). This study will take place between 21-25 march 2013 in La Manga, Spain, during a pre-season training camp. There has been conducted a pre-project witch has given some preliminary results. The preliminary results are based on interviews done with three professional football players in the Norwegian first-division. **Discussion** The primary results show that Norwegian professional football players have a mixed feelings when considering their relationship with higher education. While it does not seem uncommon that professional football players take higher education, their motivation towards seems to be low. The result of this seems to be low grades, or drop-out. Their negative attitude and motivation towards higher education seems to mainly come from their attachment to their football and team culture. The culture seems to downgrade the importance of higher education and rather seems to value material and physical goods. The findings correlates with previous research were it has been found that footballers seems to not value cultural capital, but rather physical capital (McGillivray, et al., 2005; McGillivray & McIntosh, 2006). This can be seen as a problem in today's modern society, where the football labour marked is more insecure, with shorter contracts, lower wages, and a constant danger of career-ending injuries. **References** Bourdieu, P. (1990). *The Logic of Practice*: Cambridge: Polity. Bourdieu, P., & Wacquant, J. D. (1992). *An Invitation to Reflexive Sociology*. Cambridge: Polity Press. McGillivray, D., Fearn, R., & McIntosh, A. (2005). Caught up in and by the Beautiful Game. *Journal of Sport & Social Issues*, 29(1), 102-123. McGillivray, D., & McIntosh, A. (2006). 'Football is My Life': Theorizing Social Practice in the Scottish Professional Football Field. *Sport in Society*, 9(3), 371-387.

### **THE SOCCER SCOUT AND SOCIAL NETWORK THEORY: A QUALITATIVE STUDY OF THE NORWEGIAN TALENT SCOUT IN SOCCER**

Michalsen, Ø.

*Norewegian University of Science and Technology*

**Introduction** This study uses traditional Social Network theory, including The Strength of Weak Ties, Structural Holes and The-Small-World-Phenomenon, to try and understand the soccer scouts role, content and work - related social network. In this study the soccer scout is limited to the talent scout. The talent scouts primary objective is to identify players any club wishes to register with. Previous studies in the field of talent identification focus largely on preferable attributes and skills possessed by young players. Other studies concentrate on which abilities and attitudes talent scouts rank as valuable, while many highlight The Relative Age Effect. Studies regarding talent scouts and Social Network Theory are seemingly scarce. Theory Social Network theory explore the characteristics of relations between participants (Schieffloe, 2003), while The Strength of Weak Ties outlines the significance of relations influenced by inequalities, hence access to new areas of domains (Granovetter, 1973). Structural Holes refers to the potential relationship between two parties (often in) two different social focuses, and the values of establishing the relation (Burt, 2002). The-Small-World-Phenomenon offers insight that our social network is, in theory, much larger than first assumed, due to the systematizing of frequently experiences of coincidences (Watts, 2004). **Method** Five semi - structured interviews were conducted with five different soccer scouts on national and international level in Norway, with the purpose of identifying the scouts role description and key aspects of their work - related social network. **Analysis** Preliminary findings suggests that the talent scouts social networks (i.e. colleagues etc.) are imperative to all scouts. The importance are highlighted by the logic of The Strength of Weak Ties as it gives scouts entry to new information about players and leagues. Other findings show that the scouts willingness to broadcast information are affected by the competitiveness of other clubs. Scouts awareness to the essentials of a broad, deep, close and trustworthy network will most likely showcase their ability to act on potential player targets. Furthermore the findings indicates that these scouts' attention to their social networks are random and accidental. **References** Burt, R. S. (2002). The Social Capital of Structural Holes. In M. F. Guillén, R. Collins, P. England & M. Meyer (Eds.), *The New Economic Sociology. Developments in an Emerging Field*. USA: Russen Sage Foundation. Granovetter, M. S. (1973). The Strength of Weak Ties. *American Journal of Sociology*, 78(6), 1360-1380. Schieffloe, P. M. (2003). Mennesker og samfunn. Innføring i sosiologisk forståelse. Bergen: Fagbokforlaget Vigmostad & Bjørke AS. Watts, D. J. (2004). The 'New' Sience of Networks. *Annual Review of Sociology*, 30, 243-270.

### **A MODEL OF DESIGNING INFORMATION SYSTEMS FOR MONITORING THE HEALTH LEVEL OF UNIVERSITY STUDENTS**

Shklyarenko, A.1, Kovalenko, T.2, Pushechkin, N.1, Pashkov, L.1, Ulyanov, D.2

*1: Kuban State University, the branch in Slavyansk-on-Kuban (Slavyansk-on-Kuban, Russia), 2: Volgograd State University (Volgograd, Russia)*

**Introduction** Designing information systems for monitoring has to be based on modern information technologies and on choosing a friendly interface easy enough for non-professional users, who may have little knowledge in the field computing. **Methods** The method of

research is to analyze modern information technologies and to choose the most uncomplicated interface for users with little experience in computing. The source of research was the work on creating the information system for monitoring health based on the principles of prenosological diagnostics of students of Slavyansk-on-Kuban branch of Kuban State University, Slavyansk-on-Kuban, Russia. Results As the processed information on the health of the testees has more than 20 parameters, creating a single database table is considered to be non-optimal. The data are stored in three linked tables: the table of health level, the table of optimal physical load and the table of adaptive potential. The created version of the information system project consists of an executable project module and a set of XML database files. The main form of the project is the table form of the health level. The main menu of the health level table form contains 2 dropdown submenus: Database and Reports. Database menu is used to choose actions with the health level table in whole. You can save it as an XML file, download as an XML file, clear all the contents. Item Reports of the main menu of the optimal physical load form allows to move to the auxiliary report building form. In the upper part of the form you can see the view of the result in HTML format. The lower part of the form alternatively shows the diagrams of the health level and the optimal physical load. To build a diagram you have to choose the corresponding menu item of the upper menu of the form. Having checked the correctness of the diagram built, you are to choose the menu item Save and save the final result as an HTML file. Discussion The created information program clearly demonstrates the state of health level and physical activity individually for first-year students of Physical Education Department and Social Economics Department of Slavyansk-on-Kuban Branch of Kuban State University, Russia. The program is used to monitor the process of correcting the health level and physical activity. It is uncomplicated and gives no difficulty in using the estimation of the students' health state. References Pirogov V.Yu. Information Systems and Database: Organization and Designing. St. Petersburg: БХВ-Петербург. 2009. -528 p. Podolnaya M.A., Taperova L.N. Peculiarities of Designing Medical Diagnostic Systems // Information Technologies in Health Care Service. 2002. #8-10. p.10-11.

### COMPARISON OF PHYSICAL ACTIVITY MEASURES USING SMARTPHONE BASED CALFIT AND ACTIGRAPH

Donaire-Gonzalez, D., de Nazelle, A., Seto, E., Mendez, M., Nieuwenhuijsen, M., Jerrett, M.

*Center for Research in Environmental Epidemiology (CREAL)*

Background: Epidemiological studies on physical activity lack inexpensive, objective, valid and reproducible tools for measuring physical activity levels of subjects. Novel sensing technologies built in smart phones offer the potential to fill this gap. Objective: We sought to validate estimates of physical activity and determine the utility for large population based studies of the smartphone-based CalFit software. Methods: A sample of 36 subjects from Barcelona, Spain, wore a smartphone with CalFit software and an Actigraph accelerometer for five days. The usability and physical activity measures (vertical axis counts (VT) and duration and energy expenditure predictions for light, moderate and vigorous intensity from Freedson's algorithm) of both devices were compared. Statistical analyses included: (i) Kruskal-Wallis rank sum test for usability measures, (ii) Spearman correlation and linear regression for VT counts, (iii) concordance correlation coefficient (CCC) and Bland-Altman plots for duration and energy expenditure measures. Results: Some 64% of participants were women, mean  $\pm$  standard deviation age was  $31 \pm 8$  years, and body mass index was  $22 \pm 2 \text{ kg}\cdot\text{m}^{-2}$ . The usability allowed that 25 of 36 (69%) subjects recorded at least three days with at least 10 recorded hours of physical activity. The linear association and correlations for VT counts were high (Adjusted R-squared = 0.85 and correlation coefficient 0.932 [95% CI: 0.931 to 0.933]). CCCs showed high agreement for any intensity of physical activity (from 0.73 to 0.91). Conclusions: The CalFit system may provide valid estimates to quantify and classify physical activity. Because cell phones are already carried by many people, CalFit may prove to be more cost effective and easily deployed for large-scale population health studies than specialized instruments that are not routinely carried.

### ESTIMATING THE MOBILITY MODEL OF SOCCER PLAYERS IN VARIOUS SITUATION OF A MATCH

Jamalian, A., Mehrabi, S., Rezvani, R., Hadi, B.

*Sama Technical and Vocational Training College, Islamic Azad University, Andisheh Branch, Andisheh, IRAN*

Introduction In a soccer match, the coach of team dictates his/her program to players, so they should not move or run during the match in their desired manner. It can be assumed that players of each team have their Mobility Model (MM). The MM of players could be an important parameter for assessment of team solidarity. The aim of this study was estimating the MM of soccer players of a typical team in various situation of a match such as defense, attack and counter-strike. Method We used four MM which are very similar to MM of soccer players: Random Way Point (RWP), Pursue, Freeway and Reference Point Group Mobility (RPGM). These models are inspired from literature on the subject of Mobile Ad-hoc Networks and more models can be fined in [1]. First we extracted the certain position of each player from video sequences and then calculated the velocity vector for each player within every second and, using them, calculated the parameters for performance evaluation such as Average Relative Speed and etc. In next phase, we used a Learning-Automata based algorithm by using TFSLA [2] to estimate the mobility model of players. TFSLA is a Fixed Structured Stochastic Automaton (FSSA). As it is mentioned in [3], FSSA are faster than Variable Structured Stochastic Automata (VSSA), so that they are suitable for real-time applications. Results In Defense: RWP = 39%, Pursue = 12%, Freeway = 5%, RPGM = 44%. In Attack: RWP = 4%, Pursue = 25%, Freeway = 13%, RPGM = 58%. In Counter-Strike (as Attacker): RWP = 5%, Pursue = 44%, Freeway = 39%, RPGM = 12%. In Counter-Strike (as Defender): RWP = 3%, Pursue = 52%, Freeway = 34%, RPGM = 11%. Discussion In Defense situation, some players walk randomly and some other run according to the ball position. So the average MM in most cases is either RWP or RPGM. In Attack situation, most of players move regarding the ball possessor and some others pursuing him/her and because of this, RPGM and Pursue model are ranked 1 and 2 respectively. However, in Counter-Strike situations, most players pursuing the ball possessor regardless of his/her team. Even in many cases they pursue each other like vehicles in a freeway. Hence, the average MM is something like Pursue Model or Freeway. References [1] T. Camp, J. Boleng and V. Davies. "A Survey of Mobility Models for Ad Hoc Network Research", WCMC: Special issue on Mobile Ad Hoc Networking, vol. 2, pp. 483-502, 2002. [2] A. H. Jamalian, R. Iraj, A. R. Sefidpour and M. T. Manzuri-Shalmani, "Examining the Optimality Property of a Tuneable FSSA", Proc. of 6th IEEE Intl. Conf. on Cognitive Informatics (ICCI'07), pp. 169-177, 2007. [3] M. A. L. Thathachar and P. S. Sastry, "Varieties of Learning Automata: An Overview", IEEE Trans. Syst., Man, Cybern., vol. 32, pp. 711-722, 2002.

### DEVELOPMENT OF A SYSTEM FOR REAL-TIME TRAINING CONTROL FOR GROUP-TRAINING IN ROAD CYCLING

Jaitner, T.1, Kuhlmann, C.H.1, Perl, J.2

*1: Dortmund University of Technology, 2: Johannes Gutenberg University Mainz*

Introduction In junior road cycling practicing in groups is an important type of practice. The German Cycling Federation suggested a ratio of 30:70 between single and group practice. In group practice, the necessary power output depends on the position of the rider in the

group. In the slipstream the power output can be reduced up to 36% while reaching the same speed than in the first position. In the same amount the cardiovascular load and the metabolism load is reduced in rear positions (Neumann, 2000). To optimise group training to individual specifications, speed, the group formation, the position of each rider in the group and the sequence of position changing must be adapted to the individual performance potential of each athlete. Hence, for an individual optimal training effect for all athletes participating in the group training a computer-based online-monitoring and real-time training control tool has to be developed. Using cycling computers like SRM™, Ergomo™ etc., athletes can observe data like speed, power output at the crank, cadence, heart rate etc., easily for themselves. But there is a technological deficit in systems which are able to interact between different athletes to ensure that every single athlete can reach the maximum benefit from a group training. Methods The Training Control System (TCS) consists of a hardware component, a software component and mathematical algorithms for training control (Jaitner and Trapp, 2008). Every bike is equipped with a commercial power measurement system (Ergomo™ or SRM™) and an Ultra Mobile Personal Computer (UMPC). The power measurement system is connected to the UMPC via serial port to transfer sensor data like speed, power, cadence, heart rate as input value for the training control algorithm. Training Control is based on the PerPot model (Endler and Perl, 2012), that has been adapted to cycling. It provides online feedback about optimal speed, group position, cadence, power and heart rate to each cyclist of the group and proposes changes in these variables via the display of the UMPC. Results and Discussion In the first experiments the TCS was able to control and to regulate the group and every single position during practice in the described way. Athletes were able to respond to the suggestions of the TS. Hence, they adapted their individual training load to the TCS-suggested intensity by changing the specific variable. Further studies have to be made to quantify the advantage of the TCS for every individual athlete participating in the group training. References Endler, S., Perl, J. (2012). Pre-Olympic Congress on Sports Science and Computer Science in Sport. 127-131. Jaitner, T., Trapp, M. (2008). International Journal of Computer Science in Sport, 7(2), 34-45. Neumann, G. (2000). DZSM, 51(5), 169-175.

**14:00 - 15:00**

## Mini-Orals

### PP-BN05 Biomechanics [BM] 5

#### DIFFERENCES IN ISOMETRIC STRENGTH BETWEEN DOMINANT AND NON-DOMINANT UPPER EXTREMITY IN COMPETITIVE TENNIS PLAYERS

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Introduction Tennis is physically demanding and imposes high-impact loading upon the upper extremity. Repetitive stress on the dominant side in tennis players creates anatomical differences between dominant and non-dominant upper limbs. Some of these differences are an increased size in bone mass and muscle structures and a greater arm concentric internal rotation strength compared to the non-dominant side (Ellenbecker & Roetert, 2003). The aim of this study was analyse isometric strength ratios between dominant and non-dominant upper extremity in competitive tennis players. Methods Twelve male competitive tennis players (mean  $\pm$  SD; age:  $17.2 \pm 1.0$  years; height:  $180.1 \pm 6.2$  cm; weight:  $71.9 \pm 5.6$  kg) from the International Tennis Centre of the Catalonia Tennis Federation (FCT) participated in the study. Measurements were conducted using a strain gauge (500N) connected to a portable MuscLab™ system, and included maximal isometric voluntary contraction (100 Hz) in the wrist, elbow and shoulder flexion/extension, and shoulder internal/external rotation, in both sides (dominant and non-dominant). Results All variables were significantly different in the dominant side compared to the non-dominant side (p values ranging from 0.05 to 0.001). The average difference (%) between sides ranged between  $10.7 \pm 9.4$  % in shoulder external rotation and  $11.5 \pm 4.2$  % in shoulder extension to  $26.4 \pm 12.7$  % in shoulder internal rotation and  $24.6 \pm 7.0$  % in wrist extension. Discussion The repetitive stressors and loading sequences of tennis practice create muscular imbalances leading to characteristic injury patterns and musculoskeletal adaptations. The main results of this study showed the existence of an asymmetry in isometric strength values between dominant and non-dominant upper limbs, supported by previous research in this area (Ellenbecker et al., 2009). Traditionally these differences have been reported using isokinetic devices (Saccol et al., 2010), but the present results indicate that isometric testing also has the potential to evaluate the strength ratios between dominant and non-dominant side in tennis. We can suggest that isometric testing in sports also has the potential to analyze the effects of injury and guide the rehabilitation process. References Chandler, J. et al. (1992). Am J Sports Med, 20, 455-458. Ellenbecker, T.S. et al. (2009). Strength & Condit J, 31:50-58. Ellenbecker, T.S. & Roetert, P. (2003). J Sci Med Sport, 6, 63-70. Elliot B. (2006). Br J Sports Med, 40, 392-396. Saccol, M. et al. (2010). Phys Ther Sport 11: 8-11.

#### VARIABLES THAT CAN INFLUENCE THE PERFORMANCE OF THE OLLIE TRICK

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Introduction Skateboard is a sport with a huge number of participants, however there is a lack of studies analyzing its movement biodynamic. When you analyze the correct motion of a sport, you can find that there is a proper coordination to perform it. The goal of this study was to evaluate kinematically the Ollie, a trick from skateboarding, through the observation of all body coordination, and others components that can influence the quality of this trick. Methods This is a study where was made the kinematics analysis of the Ollie trick, in the sagittal and frontal plan of the skateboard. The sample of 5 individuals with  $23,8 \pm 3,49$  years old,  $177,2 \pm 2,38$  cm of height, weighing  $68,8 \pm 6,30$  Kg. An obstacle made of wood was used to be passed over, using the Ollie. When the skateboarder could pass it over successfully 4 times in a row, the obstacle's height was raised. It was used a high speed digital camera Fuji Film HS10 (Japan), with a speed of 30 frames per second (sagittal) and 120 frames per second (frontal). To ensure the proper execution of the trick, it was placed an obstacle which has a regulable height. The distance of the obstacle was decided by the skateboarder. After 4 consecutive correct tricks, the obstacle's height was raised in 5 cm. Motion analysis software Dartfish 6.0 (Switzerland) was used to the kinematic evaluation. Five components were measured during the trick: the skateboard's speed in the approach to the obstacle, the distance that the front's wheels lose touch with the ground, the board angle in relation to the horizontal, in the moment when the front wheels were above the obstacle,

and the period of squat to initiate the trick. Results It's verified that the skateboard's speed in the approach to the obstacle was  $13,85 \pm 1,31$  km/h. The board's angle in relation to the horizontal was  $31,11 \pm 3,69^\circ$ , and the board's angle in the moment when the front wheels were above the obstacle was  $45,59 \pm 6,01^\circ$ . The distance that the front's wheels lose touch with the ground was  $78,78 \pm 13,65$  centimeters, and the period of squat to initiate the trick was  $196,18 \pm 82,35$  ms. Discussion The results showed speed and distance as important components of Ollie, as well as the period of squat to initiate the trick and the use of the dominant leg, acting like the impulse's originator. Measuring Ollie's execution, it was possible to note that there is a synchronization between the body segments, although, in some situations the sequence of these segments use is not the ideal, and as result, the movement performance is affected. The survey could conclude that the speed, the board angle and the distance are relevant components, as well as legs and arms synchronization, because once there is no coordination on it, Ollie's performance is affected.

## THE RELATIONSHIP BETWEEN APPROACH SPEED AND JUMP TRAJECTORY IN 3-DAY EVENT HORSES

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Introduction Both professional and amateur riders compete in the Olympic discipline of 3-Day Eventing, sometimes with deadly consequences (1). Of particular concern are horse falls (1) where the horse hits and somersaults over the jump. The upward force necessary to clear a jump is generated at take-off (4). If the approach is too fast, energy is wasted in a braking mechanism (propping), inhibiting upward impulse. Conversely, if the approach is too slow, the horse may not have enough horizontal velocity to clear the fence width (4). Modern cross country requires repeated velocity changes from 350-600mpm (3), which makes creating optimal take-off conditions (4, 5) difficult. Therefore, the aim of this study was to explore the relationship between approach speed and the resulting jumping trajectory. Methods Horse/rider pairs (n=22) were filmed jumping both a vertical and a square oxer from each lead at three different speeds (Collected, Working, and Forward). A camcorder recorded two approach and two landing strides and the jump itself, electronic timers measured the last stride's velocity, and a reflective ball attached near the center of the horse's scapula was a visual reference to determine trajectory. Results The take-off trajectory of 264 efforts was determined using Dartfish software by connecting a line drawn between the reflective ball locations as the leading front limb and trailing hind limb left the ground. An ANOVA comparing trajectory to actual speed ( $p < .01$ ), take-off distance to actual speed ( $p < .001$ ), and landing distance to actual speed ( $p < .001$ ) showed significant differences. Further ANOVA analyses revealed that jumping trajectory, take-off distance, and landing distance were significantly different when comparing working to forward and collected to forward paces ( $p < .01$ ). Conclusion If the horse fails to transfer enough horizontal velocity into vertical impulse to clear the jump's vertical height or the horizontal velocity decreases as a result of overcompensated vertical impulse, the possibility for falls increases. These data show that as approach speed increases, jumping trajectory flattens, necessitating a longer take-off distance to allow the flight apex to clear the center of the jump. References 1. Murray et al. (2005). Risk Factors for Cross-Country Horse Falls at One-Day Events and at Two-/Three-Day Events. *The Veterinary Journal*, 170, 318-324. 2. Improve Your Horse's Jump. (2000, January). *Practical Horseman*, 28. 3. Wofford, J. (2009, February). Safe at Any Speed. *Practical Horseman*, 16-19. 4. Powers, PNR & Harrison, AJ. (1999). Models for Biomechanical Analysis of Jumping Horses. *Journal of Equine Veterinary Science*, 19(12), 799-806. 5. Powers, PNR & Harrison, AJ. (2000). A Study on the Techniques Used by Untrained Horses During Loose Jumping. *Journal of Equine Veterinary Science*, 20(12), 845-850.

## STABILIZATION OF THE ANTICIPATED POINT OF TOUCH DOWN IN TENNIS EITHER BY DECELERATION OF THE RACKET HEAD BEFORE THE HIT OR THE USAGE OF TOPSPIN

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Introduction It is a general finding that for goal directed striking sports such as tennis, table tennis, golf, volleyball, hockey and soccer the general time-course of the end segment's velocity, e.g. the velocity of the tennis racket, is surprisingly similar [1,2]. Around the anticipated point of impact the end segment decelerates. In all such sports the ball is not hit or released at the instant of maximum velocity of the end segment but during a following decelerating phase at lower velocity. Here we show that both deceleration prior to stroke of the racket-head and the usage of topspin enhances the precision of the point of touch down of the ball. Methods A simplified analytical model of hitting a ball (not including drag and lift) is used to obtain the variation of the point of touch down with respect to the racket-head velocity and acceleration. A second model simulates the motion of the tennis ball during flight in consideration of the drag and the lift (magnus effect) with respect to the spin using the equation of motion solved by the MATLAB toolbox SIMULINK. Results An optimum trajectory of the end segment exists which guarantees a constant point of touch down even though the horizontal location of the actual strike may occur before or after the anticipated point of impact. This optimum involves a deceleration before impact. The results of the simulation of the flight (parameter study with varying initial conditions: ball velocity, angle and spin) show that the more topspin the smaller are the variations of the point of touch down. Discussion Based on the simple hit model we showed that these time-courses enhance the robustness of the strikes. It appears that there are different strategies to make the strike robust against small variations in initial conditions without the need of a sensor and a feedback-loop or controller-system. One strategy is to decelerate the racket-head before the strike. However, there are also tennis players with high positive racket-head acceleration which realize high hit rates [4]. Consequently, another strategy to stabilize the anticipated point of touch down is realized by using the topspin. Hence, tennis players have the choice to realize a higher accuracy by either slowing down the racket-head before they hit the ball or by using topspin. References [1] Ballreich, R., Kuhlowl-Ballreich, A. (1992) Biomechanik der Sportspiele. In: (Eds.), Ferdinand Enke, Stuttgart. [2] Elliott, B., Marsh, T., Overheu, P. (1989) A biomechanical comparison of the multisegment and single unit topspin forehand drives in tennis. *Journal of Applied Biomechanics*, 5, 350-364. [3] Hochstein, S. (2007) Stabilisierung des Auftreffpunkts durch Topspin im Tennis. Diploma thesis, University of Jena, Germany. [4] Ludwig, F. (2006) Kinematische Technikanalyse ausgewählter Vorhandschläge im Tennis. Diploma thesis, University of Jena, Germany

## MAXIMAL PUNCHING FORCE AND POWER IN BOXERS AND TAEKWONDO ATHLETES

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Introduction Changes in the maximal muscle torques or power output may reflect the results of the applied training loads. Force of the punches is rarely measured in athletes. Aim The aim of this study was to compare boxers and taekwondo athletes with respect to the

maximal punching force, maximal power and height of jump measured in counter movement jump. Methods The studies involved six boxers (age 16.8±1.0 years, body height 185.7±6.0 cm, weight, 75.8±7.0 kg, training experience 2.1±1.2 years) and seven taekwondo athletes (age 17.8±0.7 years, body height 180.1±4.1 cm, weight, 63.6±6.4 kg, training experience 6.4±1.5 years). Measurements of maximal punching force were carried out on a boxing dynamometer. Each participant performed six punches of rear hand (hook and straight punches) from a typical for himself position. The maximal power output and the height of rise of the body mass center during vertical jumps were measured on a force plate for counter-movement jumps (CMJ). MANOVA procedures with post-hoc Tukey test were employed for comparison of means. Results The maximal relative straight punching forces were 32.49±5.21 N/kg and 27.15±3.06 N/kg for rear hand in boxers and taekwondo athletes, respectively. The maximal relative hook punching forces were 34.25±6.18 N/kg and 30.19±7.19 N/kg for rear hand in boxers and taekwondo athletes, respectively. The values of CMJ relative maximal power and height of rise of the body mass centre were 29.83±7.13 W/kg, 0.430±0.050 m in boxers, respectively and 33.68±6.12 W/kg, 0.496±0.039 m in taekwondo athletes, respectively. The significant difference between the group was observed in height of jump and the both punches. Discussion The measured force of the punches depends on the method of measurement, technical skill athletes, the type of punch (straight or hook), inflicting a punches limbs (lead or rear hand), and the type of the boxing gloves used. The peak punch force ranged from 1990 to 4741 N in study Waliko et al. (2005). For the elite, intermediate and novice groups, respectively, the maximal straight punching forces were 4800±227 N, 3722±133 N and 2381±116 N for the rear hand (Smith et al., 2000). In this study, the values obtained by the boxers are in line with the work of Smith et al. (2000) for novice group. Conclusion In conclusions, the results of the present study demonstrate that the taekwondo athletes had better performance of lower limb than the boxers but maximal punching force was greater in the boxers than the taekwondo athletes. Acknowledgements The study was supported by Ministry of Science and Higher Education No. R RSA1 000951. References Smith MS, Dyson RJ, Hale T, Janaway L. (2000). J Sports Sci 18(6), 445-450. Waliko TJ. (2005). Br J Sports Med 39, 710-719.

### NORDIC WALKING AND PLANTAR PRESSURE. IS IT BENEFICIAL FOR DIABETICS?

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Introduction Regular physical activity (PA) is stated to reduce the risk of all-cause mortality. Diabetes (DM) is strongly affected by sedentarism and an active lifestyle may even prevent the appearance of DM. Within this population, it is estimated that 25% of DM patients develop foot problems (Pai et al, 2010). Previous research has found that plantar pressure (PP) in Nordic Walking (NW) is different in some areas of the foot compared to the natural walking pattern (Pérez-Soriano et al, 2011). For this reason, the objectives of the study were to analyse the modifications in PP after NW practice in order to find out whether these changes in PP may be beneficial for people with DM with foot problems, such as ulcers. Methods This study involved a total of 57 volunteers (12 male and 45 female [63.7 ± 2.5 years]) who walked at least 1h/day and were free of injury and pain in their lower extremities so that their normal gait pattern would not be modified. The participants were measured at two different speeds: V1: 0,9 ± 0,1 m/s and V2: 1,5 ± 0,1m/s. PP was analysed using instrumented insoles (Biofoot/IBV®) and the foot was divided into nine zones for a better understanding of the PP: Medial heel (MH), lateral heel (LH), medial arch (MA), lateral arch (LA), lateral metatarsal (LM), central metatarsal (CM), medial metatarsal (MM), hallux (H) and toes (T). Results Mean peak pressure (Pma) under H, LM, MA and LA was higher in Walking PRE (Wpre) compared to Walking POST (Wpost) and NW. However, Pma was higher under MM, CM, and MH in NW and Wpost than in Wpre (p<0.01). The percentage of time within the step to reach the Pma (TPx) was higher under H, MM, CM and LM when Wpre compared to Wpost and NW (p<0.01). Discussion After NW training, Pma resulted in beneficial values under MM, CM, and MH. Moreover, TPx was reduced after NW training under MM, CM, LM and H both in the NW and Wpost conditions. This finding is very positive for people with DM, since the metatarsal zone experiences the highest risk of ulceration as a consequence of PP increases (Pai et al 2010). It was observed a significant adaptation in the pressure pattern since Pmax and TPx was reduced in the aforementioned foot areas both in NW and Wpost conditions. Taking into account that these areas are prone to ulcers, NW can be considered as a valuable alternative for diabetics who want to do physical activity. References Pérez-Soriano, P; Llana-Belloch, S; Martínez-Nova, A; Morey-Klapsing, G; Encarnación-Martínez, A (2011). Nordic walking practice might improve plantar pressure distribution. Research Quarterly for Exercise and Sport, 82:593-599. Pai, S; Ledouz W.R. (2010). The compressive mechanical properties of diabetic and non-diabetic plantar soft tissue. Journal of Biomechanics, 43:1754-1760

### RELIABILITY OF NONLINEAR MEASURES OF CENTER OF PRESSURE IN STANDING BALANCE TASKS.

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Introduction There are several works in the literature reporting the reliability of the traditional Center of pressure (COP) variables in standing balance tasks (Ruhe et al, 2010), but little is known about the reliability of nonlinear measures of COP (Doyle et al, 2005). The aim of this study was to analyze the reliability of COP parameters that characterize the dynamic of COP and the performance of balance task in stable and unstable conditions. Methods Thirty volunteers took part in this study (Age 27 ± 6.48 years; Height 1.74 ± 0.09 m; Mass 73.94 ± 10.77 Kg). Participants were asked to stand still (30s) both on a stable and on an unstable surface over a force platform. After ten minutes they performed a posttest. Displacement and velocity of the COP were assessed. Test performance was assessed by variables of standard deviation (SD), mean velocity (MeanV) and bivariate variable error (BVE). Dynamics of COP were measured through Sample Entropy (SampEn), Fuzzy Entropy (FuzzyEn), Permutation Entropy (EP) and Detrended Fluctuation Analysis (DFA). Standard error of measurement (SEM) and intra-class correlation coefficients (ICCs) were used to analyze the absolute and relative reliability, respectively. Results In the stable condition, SD and BVE reliability were low (ICC varied from 0.49 to 0.10; SEM from 33 to 38.03%). However, MeanV showed moderate/good values of reliability (ICC=0.86 to 0.76; SEM=14.9 to 21.15%). In the unstable condition, all performance variables showed good values of reliability (ICC=0.92 to 0.71; SEM=14-22%). Regarding COP dynamics, in the stable condition, SampEn and FuzzyEn reliability were low or moderate (ICC=0.64 to 0.34; SEM=6.08 to 32.3%), PE and DFA relative reliability were low or moderate (ICC=0.74 to 0.26) but their absolute reliability was good (SEM=3.1 to 12.9%). In the unstable condition, all variables had high relative reliability values (ICC=0.93 to 0.66) but the variables of velocity showed more absolute reliability than in displacement (Velocity: SEM= 2.54 to 17.15%; Displacement: SEM=15.64 to -23.11%). Conclusions In the stable condition only the MeanV has proved to be a reliable tool for measuring stability performance. Regarding nonlinear COP dynamics, PE was the most reliable variable, although, FuzzyEn of COP velocity and DFA of COP displacement showed good values of reliability too. Under the unstable condition, all variables were reliable. Nevertheless, nonlinear tools seem to be more reliable than traditional measures of COP (Doyle et al. 2005) despite the condition. References Doyle, TL, Newton, RU, Burnett, AF. Arch Phys Med Rehabil, 2005; 86:2034-40. Ruhe, A, Fejer, R, Walker, B. Gait & Posture, 2010; 32: 436-445.

## PERFORMANCE AND COORDINATION IN REPEATED SPRINT EXERCISE FOR THE UPPER BODY

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**Introduction** Performance in repeated sprint activity is of high importance in many sports. Most studies on repeated sprint have so far focused on activity of the lower extremity. However, in various sports (water-polo, sledge hockey, wheelchair basket, cross-country skiing) the upper extremity is of high importance or even fully responsible for propulsion. In this specific study, we investigated which power determining factor (cycle rate, cycle length, pull force, pull velocity) was responsible for any decline in performance as well as if coordination (timing of muscle activity) plays any role in this respect. **Methods** Twelve male well trained cross-country skiers (mean: 25 yrs, 1.80 m, 75 kg) performed eight bouts of 8 s all-out upper body exercise (arm pulls) on a modified Concept2 ergometer, with a resisting backward arm pull and a free forward retrieval movement. A repetition started every 30 s. The athletes were seated in a sledge-hockey seat such that they could perform arm movements that resembled synchronous double-poling in skiing, without lower body propulsion. Force, displacement and electromyography (EMG) for biceps brachii (long head) and triceps brachii (short head) was recorded continuously. **Results** Average power during the 8 s bouts amounted to 281 Watts, ranging from  $310 \pm 19$  Watts in bout one to  $264 \pm 11$  Watts in bout six, thereafter power plateaued ( $270 \pm 14$  Watts in bout eight). Successive sprint bouts affected power ( $p=0.003$ , ANOVA repeated measures) and force ( $p<0.001$ ). Expressed as decrement (Spencer et al., 2006), it amounted to 11.7 (power) and 10.3% (force). The changes in power and force were strongly associated, but no clear changes for the other variables were detected. Muscle activity of biceps and triceps muscles did not change in amount from bout to bout, but the timing of triceps activity, as monitored by the ratio of integrated EMG during pull and retrieval phase, decreased in the two last repetitions ( $1.27 \pm 0.04$ ) from the first six ( $1.33 \pm 0.05$ ). **Discussion** Pulling force was the only factor that was associated with the changes in power over the bouts. All other variables that directly relate to power (cycle length, cycle rate, pulling speed) did not show any significant change nor similarity with the changes in power. This is possibly due to the properties of the Concept2 ergometer that increases internal resistance (fan airflow) with increasing pull force. Changes in timing of triceps indicate a shift in its role during pull and retrieval movements. The mechanisms and possible functionality is currently unclear. However, these findings indicate that coordination in repeated sprinting may alter and may thereby affect performance. **Reference** Spencer et al., 2006. *J. Sci. Med. Sports* 9: 181-184.

## A COMPARISON BETWEEN YOUNG AND OLD: LOWER LIMB JOINT COORDINATION DURING VERTICAL JUMPING

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**Introduction** Vertical jumping is a closed skill often used to assess musculoskeletal capacity. The overall aim is to displace the body's centre of mass in a vertical direction. With advancing age, a decline in jump performance has been noted but no significant relationship between muscle cross sectional area and age (Runge et al., 2004). This suggests that parameters other than strength maybe important when performing the jump, such as joint coordination. Therefore the aim of this research was to examine joint strategy and coordination in the lower limbs during maximal vertical jump in old and young participants. **Methods** Movements were recorded using a Vicon 9-camera system with the instruction given to jump as high as possible. The participants in the old group (O) were aged over 61 and in the young group (Y) were 18-30 years. The trial with the greatest vertical displacement was analysed for each participant. Sagittal plane coordination of hip-knee (H-K) and knee-ankle (K-A) were examined using vector coding to produce joint coupling angles (Wilson et al., 2009). The data was time normalised, left and right limbs were analysed separately but combined for statistical analysis. As the jump progresses from a rapid countermovement to propulsion an easily identifiable transition phase (TP) was identified and analysed. **Results** The jump height achieved in the old group at 0.077(0.05) was significantly lower than that achieved by the young group at 0.310(0.04) m. Two coordination strategies were adopted at the H-K: 85% of Y and 73.5% of O adopted a strategy which resulted in the knee continuing to flex while the hip extended, while for the rest of the group the knee extended first. The younger group took significantly longer % time in TP ( $Y=16.4(6.95)$ ;  $O=10.9(5.44)$ ;  $p=0.05$ ) to perform the transition from synchronised joint flexion to synchronised joint extension and the transition velocity was significantly lower ( $Y=12.65(7.54)$ ;  $O=18.64(10.78)$ ;  $p=0.024$ ). There were no significant differences in the coordination patterns at the K-A between the groups. **Discussion** Two different strategies to transition from joint flexion to joint extension were adopted, but age does not seem to be a factor in the choice of strategy. The relatively high standard deviation about the mean suggests variability in both groups indicating neither group adopts any single coordination strategy while jumping. Young jumpers spent significantly more time in the H-K TP with an overall slower velocity than the older group, while no such differences were seen in the K-A TP. It is thought that this relates to the underlying movement pattern and could be a contributing factor to greater jump height alongside other factors such as range of motion and power generation at the joints. **References** Runge, M., Rittweger, J., Russo, C.R., Schiessl, H. and Felsenberg, D., 2004. *Clin Phys Func Imag*, 24(6), pp. 335-340. Wilson, C., Simpson, S. & Hamill, J. 2009. *J Sp Sci*, 27, 277-82.

## IDENTIFICATION AND QUANTIFICATION OF HORSE RIDING TECHNIQUES IN ENDURANCE RACES

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**Introduction** In endurance races, while trying to decrease race time, the rider must continuously manage horse's gait and speed through appropriate riding techniques to optimize and preserve the global horse's functional state. Although fatigue-induced by prolonged riding is well described in the literature (Nagy et al. 2010), most studies focused on the horse, less on the rider and scarcely on the horse-rider dyad (HRD). But, the rider and the horse are two interdependent components whose interactions significantly determine the final outcome of the race and the preservation of the horse health. The recent development of mobile technologies allows recordings of combined horse and rider movements during the 90 to 130 km of such events. This study aimed to characterize the coordination patterns exhibited by expert horse-rider dyads along endurance races. **Methods** Eight HRD of international and national levels were recorded during endurance races using two tri-axial accelerometers (Equimetrix® and Locometrix®). Accelerometer data analysis concentrated on the relative horse and rider's vertical displacements to identify horse's gaits, riding techniques and horse-rider coupling patterns. Instantaneous speed and rider's heart rate were recorded in parallel. To examine potential changes, the race was divided into three time periods. Mann-Whitney U test assessed the expertise level influence on the evolution of each parameter, with  $p<0.05$ . **Results** Analysis of the Lissajous plots revealed for all HRD the use of four coordination patterns: two riding techniques per horse's gait (trot and canter). The international HRD were characterized by a higher speed during the last third of the race. This was associated with higher speed at the canter. The proportion of the sitting canter increased from 10 to 40% whereas the use of the rising trot decreased from 30 to 20%. In the two-point canter, they presented an increased ratio between the amplitudes of the rider and horse's vertical displacement, and a rise in

the rider's heart rate from 145 to 160 bpm. Discussion Dynamic system approach may thus allow identification and quantification of the four major riding techniques used in endurance races. The analysis revealed a clear influence of the expertise level on the racing speed that increased only for the international HRD. This is attributed to the observed rise in both speed and proportion of the sitting canter. In the two-point canter, in which the rider remains in equilibrium in his stirrups, the increase in speed might be more costly as reflected by larger vertical displacements of the rider and increasing heart rate. References Nagy A, Murray JK, Dyson S (2010) *Equine Vet J Suppl*: 637-643.

### **INTER- AND INTRA- JOINT COORDINATION IN LOWER LIMB JOINTS OF CLASSICAL BALLET DANCERS DURING TIPTOE STANDING**

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**Introduction** One of the fundamental elements of what makes dancers' behavior attractive is their lithe legs. Dancers might have different postural control, the process of which is each joint fluctuation, compared to non-dancers. Irrespective of the importance of tiptoe standing for classical ballet dance, its postural control has not been clarified. Moreover, on the contrary to traditional COP analysis, investigating the inter- and intra- joint coordination can elucidate the postural control process from the mechanical aspect. Therefore, we aimed to investigate the feature of inter- and intra- joint coordination acquired by ballet training. **Methods** Nine female classical ballet dancers and nine healthy female participants with no formal dance experience were asked to perform heel-toe and tiptoe standing for approximately 40s, during which the displacement of center of pressure (COP) and kinematic data of metatarsopharangeal (MP), ankle, knee, and hip joints in both sagittal and frontal planes were measured by laser sensors. As traditional parameters of postural stability, COP path length and rectangular area were calculated. Intra- and inter- joint coordination were investigated by using the principal component analysis (PCA). **Results** There was no difference in the COP path length and the rectangular area between groups. For heel-toe standing, there was no notable difference between groups. During tiptoe standing, the results of PCA showed that dancers' ankle and knee fluctuates with in-phase in anteroposterior direction, while non-dancers had anti-phase coordination between adjacent joints. In addition, dancers' sway amplitude of knee was significantly smaller. As for intra-joint coordination, dancers' MP and ankle exhibited the tendency to sway anti-phase, which means left-front or right-rear during tiptoe standing. **Discussion** Dancers' smaller knee fluctuation is considered to be due to ballet training, one of the fundamental instructions of which is to keep the knees locked. As for dancers' inter-joint coordination between the ankle and the knee, the coupling of both fluctuations up to higher frequency band (which is covered by beta-band) was associated, while the coherency of non-dancers was significant only below 10 Hz. One possible explanation for this is that dancers' posture is well controlled by motor cortex. Also, in-phase joint coordination leads the arch-looking configuration, suggesting that dancers' joint coordination might be an element of their lithe legs, that is, beautiful object. In addition, the existence of intra-joint coupling patterns suggests that the neuromuscular intra-joint control might have coupled strategy.

### **RELIABILITY AND LEARNING EFFECT OF THE COP PARAMETERS DURING UNSTABLE SITTING**

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**Introduction:** Although unstable sitting tests have been successfully used to assess postural control of the trunk (Cholewicki et al., 2000), the reliability of these protocols seems to be poor (Van Dieën et al., 2010). The aim of this study was to analyze the reliability and learning effect of a trunk postural control test performed on an unstable sitting platform. **Method:** Twenty-three physically active males performed the test 3 times, with 1 week between each testing session. Each test consisted of 5 seated 60 s balance trials with the unstable seat placed on a force platform (Kistler 9286A). Test performance was evaluated by standard deviation (SD), bivariate variable error (BVE) and PATH (total path length traveled by CoP per second). The regularity and long-range autocorrelation of both COP displacement (COPD) and COP velocity (COPV) were assessed by approximate entropy, sample entropy, fuzzy entropy (FuzzyEn), permutation entropy (PE) and detrended fluctuation analysis (DFA), respectively. The standard error of measurement (SEM) and intraclass correlation coefficient (ICC) were used to analyze the absolute and relative reliability, respectively. Repeated-measures ANOVAs were performed to analyze the learning effect. **Results:** There was a significant decrease of SD, BVE and PATH between trials and between days. In addition, there were significant increases of regularity parameters and DFA between days, but only significantly so between trials for PE. The reliability of SD and BVE between trials and between days was low to moderate (0.20).

### **ERGONOMIC FACTORS IN INDUSTRIAL WELDING**

Rein, R.1,2, Feodoroff, B.2, Biallas, B.1, Wilke, Ch.1

*German Sport University Cologne*

1: Department of Neurology, Institute of Health Promotion and Clinical Movement Science, German Sport University Cologne, 2: Centre for Sport and Health Research, Institute of Health Promotion and Clinical Movement Science, German Sport University Cologne **Introduction** A large percentage of the work force in industrialized countries is occupied with welding related activity and health statistics indicate that in particular industrial welders are prone to work related disorders (Burdorf, Naaktgeboren, Post, 1998). Apart from neurological and respiratory system disorders (Bowler et al. 2006), disorders of the musculoskeletal system show a large prevalence resulting in a significant economic factor (Alexopoulos et al., 2008). Unfortunately, few studies investigating ergonomic factors of the musculoskeletal system in industrial welding are available at present. Thus, to identify possible factors leading to muscular disorders in industrial welding the current study investigated expert and novice welders. **Methods** Six professional welding instructors and seven novice welders from the same welding school participated in the study. Three different welding positions were investigated. Key anatomical landmarks of the trunk and the upper body were identified using passive reflective markers and marker trajectories were recorded using high-speed infrared video. Bilateral muscle activations of selected trunk and arm muscles were recorded using sEMG. All trials were performed using a commercial virtual-reality welding simulator. **Results** Experts displayed superior welding performance compared with novices. Movement trajectories indicated great inter-individual differences in welding movements in both experts and novices. Muscle activation patterns showed stronger asymmetric activation of trunk muscles for novices due to greater trunk flexion and trunk torsion. Further, novices displayed greater arm movement ranges compared with experts. **Discussion and conclusion** The results suggest that welders choose individual movement solutions according to their own set of biomechanical constraints. Nevertheless, significant differences between groups indicated more upright and frontal postures in experts resulting in bilateral symmetric muscle activations minimizing individual muscular

forces. Currently, during novice welding training emphasis is placed exclusively on the welding product. However, to decrease the risk of musculoskeletal disorders later during working life, postural aspects of welding should be considered as well. References Alexopoulos, EC, Konstantinou, EC, Bakoyannis, G, Tanagra, D, Burdorf, A. (2008). *Eur Spine J*, 17: 1185-92. Bowler RM, Roels HA, Nakagawa S, Drezgic M, Diamond E, Park R, Koller W, Bowler RP, Mergler D, Bouchard M, Smith D, Gwiazda R, Doty RL. (2007). *Occup Environ Med*, 64:167-177. Burdorf, A, Naaktgeboren, B, Post, W. (1998). *Occup Environ Med*, 55: 490-5.

## 15:00 - 16:00

### Mini-Orals

#### PP-PM58 Sports Medicine [SM] 2

##### ISOKINETIC MUSCULAR STRENGTH OF ATHLETES IS NOT AFFECTED BY MENSTRUAL CYCLE

Paiva, R.F.L., Mascarin, N., Vaisberg, M., Bella, Z.I.K.J., Andrade, M.S.

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**Introduction** Women participation in sports, like as soccer player, has increased in last years; consequently injuries incidences also increase (Fonseca et al, 2007; Renstrom et al, 2008; Souza, 2012). The higher female incidence of ligamentous injuries seems to be associated to hormonal changes during menstrual cycle (Hewett et al, 2007; Adachi et al, 2008), but researchers know much less about hormonal effects on muscular performance, especially in athletes. The aim of this study was to evaluate isokinetic muscular strength of thigh muscles on a group of female soccer players at follicular and luteal phases. **Methods** Seventeen eumenorrheic soccer players were evaluated (age: 22.35±6.42; height 165.3±7.8; weight: 61.8±7.7). The phases of the menstrual cycle (luteal and follicular), was determinate by monitoring for 3 consecutive months. Evaluation of knee flexors and extensors muscles peak torque (PT) and total work (TW) was performed with 5 repetitions at 60°/s in each phase of the menstrual cycle. The study protocol was approved by the Research Ethics Committee of UNIFESP (No.160410). For data analysis we used the t test for dependent variables with significance level to 5%. Results Extensor muscles PT for non-dominant limb showed lower values in luteal phase when compared to follicular phase (P<0,001), but other analyzed variables (flexors PT and extensors and flexors TW) showed no difference between phases. Extensor and flexor muscles PT and TW for dominant limb showed no differences between the menstrual phases. **Discussion** In this study isokinetic muscular strength did not change from follicular to luteal phases of menstrual cycle in female soccer players athletes. However, these findings were limited from athletes isokinetic thigh muscular strength; and further research evaluating strength variation during menstrual cycle, using other measures of neuromuscular function such as functional tests or eccentric action, is needed. References Fonseca ST, et al. Caracterização da performance muscular em atletas profissionais de futebol. *Rev Bras Med Esporte* 2007, 13(3): 143-147. Renstrom P et al. Non-contact injuries in female athletes: an International Olympic Committee current concepts statement. *Br J Sports Med* 2008, 42:394-412 Souza LC. Associação entre estrogênio circulante e lesão do ligamento cruzado anterior em mulheres atletas. *LFDportes.com*. 2012, 17(167). Hewett TE et al. Effects of the menstrual cycle on anterior cruciate ligament injury risk – a systematic review. *Am J Sports Med* 2007, 35(4): 659-668. Adachi N et al. Relationship of the menstrual cycle phase to anterior cruciate ligament injuries in teenaged female athletes. *Arch Orthop Trauma Surg* 2008, 128: 473-478. Do not insert authors here

##### VMO RECRUITMENT AFTER THERAPY FOR PATELLOFEMORAL PAIN MEASURED BY MUSCLE FUNCTIONAL MRI

Pattyn, E., Van Tiggelen, D., Witvrouw, E.

*University of Ghent*

**Introduction** In literature and in clinical practice, restoration of quadriceps strength and -function has been demonstrated to be imperative for a successful recovery from patellofemoral pain (PFP) (Powers, 1998). Treatment generally includes exercise interventions to strengthen and optimize the use of the quadriceps and in particular the vastus medialis obliquus (VMO) (Syme et al., 2008). The aim of this study is to examine by muscle functional magnetic resonance imaging (mfMRI) if patients with PFP actually exhibit an altered activation of the muscles that play a significant role in the dynamic balance of the patella after treatment with exercises. **Methods** Thirty-six patients with PFP (16 male and 20 female, mean age 23.8 ± 6.7) underwent MRI of the quadriceps before and immediately after a squat exercise. The transverse relaxation time (T2) shift, which is an indication of muscle recruitment, was calculated for the vasti muscles. The measurements were repeated after a seven-week rehabilitation period including neuromuscular co-ordination, stabilization and strengthening exercises, stretching and home exercises. **Results** The T2 shift of VMO was lower after the therapy than before (post treatment 3.90 ± 2.79 ms vs. pre treatment 5.26 ± 3.60 ms; P=0.041), while the T2 shift of the vastus lateralis (VL) and the vastus medialis-intermedius (VMVI) were not significantly different before and after the treatment period (P=0.260 and P= 0.066). **Discussion** The results indicated that exercise therapy partially altered the recruitment of the dynamic stabilizers of the patella. After treatment for PFP, the VMO was less active during functional activity while there was no difference in activation of the VL and VMVI. It could be hypothesized that the patients have been taught in therapy to use more accurate movement strategies in functional tasks in view of decreasing patellofemoral joint stress. Perhaps the decreased use of the VMO is accompanied by enhanced and more efficient recruitment of non-local muscles. These assumptions should be verified by evaluation of hip, calf and hamstrings muscle recruitment in further mfMRI investigations in PFP. References Powers C. (1998). *J Orthop Sports Phys Ther*, 28(5), 345-354. Syme G, Rowe P, Martin D, Daly G (2009). *Man Ther*, 14(3), 252-263.

##### PASSIVE DEHYDRATION EFFECTS ON EXPLOSIVE STRENGTH PERFORMANCE

Castro, M., Salinas, H., Astudillo, S., Rosales, G., Perez, C.

*Mayor university*

**Introduction:** Dehydration on athletes has been regarded as a factor impairing athletic performance. Despite this, there is evidence of dehydration methods that have shown increases on vertical jump, which has been associated to a higher muscle power to body mass ratio. There are three methods to generate dehydration: active dehydration, passive dehydration, and mixed method. Active dehydration makes it impossible to isolate dehydration effect from that of muscle glycogen decrease. There is very limited literature regarding the

effects of passive dehydration on vertical jump height and short sprint speed. The objective of this study is to determine whether the weight loss caused by a passive dehydration protocol in wet sauna, affects jump height and time of 30 m. sprint. Métodos: Ten healthy, recreationally active males were voluntarily recruited. (Age  $26,6 \pm 6,6$  years, height  $170,1 \pm 8,1$  cm, body mass  $73,15 \pm 11,34$  Kg.) Before and after dehydration process participants were tested on vertical jump height (SJ and CMJ) and 30 m. sprint times (TC). Dehydration process consisted of three 10 minutes periods on wet sauna ( $55^{\circ}\text{C}$ , 95% RH). Resulted: All participants reached a body mass loss between 0.6% and 1.7% (0.4 - 1.3 kg). Average values for the test group on velocity (TC) in 30 m. and jumping ability tests (SJ and CMJ) indicate a significant difference between pre and post dehydration results ( $\alpha = 0.05$ ). Discussion: The results found show that the dehydration protocol used improves the results of the three variables. The average performance improvements in SJ and CMJ and TC are 2.8%, 5.2% and 3.1% respectively. A study by Viitasalo J.T. showed the effects of three methods of weight reduction in maximum force, rate of force development, vertical jump height and mechanical energy, obtaining results in the same direction of the findings of the present study, but by reaching higher dehydration levels. References: Murray R. 1996. Dehydration, hyperthermia and athletes: science and practice. *Journal of Athletic Training*, 31 248-252 Baker L. 2007. Dehydration impairs vigilance-related attention in the male basketball players. *Medicine and Science in Sports and Exercise* 39 976-983. Casa DJ. 2000. NATA Position Statement: Fluid Replacement for Athletes. *Journal of Athletic Training* 35 212-224. Chevront S, Sawka M. 2009. Hydration Assessment of Athletes. *Sport Science exchange* Vol 18.

### **LONGER HAMSTRINGS ELECTROMECHANICAL DELAY IMPAIRS EARLY PHASE EXPLOSIVE FORCE PRODUCTION AND MAY COMPROMISE KNEE JOINT STABILITY**

Hannah, R., Minshull, C., Smith, S.L., Folland, J.P.

*Nottingham Trent University*

Introduction: A low ratio of hamstrings-to-quadriceps (H/Q) strength is suggested to increase the risk of non-contact anterior cruciate ligament (ACL) injury [1]. The time available to develop force to stabilise the knee and prevent injury during landing and turning movements may be a little as 50 ms [2], which is considerably less than the time required to develop maximal muscle force (300 ms, [3]). Since maximum force seems unlikely to be attained in the time available, the capacity for knee joint stabilisation may depend more on the relative ability of the knee muscles to exert force explosively during the initial phase of contraction. However, the time course of the rise in explosive force of the hamstrings and quadriceps from their initial activation, and thus the explosive H/Q force ratio, has not been documented. Methods: The neuromuscular performance of untrained males ( $N = 20$ ) was assessed during a series of voluntary isometric knee flexion and extension contractions; explosive and maximal voluntary efforts (knee angle  $150^{\circ}$ ). Force and EMG of the hamstrings and superficial quadriceps were assessed in short intervals from agonist EMG onset and at maximum voluntary force (MVf). Hamstrings force was expressed relative to quadriceps force (%) to produce hamstring-to-quadriceps ratios of explosive H/Q force and H/Q MVf. For the explosive contractions, agonist electromechanical delay (EMD) and agonist neuromuscular activity (normalised to maximal EMG) were calculated. Results: The quadriceps MVf was 79% greater than the hamstrings ( $P < 0.001$ ), but by contrast, quadriceps explosive force was >5-fold greater than the hamstrings from 25-50 ms ( $P < 0.001$ ). Consequently the explosive H/Q force ratio was very low at 25 and 50 ms (0-17%) and significantly different from H/Q MVf ratio (56%,  $P < 0.001$ ). Hamstrings EMD was ~2-fold greater than quadriceps EMD (44.0 vs 22.6 ms,  $P < 0.001$ ) resulting in a 21 ms later onset of force in the hamstrings that appeared to explain the low explosive H/Q force ratio in the early phase of activation. Agonist EMG was similar between the two muscle groups in the first 100 ms of activation, suggesting the prolonged hamstring EMD was not due to a difference in neural drive to the involved muscles. Conclusions: Prolonged hamstrings electromechanical delay appears to impair early phase (0 – 50 ms) explosive force production relative to the quadriceps and may compromise knee joint stability during this period where ACL injuries are thought to occur. References [1] Renstrom et al (2008) *Br J Sports Med*, 42, 394 [2] Krosshaug et al (2007) *Am J Sports Med*, 35, 359 [3] Thorstensson et al (1976) *Acta Physiol Scand*, 98, 232

### **PEAK ECCENTRIC HAMSTRING STRENGTH AND SINGLE-LEG-HOP-AND-HOLD-FOR-DISTANCE CAN PREDICT HAMSTRING INJURY IN BACHELOR PE STUDENTS**

Goossens, L.1, Witvrouw, E.2, De Clercq, D.1

*Ghent University*

Introduction Various studies reported high incidences of hamstring injuries in sports such as soccer, rugby and sprinting (1,3,5). In these homogeneous groups, risk factor analyses showed non-uniform outcomes concerning muscle strength measures (4). The aims of this study were to describe the epidemiology of hamstring injuries in Physical Education Teacher Education (PETE) students and to conduct a risk factor analysis including various functional muscle strength measures. Methods 102 freshmen academic bachelor PETE students were followed prospectively for occurrence of sports injuries during one academic year. At the start of the academic year, maximal muscle strength tests using a hand-held dynamometer (hip ab- and adductor, gluteus, concentric (CON) and eccentric (ECC) hamstrings, quadriceps, hip internal and external rotators) were taken from 81 subjects. 69 of these also completed a single leg hop and hold for distance (SLHH) test. Results 16 hamstring injuries occurred to 10 subjects, 8 of these completed all tests. There was a hamstring injury risk of 0.16 and an incidence rate of 0.45 hamstring injuries/1000 hrs. Logistic regression analyses showed that, after taking account of gender, maximal ECC hamstring strength (ODD=0.977;  $p=0.043$ ), CON hamstring /ECC hamstring strength ratio (ODD=970.500;  $p=0.019$ ) and SLHH (ODD=0.884;  $p=0.005$ ) were significant risk factors for having a hamstring injury. Discussion Hamstring injury incidence rate is lower in PETE students compared with male soccer (0.90) (1) and rugby players (0.77) (3) and competitive sprinters (0.87) (5). Hamstring injury risk is higher in PETE students than in male soccer players (0.10) (1) but lower than in competitive sprinters (0.34) (5). In contrast to results of an earlier study (2), our data show that lower ECC hamstring strength is a risk factor for having a hamstring injury. So far, unilateral functional tests like the single-leg Counter Movement Jump were not predictive for having a hamstring injury (1). Nevertheless, our results reveal a higher risk of suffering from a hamstring injury with a lower score on the SLHH, possibly due to the large eccentric component of this task. This offers great perspectives for a structured screening of athletes-at-risk in the field. References 1.Arnason A, Sigurdsson S B, Gudmundsson A, Holme I, Engebretsen L, Bahr R. (2004) *Am J Sports Med*, 32 (1) Suppl 2.Bennell K, Wajswelner H, Lew P, Schall-Riauour A, Leslie S, Plant D, Cirone J. (1998) *Br J Sports Med*, 32: 309-314 3.Brooks J H M, Fuller C W, Kemp S P T, Reddin D B. (2006) *Am J Sports Med*, 34 (8): 1297-1306 4.Freckleton G, Pizzari T. (2012) *Br J Sports Med*, doi:10.1136/bjsports-2011-090664 5.Yeung S S, Suen A M Y, Yeung E W. (2009) *Br J Sports Med*, 43: 589-594

## THE EFFECT OF KINESIO TAPING IN MUSCLE ACTIVATION DURING ISOKINETIC ECCENTRIC MOVEMENT IN SOCCER PLAYER

Wu, S.N., Lou, P.C., Lin, C.Y., Hu, C.Y., Lin, H.T.

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Introduction Soccer has becoming one of the most popular sports in the world. During player kicking, muscle eccentric contraction was occurred in the supporting leg and kicking foot. However, muscle eccentric contraction was easy to lead injury and muscle fatigue. Recently, KINESIO tape was usually used to prevent exercise injuries. It could improve blood circulation and stimulate skin proprioception because of its stickiness, and it could hereby enhance the muscle function and make it stronger (Konishi, 2012). Previous study showed that the KINESIO tape might postpone muscle fatigue in kicking players' rectus femoris muscle (Fu et al., 2008). Therefore, our purpose of the study is to investigate the effect of KINESIO tape in muscles activations during eccentric exercise. Methods Six male soccer players who are play for their college at least two years (averaged age is  $22.1 \pm 1.6$  yrs, height is  $172.1 \pm 6$  cm, and weight is  $68.6 \pm 6.6$ kg) were participated in this study. Biodex<sup>®</sup> (system 3, Biodex Medical System Inc., USA) was used for isokinetic exercise at two various testing velocities ( $60^\circ/\text{sec}$ ,  $90^\circ/\text{sec}$ ). Twenty and thirty continuous cycles were tested for two testing velocities respectively. Each subject tested in both non-taping and KINESIO taping conditions. Electromyography system (Trigno<sup>™</sup>, DELSYS, MA) was used for muscle activation detection and electrodes were attached on the non-dominant leg's rectus femoris, and the dominant leg's medial and lateral gastrocnemius. The muscle maximum voluntary contraction (MVC) was used for normalizing muscle activation. The functional test such as run-return, single leg with eye close, and sound reflection were tested before and after the eccentric exercise (Ergen et al., 2008). Paired t-test was used to test the differences of muscle activation between non-taping and KINESIO taping. Results Results showed that there was no significant difference in mean muscle activation between KINESIO and non-taping, however, the mean muscle activation in last 1/3 cycles was larger than in first 1/3 repetitions in KINESIO taping. Moreover, there had significant difference in the "sound reflection" test (KINESIO tape vs. non-tape: 212.1 ms vs 272.1 ms,  $p < 0.05$ ). Discussion KINESIO tape might activate the skin proprioception and improve sound reflection ability. The decreased muscle activation of leg in the last 1/3 cycles may result from the other muscles cannot complete the work and have to recruit more fibers in taping muscle. Some subjects reflected that KINESIO taping could reduce pain after eccentric contraction. KINESIO taping could help muscle to have better performance during eccentric exercise. References Konishi Y. (2013). *J Sci Med Sport*, 16, 45-48. Fu TC, Wong AM, Pei YC, Wu KP, Chou SW, Lin YC. (2008). *J Sci Med Sport*, 11(2), 198-201. Ergen E, Ulkar B, (2008). *Clin Sports Med*, 27(1), 195-217.

## INFLUENCE OF TESTING POSITION ON HAMSTRING / QUADRICEPS RATIO IN SOCCER PLAYERS

Hautier, C.1, Morel, B.1, Vigne, G.2, Monnot, D.2, Dellal, A.2,3

1: CRIS, University Lyon 1, Lyon, France, 2: Medical Centre Excellence FIFA, Santy Orthopédicae clinical, Lyon, France, 3: OGC NICE, France

Introduction Previous studies suggest that a high hamstring to quadriceps isokinetic force ratio (H/Q) may stabilize the knee during jump landings and cutting, and prevent anterior cruciate ligament injuries (Croisier et al, 2008). Subjects are usually seated on the dynamometer chair when performing isokinetic measurements. However, these protocols impose an  $80^\circ$  to  $120^\circ$  Hip angle which is not in line with the hip angles when injury occurs. The aim of the present study was to compare H/Q ratios and EMG levels in two testing positions, seated (Hip angle  $80^\circ$ ) and lying in supine position (Hip angle  $26^\circ$ ). Methods 10 male soccer players accepted to participate in this study. EMG activity of the Vastus Lateralis, Vastus Medialis (VM), Rectus Femoris (RF) and Biceps Femoris (BF) of the dominant leg were measured using surface EMG electrodes (EMG Triode electrode, Thought Technology, Montreal, Canada). Subjects performed in a randomized order, seated and lying isokinetic tests composed of maximal concentric and eccentric contractions at 30, 60 and  $240^\circ \cdot \text{s}^{-1}$ . Conventional H/Q ratios have been calculated for each position and velocity as well as EMG level. Comparisons have been performed using a single factor analysis of variance. Level of significance was set at  $p < 0.05$ . Results Players produced significantly ( $p < 0.01$ ) lower knee extension moments in lying position compared to seated position at  $60^\circ \cdot \text{s}^{-1}$ ,  $240^\circ \cdot \text{s}^{-1}$  and  $30^\circ \cdot \text{s}^{-1}$ . No differences were observed in knee flexor moments at  $60^\circ$  and  $240^\circ \cdot \text{s}^{-1}$  whereas eccentric moments measured at  $30^\circ \cdot \text{s}^{-1}$  were lower when lying ( $p < 0.01$ ). Conventional H/Q ratios were significantly higher in lying position at  $60^\circ \cdot \text{s}^{-1}$  (0.67 vs 0.53,  $p < 0.01$ ) and  $240^\circ \cdot \text{s}^{-1}$  (0.75 vs 0.58) but not at  $30^\circ \cdot \text{s}^{-1}$ . No differences have been observed in EMG activation level of extensors and flexors muscles whatever the position and the velocity. Discussion This study demonstrated that conventional H/Q ratios are significantly influenced by the testing position. These differences can't be explained by modifications in muscle activation levels. On the other hand, RF and BF muscle lengths are different in the two conditions. RF is shortened at the end of the knee extension movement when seating and its contribution to total force is near to zero for the 40 last degrees of extension. In the same way, BF is shortened at the end of the knee flexion movement when lying and its contribution to total force is lowered during the 40 last degrees of flexion. This phenomenon must be taken into account to test H/Q ratios in soccer players in the most meaningful protocol. References Croisier JL, Ganteaume S, Binet J, Genty M, Ferret JM (2008). *Am J Sports Med*. 36(8):1469-75

## THE ANALYSIS OF ELECTROMYOGRAPHIC ACTIVITY OF ANKLE MUSCLES DURING BALANCE TRAINING.

Masunari, A.1,2, Kunugi, S.2, Kondo, H.2,3, Yoshida, N.4, Kobayashi, N.4, Miyakawa, S.2

1: IPU (Ibaraki, Japan), 2: NTU (Ibaraki, Japan), 3: NTUT (Ibaraki, Japan), 4: THU (Tokyo, japan)

Introduction The balance training is one of the neuromuscular trainings and performed on a rehabilitation of ankle instability. However, these trainings only assign the players the task of maintaining postures but do not assign another task. It is often found in the sports scenes such as the football to perform tasks more than two, and the training method had better be closer in the competition scene to use the dual task training. This is another report that the balance board training combined with the task of catching a ball could prevent the recurrence of the ankle sprain. Although such training is often used clinically, effects of conditions applied to the muscle activity is not clear. Therefore, the aim of this study was to analyze the electromyographic activity of the muscles surrounding the ankle joint on different types of condition. Methods Nine healthy male college football players participated in this study. Surface electromyograms (EMG) were recorded during balance exercises in four conditions; standing one leg (SL), standing one leg and playing catch (SLP), standing one leg on the balance board (SLB), standing one leg on the balance board and playing catch (SLBP). The tibialis anterior, tibialis posterior, peroneus longus, peroneus brevis, gastrocnemius lateralis and soleus were chosen for analysis, and root mean square (RMS) was calculated from the electromyographic signal at each muscles. Results There was a significant increase in the tibialis anterior activity at SLBP compared to SL ( $p < 0.05$ ). As for the other muscles, there were no significances. Discussion The tibialis anterior exhibited greater electromyographic activity by increasing the difficulty of the balance task. Postural sway of the anterior-and-posterior direction was increased by standing on the balance board, and playing catch on the balance board increase the postural sway more. Tibialis anterior controls the Postural sway

of the anterior-and-posterior. Therefore, there is a possibility that the increased activity of the tibialis anterior muscle to control these body sway. References Verhagen E, van der Beek A, Twisk J, Bouter L, Bahr R, van Mechelen W. (2004). *Am J Sports Med*, 32(6), 1385-93. Braun Ferreira LA, Pereira WM, Rossi LP, Kerpers Il, Rodrigues de Paula A Jr, Oliveira CS. (2011). *J Bodyw Mov Ther*, 15(4), 496-501.

### RATE PRESSURE PRODUCT RESPONSE TO DYNAMIC AND ISOMETRIC SETS OF RESISTANCE EXERCISE

Marocolo, M., Maior, A.S., Katayama, P.L., Neto, O.B., Freitas, D.G.S., Mota, G.R.

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**Introduction** The dynamic or isometric protocols of resistance exercise [RE] have been recommended for improvement of cardiovascular conditioning. Rate-pressure product [RPP] correlates with myocardial oxygen consumption, and the magnitude of blood pressure [BP], heart rate [HR] and RPP responses during RE are directly related to intensity, repetitions, sets and rest interval (Salles et al. 2010). Thus, the aim of this study was to compare the acute responses of RPP after dynamic and isometric exercises using different intensities. **Methods** Nineteen active men ( $22.7 \pm 2.2$  yrs) attended the laboratory 7 times with 48h among visits. They performed anthropometric and hemodynamic measurements and one maximum repetition tests (1RM) in leg press (LP) and bench press (BP). Following tests were carried out: LP and BP isometric, LP and BP dynamic (at 25, 50, 75% of 1RM for 1st, 2nd and 3th sets respectively; 3min rest between sets; isometric 40 s and dynamic 10 repetitions per set). In sequence, in the 6th and the 7th visits the volunteers did only LP exercise isometric and dynamic (3 sets at 75% 1RM, respectively). The RPP was obtained immediately after each set. **Results** RPP was higher in LP than in the BP in all protocols. It was showed that the RPP was increased proportionally with the exercise intensity. While in the BP the isometric protocol causes higher responses of the RPP, in LP the higher responses occurred in the dynamic protocol. Additionally, we showed a cumulative effect of the sets in RPP response, in both RE protocols with 75% 1RM in all 3 sets. **Discussion** Our main finding is that RPP was significantly higher in LP compared to BP in both RE protocols. It may be due muscle mass, once that the LP has more muscle mass than the BP. Gálvez et al. (2000) demonstrated that the magnitude of HR increasing is related to recruited muscle mass and intensity. Absolute RPP responses on lower limbs are significantly higher than upper limbs in both RE protocols. For lower limbs exercise, those responses are greater for dynamic compared to isometric protocol, while the same comparison for upper limbs shows higher responses for isometric compared to dynamic protocol. **References** Gálvez, JM, Alonso JP, Sangrador LA, Navarro G. (2000). Effect of muscle mass and intensity of isometric contraction on heart rate. *J Appl Physiol*, 88: 487-492.

### EFFECTS OF PELVIC FLOOR MUSCLE TRAINING IN JAPANESE FEMALE ATHLETES

Yamamoto, S.1, Maruo, A.2, Tanaka, S.3

*Mukogawa Women's University*

**Introduction** Pelvic floor muscle training (PFMT) is utilized to improve the pelvic floor muscle (PFM) and symptoms of stress urinary incontinence (SUI). However, there have been few studies of PFMT in female athletes reported. We compared the effects of PFMT between Japanese female athletes and non-athletes. **Methods** We investigated 14 female university students [6 athletes with SUI (group I-A), 4 athletes without SUI (I-B), 4 non-athletes (II)], mean age  $20.5 \pm 0.9$  years], each of whom underwent PFMT. The outcome measure tools used were the International Consultation on Incontinence Questionnaire - Short Form (ICIQ-SF) and an original questionnaire. PFM strength was evaluated by a pad test. **Statistical analyses** included one-way ANOVA and Kruskal-Wallis test results. P values  $< 0.05$  were considered to be significant. **Results** The weight of the pad increased by  $0.08 \pm 0.20$ g in group I -A and  $0.02 \pm 0.16$  g in group I-B, while it decreased by  $0.11 \pm 0.16$ g in group II, though the differences among the 3 groups were not significant. Of 8 actions queried regarding the desire to urinate or urinary incontinence, many students noted that urine leakage changed to a desire to urinate after training. **Discussion** A previous study noted that a minimum of 6 weeks of PFMT was needed to obtain the desired effect (Bo et al., 1990). However, only 3 of the present students were able to train for more 6 weeks, thus no statistically significant differences were found regarding changes in pad weight among the 3 groups, though a slight decrease in pad weight was noted in group II. Therefore, a training effect was easily noted in the present non-athletes. On the other hand, the PFM of the athletes in the present study was developed by participation in daily club activities and considered to have a certain level of strength. As for the desire to urinate or urine leakage, many students noted improvements as a result of PFMT. Thus, we considered that PFMT should be continued and female athletes with SUI require additional PFM training as compared to non-athletes (Bo, 2004). **References** Bo, K., Hagen, RH., Kvarstein, B., et al. Pelvic floor muscles exercise for the treatment of female stress urinary incontinence: III. Effects of two different degrees of pelvic floor muscle exercise. *Neurourology and Urodynamics*, 9, 489-502, 1990. Bo, K. Urinary Incontinence, Pelvic Floor Dysfunction, Exercise and Sport. *Sports Medicine*, 34(7), 451-464, 2004.

### HAMSTRING EXTENSIBILITY AND SAGITTAL SPINAL POSTURE IN HIGHLY TRAINED PADDLERS.

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**Introduction** Hamstring muscle extensibility has been associated to changes in lumbopelvic rhythm and spinal posture. However, most studies included non-athlete population. Therefore, the purpose of this study was to determine the influence of hamstring muscle extensibility on sagittal spinal curvatures and pelvic inclination in paddlers. **Methods** A total of 100 highly trained paddlers (mean age:  $16.11 \pm 0.91$  years) participated in the study. The thoracic and lumbar angles as well as pelvic inclination were measured with a Spinal Mouse in relaxed standing and maximal trunk flexion with knees extended (sit-and-reach test). Hamstring muscle extensibility was determined in both legs by passive straight leg raise test (PSLR). The sample was divided into three groups: group 1 (lower extensibility;  $PSLR < 75^\circ$ ,  $n=35$ ); group 2 (intermediate extensibility;  $PSLR = 75-90^\circ$ ,  $n=34$ ); and group 3 (greater extensibility;  $PSLR > 90^\circ$ ,  $n=31$ ). **Results** The one-way ANOVA analysis showed no significant differences between groups in standing. With regards to the sit-and-reach test, thoracic angle was more reduced in the greater extensibility group (group 1:  $59.15 \pm 11.53^\circ$ ; group 2:  $55.60 \pm 10.51^\circ$ ; group 3:  $48.02 \pm 14.23^\circ$ ,  $p < 0.001$ ). Pelvic inclination was higher in the group 3 (group 1:  $-12.15 \pm 11.06^\circ$ ; group 2:  $-6.44 \pm 11.81^\circ$ ; group 3:  $0.35 \pm 11.89^\circ$ ;  $p < 0.001$ ). However, no significant differences were found in lumbar angle (group 1:  $31.26 \pm 8.10^\circ$ ; group 2:  $30.56 \pm 6.28^\circ$ ; group 3:  $32.17 \pm 7.64^\circ$ ). Post hoc analysis showed significant differences between all pairwise comparisons for thoracic angle and pelvic inclination ( $p < 0.01$ ). **Discussion** Hamstring extensibility has been shown to affect lumbo-sacral posture due to the muscles' direct attachment on the ischial tuberosities (Gajdosik et al., 1994; Congdon et al., 2005). As the subject bends forward, the pelvis freely rotated forward until the passive tension in the hamstrings begins to influence pelvic rotation (Shin et al., 2004). The subjects with lower hamstring extensibility showed a higher posterior pelvic tilt when maximal trunk flexion was performed, which can overload the spine. Furthermore, a relationship between hamstring

extensibility and thoracic posture was detected. Paddlers with lower extensibility have greater thoracic flexion in the sit-and-reach test. This posture could indicate that they were compensating for their pelvic restriction when a maximal trunk flexion movement with knees extended is performed. References Congdon R, Bohannon R, Tiberio D. (2005). *Clin Biomech*, 20, 947-951. Gajdosik RL, Albert CR, Mitman JJ. (1994). *J Orthop Sports Phys Ther*, 20, 213-219. Shin G, Shu Y, Li Z, Jiang Z, Mirka G. (2004). *J Electromyography Kinesiology*, 14, 485-494.

### STRAIN GAUGE EVALUATION OF FUNCTIONAL FEATURES OF DIFFERENT ANKLE TAPINGS

Nakanishi, K.1, Watanabe, H.2, Ashihara, M.3, Kaji, K.1, Takahashi, M.1, Takahira, N.1

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**Introduction** Lateral ankle sprains are the most frequently encountered sports injuries. Ankle taping has commonly been used to prevent these sprains. Although there are several methods of ankle taping, to our knowledge there have been no reports of the functional features of each type of taping used. Our aim was to examine the functional features of the tapings used to prevent ankle sprain by measuring the loads on the tapes under lateral cutting movement and running stop movement. **Methods** The subjects were 9 male healthy volunteers (age, 22.1±1.4 years; height, 168.4±3.7 cm; body weight [BW], 63.4±5.8 kg). For measurement, a KFG5-120 strain gauge (Kyowa Electronic Instruments Inc.) was bonded to white tape 38 mm wide (Johnson & Johnson Inc.). Four calibrated tapes (stirrup, SU; horseshoe, HS; lateral heel lock, LHL; figure-of-eight, FE) were individually applied to the subject's ankle on the dominant side by the same examiner. The force plate (AMT Inc.) and strain force on the tapes were set to a sampling frequency of 1000 Hz, and the subjects performed lateral cutting movement and running stop movement on the force plate. Strain forces on the tapes were converted into weight by using calibration curves and defined as the loads on the tapes. Loads on the tapes were corrected by body weight and used in our analyses. **Results** The loads on all four tapes during both movements were significantly greater than at rest ( $P < 0.01$ ). During lateral cutting movement, the load on SU (15.7%±5.9% of BW), LHL (15.6%±6.2% of BW), and FE (13.0%±4.6% of BW) were significantly larger than that on HS (7.7%±3.2% of BW) ( $P < 0.01$ ). During running stop movement, the loads on the tapes reached 5.3%±2.5% of BW for SU, 6.4%±2.4% of BW for HS, 6.3%±4.1% of BW for LHL, and 9.9%±3.8% of BW for FE; the load on FE was significant greater than that on SU ( $P < 0.01$ ). At the same time, a backward ground reaction force of 756±303N was applied to the subject's foot. **Discussion** During lateral cutting movement, the loads on SU and LHL were large. As lateral cutting movement is a major cause of lateral ankle sprains, SU and LHL play an important role in preventing lateral ankle sprains. During running stop movement, the load on FE was large. Moreover, a large backward component of ground reaction force was applied to the subject's foot. Therefore, a large anterior-posterior force was applied to the ankle joint, and FE might have helped to brake this force.

### CHARACTERISTICS OF TRUNK MUSCLE BALANCE IN DANCE SPORT PLAYERS

Wachi, M., Kurihara, T., Sanada, K., Toda, Y., Shimozaki, Y., Isaka, T.

ritsumeikan university

**Introduction** Dance sport players often intend to improve their core stability, because straight posture directly affects to the dance performance. They focused on perfecting alignment of the human skeleton (Deckert et al., 2007), and it causes the trunk muscle activated. Therefore, a hypertrophy in trunk muscle is one of the features of dancers, but excessive and/or incorrect core training may induce muscle imbalance. The aims of this study are to measure the cross-sectional areas (CSA) of trunk muscle and compare these muscle balances between dancers and age-matched subjects. **Methods** Nineteen young dance sport players (10 male, 9 female, age 19.3 ± 1.0 yrs, height 166.9 ± 7.7 cm, weight 56.3 ± 7.1 kg, means ± S.D.) and twenty sedentary young subjects (12 male, 8 female, age 18.6 ± 0.7 yrs, height 167.3 ± 8.9 cm, weight 60.5 ± 8.2 kg) were participated. Dancers were experienced at least 1 year of training (2.37 ± 1.86 yrs) and regularly exercised 4 days per week. CSA of trunk muscles (rectus abdominis (RA), abdominal obliques (AO), psoas major (PM), quadratus lumborum (QL), multifidus (MF), erector spine (ES)) were measured using magnetic resonance imaging (MRI) at L4/5 (disk between 4th and 5th lumbar spine). The bilateral difference (BL-Diff) of each muscle was evaluated as BL-Diff = [(large side - small side)/large side\*100] (Hides et al., 2008). The anteroposterior balance (AP-Bal) was calculated by AP-Bal = [(RA + AO) / (MF + ES) \* 100]. **Results and discussion** BL-Diff were 12.4 ± 10.5% (RA), 9.7 ± 5.2% (AO), 7.6 ± 5.6% (PM), 14.6 ± 11.7% (QL), 10.4 ± 6.8% (MF), and 10.0 ± 5.8% (ES) in dancers and 10.0 ± 7.8% (RA), 8.3 ± 5.7% (AO), 5.7 ± 4.1% (PM), 16.8 ± 9.1% (QL), 7.2 ± 6.3% (MF), and 9.8 ± 7.1% (ES) in normal subjects. No significant difference was seen any in BL-Diffs between groups. AP-Bal of dancers was significantly larger than that of normal subjects (29.1 ± 14.8% for dancers, 18.8 ± 10.0% for normal subjects,  $p < 0.01$ ). These results imply sagittal plane of trunk movement executed more than lateral movement in dance sport. Throughout the dance movement, the expert dancers hold their posture in upright position (Steven et al., 2007). However, anterior pelvic tilt and lumbar lordosis are a common technical fault among pre-professional ballet dancers (Deckert et al., 2007). To keep upright posture without anterior pelvic tilt or lumbar lordosis, activation of abdominals are required. Therefore, AP-bal in dancers was larger than that in normal subjects. References Deckert J, et al. (2007). *J Dance Med Sci*, 11, 110-117 Hides J, et al. (2008). *J Orthop Sports Phys Ther*, 38, 101-108 Kujara UM, et al. (1997). *Clin Biomech*, 12, 181-184 Chatfield S, et al. (2007). *J Dance Med Sci*, 11, 76-84

### THE EFFECT OF ANKLE TAPING ON THE GROUND REACTION FORCE IN VERTICAL JUMP PERFORMANCE

Koyama, K.1, Honda, I.1, Yanase, R.1, Kato, T.1, Yamauchi, J.2,3

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**[Introduction]** Ankle joint injuries are the most common injuries across a wide variety of sports (Rovere et al., 1998). One of most common ankle injuries is an ankle sprain, which is often caused by an inversion of foot so that the muscles, tendons and ligaments on the outside of the ankle are injured. Accordingly, ankle taping is commonly used when athletes return to play after ankle injuries in order to prevent re-injuries. The prescription of an ankle taping is designed to protect the structures re-injured the connective tissues so as to limit the joint movement. On the other hands, ankle taping may restrict ankle plantar-flexion movement in some degrees (Quackenbush et al., 2008). Such limitation of movement may affect to the athletic performance. However, despite requiring ankle taping in many sport activities, there are only few researches on the study of the effect of ankle taping on the muscle force generating capacity in the dynamic movement. Therefore, the purpose of this study was to investigate the effect of closed basket weave ankle taping on the vertical ground reaction force in vertical jump performance. **[Method]** Thirteen healthy young men (age, 20.2±1.3year; height, 1.76±0.05m; body weight, 66.1±6.1 kg; mean±SD) performed the vertical jump performance on the force plate with (CON) or without ankle taping. Ankle taping with closed basket weave technique (CLO) was performed on the right ankle joint. Vertical jump ability was assessed by using four styles of

vertical jump as follows: a countermovement jump without using arm swing (CMJ) and squat jump without using arm swings (SJ). In CMJ and SJ, subjects placed their arms in front of their chest throughout the entire jump and kept their torso in an upright position in order to emphasize using the leg extensor muscles. Subjects attempted to jump as high as possible and performed three trials of each type of vertical jump with sufficient time for recovery between attempts. Height of vertical jump was calculated from the ground reaction force (GRF) measured with the force plate (Kistler, Switzerland) at 1 kHz. Impulse and maximum GRF were also calculated and time-series GRF was recorded. The highest trial of each type of vertical jump was used for further analysis. [Result] Jump height was significantly lower for CLO than CON (CLO:  $36.6 \pm 6.6$  cm vs. CON:  $38.1 \pm 6.7$  cm,  $p < 0.01$ ). In the time-series GRF, GRF was also significantly lower for CLO ( $12.8 - 19.4$  N/kg) than CON ( $13.3 - 20.3$  N/kg) before take off, and these decreases in CLO represent 2.9-6.4% of CON. On the other hands, impulse and maximum GRF were not significantly different in each condition. [Discussion] These results suggest that ankle-taping (CLO) limits the range of ankle plantar flexion and force generation of plantar flexor muscles during vertical jump, causing to an impairment of jump performance. [References] Quackenbush KE, Barker PR, Stone Fury SM, Behm DG. (2008). *N Am J Sports Phys Ther*, Rovere GD, Clarke TJ, Yates CS, Burley K. (1988). *Am J Sports Med*, 16, 228-233.

**15:00 - 16:00**

## Mini-Orals

### PP-PM35 Physiology [PH] 2

#### ACCELEROMETRY OF SELF-PACED CHILDREN'S GAMES DURING ACTIVE PLAY

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**Introduction** When monitoring children's physical activity, accelerometer (ACC) assessments of vector magnitude (VM) and vertical axis (V-A) are effective for estimating energy expenditure of locomotor activities. During self-paced physical activity (PA) the linear relationships for VM and V-A are modified (i.e., higher intercept and less slope), promoting increased mean standard error and decreased explained variance. The implication is that ACC profiles derived from linear equations (treadmill calibration) are limited when assessing children's active play; however factors contributing to this limitation with self-paced PA are uncertain. The purposes of the study were to determine: a) the nature of the relationships between counts from individual axes and VM for self-paced/unregulated children's games; and b) assess what impact a dominant axes may have on these relationships. **Methods** Children's ( $n=15$ ,  $9.3 \pm 1.2$  yrs; BMI  $20.5 \pm 4.0$ ) cardiorespiratory and metabolic responses to treadmill activity (4, 6 and 8 km/h (0% grade)) and active playing of 6 games were determined using FITMATE. Accelerometers (ActiGraph GT3X) collected PA counts (10sec epochs) for all activities. The linear regression equations (VM for time, VO<sub>2</sub>) generated for each activity, and relative contribution of each axes, were compared (ANOVA) and assessed at  $p=0.05$ . **Results** During treadmill activity the linear relationships for VM with speed (at 4, 6, and 8 km/h) and oxygen consumption (VO<sub>2</sub>) were  $0.90 \pm 0.03$  and  $0.82 \pm 0.05$ , respectively ( $p > 0.05$ ). The linear relationships (VM with time and measured VO<sub>2</sub>) averaged over 6 self-paced games were  $0.061 \pm 0.035$  and  $0.006 \pm 0.002$  ( $p < 0.05$ ). Linear regressions for each game resulted in a range of intercepts, for VM and time, from  $520 \pm 198$  cnts/10sec to  $1189 \pm 196$  cnts/10sec ( $p < 0.05$ ) compared to treadmill values of  $193 \pm 95$  cnts/10sec ( $p < 0.05$ ). The measured VO<sub>2</sub> values for self-paced games were consistently higher at lower counts (VM) for all games. The percent difference in axis contribution to VM between the dominant and lowest axis was  $41 \pm 14\%$  and  $7 \pm 5\%$  for treadmill activity and self-paced games, respectively ( $p < 0.05$ ). **Discussion** This study reveals that characteristics of children's self-paced PA impacts the linear relationship identified by ACC for locomotion activities. The higher estimates of VO<sub>2</sub> at constant VM for self-paced active play using linear regression calibrations from increasing treadmill activity (speed) is related to the presence of a dominant axis with ACC counts for treadmill, but not with ACC counts for self-paced active playing of games. The finding that axes dominance may underestimate VM up to 30% when total counts are similar may require ACC assessments of active play to be corrected.

#### THE EFFECTS OF A 6 WEEK ACSM EXERCISE INTERVENTION ON BODY COMPOSITION IN SEDENTARY OLDER MEN.

Herbert, P.2, Sculthorpe, N.1, Ratcliffe, J.1, Baker, J.1, Richards, J.3, Grace, F.1

*University of the West of Scotland*

**1**Institute for Clinical Exercise and Health Science, University of the West of Scotland, Hamilton, Scotland ML3 0JB **2**University of Wales, Trinity Saint Davids, Camarthen Campus, Camarthen SA31 3EP **3** Institute of Sport and Physical Activity Research, University of Bedfordshire, Bedford MK41 9EA **Introduction** The American College of Sports Medicine (ACSM) recommends a weekly exercise dosage of 150 minutes for adults (Garber et al., 2011) in order to improve and ensure long term physiological wellbeing. However, there is a lack of supporting evidence for the efficacy of these recommendations in older adults. The present study set out to examine the effect of a 6 week intervention using the ACSM guidelines on body composition in sedentary older males. **Methods** Untrained older males (UT,  $n=22$ ,  $62.4 \pm 5.4$  yrs) underwent 6 weeks of training in accordance with the ACSM's guidelines for the development and maintenance of cardiorespiratory fitness ( $\geq 30$  min.d<sup>-1</sup> on  $\geq 5$  d.wk<sup>-1</sup> for a total of  $\geq 150$  min.wk<sup>-1</sup>). Harpenden skinfold calipers were used to determine skinfold thickness at the biceps, triceps, subscapular and suprailiac sites on the left side of the subjects' body. Triplicate measures were obtained with average values used as criterion. Body density was estimated using the sum of skinfolds using procedures of Durnin and Womersley (1974). Percentage body fat (%BF) was estimated from body density using Siri's (1956) equation. Fat Free Mass (FFM) was calculated by subtracting fat mass (FM) from total body mass (TBM). Body Mass Index (BMI) was calculated by dividing subject body mass by height squared. Measures were obtained (Pre) and following 6 weeks of training (Post). At both time points, UT were compared with a group of master athletes (MA,  $n=17$ ,  $60.4 \pm 5.2$  yrs) acting as a positive control. Data were analysed using SPSS v 20 software using an ANOVA. Simple effects were investigated using a paired samples t-test. The alpha level was set at 0.05. **Results** Body composition did not change from Pre to Post in the MA group. However, TBM and BMI decreased significantly ( $p < 0.05$ ) in addition to % BF decrease ( $p < 0.01$ ) and subsequent increase in %FFM in the UT group from Pre to Post. When compared with the MA group, UT had significantly higher BF at all time-points ( $p < 0.01$ ). **Discussion** Data from the present study suggest that the ACSM guidelines are effective as a short term exercise intervention in improving body composition in older sedentary populations. Further, short term exercise interventions which conform to the ACSM guidelines can produce significant loss of fat mass. It remains to be seen whether body composition changes can translate to

improved metabolic regulation in ageing populations. References Garber, C. E., Blissimer, B., Deschenes, M. et al. 2011. *Med Sci Sports Exerc*, 43, 1334-59.

### REST AND EXERCISE FAT METABOLISM ADAPTATIONS IN RELATION WITH DIFFERENT AEROBIC TRAINING VOLUME

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**INTRODUCTION** The aerobic training volume required to induce changes in fat oxidation is not well known (Achten & Jeukendrup, 2004). The aim of this study was to analyse changes in plasma nonesterified fatty acids (NEFA) and triglycerides during rest and exercise in groups with different aerobic training volume in order to determine fat metabolism adaptations. **METHODS** "Well-trained" (WTr) (n=20) VO<sub>2</sub>max 68.31±8.65 ml·min<sup>-1</sup>·kg<sup>-1</sup> (20 hours of training pw), "Trained" (Tr) (n=20) VO<sub>2</sub>max 45.91±7.54 ml·min<sup>-1</sup>·kg<sup>-1</sup> (4-7 hours of training pw) and "Untrained" (UTr) (n=20) VO<sub>2</sub>max 35.49±4.93 ml·min<sup>-1</sup>·kg<sup>-1</sup> performed an incremental maximal test on cycloergometer starting at 100 watts, increasing workload each 3 minutes 25 watts until exhaustion. At the end of each step during testing protocol, blood sample was collected. Plasma nonesterified fatty acids and triglycerides were determined by spectrophotometry (Coulter model 6706319, Coulter Electronics LTD., England). Four points were chosen to compare NEFA and triglycerides concentrations (Baseline (B), Aerobic Threshold (AT), Anaerobic Threshold (AnT) and Final (F)). ANOVA and repeated measured test was performed for statistical analysis. A p<0.05 was used to determine statistical significance. **RESULTS** Baseline plasma NEFA concentration was higher in untrained group (WTr: 5.74±3.22mg/dL; UTr: 9.46±3.80mg/dL; p<0.05). Well Trained subjects showed lower plasma triglycerides concentrations in all points measured than other groups. Well-trained (B: 74.59±25.02mg/dL; AT: 76.68±18.19mg/dL; AnT: 80.52±17.35mg/dL; F: 86.73±22.04 mg/d) Trained (B: 93.5337.40 mg/dL; AT: 98.9339.54; AnT: 103.8739.85; F: 109.2141.12 mg/dL) and Untrained (B: 82.79±37.81mg/dL; AT: 89.75±35.49; AnT: 95.18±36.55; F: 98.57±35.31mg/dL). **DISCUSSION** The differences between groups in plasma fatty acids may be due to the adaptations observed in endurance athletes who increasing fat oxidation and it has been suggested that an increased capacity to oxidize fat is related to endurance capacity (Achten & Jeukendrup, 2004). Our data suggest that moderate exercise (4-7 hours per week) could be enough to cause a fat mobilization to be considered part of interventions aiming at body weight/fat reduction. **REFERENCES** Achten, J., & Jeukendrup, A. E. (2004). Optimizing fat oxidation through exercise and diet. [Review]. *Nutrition*, 20(7-8), 716-727. doi: 10.1016/j.nut.2004.04.005

### EFFECT OF OBESITY-RELATED GENE POLYMORPHISMS ON WEIGHT LOSS IN WRESTLERS

Nishimaki, M.1, Sakamoto, S.1, Hayakawa, Y.2

1:*Waseda University*,2:*Sigakkan University*

**Introduction** Single nucleotide polymorphisms (SNPs) of UCPI, ADRB3, and ADRB2 are associated with metabolic changes (Kahara et al., 2002). However, there is little understanding of the relationship between these SNPs and rapid weight loss in wrestlers (Shimizu et al., 2007). Therefore, the aim of our study was to examine the effects of SNPs in the UCPI, ADRB3, ADRB2 genes on rapid weight loss in wrestlers. **Methods** We studied 23 female wrestlers, aged 18.2 ± 2.1 years, who needed to lose weight rapidly before competing in national championships. Saliva samples were collected from these study subjects by using an Oragene™ DNA Self-Collection Kit. We developed a genotyping method by using quenching probes. The Q-Probe is a singly labeled oligonucleotide bearing a fluorescent dye that is quenched via electron transfer between the dye and a guanine base at a particular position. **Results** The rate of weight loss was higher in ADRB2 heterozygous individuals than in wild-type individuals (-2.3% ± 0.9% vs. -4.8% ± 2.7%, paired t-test, p = 0.049). The rate of change in body mass index (BMI) during rapid weight loss term was higher in ADRB2 heterozygous individuals than in wild-type individuals (-5.0% ± 2.7% vs. -1.9% ± 1.2%, paired t-test, p = 0.030). The percentage of body fat and BMI before rapid weight loss was lower in ADRB3 wild-type individuals than in heterozygous individuals, although the difference was only slightly significant. The percentage of body fat at 1 month after a wrestling match was lower in ADRB3 wild-type individuals than in heterozygous individuals (19.9% ± 3.3% vs. 23.4% ± 3.4% respectively, paired t-test, p = 0.022). **Discussion** We found that the ADRB2 Arg16Gly polymorphism was significantly associated with accelerated weight loss and reduced BMI in these female wrestlers. Thus, individuals with the ADRB2 Arg16Gly polymorphism may be at an advantage when rapid weight loss is required before wrestling matches. **References** Kahara T, Takamura T, Hayakawa T, Nagai Y, Yamaguchi H, Katsuki T, Katsuki K, Katsuki M, Kobayashi K. (2002). *Diabetes Res Clin Pract*. 57(2):105-110. Shimizu K, Aizawa K, Suzuki N, Kukidome T, Kimura F, Akama T, Mesaki N, Kono I. (2007). *The journal of Japanese Society of Clinical Sports Medicine*. 15(3):441-446. (in Japanese)

### BENEFITS OF INTERVALLIC AEROBIC EXERCISE ON PARAMETERS OF METABOLIC SYNDROME IN GENETICALLY OBESE RATS.

Aparicio, V.A., Andrade, A., Kapravelou, G., Marfinez, R., Bustos, L., Nebot, E., Camiletti-Moiron, D., Aranda, P., López-Jurado, M., Delgado-Fernández, M., Galisteo, M., Arrebola, P., Porres, J.M.

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**Introduction** The regular practice of physical exercise provides unquestionable health benefits, including preventive effects on obesity, abnormal lipid and glucose metabolism, and oxidative stress. This study aimed to test the protective effect of intervallic aerobic exercise on metabolic syndrome parameters like hyperglycemia, hyperlipidemia and impaired antioxidant defenses. **Methods** A total of 40 male Zucker rats were divided into 4 experimental groups: lean exercise, lean sedentary, obese exercise, and obese sedentary. The study lasted for 8 weeks. Training took place 5 days a week increasing in intensity and duration. It was performed in a computerized treadmill with special design for rats (Haram et al.2008). VO<sub>2</sub> max was determined after performing an incremental test based on the protocol developed by Wissloff et al. (2001). Other parameters evaluated were plasma glucose, t-cholesterol, LDL-cholesterol and triglycerides, and hepatic antioxidant enzymes Cu/Zn-SOD, Mn-SOD, and catalase. **Results** The protocol of aerobic intervallic exercise improved the aerobic capacity of experimental animals as reflected in a trend towards increased VO<sub>2</sub>max and significantly higher VO<sub>2</sub>max speed and incremental test duration time. Significant hepatomegalia and steatosis, and higher levels of plasma glucose, t-cholesterol, LDL-cholesterol and triglycerides were observed among obese rats when compared to their lean controls, whereas all these parameters were lowered in the group of obese animals that performed exercise. The hepatic activity of Cu/Zn-SOD and Mn-SOD was significantly altered in obese rats and improved with exercise. **Discussion** The completion of an aerobic interval training protocol as an intervention to mitigate the symptoms of metabolic syndrome had positive effects on plasma lipid levels, response to oral glucose administration, liver status, and liver antioxidant capacity in an experimental model of genetically obese rats. Such improvements are related to the improve-

ment in aerobic capacity by the exercise groups as described by Haram et al. (2008). The beneficial effects of aerobic intervallic exercise in liver antioxidant status were more noticeable in obese when compared to lean animals, and point out to a buffering action of exercise on the oxidative stress conditions induced by the metabolic syndrome. References Wisloff U, Helgerud J, Kemi OJ, Ellingsen Ay Am. J. Physiol.-Heart and Circulatory. 2001;280:H1301-H10. Haram PM, Kemi OJ, Wisloff U. Front Biosci. 2008;13:336-46.

### **INTERVAL TRAINING IMPACTS BLOOD PRESSURE MORE EFFECTIVELY THAN WORK MATCHED CONTINUOUS TRAINING IN OVERWEIGHT AND OBESE FEMALES.**

Lyall, G.K., Harris, E., Birk, G.K., Weeks, A., Khalil, A., Ferguson, C., Lawton, C., Dye, L., Birch, K.M.

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**Introduction:** The risk of cardiovascular disease (CVD) is significantly increased with obesity. A key element of this risk is the impact of obesity upon blood pressure and vascular function. Exercise training can improve CVD risk through improvement of these risk factors, however the relative effectiveness of traditional continuous exercise (CON) versus interval exercise (INT) training upon these parameters is not clear. The aim of this study was to compare the impact of heavy intensity work matched CON with that of INT training upon indices of vascular health in overweight and obese premenopausal women. **Method:** 20 sedentary females (42±6yrs) with a BMI>28 (mean 32±4kg/m<sup>2</sup>) and %Body Fat (mean 42.5±3.8%) were assessed at baseline for resting blood pressure (BP), resting heart rate, body composition, pulse wave velocity (PWV) using applanation tonometry and maximal aerobic capacity using a ramp-incremental (12W/min) step test. Participants were then matched for BMI and age and randomly assigned to either the INT (n=10) or CON (n=10) training group. Each participant trained on a cycle ergometer twice/week for 12 weeks. Both groups exercised within the heavy intensity exercise domain (~120% lactate threshold) with work being matched through total energy expenditure. The INT training involved repeated 40s exercise with 80s recovery (20W) bouts. Baseline measures were repeated after 12 weeks. Data were assessed by two-way mixed mode ANOVA. **Results:** Baseline data did not differ between groups (P > 0.05). Following training there was a trend for increased VO<sub>2</sub>max in both groups (INT pre 2051.2±389.1, post 2086.9±347.1, CON pre 2136.6±262.4, post 2224.7±259.8 ml/min: p=0.07). Superior benefits were seen for INT training for systolic BP (CON pre 124.8±14.5, post 124.1±14.0: INT pre 124.3±10.8, post 118.7±6.9mmHg: gpxtime interaction: p>0.05), systemic vascular resistance (CON pre 27.9±8.2, post 29.8±6.1: INT pre 27.3±4.9, post 24.3±3.3mmHg.min/L: gpxtime interaction: p=0.06) and fat free mass (CON pre 59.0±4.3, post 57.6±3.7: INT pre 56.1±2.4, post 57.2±3.4%: gpxtime interaction: p=0.07). There were no training induced changes in BMI, W:H, PWV, or diastolic BP in either group (P > 0.05). **Discussion:** These results indicate that heavy intensity INT training for 12 weeks reduces systolic BP and systemic vascular resistance in a population of overweight and obese females. In addition there were superior changes in fat free mass associated with the higher work rates undertaken during INT. Arterial stiffness assessed via PWV did not change following either exercise training regime.

### **EFFECT OF PHYSICAL EXERCISE IN CHILDREN DIFFERING IN BODY MASS**

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**Introduction** Alongside a range of health problems associated with increased body mass (BM), overweight or obesity is an important limiting factor for realization of regular physical exercise and qualitative life style. **Methods** The study goal was to assess the effect of movement intervention in children differing in BM. Study was carried out in 98 children with normal BM (age 12.4 ± 2.2 years), 68 overweight children (age 12.1 ± 2.0 years) and 59 obese children (age 12.7 ± 2.6 years). Body composition was determined by whole body multi-frequency bioimpedance method by tetrapolar configuration of electrodes using prediction equations that are valid for the Czech child population. The maximum functional variables were determined on a treadmill with a slope of 5% during a progressive walking test until subjective exhaustion. The initial speed on the treadmill was 4km.h<sup>-1</sup>, and was increased each minute by 1 km.h<sup>-1</sup>. The cardiorespiratory variables were measured in an open system using an online method by TEEM 100 (Aerosport). All analyzers were checked before and after each test by calibration gas of known concentration. The ventilation was controlled before and after test by a mechanical pump. The energy demand of physical exercise was measured by a Caltrac monitor, and simultaneously by an assessment of energy cost during the exercise from the general relationship between the exercise intensity and the energy that a person needs to cover the activity. The differences between both methods were lower than 12%. **Results** Weekly movement program for children with normal BM ranged the energy content from 1360 kcal (5685 kJ) to 2620 kcal (10952kJ) (mean 1980 ± 310 kcal - 8276 ± 1296 kJ) in children with overweight from 1650 kcal (6897 kJ) to 2310 kcal (9656 kJ) (mean 1920 ± 230 kcal - 8026 ± 960 kJ) and in obese children, then from 1940kcal (8109 kJ) to 2550 kcal (9045 kJ) (mean 2260 ± 290 kcal - 9447 ± 1212 kJ). Relative changes in %BF ranged from 15.4 to 16.6%, the similar changes were found in body cell mass (BCM) from 14.2 to 16.1% and in relationship ECM/BCM - 15.0 - 16.3%, and in VO<sub>2</sub>peak from 13.9 to 15.7%. Changes in peak treadmill walking speed ranged from 12.8 to 15.3%. **Discussion** In children differing in BM are absolute changes in somatic and functional parameters like a result of imposed movement intervention substantively and statistically significant. On the contrary, differences in relative terms are insignificant. We may conclude that a similar intervention movement program may invoke the similar changes in body composition and in both motor and functional performance in children differing in BM, i.e. independently on actual body mass assessed child.

### **THE ENERGETIC COST OF ZUMBA CLASS IN MIDDLE AGED WOMEN**

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**Introduction** These days, there is a decrease in the activity of the population and as a result there is an increase in the percentage of overweight or obese people. In general, the criteria for improving the cardiorespiratory capacity are: training frequency 3-5 days per week, an intensity of 65-90% from maximal heart rate (HRmax); 50-85% of maximal oxygen uptake (VO<sub>2</sub>peak) and duration of 20-60 min of continuous and intermittent activity using large muscle groups (ACSM, 2010; Laukkanen et al., 2001). These aspects lead to us to find new forms of acceptable movement activities. Nowadays, people fancy dance fitness programmes such as Zumba. Therefore the aim of this study was to compare the cardiorespiratory cost of such exercise with other aerobic exercises and to assess the energy expenditure during Zumba class in middle age women group. **Methods** The subjects were recruited from the clients of a private fitness club. A group of 6 women (age range 27-37 years) volunteered to participate in the study. Anthropometric data (body weight, high, total body fat) were 68.5±10.8 kg, 170.3±6.6 cm, 27.4±6.6 % and maximal aerobic capacity (VO<sub>2</sub>peak) during running test on the treadmill with maximal heart rate was 27.4±6.6 ml•kg<sup>-1</sup>•min<sup>-1</sup> and 183±15 bpm. Oxygen uptake (VO<sub>2</sub>) was measured during the whole Zumba class. The

energy cost was calculated converting the estimated VO<sub>2</sub> to kcal, using the constant of 5 kcal (4.18 kJ) on 1 l VO<sub>2</sub> oxygen consumption with respiratory exchange ratio equals number 1 (Otto et al., 2011). Results The percentage of average HR, VO<sub>2</sub> during whole Zumba class compared with maximal running test were in the 76.7 % from the maximal HR and 51.2 % from the VO<sub>2</sub> peak. The intensity of the whole Zumba class is on the 68.4 % of maximal running test with the oxygen consumption. In the whole the lesson was consumed 404.8 kcal (resp. 1692.2 kJ). The intensity of whole lesson reported by HR was covered by 67.5 % from maximal HR-high intensity exercise. In the central phase there was the highest energetic cost (336.3 kcal, resp. 1405.9 kJ). Discussion Our results showed that the energy cost of Zumba is in the middle exercise intensity of maximal oxygen consumption according ACSM (ACSM, 2010). Regardless of the variety of the participants and the apparent effect, there is the growing popularity of Zumba classes as the new trend of fitness. It could be used thanks to the intensity and energy expenditure as weight reduction program for obese patients via funny dancing activity. References ACSM. (2010). Guidelines for Exercise Testing and Prescription. Baltimore: Lippincott, Williams and Wilkins. Laukkanen, R. M. et al. (2001). European Journal of Applied Physiology, 84(1-2), 64-68. Otto, R. M. et al. (2011). Medicine and Science in Sports and Exercise, 43(5), 329. Wyon, M. A. et al. (2004). Journal of Strength and Conditioning Research, 18(3), 646-649.

### **RESISTANCE TRAINING ALONE OR COMBINED WITH DIETARY MODIFICATIONS? SEARCHING FOR OPTIMAL STRATEGIES TO MAINTAIN MUSCLE MASS IN HEALTHY ELDERLY**

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Introduction It is well documented that resistance training is beneficial for maintenance of muscle mass in elderly (Peterson et al., 2011). However, there are very few studies performed on healthy elderly women which are considered to be successfully aged. There is also little information about the effects of combined training and dietary interventions on muscle mass. The purpose of this study was to determine the effects of long-term resistance training and dietary interventions on whole body composition and muscle mass, biomarkers of inflammation and oxidative stress in healthy and physically active elderly women. Methods 61 healthy elderly women (65-70 yrs) were randomized into a control group (C), a training group (T) and a training group assigned to a diet with anti-inflammatory properties according to Nordic nutritional recommendations (TD). Both training groups performed a 24-week training program consisting of resistance exercises for both the lower- and upper body. Leg strength was assessed using 1 RM test in leg-extension, and body composition was determined using Dual X-ray Absorptiometry (DXA). Muscle biopsy samples were obtained from the mid-portion of m.vastus lateralis using the percutaneous needle biopsy technique. In plasma samples, levels of oxidative stress markers were evaluated using a sandwich enzyme-linked immunosorbent assay (ELISA) and levels of inflammation markers were assessed using GC 2010 gas liquid chromatograph (Shimadzu, Japan). Immunohistological and biochemical analyses are performed on muscle biopsies. Results Preliminary results show the occurrence of significant increase in 1 RM of leg-extension in training groups, approximately 20 % in T and 22 % in TD, whereas no changes were found in C. In contrast to changes seen on performance markers, a significant reduction of approximately 4.35 % in total body fat occurred only in TD but not in T or C. Similarly, a significant increase in leg lean mass occurred in TD but not in T and C. Significant associations were found between inflammatory markers, oxidative stress markers and fat mass. Cellular and molecular events behind the effects observed are under investigation. Discussion This study clearly demonstrates that in healthy and physically active elderly women, resistance training should be associated with dietary modifications in order to promote positive effects on muscle mass. Cellular and molecular pathways involved in the response to the combination of resistance training and dietary interventions should be depicted. References Peterson M., Sen A., Gordon P. (2011). MSSE, 43 (2), 249-258.

### **DOES RESTING METABOLIC RATE REMAIN ELEVATED FOLLOWING HIGH INTENSITY INTERMITTENT EXERCISE?**

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Introduction Interest surrounding high intensity intermittent training (HIIT) has increased due to findings demonstrating a striking capacity to improve diverse metabolic health parameters after very brief interventions (Gibala & Little, 2010). HIIT can favourably alter body mass and composition with changes occurring with a low training volume and associated energy expenditure (EE) (Boutcher, 2011). This investigation sought to characterise the EE and excess post exercise oxygen consumption (EPOC) (11 h post-exercise) of two common HIT protocols. Methods Oxygen consumption ( $l \cdot min^{-1}$ ), respiratory exchange ratio (RER), and EE ( $kJ \cdot min^{-1}$ ) were measured in nine healthy males over 12 h under three conditions; resting control (CON), H1E1 (10 x 60 s intervals) and H1E2 (10 x 4 min intervals). The abbreviation H1E refers to an acute bout of high intensity exercise as opposed to a training programme consisting of HIIT. All parameters were recorded continuously during the exercise period (EP) and for ~1h post exercise (RP - rapid phase of EPOC). Thereafter, the first 15 of every 30 min period was measured until ~2015 h (SP - slow phase of EPOC). Results Total EP (0h - 1h) EE during H1E1 (1151 (205) kJ) was significantly lower than H1E2 (2788 (322) kJ);  $p < 0.05$ ). The EE during exercise recovery periods in H1E1 and H1E2 contributed to ~293 and ~473 kJ respectively. EE during the RP period (1h - 2h) immediately after exercise was significantly higher after H1E1 (431 (50) kJ) and 2 (431 (42) kJ) compared with control (368 (46) kJ);  $p > 0.05$ ), with no differences between exercise conditions. During the SP period (2 h - 12 h) there were no significant differences in EE or fuel utilisation in any experimental condition. In the RP period RER was significantly lower in H1E1 (0.78 (0.06)) and H1E2 (0.76 (0.04)) compared with CON (0.87 (0.06));  $p < 0.05$ ), with no significant differences between exercise conditions. Conclusion • This study reveals that during exercise H1E2 expends significantly more energy compared to H1E1 with both exercises expending more energy than a control trial. • For ~ 60 minutes after exercise RMR is significantly elevated above that of control for both exercise conditions. There is no difference between exercise conditions. • Between 2-12 hours there is no significant difference in RMR between any experimental condition. • Collectively over the 12h period H1E1 and H1E2 showed a greater EE compared with control, with EE in H1E2 being significantly higher than H1E1. References Boutcher SH (2011) High-intensity intermittent exercise and fat loss. J Obes: 868305 Gibala MJ, Little JP (2010) Just HIT it! A time-efficient exercise strategy to improve muscle insulin sensitivity. J Physiol 588: 3341-2

### **INCREASES IN RESTING ENERGY EXPENDITURE AND ORGAN-TISSUE MASSES WITH WEIGHT GAIN IN ATHLETES**

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*Waseda University*

Introduction: Although overweight athletes have greater resting energy expenditure (REE) and fat-free mass (FFM) including high metabolic rate organ-tissue, the associations between REE and each internal organ-tissue mass in athletes with great changes in body weight are not yet clear. The previous cross-sectional study suggested that high REE in overweight athletes was due to greater absolute FFM,

including low and high metabolic rate organ-tissues, such as skeletal muscle (SM), liver, and kidney, and that the ratios of liver, brain, heart, and kidney masses to FFM in Sumo wrestlers were similar to those in non-athletic control peers. However, it has not been confirmed by longitudinal study whether the combination of overfeeding with physical training increases organ-tissue mass of FFM except for skeletal and heart muscles in athletes. Therefore, we determined whether overfeeding and physical training in collegiate male American football players increases REE and high and low metabolic rate organ-tissue masses in cross-sectional and longitudinal studies. Methods: Freshmen (n = 10) and senior American Football players in their second and third years of college (n = 17) participated in the cross-sectional study. In the longitudinal study, freshmen (n = 10) were followed-up for one year of overfeeding and physical training. FFM, SM, adipose tissue, liver, kidney, brain, and heart volumes were estimated by DXA, MRI, or echocardiography. Measured REE was determined by indirect calorimetry. Predicted REE was estimated as the sum of individual organ-tissue masses multiplied by their metabolic rate constants. Results: In the cross-sectional study, senior players showed higher measured REE than freshmen (2010 vs. 1656 kcal/day,  $P < 0.01$ ). Senior players had higher FFM and organ-tissues mass, but no differences in ratio of organ-tissue mass to FFM. In the longitudinal study, SM, liver, heart, and kidney masses in freshmen increased after one year, but there were no changes in ratio of organ-tissues to FFM. Measured and predicted REEs increased by 5.3% and 8.9%, respectively, with overfeeding and physical training ( $P < 0.01$ ). CONCLUSION: The present cross-sectional and longitudinal investigations indicated that there are increases in not only low metabolic rate organ-tissue masses, such as SM and AT, but also in high metabolic rate organ-tissue masses, such as the liver and kidney, with a combination of overfeeding and physical training in collegiate male American football players. Furthermore, these increases in low and high metabolic rate organ-tissue masses may lead to increased REE of these athletes. These findings suggest that changes in REE in athletes with overfeeding and physical training respond to variation in body composition or each organ-tissue mass in overweight athletes.

### EFFECTS OF 4-WEEKS LOW-VOLUME HIGH-INTENSITY INTERVAL TRAINING IN OBESE INDIVIDUALS

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Introduction Obesity strongly increases the risk for insulin resistance, type 2 diabetes and cardiac disease. Low-volume, high-intensity interval training (HIT) has recently been suggested as a time effective exercise strategy to improve cardiovascular and skeletal muscle metabolism (Gibala et al., 2012). Acute and short-term (2 weeks) HIT has been shown to improve glucose homeostasis and muscle metabolism in type 2 diabetic patients (Gibala et al., 2012), however, to our knowledge, the long-term effects of this exercise model in obese people have yet to be studied. Methods Nine obese participants ( $51 \pm 2$  yrs; BMI  $40 \pm 2$  kg/m<sup>2</sup>) performed 12 sessions of low-volume HIT over a period of 4 weeks. Each session consisted of 5 to 12 repetitions of 1 min cycling at  $\approx 90\%$  of the maximal heart rate with 1 min of active recovery between each repetition. Pre- and post-training peak power output (W<sub>max</sub>) and peak oxygen consumption (VO<sub>2peak</sub>) were measured by a maximal exercise test on a cycle ergometer. In addition, glucose tolerance was assessed via a 2 h oral glucose tolerance test (OGTT) and resting metabolic rate (RMR) was measured by indirect calorimetry. Finally, blood lipid profiles were studied via standard techniques. Results Twelve sessions of training resulted in a significant increase of exercise performance (PRE  $144 \pm 10$  W<sub>max</sub> vs. POST  $164 \pm 12$  W<sub>max</sub>;  $p < 0.05$ ), without any significant increases in VO<sub>2peak</sub>. In addition, we observed a 20% increase in RMR (PRE  $1977 \pm 250$  kcal/day vs. POST  $2376 \pm 236$  kcal/day;  $p < 0.05$ ). The area under the curve (AUC) calculated during the OGTT showed a significant reduction of 8% post training ( $p < 0.05$ ). Finally, serum levels of high-density lipoprotein (HDL) increased 10% (PRE  $49 \pm 4$  mg/dL vs. POST  $54 \pm 5$  mg/dL;  $p < 0.01$ ) after training. Discussion In line with the effects of short-term low-volume HIT (Gibala et al., 2012), we have found an improvement on exercise performance and glucose homeostasis after 4 weeks of a similar training program. Moreover, we demonstrate that this approach also increases the RMR and serum levels of HDL, both parameters associated to metabolic health improvements. In conclusion, these data add further support to show that low-volume HIT is an efficient strategy to enhance cardiorespiratory fitness and metabolic profile in obese people. References Gibala, M. J., Little, J. P., Macdonald, M. J., & Hawley, J. A. (2012) Physiological adaptations to low-volume high-intensity interval training in health and disease. *J Physiol.* doi: 10.1113/jphysiol.2011.224725.

### STAY SLIGHTLY COOL TO STAY WARM IN THE MOUNTAINS

Draper, N., Corry, C., Fryer, S., Dickson, T., Hamlin, M.

University of Canterbury

Introduction There is an old adage that states to stay warm in the mountains you need to stay slightly cool. Yet typically clothing manufacturers advocate for a three layer clothing system for use by mountaineers (Nimmo, M. 2004; Long, 2003). Twight and Martin (1999) advocated for an alternative approach. The aim of this study was to compare the two different clothing systems, in simulated alpine conditions, to examine differences in physiological responses and effects on manual dexterity/skilful movement. Methods Ten healthy males, mean  $\pm$  (SD): age  $21.6 \pm 1.9$  yr, height  $1.81 \pm 0.09$  m, and mass  $80 \pm 3.4$  kg completed written informed consent and a medical health history questionnaire prior to taking part in the study. Participants completed the test twice (separated by 7 days) wearing one of the two clothing systems. The test protocol was conducted on a Woodway (Waukesha, Wisconsin, USA) treadmill and included a 5 min warm-up (4 km.hr, 9% gradient) before the participants completed two 20 min steady state exercise periods (4 km.hr, 9% gradient) each followed by a 10 min stationary (rest) period. Two way repeated measures ANOVA tests were calculated to assess for differences in thermal comfort, oxygen consumption, heart rate, core temperature and time to complete tying into the harness. Results There was a significant interaction effect  $F(3,24) = 21.50$ ,  $p < 0.0005$ , with post-hoc testing indicating significant differences at the end of each period except the second exercise period. There were no other significant differences between the clothing systems for the physiological measured assessed. Discussion The Twight system (Twight and Martin, 1999) has been proposed as an alternative clothing strategy for mountaineers. The aim of this study was to examine potential benefits of the Twight system over traditional layering during exercise in a simulated alpine environment. Results of the study indicated there were significant benefits with regard to thermal comfort but these were not realised in statistical differences between the physiological and skill-related measures (oxygen consumption, HR, core temperature, tying-in time). The length of the protocol could be usefully extended in a future study to examine these parameters in a longer duration protocol more akin to the days experienced by mountaineers. Such a study might result in the differences in thermal comfort being also seen in the physiological and skill-related measures. References Long, S. (2003). Hill Walking. The Mountain Training Trust, Nottingham. Nimmo, M. (2004) Exercise in the Cold. *Journal of Sports Sciences*, 22, p898-916. Twight, M. and Martin, J. (1999) Extreme alpinism: Climbing light, fast and high. The Mountaineers Books, Seattle, WA, USA.

15:00 - 16:00

## Mini-Orals

## PP-PM40 Physiology [PH] 7

**THE EFFECT OF MECHANICAL OVERLOAD ON FASTING-RELATED MUSCLE ATROPHY**

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Introduction Fasting, or extreme calorie restriction, is frequently used for rapid weight loss in athletes who participate in sports with weight classes. However, fasting not only causes weight reduction, but also causes muscle atrophy as a result of nutrient deficiency. Fasting-related muscle atrophy is more common in fast-twitch muscles than in slow-twitch muscles. Therefore, we hypothesize that different sensitivities exist in fast-twitch and slow-twitch muscles in response to fasting, and that these sensitivities are partially associated with the frequency of mechanical stress in each muscle type. The purpose of the present study is to examine the relationship between fasting and muscle activity in response to functional overload in the rat plantaris muscle. Methods 8-week-old Fischer 344 rats were assigned to four groups: control (n=6), fasting (n=6), functional overload (FO; n=8), and FO+fasting (n=9). Rats in the fasting group were deprived of food for 72 hours and given ad libitum access to water. FO was applied to the plantaris muscle for 2 weeks. FO was applied by cutting synergists of plantaris muscle in FO rats. Western blot analysis was used to determine changes in mTOR and p70S6K phosphorylation in isolated plantaris muscles. Results The decreased reduction rate of plantaris muscle weight was observed in FO+fasting compared to fasting rats. Phosphorylated mTOR was elevated in the FO+fasting group but was not observed in the fasting group. In addition, levels of phosphorylated p70S6 kinase were higher in the FO+fasting group compared to the fasting group. Discussion Increased mechanical stress reduces fasting-related muscle atrophy. The elevation in phosphorylated mTOR observed in mechanically overloaded muscle may partially explain the reduction in muscle atrophy in FO+fasting rats. These findings suggest that frequent mechanical stress causes preferential atrophy in fast-twitch muscles compared with slow-twitch muscles.

**ANALYSIS OF MUSCLE BLOOD BIOMARKERS RELATED TO BIOMECHANICAL VARIABLES OF A CONCENTRIC EXERCISE UNTIL VOLITIONAL FAILURE**

Carmona, G.1, Guerrero, M.2, Bedini, J.L.3, Bescós, R.1, Cussó, R.2, Moras, G.1, Lloret, M.2, Rodas, G.4, Cadefau, J.2,3

*INEFC*

1: INEFC-UB (Barcelona, Spain), 2: Dep. de Ciències Fisiològiques I. UB (Barcelona, Spain), 3: Hospital Clínic (Barcelona, Spain), 4: Futbol Club Barcelona (Barcelona, Spain) Introduction Exercise-induced muscle damage is widely described in literature (Clarkson & Hubal, 2002; Schoenfeld, 2012). Using different blood markers of muscle damage it would be feasible to determine the overall magnitude of damage into the muscle, as well as the type of fibres affected. Methods Seven healthy volunteers performed an exercise test in a pneumatic leg press Air300 (KeiserTM, USA). The test consisted in a maximum of 10 sets with repetitions until volitional failure (Burd et al., 2010) at workload equivalent to 75% of 1RM. The power of each repetition was recorded using a linear encoder integrated to Musclelab 4020e (ErgotesTM, Norway) system. Three blood samples were taken (1: before exercise test; 2: 24 h post exercise; 3: 48 h post exercise) of each subject to analyse the plasmatic concentration of myosin muscle isoforms (fast and slow) and creatine kinase (CK). ELISA method was used to determine myosin concentration in plasma (adapted from Guerrero et al., 2007). Results CK levels were significantly increased at 24 hours post-exercise and significantly decreased at 48 hours post-exercise. In contrast, a different pattern was shown in myosin isoforms, which experimented a moderate raise at 48 hours post-exercise and only slow myosin was found statistically significantly elevated. Moreover, the 48 hours fast myosin serum peak value was strongly correlated to maximum strength (one maximum repetition -1RM-) ( $r=0,94$ ;  $p<0,01$ ) and fatigue index ( $r=0,78$ ;  $p<0,05$ ). On the other hand, the significant increase of slow myosin was correlated with the total amount of repetitions ( $r=0,79$ ;  $p<0,05$ ). Finally, the CK 24 hours peak value was inversely correlated with fatigue index ( $r=-0,82$ ;  $p<0,05$ ). Discussion High serum levels of CK indicated muscle damage, which would be associated with an increase of membrane permeability (Baird et al., 2012). Although the concentric exercise (even until volitional failure) seems to produce a modest degradation of the contractile apparatus the serum increases in both fast and slow myosin isoforms, could be related with the exercise pattern performed by subjects. Interestingly, this fact may explain a major or less recruitment of the different types of muscle fibres during the physical exercise. References Baird MF, Graham SM, Baker JS and Bickerstaff GF. (2012). *J Nutr Metab.* 2012: 960363. Burd NA, West DWD, Staples AW, Atherton PJ, Baker JM, et al. (2010). *PLoS ONE.* 5: e12033. Clarkson, PM and Hubal, MJ. (2002). *Am J Phys Med Rehabil.* 81: 52-69. Guerrero M, Guiu M, Cadefau JA, Parra J, Balius R, Estruch A, Rodas G, Bedini JL, Cussó R. (2007). *Br J Sports Med.* 21668: 64-74. Schoenfeld, BJ. (2012). *J Strength Cond Res.* 26: 1441-1453. This study was funded by MuscleTech Network. Barcelona. FIS DPS2008-0692

**COMPARISON OF MUSCLE DAMAGE INDUCED BY MAXIMAL ECCENTRIC CONTRACTIONS BETWEEN ELBOW FLEXORS AND KNEE EXTENSORS OF OLDER ADULTS**

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Introduction Unaccustomed eccentric exercise (ECC) results in muscle damage characterised by delayed onset muscle soreness and prolonged decreases in muscle function. Previous studies showed that the magnitude of muscle damage following ECC is smaller for knee extensors (KE) than elbow flexors (EF) in young individuals, probably due to a protective effect in the lower limb muscles conferred by submaximal ECC performed in daily activities (1,2). However, it is not known whether this is also the case for older individuals. It is possible that the greater decreases in leg muscle function with ageing compared with arm muscle function narrows the difference in the susceptibility to muscle damage between EF and KE. This study compared changes in muscle damage markers following maximal ECC between EF and KE of older adults. Methods Eight older adults ( $61.6 \pm 1.8$  y,  $75.6 \pm 3.5$  kg,  $1.66 \pm 0.04$  m) with moderate level of daily life activities performed 5 sets of 6 maximal isokinetic ( $90^\circ/s$ ) eccentric contractions of the EF ( $80-20^\circ$ ) and KE ( $30-90^\circ$ ) in a randomised, counterbalanced order with 2 wks between bouts. Maximal voluntary isometric (MVC-ISO) and concentric contraction torque (MVC-CON),

optimum angle (OA), range of motion (ROM), muscle soreness and serum creatine kinase (CK) activity were measured before, immediately after (except CK), and 24, 48, 72 and 96 h following ECC. Normalised changes in the variables following ECC were compared between EF and KE by a mixed model ANOVA. Results All dependent variables except OA showed significant changes over time after both EF and KE ECC, demonstrating muscle damage regardless of the limb utilised. However, the magnitude of change in the variables was small for both exercises. Only MVC-ISO and ROM demonstrated smaller decreases after KE compared with EF (group effects,  $p < 0.05$ ), but no significant muscle  $\times$  time interaction effects were found for the changes in any of the variables. Discussion The previous studies with young adults reported significantly smaller changes in muscle damage variables after ECC of KE when compared with EF (1,2). The results of the present study suggest that the difference in the susceptibility to ECC-induced muscle damage between EF and KE becomes smaller with ageing. It may be that neuromuscular adaptation of the KE to submaximal eccentric contractions performed in daily activities is attenuated with ageing. It is concluded that the KE of older adults are relatively as susceptible to muscle damage as EF, or at least, the difference in muscle damage between EF and KE is small for older adults. References 1) Jamurtas et al. (2005). *Eur J Appl Physiol*, 95:179-85. 2) Chen et al. (2011). *Eur J Appl Physiol*, 111:211-23.

## REPEAT BOUT EFFECT ON ECCENTRIC EXERCISE INDUCED MUSCLE DAMAGE AND GLYCAEMIC RESPONSE

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Introduction Following eccentrically biased exercise there are alterations in whole body glycaemic control (Kirwan et al., 1991). These alterations are associated with reduction in the quantity of glucose transporters available for translocation to the cell membrane (Asp et al., 1995), therefore reducing the muscle's ability to adequately synthesise glycogen following eccentric biased exercise (Costill et al., 1990). Following an initial bout of eccentric biased exercise, skeletal muscle experiences a "repeat bout" effect (Byrnes et al., 1985). That is, a subsequent bout of eccentric work performed by the same muscle results in reduced muscle soreness and reduction in function. The purpose of this study was to investigate whether disruptions to the glucose and insulin response to an oral glucose tolerance test (OGTT) following eccentric exercise can be attenuated after a repeated bout of eccentric exercise. Methods Eight male participants performed an initial bout of squat exercise (SE1), followed 14 days later by another (repeat) bout of squat exercise (SE2). OGTTs were administered at baseline and 48 hours after SE1 and SE2, and circulating glucose and insulin were measured. Fasting levels of glucose, insulin, serum CK activity and performance measures (MVC, counter jump performance (CMJ) and perceived soreness) were also assessed pre, 24, 48 and 96 hours post SE1 and SE2. Results A trial  $\times$  time interaction was evident for CK, describing a significantly bigger increase following SE1 than SE2 ( $P = 0.006$ ). A significant trial  $\times$  time interaction was also evident for CMJ ( $P = 0.022$ ), with a greater decrease in height following SE1. A main effect of trial for perceived soreness ( $P < 0.001$ ) was revealed between SE1 and SE2 indicating a repeat bout effect had occurred. There were no significant differences in the fasting insulin ( $P = 0.968$ ) and glucose levels ( $P = 0.834$ ) following either SE1 or SE2. There were also no significant differences in the response of glucose or insulin ( $P = 0.905$ ;  $P = 0.762$  respectively) to the OGTT following the SE1 and SE2 in comparison to a control trial. The area under the curve (AUC) for both glucose and insulin following SE1 and SE2 also showed no significant difference from that of the control measure ( $P = 0.742$  and  $P = 0.955$ ). Discussion In conclusion, a bout of eccentric biased (squatting) exercise resulted in mild muscle damage. Recovery from the initial bout of eccentric exercise conferred a protective effect on the muscle performance following a subsequent bout of the same exercise performed 14 days later. However, this "repeat bout" effect was not associated with an altered glycaemic or insulinaemic response. References Asp, Daugaard & Richter (1995). *J Physiol*, 482, 705-712. Byrnes, Clarkson, White, Hsieh, Frykman & Maughan (1985). *J Appl Physiol*, 59, 710-715. Costill, Pascoe, Fink, Robergs, Barr & Pearson (1990). *J Appl Physiol*, 69, 46-50. Kirwan, Bourey, Kohrt, Staten & Holloszy (1991). *J Appl Physiol*, 70, 246-250.

## EFFECT OF ANTIOXIDANT-RICH DATES ON ECCENTRIC EXERCISE-INDUCED MUSCLE DAMAGE

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Introduction Dates which already know contain high antioxidant-rich originally cultivated from middle-east countries with scientific name "Phonex Dactylifera" are very common among muslims especially in fasting months. Proven scientifically for its high antioxidant nutrients, ingestions of these dates may assist the recovery of muscle damage as supplementation with antioxidants or beta-hydroxy-beta-methylbutyrate appears to provide a prophylactic effect in reducing muscle damage. The purpose of this study was to examine the effect of the dates intake during the recovery process following eccentric exercise on indirect markers of muscle damage. Methods Ten healthy male subjects (age:  $24.4 \pm 1.5$  y; height:  $168.3 \pm 7.1$  cm; weight:  $67.3 \pm 8.5$  kg) without history of muscle injury of upper arm and had not participate in specific strength training or exercises were involved in this cross-over design study. One arm was used for the experimental condition and the other arm for control condition in a randomised fashion with a 2-week interval. The exercise consisted of 6 sets of 10 eccentric contractions of the elbow flexors using a dumbbell equivalent to 70% of isometric maximal voluntary contraction with a 60 s rest between sets. In the treatment condition, the subjects ingested  $\pm 10$  g of dates (Phonex Dactylifera) a day for seven consecutive days following exercise. In the control condition, no dates were ingested during the recovery days. Muscle damage markers included upper arm circumference, range of motion (ROM), delayed onset muscle soreness (DOMS) and maximum isometric strength. These were measured before and one hour after exercise, and 1, 2, 3, 4 and 7 days after exercise. Repeated measure ANOVA were used to examine day to day changes following damage. Results No significant differences between conditions were evident for changes in MVC, ROM and DOMS, although they showed significant changes over time. Upper arm circumference showed a significant ( $P < 0.05$ ) difference between conditions, where there are significantly smaller increase experimental condition compared with the control condition Discussion It is concluded that dates fruit is only effective in reducing the diameter of the swelling but not effective to lessen DOMS and other indicator of muscle damage References Anwar-Shinwari, M. (1987). Iron content of date fruits. *Journal of the College of Science-King-Saud-University*, 18(1), 5-13. Cheung, K., P. A. Hume, et al. (2003). 'Delayed onset muscle soreness. Treatment strategies and performance factors.' *Sports Medicine* 33(2): 145-164. Halliwell B, Gutteridge JM. Free radicals in biology and medicine. Oxford: Clarendon Press; 1999. Sen CK, Roy S. Antioxidant regulation of cell adhesion. *Med Sci Sports Exerc* 2001;33:377-81. Aoi W, Naito Y, Takanami Y, Kawai Y, Sakuma K, Ichikawa H, et al. Oxidative stress and delayed-onset muscle damage after exercise. *Free Radic Biol Med* 2004;4:480-7.

### EFFECT OF NEUROMUSCULAR ELECTROSTIMULATION VIA THE PERONEAL NERVE ON MUSCLE SORENESS AND SERUM CREATINE KINASE ACTIVITY FOLLOWING INTENSE INTERMITTENT EXERCISE

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**Introduction** Numerous techniques are reported to enhance recovery following intense exercise under the premise that enhanced blood flow facilitates the removal of metabolites associated with muscle damage; however, there is equivocal support for such claims. A novel technique of neuromuscular electrostimulation (NMES) of the lower limb via the peroneal nerve has been shown to augment venous, arterial and microvascular blood flow (Tucker et al., 2010) which could enhance the recovery process following intense intermittent exercise. The aim of the present study was to examine the effects of NMES on muscle soreness and serum creatine kinase (CK) activity following intermittent exercise. **Methods** Twenty-one (age  $21 \pm 1$  years, height  $179 \pm 7$  cm, body mass  $76 \pm 9$  kg, predicted  $\text{VO}_2\text{max}$   $54 \pm 5$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) healthy males performed a 90 min (2 x 45 min) intermittent shuttle running test on three occasions. Following exercise, one of the following interventions were applied: passive recovery (CON), graduated compression socks (GCS) or neuromuscular electrical stimulation (NMES). Interventions were applied 1 hr after the exercise and maintained for at least 12 hrs. Perceived muscle soreness (PMS) was measured and a venous blood sample taken pre-exercise and 0, 1, 24, 48 and 72 hrs following exercise. PMS was rated on a visual analogue scale ranging from 0 to 10. Serum CK activity was measured spectrophotometrically. PMS was analysed using a Friedman's ANOVA for non-parametric data. Serum CK activity was analysed using a two-way ANOVA. Significance was accepted at  $P < 0.05$  and data are presented as mean  $\pm$  SD. **Results** PMS increased ( $P < 0.05$ ) in all conditions immediately, 1 hr and 24 hrs post-exercise. PMS remained elevated in CON at 48 and 72 hours after exercise and in GCS at 48 hrs post-exercise ( $P < 0.05$ ). At 24 hrs PMS was lower in GCS compared to CON ( $3.2 \pm 2.1$  and  $4.6 \pm 2.0$ , respectively;  $P < 0.05$ ) and in NMES ( $2.0 \pm 1.6$ ) compared to GCS ( $P < 0.05$ ). At 48 hrs PMS was lower in NMES than in CON ( $1.3 \pm 1.5$  and  $3.1 \pm 1.8$ , respectively;  $P < 0.05$ ). Serum CK activity increased in all conditions immediately and 1 hr post-exercise ( $P < 0.01$ ). NMES had a tendency to be associated with a lower CK activity at 24 hrs, however, there were no differences between treatments at any time point. **Discussion** The use of a novel NMES technique reduces perceived muscle soreness and is superior to GCS in reducing perceived muscle soreness following intense intermittent exercise. **References** Tucker A, Maass A, Bain D, Chen L H, Azzam M, Dawson H and Johnston A. (2010). *Int J Angiol*, 19, 31-37. Supported by Sky Medical Technology.

### EFFECT OF NEUROMUSCULAR ELECTROSTIMULATION VIA THE PERONEAL NERVE ON ONE-LEGGED PEAK OXYGEN UPTAKE AND PEAK POWER OUTPUT FOLLOWING FOUR WEEKS OF HIGH INTENSITY INTERMITTENT TRAINING

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**Introduction** Numerous techniques have been suggested to enhance recovery following intense exercise; however, there is evidence that some of these practices, such as cold water immersion, may actually blunt the long term adaptive response to exercise (Yamane et al., 2006). We have previously demonstrated that the use of a novel technique of neuromuscular electrostimulation (NMES) enhances the recovery process following intense intermittent exercise (Ferguson et al., 2013). However, the long term effect of this technique and its impact on the adaptive response to training is not known. The aim of the present study was to examine the effects of NMES immediately following each training session during 4 weeks of high intensity intermittent training (HIIT). **Methods** Seven healthy males (age  $23 \pm 2$  years, height  $177 \pm 8$  cm, body mass  $79 \pm 17$  kg,  $\text{VO}_2\text{max}$   $47 \pm 7$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) completed 12 sessions of HIIT (3 sessions per week), which consisted of 3-7 repetitions of 30 second maximal sprints on a cycle ergometer, each separated by 4 minutes recovery. Immediately after each training session, using a within-subjects design, one leg underwent NMES treatment for an 8 hour period and the contralateral leg did not undergo any treatment (CON). Pre- and post-training measurements were made in each leg of one-legged peak oxygen uptake ( $\text{VO}_2\text{peak}$ ) and peak power output. A two-way (2 x 2) ANOVA with repeated measures was conducted to analyse the within-subject effect of treatment (NMES, CON) and time (pre, post). Significance was accepted at  $P < 0.05$  and data are presented as mean  $\pm$  SD. **Results** Whole body  $\text{VO}_2\text{max}$  increased ( $P < 0.05$ ) following 4 weeks of HIIT ( $47 \pm 7$  vs.  $51 \pm 7$  ml.kg<sup>-1</sup>.min<sup>-1</sup>, pre and post-training, respectively). There was a main effect for time for one-legged  $\text{VO}_2\text{peak}$  ( $P < 0.05$ ), which increased following training in CON from  $37 \pm 8$  to  $40 \pm 8$  ml.kg<sup>-1</sup>.min<sup>-1</sup> and in NMES from  $38 \pm 6$  to  $42 \pm 6$  ml.kg<sup>-1</sup>.min<sup>-1</sup>. There was a main effect for time on one-legged peak power output ( $P < 0.05$ ), which increased following training in CON from  $138 \pm 24$  W to  $157 \pm 32$  W and in NMES from  $142 \pm 36$  W to  $165 \pm 30$  W. There were, however, no differences between CON and NMES for either measure. **Discussion** The use of a novel NMES technique immediately following each training session during 4 weeks of HIIT does not have a detrimental effect on the adaptive response. **References** Ferguson RA, Dodd MJ, Aw Yong XH, Kent HE, Malley AJ, Price SM, and Thorpe BA. (2013). *ECSS, Barcelona*. Yamane M, Teruya H, Nakano M, Ogai R, Ohnishi N and Kosaka M. (2006). *Eur J Appl Physiol*, 96, 572-580. Supported by Sky Medical Technology.

### EFFECT OF CONCENTRIC AND ECCENTRIC EXERCISE ON BREATHING EFFICIENCY

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**Introduction** Ventilatory equivalents for carbon dioxide ( $\text{CO}_2$ ) and oxygen ( $\text{O}_2$ ) are the ratios of minute ventilation and  $\text{CO}_2$  output and  $\text{O}_2$  uptake, respectively, and indicators for breathing efficiency (Cooper and Storer, 2001). During steady-state cycling at 60% of maximal intensity, the ventilatory equivalent for  $\text{O}_2$  was increased 48 hours after eccentric-contraction induced muscle damage (Twist and Eston, 2009). It is not known whether the breathing efficiency differs during non-damaging and damage-inducing exercise. We examined the effect of concentric (non-damaging) and eccentric (damage-inducing) exercise, matched for intensity, on the ventilatory equivalents for  $\text{CO}_2$  and  $\text{O}_2$ . **Methods** Nine men ( $27 \pm 9$  yr,  $179 \pm 7$  cm,  $75 \pm 12$  kg,  $\text{V}'\text{O}_2\text{max}$ :  $52.0 \pm 7.7$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) underwent two 40-min (5x8-min with 2-min inter-bout rest) of concentric (level running, 0%, CON) and eccentric exercise (downhill running, -12%, ECC) on separate days. Running intensity was matched at 60% of maximal metabolic equivalent (MET) by measurements of individual 1 MET, relationship between level and downhill running speeds and MET and maximal MET obtained during a  $\text{V}'\text{O}_2\text{max}$  test. The Douglas bag technique was used for collection of expired gas samples. Maximal isometric force of m.quadriceps femoris of both legs was measured before and after the running protocols. Data were analysed with paired t-tests with significance set at  $P < 0.05$ . **Results** Running speed (CON:  $9.7 \pm 2.3$ , ECC:  $13.5 \pm 3.2$  km.h<sup>-1</sup>) and isometric force deficits (CON:  $-2.0 \pm 6.9\%$ , ECC:  $-17.2 \pm 7.7\%$ ) were higher for downhill running. Level and downhill running bouts had similar  $\text{V}'\text{O}_2$  (CON:  $2.28 \pm 0.51$ , ECC:  $2.20 \pm 0.34$  L.min<sup>-1</sup>), heart rates (CON:  $143 \pm 16$ ; ECC:  $147 \pm 19$  b.min<sup>-1</sup>) and respiratory exchange ratio (CON:  $0.89 \pm 0.03$ , ECC:  $0.89 \pm 0.05$ ) indicating matched intensity and metabolic demands. During downhill running, the ventilatory equivalents for  $\text{O}_2$  (CON:  $27.2 \pm 1.6$ , ECC:  $29.7 \pm 3.3$ ) and  $\text{CO}_2$  (CON:  $30.4 \pm 1.9$ , ECC:  $33.3 \pm 2.7$ ) were 7.1% and 8.3% higher, re-

spectively. Discussion Non-damaging and damage-inducing running exercise, matched at an intensity of 60% of maximal MET, showed a difference in breathing efficiency. Higher breathing efficiency during damage-inducing downhill running exercise may be related to higher impact forces. Because impairment of group III and IV muscle afferents elevated the ventilatory equivalent for CO<sub>2</sub> during steady-state cycling (Amann et al., 2010), damage-inducing downhill running exercise may occur with elevated discharge of group III and IV afferents. References Amann M, Blain GM, Proctor LT, Sebranek JJ, Pegelow DF, Dempsey JA (2010). *J Appl Physiol* 109, 966-976. Cooper CB, Storer TW. (2001). Cambridge University Press. Twist C, Eston RG. (2009). *Eur J Appl Physiol* 105, 559-567.

### **INFLUENCE OF REGULAR POST EXERCISE COLD WATER IMMERSION ON SKELETAL MUSCLE MICROVASCULAR FUNCTION ASSESSED BY NEAR INFRARED SPECTROSCOPY**

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Do not insert authors here Introduction Exercise training improves microvascular (MV) function via elevated nitric oxide production and/or via an increase in capillary density (Lash et al. 1992). An acute post exercise cold water immersion (CWI) intervention enhanced the gene expression of vascular endothelial growth factor and nitric oxide (NO) synthase (NOS) (Ihsan et al. unpublished data). However, MV adaptations to regular post exercise CWI have yet to be investigated. The present study aimed to investigate the effect of training and regular post exercise CWI on MV function. Methods Eleven males performed 3 sessions/week of endurance training for 4 weeks. Following each session, subjects immersed one leg in a cold water bath (10°C; CWI) to the level of their gluteal fold for 15 min while the contra-lateral leg served as control (CON). Prior to, and following the training intervention, subjects performed a graded running test to exhaustion to determine their maximal oxygen uptake (VO<sub>2</sub>max) and aerobic speed (MAS). Additionally, MV function of the gastrocnemius was assessed in a randomised and counterbalanced order (i.e. CON & CWI limbs) using near infrared spectroscopy. While resting in a supine position, 5 min of popliteal artery occlusion was applied and upon cuff release, maximal changes in oxyhaemoglobin amplitude (O<sub>2</sub>Hbmax) response time associated with reaching O<sub>2</sub>Hbmax (RT) and 50% of O<sub>2</sub>Hbmax (RT50%), response rate (R-RATE; O<sub>2</sub>Hbmax/RT) and initial R-RATE (R-RATE50%; 50%-O<sub>2</sub>Hbmax/RT50%) were determined. Results Exercise training improved VO<sub>2</sub>max (6.0±7.7%, p=0.026) and MAS (6.4±3.9%, p<0.001). While RT, RT50% and R-RATE were not influenced by training (p>0.05), R-RATE50% increased by 26±47% in the CON limb post training (p=0.037). Furthermore, O<sub>2</sub>Hbmax was increased in both the CON (18±21%, p=0.049) and CWI (20±34%, p=0.018). As a result, when expressed relative to pre O<sub>2</sub>Hbmax, significant training effects were observed in RT (CON; 55±13%, p<0.001, CWI; 49±26%, p<0.001) and R-RATE (CON; 55±13%, p<0.001, CWI; pre=49±26%, p<0.001). Yet, when expressed relative to pre O<sub>2</sub>Hbmax, improvements in RT50% (CON; 23±46%, p=0.003, CWI; pre=14±34%, p=0.263) and R-RATE50% (CON; 23±46%, p=0.045, CWI; pre=14±34%, p=0.407) was only significant in the CON limb. Discussion The present findings suggest that regular post exercise CWI may suppress MV adaptations associated with the initial rate of O<sub>2</sub>Hb resaturation (RT50% and R-RATE50%). Somewhat contradictory to acute exposure (Ihsan et al. unpublished data), it is possible that regular CWI treatment may have attenuated exercise-induced NOS expression and hence flow-mediated MV function. References Lash JM, Bohlen HG. (1992). *J Appl Physiol*, 72(6), 2052-2062.

### **ALLOPURINOL AND INDOMETHACIN SYNERGISTICALLY PREVENT SKELETAL MUSCLE ATROPHY. ROLE OF E3 UBIQUITIN LIGASES**

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Abstract: Muscle atrophy is linked to reactive oxygen species (ROS) production during hindlimb-unloading due, at least in part, to the activation of xanthine oxidase (XO). The major aim of our study was to determine the mechanism by which ROS cause muscle atrophy and its possible prevention by allopurinol, a well-known inhibitor of XO widely used in clinical practice, and indomethacin, a non-steroidal anti-inflammatory drug. We studied the activation of p38 MAP Kinase and NF-κB pathways, and the expression of two E3 ubiquitin ligases involved in proteolysis, the Muscle atrophy F-Box (MAFb) and Muscle RING Finger-1 (MuRF-1). Male Wistar rats (3 m old) conditioned by 14 days of hindlimb unloading (n=18), with or without the treatment, were compared with freely ambulating controls (n=18). After the experimental intervention, soleus muscles were removed, weighted and analyzed to determine oxidative stress and inflammatory parameters. We found that hindlimb unloading induced a significant increase in XO activity in plasma (39%, p=0.001) and in the protein expression of CuZnSOD and Catalase in skeletal muscle. Inhibition of XO partially prevented protein carbonylation, both in plasma and in soleus muscle, in the unloaded animals. The most relevant new fact reported is that allopurinol prevents soleus muscle atrophy by ~20% after hindlimb unloading. Combining allopurinol and indomethacin we found a further prevention in the atrophy process. This is mediated by the inhibition of the p38 MAPK-MAFbx and NF-κB -MuRF-1 pathways. Our data point out the potential benefit of allopurinol and indomethacin administration for bedridden, astronaut, sarcopenic and cachexic patients. This work was supported by grants SAF2010-19498, ISCIII2006-RED13-027, PROMETEO2010/074, 35NEURO GenxGent and EU Funded COSTB35 and CM1001. The study has been financed by FEDER funds from the European Union.

### **EFFECT OF CONCENTRIC AND ECCENTRIC EXERCISE ON POST-EXERCISE GLUCOSE CLEARANCE**

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Introduction Transient insulin resistance (i.e. a temporary decrease in insulin-mediated glucose clearance) has been demonstrated 48 hours after eccentric exercise (Green et al., 2010; Sherman et al., 1992). However, the acute effect of eccentric exercise on the responses of insulin and glucose to an oral glucose challenge is unknown. We examined the acute effect of concentric and eccentric exercise, matched for intensity, on the responses to an oral glucose tolerance test (OGTT). Methods Ten men (27±9 yr, 178±7 cm, 75±11 kg, V̇O<sub>2</sub>max 52.3±7.3 ml•kg<sup>-1</sup>•min<sup>-1</sup>) underwent three OGTTs after an overnight 12-hr fast: rest (C), 40-min (5 x 8-min with 2-min inter-bout rest) of concentric (level running, 0%, CON) or eccentric exercise (downhill running, -12%, ECC). Running intensity was matched at 60% of maximal metabolic equivalent (MET) by individual determination of 1 MET, relationship for level and downhill running speeds and MET and maximal MET obtained during a V̇O<sub>2</sub>max test. Douglas bag technique was used for expired gas samples. For OGTT, 75-g of glucose in water (Trutol 75, NERL Diagnostics) was consumed with 15-min blood samples for 2-hr and analysed for plasma glucose (YSI 2300 Stat Plus) and insulin (ELISA, IBL International). Maximal isometric force of m.quadriceps femoris of both legs was measured before and

after the running protocols. Data were analysed with ANOVA and t-test with significance set at  $P < 0.05$ . Results Downhill running speed was higher (CON:  $9.7 \pm 2.1$ , ECC:  $13.8 \pm 3.2$  km•h<sup>-1</sup>). Running protocols had similar  $\dot{V}O_2$  (CON:  $2.28 \pm 0.51$ , ECC:  $2.20 \pm 0.34$  L•min<sup>-1</sup>, n=9) and heart rates (CON:  $143 \pm 16$ , ECC:  $147 \pm 19$  b•min<sup>-1</sup>, n=9) indicating matched intensity. Downhill running resulted in higher isometric force deficits (CON:  $-3.0 \pm 6.7$ , ECC:  $-17.1 \pm 7.3\%$ ). During OGTTs, area-under-the-curve for plasma glucose (C:  $724 \pm 97$ , CON:  $710 \pm 77$ , ECC:  $726 \pm 72$  mmol•L<sup>-1</sup>•120 min<sup>-1</sup>) and insulin (C:  $4166 \pm 1882$ , CON:  $3887 \pm 1736$ , ECC:  $3640 \pm 1695$   $\mu$ U•mL<sup>-1</sup>•120 min<sup>-1</sup>), peak glucose (C:  $8.1 \pm 1.3$ , CON:  $7.7 \pm 1.2$ , ECC:  $7.7 \pm 1.1$  mmol•L<sup>-1</sup>) and peak insulin levels (C:  $60.2 \pm 31.4$ , CON:  $53.7 \pm 29.8$ , ECC:  $49.8 \pm 25.3$   $\mu$ U•mL<sup>-1</sup>) were similar. Discussion Post-exercise responses for plasma glucose and insulin to an oral glucose challenge were similar for concentric and eccentric exercise and not different from baseline. Insulin binding, insulin signalling pathways, glucose transporter availability and intracellular glucose disposal pathways do not seem to be affected by the acute effects of unaccustomed eccentric exercise. Post-exercise events in the days following unaccustomed eccentric exercise are required to develop transient insulin resistance. References Green MS, Doyle JA, Ingalls CP, Benardot D, Rupp JC, Corona BT. (2010). *Int J Sport Nutr Exerc Metab* 20, 181-190. Sherman WM, Lash JM, Simonsen JC, Bloomfield SA. (1992). *Int J Sport Nutr* 2, 251-259.

### POST-EXERCISE COLD WATER IMMERSION ENHANCES GENE EXPRESSIONS RELATED TO MITOCHONDRIAL BIOGENESIS AND VASCULAR REMODELLING

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Do not insert authors here Introduction Post-exercise cold water immersion (CWI) reduces core and muscle temperatures, muscle metabolic activity and blood perfusion (Ihsan et al., 2013; Peiffer et al., 2009). While these physiological responses may alter acute subsequent exercise capacity, the influence of CWI on muscle oxidative, vascular and metabolic adaptations are unclear. As such, the purpose of this study was to investigate the influence of CWI on post-exercise on vascular, metabolic and mitochondrial-related gene expression. Methods Nine physically active males performed 30 min of continuous running at 70% of their maximal aerobic running speed (MAS), followed by intermittent running to exhaustion at 100% MAS. Following exercise, participants immersed one leg in a cold water bath (10°C; CWI) to the level of their gluteal fold for 15 min. The contra-lateral leg remained outside the water bath and served as control (CON). Core body temperature (T<sub>c</sub>) was monitored throughout the experiment, while muscle biopsies and muscle temperature (T<sub>mus</sub>) measurements were obtained from vastus lateralis prior to exercise (PRE), immediately post exercise (POST-EX; muscle temperature only), immediately following CWI (POST-CWI) and 3 hr post exercise (POST-3HR). Significance was accepted at  $p < 0.05$ . Results The exercise protocol significantly increased T<sub>c</sub> (PRE;  $37.1^\circ\text{C} \pm 0.4$  vs. POST-EX;  $39.3^\circ\text{C} \pm 0.5$ ) and T<sub>mus</sub> (CON;  $38.8^\circ\text{C} \pm 1.0$  vs. CWI;  $39.0^\circ\text{C} \pm 1.4$ ). In contrast, CWI resulted in lower T<sub>mus</sub>, compared with CON ( $28.9^\circ\text{C} \pm 2.3$  vs.  $37.0^\circ\text{C} \pm 0.8$ ). PGC1- $\alpha$  mRNA content was 9-folds higher in CWI, compared with CON at POST-3HR (1792  $\pm$  1374 a.u. vs. 484  $\pm$  402 a.u.). Compared with PRE, mRNA content of VEGF and nNOS were significantly higher at POST-3HR in the CWI (5.3 & 13.4 fold, respectively), but not CON (2.6 & 6.8 fold, respectively). Likewise, a trend towards an increase in iNOS mRNA was observed in the CWI ( $p = 0.055$ ). No changes in gene expression were observed for COX-4, GLUT-4 and eNOS in either CWI or CON. Discussion These data indicate that an acute post exercise CWI intervention may enhance the gene expression of key regulators associated with mitochondrial biogenesis and vascular remodelling. As such, the use of post exercise CWI may enhance favourable adaptations and therefore have implications in both athletic and clinical settings. Further research investigating longer term exercise-induced muscle adaptations with regular CWI interventions is warranted. References Ihsan M, Watson G, Lipski M, Abbiss C. (2013). *Med Sci Sports Exerc*, (in press). Peiffer JJ, Abbiss C, Watson G, Nosaka K, Laursen PB. (2009). *J Sports Sci*, 27(10), 987-93.

### EXERCISE-INDUCED ATGL UPREGULATION INVOLVES AMPK IN SKELETAL MUSCLE

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Introduction: Endurance exercise training increases lipolytic capacity and fat utilization in skeletal muscles (Hurley et al., 1986). This adaptation results from upregulation of proteins involved in lipolysis, such as adipose tissue triglycerol lipase (ATGL), hormone sensitive lipase (HSL) and MLDP (Alsted et al., 2009, Peters et al., 2012). However, the molecular mechanisms of how exercise modulates lipolysis-associated proteins are unclear. The purpose of this study was to elucidate the mechanisms underlying endurance exercise-induced lipolysis-associated proteins in rat skeletal muscles. Materials and Methods: Male Wistar rats swam for 6 h in two 3-h sessions separated by 45 min of rest. Immediately after or 18 h after the swimming exercise ended, the rats were anesthetized and epitrochlearis and soleus muscles were dissected out. C2C12 Myoblast were cultured in 12-well plates in DMEM supplemented with 10% FBS. Myoblast differentiation was induced by switching to medium containing 2% horse serum when myoblasts were confluent. Four days later differentiation, the myotubes were treated with 50  $\mu$ M 2,4-Dinitrophenol (DNP; an uncoupler of oxidative phosphorylation) for 18 h. Results: A bout of 6-h swimming exercise increased lipolysis-associated proteins (ATGL, MLDP and HSL) in rat epitrochlearis muscle. However, there was no significant increase in these proteins in exercised rat soleus muscle. Phospho-AMPK protein content in epitrochlearis muscle significantly increased immediately after swimming exercise, but not in soleus muscle. Treatment of C2C12 myotubes with 50  $\mu$ M DNP significantly increased phospho-AMPK and ATGL protein content. However, DNP treatment did not affect MLDP and HSL protein contents in C2C12 myotubes. Conclusion: These results suggested that activation of AMPK is involved in exercise-induced increase in ATGL protein content in skeletal muscle. References: Hurley BF, Nemeth PM, Martin WH 3rd, Hagberg JM, Dalsky GP, Holloszy JO. *J Appl Physiol*. 1986 Feb;60(2):562-7. Alsted TJ, Nybo L, Schweiger M, Fledelius C, Jacobsen P, Zimmermann R, Zechner R, Kiens B. (2009) *Am J Physiol Endocrinol Metab*. 296(3):E445-53. Peters SJ, Samjoo IA, Devries MC, Stevic I, Robertshaw HA, Tarnopolsky MA. (2012) *Appl Physiol Nutr Metab*. 37(4):724-35.

15:00 - 16:00

## Mini-Orals

## PP-PM46 Physiology [PH] 13

**RELATIONSHIP BETWEEN BREAKFAST AND EXERCISE IN THE MORNING AND THE DAILY RHYTHMS OF PHYSIOLOGICAL PARAMETERS IN HUMANS**

Nishimura, K.1, Nagasaki, K.1, Yamaguchi, H.2, Yoshioka, A.3, Tamari, Y.4, Onodera, S.5, Takamoto, N.1

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**Purpose:** The purpose of the present study was to determine the relationship between breakfast and exercise in the morning and the daily rhythms of physiological parameters such as oral temperature, heart rate, blood pressure, and cardiac parasympathetic nervous system modulation in humans. **Method:** Ten healthy Japanese men (age,  $21.9 \pm 1.4$  years) volunteered to participate in this study and provided written informed consent before participation. The oral temperature, heart rate, blood pressure, and cardiac autonomic nervous system modulation were first recorded at 0700, and then recorded every 2 h from 0800 to 2200. This study involved 2 conditions, and each condition was simulated on a different day. One was the breakfast and exercise (BE) condition. The BE -condition involved eating breakfast at 0730 and performing cycling exercises for 15 min at 0830. The exercise intensity was adjusted to 40% of maximum oxygen uptake. The other condition was the control (C) condition, in which the subjects did not eat breakfast or perform exercise. Each subject ate lunch at 1230 and dinner at 1830 in both conditions. The peak value and time of each physiological parameter assessed for daily rhythms were calculated by the least squares method. Each parameter was tested using two-way analysis of variance (ANOVA). Post-hoc Bonferroni/Dunn test was performed when a significant difference was observed in ANOVA. **Results and Discussion:** The oral temperature of the C -condition participants changed significantly over 24 h (ANOVA;  $p < 0.05$ ); Natural circadian rhythms were observed in all subjects. The changes in the oral temperature, heart rate, and diastolic blood pressure of participants in the BE -condition were more significant than those in the C -condition (ANOVA;  $p < 0.05$ , respectively). At 0800 and 1400, the ln HF, index of cardiac parasympathetic nervous system modulation, in participants in the BE -condition was significantly lower than that in the C -condition. The peak times of oral temperature, heart rate, cardiac parasympathetic nervous system modulation, and blood pressure of participants in the BE-condition were significantly shorter than those in the C -condition ( $p < 0.05$ , respectively). These data suggested that daily rhythms in humans might be maintained by habitual breakfast and exercise. In conclusion, the daily rhythms of the physiological parameters in humans were accelerated by habitual breakfast and exercise in the morning.

**ALTERATIONS OF NEUROMUSCULAR FUNCTION AFTER THE WORLD MOST CHALLENGING MOUNTAIN ULTRA- MARATHON**

Saugy, J., Place, N., Millet, G.Y., Degache, F., Schena, F., Millet, G.P.

*Lausanne University*

**Introduction** The aim of the present study was to investigate the etiology of neuromuscular fatigue on the most extreme MUM (mountain ultra-marathon) in the world. By using data recorded prior, during and after the event on both runners and control subjects, we aimed to characterize the specificities of such MUM and better describe the underlying mechanisms of extreme fatigue. **Methods** The race supporting this study was the Tor des Géants, 330km and 24000m elevation. 25 male runners took part to the present study and were tested before (Pre-); during (Mid-) and approximately 30 minutes after the run (Post-). A control group ( $n=8$ ) participated to this study, and was tested at Pre- and Post-. Both groups were constrained of the same level of sleep deprivation. MVC force loss of knee extensors (KE) and plantar flexors (PF) was evaluated to provide an index of global fatigue [1]. The voluntary activation ratio of KE and PF was assessed using superimposed high-frequency doublet to detect central fatigue. Finally, evoked stimulations were delivered to determine the extent and type of peripheral fatigue. **Results** Maximal voluntary contraction force declined significantly at Mid- ( $-13 \pm 17\%$  and  $-10 \pm 16\%$ ,  $P < 0.05$  for knee extensor, KE, and plantar flexor muscles, PF, respectively) and further decreased at Post- ( $-24 \pm 13\%$  and  $-26 \pm 19\%$ ,  $P < 0.01$ ) with alteration of the central activation ratio ( $-24 \pm 24\%$  and  $-28 \pm 34\%$ ,  $P < 0.05$ ) in runners whereas these parameters did not change in the control group. Peripheral neuromuscular fatigue markers as 100Hz doublet (KE:  $-18 \pm 18\%$  and PF:  $-20 \pm 15\%$ ,  $P < 0.01$ ) and peak twitch (KE:  $-33 \pm 12\%$ ,  $P < 0.001$  and PF:  $-19 \pm 14\%$ ,  $P < 0.01$ ) were also altered in runners but not in controls. **Discussion** This event induced lesser muscle damages than similar types of event of shorter duration, probably as a result of the very low concentric/eccentric contractions intensity due to the slow pace showing that the amount of neuromuscular fatigue is not necessarily correlated to the difficulty of the event. In addition, a control group allowed us to minimize the effects of sleep deprivation as the main factor of the neuromuscular fatigue in the runners. Beyond the influence of exercise duration on ultra-distance trails, the reduction in maximal force generating capacity seems to be related to other factors such pain in muscles and joints. Paradoxically, such extreme MUM seems to induce relative muscle preservation. **References** 1. Millet GY, Tomazin K, Verges S, Vincent C, Bonnefoy R, et al. (2011) Neuromuscular consequences of an extreme mountain ultra-marathon. *PLoS ONE*

**BENEFICIAL EFFECTS OF NECK COOLING ON EXERCISE CAPACITY AND COGNITIVE PERFORMANCE IN A WARM ENVIRONMENT**

Hasegawa, H., Shimizu, M.

*Hiroshima University*

**Introduction** The increase in core body temperature observed during exercise in hot environments is associated with decreases in prolonged exercise performance. A number of strategies, such as cold water immersion, wearing an ice jacket and cooling the neck region, have been suggested to combat the negative effects of associated high body temperature. The purpose of this study was to investigate the effect of cooling the neck region on endurance exercise capacity and cognitive function in a warm environment. **Methods** Eight male subjects underwent two familiarization trials and two experimental cycling trials. Subjects completed two experimental cycling trials at 65% maximum voluntary exercise to exhaustion with cooling collar at the neck during exercise (COOL) and without cooling collar (CONT)

at 30°C and 80% relative humidity. The modified Stroop color-word test (Stroop, 1935) and executive processing test (Tomprowski, 2007) were conducted to evaluate cognitive function every 10 min during exercise and at the exhaustion. During the cycling session, rectal temperature, skin temperatures, heart rate, ratings of perceived exertion, and thermal sensations were measured. Results In the COOL, time to exhaustion was significantly longer than that for the CON (COOL: 50.2 ± 6.3 min, CON: 43.9 ± 4.1 min,  $p = 0.04$ ). The reaction time of the Stroop color-word test for the CONT tended to long after 40 min exercise, and it was significantly worsened at the exhaustion compared to the COOL. Compared to baseline values, the total reaction time of executive processing test for the COOL was improved during the latter stages of exercise. Rectal temperature and heart rate were increased during exercise, but these physiological responses were not significantly different between the conditions at the same time points. In the COOL, ratings of perceived exertion at 35 and 40 min and thermal sensation from 15 to 45 min exercise were significantly lower than that for the CON trial. Discussion The present findings indicate that practical neck cooling increased the time taken to reach volitional exhaustion and cognitive function by dampening the perceived levels of exercise effort and thermal strain without altering physiological responses in a warm environment. These responses are consistent with the results of practical internal cooling techniques, such as cold drink and ice slurry ingestion during exercise in hot environments (Siegel, 2012). References Stroop JR. (1935). *J Exp Psychol* 18, 643-662. Tomporowski PD, Beasman K, Ganio MS, Cureton K. (2007). *Int J Sports Med* 28, 891-896. Tyler C, Sunderland C. (2011). *J Athletic Train* 46, 61-68. Siegel R, Laursen PB. (2012). *Sports Med* 42, 89-98.

### POST-EXERCISE HYPOTENSION IS GREATER IN THE MORNING THAN THE EVENING IN PRE-HYPERTENSIVE MEN

Brito, L.1, Rezende, R.1, Silva Jr, N.D.1, Menna-Barreto, L.S.3, Tinucci, T.1, Cipolla-Neto, J.2, Forjaz, C.L.M.1

1: EEFUSP (São Paulo, Brazil), 2: ICBUSP (São Paulo, Brazil), 3: EACHUSP (São Paulo, Brazil).

Introduction: Aerobic exercise is recommended to prevent hypertension in pre-hypertensive individuals. An acute bout of aerobic exercise promotes post-exercise hypotension (PHE). Some studies suggest that PEH is lower when exercise is performed in the morning. However, these studies did not include a control condition (without exercise) for controlling the circadian variations of blood pressure (BP), which limits data interpretation. Therefore, the aim of this study was to compare BP response and its hemodynamic mechanisms after an aerobic exercise bout performed in the morning and evening and corrected by the responses obtained in the control session performed at the same times of day. Methods: 12 young pre-hypertensive men underwent four randomized sessions - two conducted at 9 am and two at 6:30 pm. At each time of day, the subjects underwent a control and an exercise bout (cycle ergometer 45 min, 50% VO<sub>2</sub>peak). Before and after the interventions, BP, cardiac output (CO), stroke volume (SV), peripheral vascular resistance (PVR) and heart rate (HR) were evaluated. The net effects of exercise [(post-pre exercise) - (post-pre control)] were calculated for each time of day and were compared by a paired T-test.  $P < 0.05$  was accepted as significant. Results: Systolic BP decreased significantly, more in the morning than the evening (-8±1 vs -3±1 mmHg), while diastolic and mean BP decreased similarly at both times of day (-3±1 vs -3±1 and -4±1 vs -3±1 mmHg, respectively). CO decreased and PVR increased in the morning, while they did not change in the evening (-0.464±0.158 vs +0.058±0.188 l/min, and +3±1 vs -1±1 mmHg/l, respectively). SV decreased similarly at both times of day, while HR increased less in the morning (-12±3 vs -12±3 ml and +5±1 vs +9±1 bpm, respectively). Discussion: PEH occurred at both times of day, however, the net effect of exercise was greater in the morning than the evening for systolic BP. This difference was observed because CO decreased more in the morning due to a lower increase in HR at this time of day. Even though PVR increased in the morning, this increase was not sufficient to compensate CO reduction and to blunt systolic BP decrease. In conclusion, aerobic exercise has a greater hypotensive effect in the morning, because CO decreases more after exercise at this time of the day. Financial support: CNPq: 472288/2011-3, FAPESP: 2011/03384-8.

### THE EFFECTS OF ACUTE EXERCISE ON SLEEP IN CHILDREN

Yukako, I.

National Center of Neurology and Psychiatry

Introduction Sleep is an important component of adolescent growth and development. Laboratory studies using polysomnography in adults have shown that acute exercise results in a small improvements change in the quality of sleep (Kubitz KA et al., 1996). However, most studies with school-aged children have examined sleep duration and/or objective sleepiness by using questionnaires and, therefore, were unable to quantify sleep quality. The purpose of this study was to investigate the effect of acute high-intensity exercise on quality of sleep in children by using polysomnography. Understanding associations of physical activity and/or exercise with sleep quality could shed light on ways to promote sufficient sleep in children. Methods Seven healthy male subjects (mean age ± SD, 12.4 ± 0.5 years) were recruited for this study and underwent two conditions (Rest, Exercise). The exercise condition was performed using a bicycle ergometer for 30-min at 85% of maximal heart rate, 6-7 h prior to bedtime. In the rest condition, subjects rested quietly for 30-min. Polysomnography measurements were performed on two nights in random order at the subject's house. Vigilance test were carried out immediately after waking up. Results Data were analyzed from the five complete samples. The data of two samples could not complete for measurement by the device trouble. Mean total sleep time (TST) was 505.8 ± 31.7 min (Rest) and 495 ± 32.0 min (Exercise). Sleep efficiency was 93.9 ± 4.5% (Rest) and 92.2 ± 7.3% (Exercise). There were no significant differences in the TST, sleep efficiency or the duration of each sleep stage when the rest and exercise conditions were compared. Discussion This is one of the first studies to use polysomnography to obtain estimates of nocturnal sleep quality in response to exercise in children. There was no difference in sleep quality after acute high-intensity exercise in this population. However, ceiling effects for "good sleepers" have also been suggested (Youngstedt et al., 2006). This study may have included "good sleepers," whose age and fitness habits may have affected the results; the lack of differences in sleep quality may suggest that ceiling effects played a role. While this study demonstrated the feasibility of performing polysomnography at a subject's home, in order to estimate sleep quality in children, further research should include larger and/or more varied samples to examine the effects of exercise on sleep patterns. Reference Kubitz KA et al., (1996). *Sports Med*, 21, 277-291. Youngstedt SD, Kline CE. (2006). *Sleep Biol Rhythms*, 4, 215-221.

### PHYSICAL ACTIVITY LEVEL IS DEPENDENT ON EXERCISE TRAINING AMOUNT IN FEMALE ATHLETES

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Waseda University

1: Waseda University (Saitama, Japan), 2: National Institute of Health and Nutrition (Tokyo, Japan) Introduction We have shown previously that there is substantial inter-individual variability in physical activity level (PAL) in female athletes (Yoshida et al., 2012). In ordinary people, PAL is affected by energy expenditure derived from daily physical activity (PA) except for exercise, as lifestyle PA, because of spending no

or short time for exercise. In people who exercise for long periods of time, including exercise training as athletes, it is not clear whether their PAL values depend mainly on exercise or lifestyle PA. This study therefore examined the relationships between PAL values and the amount and duration of exercise and lifestyle PA in female athletes. Methods The study participants included 11 rhythmic gymnasts (RGs) and 11 lacrosse players (LPs). PAL values were calculated by dividing total energy expenditure (TEE) assessed by the 8-day doubly-labeled water method, by resting metabolic rate, measured using an indirect calorimeter. The participants kept an activity diary, with daily PA being classified as training, sleeping, or other PA (lifestyle PA). The intensity of lifestyle PA was assessed using a tri-axial accelerometer. The amount of each PA pattern was calculated as (daily metabolic equivalent value) x (duration) (METs·h), and the amount of training as (daily total amount of PA assessed by TEE and diet induced thermogenesis) - (amount of PA other than training). Results No significant difference in mean PAL was observed between the RGs (2.59±0.63) and LPs (2.43±0.46) groups. The duration and amount of training were higher in the RGs than in the LPs, while mean PA intensity during training was similar in the two groups (RGs, 5.6±2.5 METs; LPs, 6.1±2.5 METs). Although the LPs had longer duration and a smaller amount of lifestyle PA than RGs, the duration and amount of each intensity of lifestyle PA relative to total lifestyle PA were not significantly different between the two groups. In RGs, a higher PAL was associated with a greater amount of training ( $r=0.875$ ,  $p<0.001$ ) and a smaller amount of lifestyle PA ( $r=-0.773$ ,  $p=0.005$ ). In LPs, a higher PAL was associated with a greater amount of training ( $r=0.927$ ,  $p<0.001$ ). Discussion This study showed inter-individual variability in the PAL values was dependent on the amount of training and lifestyle PA in RGs, whereas in LPs, PAL was related only to the amount of training. It is therefore necessary to assess both the amount of lifestyle PA and training using a combination of duration and intensity in order to predict PAL accurately in female athletes, and also take into account different sporting categories. Reference Yoshida, A., Ishikawa-Takata, K., Taguchi, M., Tatsuta, W., Totani, M., Higuchi, M. (2012). *Nihon Eiyougaku Zasshi* [in Japanese], 70, 305-315

### THE INFLUENCE OF MORNING AND EVENING ENDURANCE EXERCISE ON METABOLIC RESPONSES AND INFLAMMATORY CYTOKINES IN YOUNG MEN

Kim, H.1, Takahashi, M.1, Numao, S.2,3, Endo, N.1, Konishi, M.3, Suzuki, K.1, Sakamoto, S.1

1:Faculty of Sport Sciences, Waseda University, 2:Department of Health and Sports Sciences, Kyoto Pharmaceutical University, 3:Waseda Institute for Sport Sciences

Introduction Endurance exercise is a potent stimulus that improves cardiovascular fitness and prevents obesity as well as obesity-related diseases. The circadian rhythm influences all aspects of physiological function including endocrine, nervous, immune system. However, the effects of endurance exercise in time of day on metabolic responses and inflammatory cytokines during and after exercise are unclear. Methods Fourteen healthy young men completed two trials in a randomized cross-over design: (1) morning (0900-1000) and (2) evening (1700-1800) trials. In the morning and evening trials, subjects walked for 60 minutes at 60% of maximal oxygen uptake on a treadmill. Pulmonary gas exchange was determined breath-by-breath by a gas analyzer. Blood samples were collected to determine hormones, metabolites, and inflammatory cytokines at pre-exercise, immediately and 2 hour after exercise. Results Plasma adrenaline, interleukin (IL)-6, and serum growth hormone concentrations were significantly higher immediately after exercise in the evening trial than in the morning trial ( $P < 0.01$ ,  $P < 0.05$ , and  $P < 0.001$  respectively). Plasma TNF- $\alpha$  and IL-1 $\beta$  concentrations did not change between trials. Serum free fatty acids concentrations were significantly higher in the evening trial than in the morning trial at 2-hour after exercise ( $P < 0.05$ ). However, there was no significant difference in fat oxidation between the morning and evening trials. Discussion Plasma catecholamines show a circadian rhythm with levels being evening than at morning (Trine and Morgan 1995). Catecholamines are known to play a major role in the regulation of substrate metabolism, affecting glucose production, glycogen mobilization, and lipolysis (Jabbour G et al., 2011). Furthermore, IL-6 is also known to increase hepatic glucose production during exercise or lipolysis in adipose tissue (Pedersen and Fischer, 2007). Therefore, higher catecholamines and IL-6 concentrations in the evening trial may contribute to increase in serum free fatty acids concentrations after exercise in the evening. These findings suggest that acute endurance exercise in the evening induces greater lipolysis than that in the morning and that inflammatory cytokines do not change between morning and evening exercise in young men. References Trine RM, Morgan WP. (1995). *Sports Med*, 20, 328-337. Pedersen BK, Fischer CP. (2007). *Trends Pharmacol*, 28, 152-156. Jabbour G, Lemoine-Morel S, Casazza GA, Hala Y, Moussa E, Zouhal H. (2011). *Med Sci Sports Exerc*, 43, 408-415.

### THE RESPONSE OF PLASMA VOLUME TO OPTIMAL DOSAGE GLYCEROL HYPERHYDRATION

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University of Bedfordshire

THE RESPONSE OF PLASMA VOLUME TO OPTIMAL DOSAGE GLYCEROL HYPERHYDRATION 1Institute of Sport and Physical Activity Research, University of Bedfordshire, UK. 2Department of Health and Physical Education, Marywood University, USA. Introduction Previous research has investigated the potential ergogenic effects of in vivo glycerol hyperhydration (G-HH) prior to endurance exercise, typically in a hot environment (>30°C). Glycerol is readily absorbed in vivo; promoting fluid retention in vascular spaces facilitating plasma volume (PV) expansion (although with often equivocal results). Currently no research has observed the effect optimum G-HH dosage (Goulet et al., 2007) has on change in PV (% $\Delta$ PV) in a sedentary state compared to water hyperhydration (W-HH) and the length of time PV expansion transpires for. Method 16 resting males' ingested one of two solutions evenly over a 90 min period (scheduled amount ingested every 15min). Glycerol solution (G-HH) (1.2 g·kg<sup>-1</sup> of body mass (BM) glycerol mixed in 26 ml·kg<sup>-1</sup> of BM of water) or a water solution (W-HH) (26 ml·kg<sup>-1</sup> of BM of water). Urine osmolality was measured prior to ingestion to confirm euhydration. Capillary blood samples were taken every 15 min for 135 min post ingestion to measure haemoglobin (Hb) and haematocrit (Hct) levels. Hb and Hct were used to calculate % $\Delta$ PV (Dill & Costill, 1974). Independent T-Tests and one way ANOVA were performed. Results It was revealed that peak % $\Delta$ PV was significantly higher after G-HH (22.16 ± 3.8%) than W-HH (9.74 ± 5.3%) ( $F_{1,12} = 24.31$ ,  $P < 0.001$ ). Post Hoc analysis illustrated that G-HH increased % $\Delta$ PV significantly higher than W-HH at time points: 0 - 15 min ( $P = 0.002$ ) and 105 - 120 min ( $P = 0.021$ ) post ingestion. Discussion Peak % $\Delta$ PV was 12.4% higher after G-HH compared to W-HH. There were two notable (biphasic) peaks of % $\Delta$ PV during the measured time period; rate of glycerol turnover (rate of appearance of glycerol) may account for this response. With the solution being ingested over 90 min the glycerol turnover could be at a staggered rate (Nelson & Robergs., 2007). The positive % $\Delta$ PV was sustained for 135 min. these results support the use of glycerol as an effective hydrating agent to aid occupational pursuits where dehydration can play a fundamental role in the onset of physiological and cognitive fatigue. It is recommended that occupational pursuits commence immediately post the 90 min ingestion period when PV expansion is highest, to delay the onset of dehydration. References Dill, D.B & Costill, D. L. (1974) *J App Phys* 37 (2), 247 - 248. Goulet, E. D. B., Aubertin-Leheudre, M., Plante, G. E. & Dionne, I. J. (2007) *Inter J of Sport Nut Ex Meta*, 17 (4), 391 - 410. Nelson, J. L. & Robergs, R. A. (2007) *Sports Med*, 37 (1), 981 - 1000.

## THE INTRAMYOCYELLULAR LIPID CONTENT IN THE ARMS OF ELITE CROSS COUNTRY SKIERS IS LOWER THAN IN THEIR LEGS

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**Introduction** Intramyocellular lipid (IMCL) content (Schrauwen-Hinderling et al. 2003) and fat oxidation during exercise (Helge 2010) has been reported to be lower in arm compared with leg muscles, and it has been argued to be due to lower training status in the arm than in the leg muscle of the study populations (Helge 2010). The aim of the present study was to compare IMCL content of arm and leg muscles in elite cross country skiers, who have highly endurance-trained arm and leg muscles. **Methods** Ten male elite cross-country skiers participated in the study. Their mean ( $\pm$ SD) age, and maximum oxygen uptake ( $\dot{V}O_{2max}$ ) was  $22 \pm 1$  years and  $72 \pm 2$  ml  $kg^{-1} min^{-1}$ , respectively. Muscle biopsies were taken from arm (m. triceps brachii) and leg (m. vastus lateralis) muscles. Muscle segments were prepared for transmission electron microscopy and the IMCL content was estimated by point counting on images photographed at  $\times 40,000$  magnification in 9 fibres per biopsy. Values are presented as medians and interquartile range. **Results** The IMCL content of the arms (0.13 (0.09-0.16) % of the total fibre volume) was only 25% of that in the legs (0.52 (0.37-0.85) %) ( $P < 0.0001$ ). Furthermore, examination of intermyofibrillar (IMF) and subsarcolemmal (SS) IMCL revealed that the latter was almost absent from the arms (0.0010 (0.0005-0.0024) volume per fibre surface) and more than 10-fold higher in the legs (0.0108 (0.0078-0.0137)) ( $P < 0.0001$  for the two-way interaction between limb and localization). Consequently, the relative contribution of SS IMCL to total IMCL was lower in the arms (3.6 (2.2-5.2) %) than the legs (10.2 (7.7-13.4) %) ( $P = 0.0001$ ). The proportions of myosin heavy chain (MHC) I and II in legs ( $58 \pm 2\%$  and  $41 \pm 2\%$ ) were higher and lower, respectively, than in the arms ( $40 \pm 3\%$  and  $60 \pm 3\%$ ) ( $P < 0.05$ ). **Discussion** The major finding documented here is that the IMCL content of the arms of elite male cross country skiers, who train both their arm and leg bodies intensively, is nonetheless substantially lower than in their legs. The difference cannot be explained by differences in the relative levels of myosin heavy chain I and II in the arm and leg muscles and is therefore unlikely to be dependent on training status. In addition, in contrast to the legs, the arms exhibit virtually no deposition of IMCL in the subsarcolemmal space, indicating a muscle phenotype-related difference in the subcellular distribution of lipids. **References** Helge JW (2010). *Acta Physiol*, 199,519-528 Schrauwen-Hinderling et al. (2003). *J Appl Physiol*, 95,2328-2332

## EFFECTS OF HIGH RESISTANCE CIRCUIT TRAINING VS TRADITIONAL STRENGTH TRAINING ON VO2MAX AND BODY COMPOSITION IN SOCCER PLAYERS.

Marín-Pagán, C., Romero-Arenas, S., Martínez-Valencia, M.A., Alcaraz, P.E.

Catholic University San Antonio

**Effects of High Resistance Circuit Training (HRC) vs Traditional Strength Training (TS) on VO<sub>2max</sub> and Body Composition in Soccer Players.** **Introduction** Effects of HRC protocol have been studied in resistance-trained males (1) but no studies that have focused on effects of HRC in soccer populations have been found. Maximal strength training (MS) is a key factor for soccer players, in addition, this training can be applied to achieve endurance improvements and injury prevention (2) in many sports. The aim of this study was to compare cardiorespiratory and body composition changes after 8 weeks of resistance training applying HRC vs. TS protocols in soccer players. **Methods** 18 semiprofessionals soccer players participated in the study (HRC=9; TS=9). Subjects completed an 8-wk training period (1-3 sets: 2 blocks  $\times$  3 exercises at 6 repetition maximum, twice weekly). The difference between protocols was the time of rest between exercises (TS=3'; HRC=35"). Local rest was the same (3') in both protocols. Maximal oxygen uptake normalized to body weight (VO<sub>2maxR</sub>) and body compositions (DEXA) were determinate in pre-post test. **Results** Trend to significant ( $p \leq 0.1$ ) was obtained in VO<sub>2maxR</sub> for the HRC group ( $1.3 \pm 2.5$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$ ) but not in the TS group ( $-0.6 \pm 2.8$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$ ). Time to complete the test was also improved significantly ( $p \leq 0.05$ ) in HRC group ( $16.4 \pm 22.4''$ ) while TS group was worse ( $-9.4 \pm 70.4''$ ) in pre-post test. Fat mass (FM) was reduced significantly in HRC ( $-2.2 \pm 1.0$  kg), TS group reduced FM ( $-0.6 \pm 2.8$  kg) but these different are not statistically significant. Both groups not significantly improve the lean mass (HRC= $0.8 \pm 1.1$ ; TS= $0.9 \pm 1.4$  kg). In %FM, both training protocols groups reduced significantly (HRC= $-2.7 \pm 1.4$ ; TS= $-1.1 \pm 1.1\%$ ) and HRC group obtained significant differences respect to TS group. **Discussion** Recently, one study (3) has reported improvements in VO<sub>2maxR</sub> ( $\sim 5.3$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$ ) after 8-wk of concurrent MS and high-intensity endurance training (ET) in top-level soccer players, in our study we obtained minor cardiorespiratory improvements, probably due to total training volume and additional ET in the Helgerud et al. study (3). Respect body composition parameters, our results in HRC group were higher than those obtained in the other study only for %FM and FM (%FM= $-1.5 \pm 1.6\%$ ; FM= $-1.1 \pm 1.5$  kg; LM= $1.5 \pm 1.9$  kg) (1), which applied the same training protocols, while for TS group were reported similar values (%FM= $-1.1 \pm 1.9\%$ ; FM= $-0.8 \pm 1.8$  kg; LM= $1.2 \pm 1.6$  kg). HRC could be considered as a good tool for applied in soccer players for achieve improvements in maximal strength, VO<sub>2max</sub> and body composition parameters with reduced training time. **References** 1. Alcaraz et al. *J Strength Cond Res*. 2011 Sep;25(9):2519-27. 2. Hoff et al. *Scand J Med Sci Sports*. 2002 Oct;12(5):288-95. 3. Helgerud et al. *Int J Sports Med*. 2011 Sep;32(9):677-82. **sert authors here**

## TASK-RELATED THOUGHTS EMERGE SPONTANEOUSLY DURING PROGRESSIVE MAXIMUM EXERCISE

García, S.1, Montesinos, E.1, Anguita, A.1, Morales, J.1, Hristovski, R.2, Balagué, N.

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**Introduction** A nonlinear model of attention focus showing the spontaneous emergence and nonlinear dynamics of task-related thoughts (TRT) during constant intensity running has been recently proposed using tools of dynamical systems theory (Balagué, Hristovski, Aragonés & Tenenbaum, 2012). The aim of this study is to test the nonlinear attention focus model under different exercise conditions and reporting methodology. **Methods** Twelve physically active participants previously familiarized with the experimental procedures performed twice a progressive cycling test until exhaustion. The initial load was 20W and increased 20W/min until the required pace (70 rpm) could not be kept for more than 10 s. During the first test their intrinsic dynamics of attention focus was established. During the second they were asked to intentionally maintain a Task-Unrelated Thought (TUT) and report every 30 sec through finger signs (thumb up/thumb down) about the type of thought (TUT or TRT) they had. The dynamics of TUT-TRT were plotted for each participant and divided into 10 non-overlapping temporal windows to obtain TUT-TRT probabilities in each interval. Non-parametric repeated measures Friedman ANOVA was used to compare the different windows. **Results** The 10 exertion time windows repeated-measures Friedman ANOVA ( $N = 12$ ,  $df = 9$ ) revealed a significant effect,  $\chi^2(12, 9) = 70.65$ ,  $p < .0001$ , of exertion time on TUT probabilities. The median probability of finding a TUT state began at 100% in the first half of the test, decreasing around 60% in periods 6,7,8, and to 0% in the last two periods. **Discussion** The time interval probabilities reveal three effort phases coinciding with 3 qualitative different states of the attention focus (i.e.,

stability of the intentionally imposed TUT, spontaneous emergence of TRT intermittently switching with TUT, and stable TRT). The obtained results corroborate the previous nonlinear model of attention focus tested through a different type of exercise and reporting methodology. References Balagué, N., Hristovski, R., Aragonés, D. & Tenenbaum, G. (2012). *Psychology of Sport and Exercise*, 13, 5, 691-697.

### **INFLUENCE OF AGE ON ELECTROMECHANICAL DELAY OF THE KNEE EXTENSOR MUSCLES**

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**Introduction** One of the factors that increase the incidence of falls in the elderly is the impairment of the neuromuscular function of the lower limbs. This impairment can be observed as decreases in rate of torque development (RTD), which is positively associated with functionality and the number of falls in the elderly (1). In addition, the time interval required to occur the excitation-contraction coupling (2) and to take the slack of the muscle-tendon unit (3) may also be important to recovery from a trip, as it reflects how fast the muscle tendon unit would start pulling a bone and move a body's segment. The electrical mechanical delay (EMD) (i.e. the time interval between the electromyographic activity and the onset of the voluntary torque production) is a good candidate to assess the effects of the aging process in the ability to produce torque rapidly. However, there is paucity of data regarding the effects of the aging process on the EMD. The aim of this study was to investigate effects of aging process in the EMD and RTD of the knee extensor muscles. **Methods** The volunteers were assigned to three groups: young group (YG - 23.44 ± 4.74 yrs, 78.14 ± 15.11 kg, 1.72 ± 0.05 m), middle-aged group (MAG - 49.56 ± 6.06 yrs, 72.01 ± 14.07 kg, 1.67 ± 0.06 m) and elderly group (EG- 68.67 ± 9.06 yrs, 67.96 ± 7.60 kg, 1.64 ± 0.07 m). The RTD were obtained through maximal volunteer ballistic isometric contraction (MVBIC) (60°). Muscle electrical activity was recorded by electromyograph (EMG) during MVBIC in the vastus lateralis (VL), vastus medialis (VM) and rectus femoris (RF) muscles. The EMD also was calculated during the MVBIC, taking the time difference between the EMG and torque onsets. **Results** RTD were higher for YG than MAG (P = 0.002) and EG (P = 0.002). There were no significant differences in EMD among the three age groups for VL, VM and RF (P > 0.05). **Discussion** It is known that the RTD decreases with aging (1), what was confirmed in the present study. Previous studies reported greater EMD in middle-age than young subjects (4). However, the present study found no difference between the age groups for the EMD. It is possible to suggest that maintenance of quadriceps muscles EMD with aging are related to a relatively greater recruitment of these muscles in daily activities (such as sitting down and standing up) (5). **Conclusion** Our study indicates that age affect the RTD, but not EMD of VL, VM and RF. **References** 1) Bento et al. (2010). *Clin Biomech*, 25: 450-454. 2) Prochniewicz et al. (2005). *J Gerontol A Biol Sci Med Sci*, 60: 425-431. 3) Reeves et al. (2004). *Exp Physiol* 2004; 89: 675-689. 4) Yavuz et al. (2010). *Clin Neurophysiol*, 121: 1700-1706. 5) Landers et al. (2001). *J Gerontol A Biol Sci Med Sci*, 56: B443-448.

### **THE EFFECTS OF A 6 WEEK ACSM INTERVENTION ON MEASURES OF POWER OUTPUT IN SEDENTARY OLDER MEN.**

Herbert, P.1, Grace, F.2, Ratcliffe, J.2, Baker, J.2, Richards, J.3, Sculthorpe, N.2

University of the West of Scotland

1University of Wales, Trinity Saint Davids, Camarthen Campus, Camarthen SA31 3EP 2 Institute for Clinical Exercise and Health Science, University of the West of Scotland, Hamilton, Scotland ML3 0JB 3 Institute of Sport and Physical Activity Research, University of Bedfordshire, Bedford MK41 9EA **Introduction** Ageing is associated with increased sedentariness and a concomitant decline in absolute and relative maximal power output (Pmax). The American College of Sports Medicine (ACSM) recommends 150 minutes of moderate exercise per week (Garber et al., 2011) for adults to develop and maintain musculoskeletal fitness. However, there is a lack of supporting evidence for the efficacy of these recommendations in improving power output older adults. The present study set out to examine the effect of a 6-week intervention using the ACSM guidelines on measures of muscle power in sedentary older males. **Methods** Participants consisting of untrained older males (UT, n= 22, 62.4±5.4 yrs) underwent 6 weeks of training in accordance with the ACSM's guidelines for the development and maintenance of musculoskeletal fitness (≥30 min.d-1 on ≥5 d.wk-1 for a total of ≥150 min.wk-1). Prior to (Pre) and following (Post) the training intervention participants were assessed for bodymass (BM) and lean body mass (LBM) using standard anthropometric procedures. Additionally maximal lower body power was assessed using a 6 second maximal effort on an air braked cycle ergometer (Wattbike UK). Maximal values were further indexed for bodymass (Pbm) and fat free mass (Pffm). At both time points UT were compared with a group of aerobically trained master athletes (MA, n=17, 60.4±5.2 yrs) who acted as a positive control. Data were analysed using SPSS v20 software using a mixed design ANOVA and post-hoc analyses. The alpha level was set at 0.05. **Results** At Pre UT were not different to MA in terms of Pmax but had significantly lower Pbm and PFFM (p<0.01). Following 6 weeks of intervention, UT did not significantly change Pmax, Pbm or PFFM. Additionally, at Post, UT were again not significantly different from MA in terms of Pmax but were significantly lower than MA for both Pbm and PFFM (p<0.01). **Discussion** These data suggest that the ACSM guidelines are not effective as a short term exercise intervention for improving lower body maximal muscle power. Longer duration or higher intensity interventions may be more beneficial to improve the power profile of ageing muscles. Additionally the data presented here suggest that long term exercise is effective in reducing the age related decline in muscle power relative to body mass and to fat free mass. **References** Garber, C. E., Blissimer, B., Deschenes, M. et al. 2011. *Med Sci Sports Exerc*, 43, 1334-59.

15:00 - 16:00

## Mini-Orals

## PP-PM54 Rehabilitation [RE] 1

**AUTO-STABILIZATION PERFORMANCES IN SITTING POSITION: MODIFICATION OF POSTURAL STRATEGIES IN OLDER PEOPLE.**

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Human movement and daily activities are performed through adaptive and permanent sensory-motor interactions. In aging subjects, the loop is impaired and the postural stability decreases. Risk of fall becomes a major problem. The medio-lateral (ML) balance is particularly altered in older subjects during quiet standing (Raymakers & al., 2005). We need to focus on the upper part of the body and consider the seated position because lower limbs are implicated in the postural deficit. Our main objective is to highlight specificities of sensory-motor strategies used by elderly people in auto-stabilization paradigm in order to increasing postural adjustment effects. Methods 15 young subjects (Adult Group, 24.8 +/- 4.6 years old) and 12 healthy elderly subjects (Senior Group, 57.9 +/- 2.4 years old) were asked to actively maintain a sitting posture as stable as possible during 12.8 seconds, on a seesaw placed in order to allow roll or pitch oscillation, with or without vision. We determined standard postural parameters and a postural performance index (PI). PI is represented by the area under the curve and is defined with respect to the movement axes (roll: X axis; pitch: Y axis). Appropriate MANOVA and t-Student tests were used, with statistical significance set at  $p < 0.05$ . Results Surface areas and lengths differed with auto-stabilization planes in the "vision" condition, with larger values during roll auto-stabilizations. Concerning surfaces, we found a visual effect during pitch auto-stabilizations. Group effect showed reduced length values for the Senior Group. During roll auto-stabilizations, the variation of X position was larger in the Senior Group. PIx differed between groups during roll auto-stabilizations, with greater values for the Senior Group, whereas no difference was found for Ply during pitch auto-stabilizations. Discussion Postural strategies appear to be modified with aging. Surfaces of CoP displacement are similar whereas lengths decreased with age. Young adult subjects have abilities for a pertinent of multi-sensory and multi-motor integration (Schmid & al., 2008), necessary to perform auto-stabilizations. In contrast, elderly persons seem voluntarily decrease sources of information, trying to diminish the current movement. A specific control is focus on the antero-posterior axis, with less control and more variability on the ML axis. The vision appears stabilizing only during pitch auto-stabilizations. The ML control needs to be specifically involved in an individualized postural training in order to improve balance and preserve the greatest autonomy for motor activities. Raymakers, JA., Samson, MM., Verhaar, HJ. (2005) Gait & posture, 21(1):48-58. Schmid, M., Casabianca, L., Bottaro, A., Schieppati, M. (2008) Neuroscience, 153(4):1079-91.

**TRUNK MUSCLE ENDURANCE AND LOW BACK PAIN IN CONTEMPORARY DANCE STUDENTS**

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Trunk muscle endurance and low back pain in contemporary dance students Introduction Low back pain (LBP) is often cited as a common condition in all levels of dance. Evidence suggests that reduced endurance of the trunk muscles can predispose an individual to LBP. The purpose of this study was to examine differences in trunk muscle endurance in a sample of contemporary dance students with and without LBP. Methods Fifteen full-time dance students were divided into four groups: females with LBP (n=6), females without LBP (n=4), males with LBP (n=2), and males without LBP (n=3). All participants provided informed consent, and the study was approved by an institutional ethics review board. Participants performed four isometric tests that assess trunk muscle endurance: the right and left side plank (McGill et al., 1999), double straight leg raise (Arab et al., 2007), and the Sorensen test (Biering-Sorensen, 1984). A modified version of the Osaka City University test (Kazunori et al., 2004) was used to assess the presence of LBP. Results A significant difference ( $p < 0.05$ ) between female dance students with and without LBP was observed in the left side plank. No other significant differences were found. Discussion This study offers some evidence that reduced trunk muscle endurance is present among dancers with LBP, and provides direction for future research into back health among dancers and other athletic populations. References Arab AM, Salavati M, Ebrahimi I, Ebrahim Mousavi M. Sensitivity, specificity and predictive value of the clinical trunk muscle endurance tests in low back pain. Clin Rehabil. 2007;21(7):640-647. Biering-Sorensen F. Physical measurements as risk indicators for low-back trouble over a one-year period. Spine. 1984;9(2):106-119. Kazunori I, Nakazato K, Irie K, et al. Trunk muscle strength and disability level of low back pain in collegiate wrestlers. Med Sci Sports Ex. 2004;36(8):1296-1300. McGill S, Childs A, Liebenson C. Endurance times for low back stabilisation exercises: clinical targets for testing and training from a normal database. Arch Phys Med Rehabil. 1999;80(8):941-43.

**ASSOCIATION BETWEEN LOWER-LIMB MUSCLE STRENGTH AND CLINICAL FEATURES IN JUVENILE DERMATOMYOSITIS**

Solis, M.Y.1, Hayashi, A.P.T.1, Otaduy, M.C.G.1, Kozu, K.T.1, Aikawa, N.E.1, Sallum, A.M.E.1, Pinto, A.L.S.1, Silva, C.A.1, Pinto, A.J.1, Pereira, R.M.R.1, Gualano, B.1

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Introduction Juvenile dermatomyositis (JDM) is a rare idiopathic inflammatory myopathy (also called myositis) characterized by skin rashes, muscle atrophy, myalgia, fatigue, hypoactivity, and poor quality of life. The role of muscle strength in these clinical symptoms has been underexplored. Thus, we aimed to examine the possible relationship between muscle strength and clinical features in JDM patients. Methods This is a cross-sectional study involving 17 JDM patients (14.6 ± 3.4 years old; 12 female). Clinical features (i.e., disease activity, physical function, health-related quality of life) were evaluated by Patient Visual Analogue Scale (P-VAS), Doctor Visual Analogue Scale (D-VAS), Childhood Health Assessment Questionnaire (CHAQ), Childhood Myositis Assessment Scale (CMAS), Disease Activity Score (DAS), Manual Muscle Testing (MMT). For P-VAS, D-VAS, and DAS, higher scores mean worse health/disease activity; for CMAS, MMT and CHAQ, higher scores mean better health/quality of life/physical function. Muscle strength was assessed by leg-press one-repetition maximum test (1-RM). Person's correlations were performed between leg-press 1-RM and the scores obtained from the clinical tests. Results Leg-press 1-RM (32.3 ± 12.7 Kg) was inversely related to D-VAS (-0.55;  $p = 0.02$ ), P-VAS (-0.52;  $p = 0.029$ ), and DAS (-0.52;  $p =$

0.29), and positively associated with CMAS (0.54;  $p = 0.027$ ). No significant correlation was seen between leg-press 1-RM and CHAQ ( $-0.09$ ;  $p = 0.70$ ) and MMT (0.18;  $p = 0.47$ ). Discussion In general, this study demonstrated that lower-limb muscle strength is negatively associated with disease activity (as assessed by DAS) and positively associated with physical function in JDM patients. Exercise has long been proscribed for patients with idiopathic inflammatory myopathies due to the fear that it could worsen disease activity. However, increasing evidence has suggested that exercise is not only safe but also effective in improving some symptoms in myositis. The present data further supports this notion, suggesting that lower-limb muscle strengthening could be of therapeutic relevance in the management of JDM. Future randomized clinical trials involving well-designed physical training programs, namely resistance training, should test this hypothesis. Supported by Fundação de Amparo à pesquisa do Estado de São Paulo (FAPESP) Grant# 2010/187081.

## **INTENSIFIED VS. STANDARDIZED EXERCISE THERAPY IN THE IN-PATIENT REHABILITATION AFTER PRIMARY TOTAL HIP OR AND KNEE REPLACEMENT – A RANDOMIZED CONTROLLED TRIAL**

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Exercise therapy plays a dominant role in rehabilitation after total hip (THR) or knee replacement (TKR). The objective of this study is to evaluate the effectiveness and sustainability of an intensified compared to a conventional exercise therapy program in rehabilitation after THR and after TKR. Methods: 61 THR patients as well as 61 TKR patients were each randomized to a conventional (control groups/CG) or an intensified (intervention groups/IG) exercise program. In both indications, IGs received an intensified strength training protocol compared to CGs ("usual care"). The programs were standardized in both groups. Exercise therapy dosage was documented via diaries. Joint function (primary outcome - WOMAC), Health related quality of life (HrQoL, SF36), walking speed (Timed 10m walk) and range of motion (neutral-zero method) were tested at beginning and end of in-patient rehabilitation and as two follow-up measurements (three and nine months). Statistics: Repeated measures ANOVA were used to investigate interaction effects and changes across time. Confidence intervals and effect sizes were calculated. Results: In both indications, strength training intensity was significantly higher in the IGs compared to the CGs (THR IG:  $13.4 \pm 0.7$ , CG:  $11.7 \pm 0.6$ ,  $p = 0.000$ ; TKR IG:  $13.4 \pm 0.7$ , CG:  $11.9 \pm 0.8$ ,  $p = 0.000$ ). Perceived pain did not differ between IGs and CGs (THR IG:  $0.3 \pm 0.5$ , CG:  $0.1 \pm 0.3$ ,  $p = 0.109$ ; TKR IG:  $0.4 \pm 0.5$ , CG:  $0.4 \pm 0.7$ ,  $p = 0.897$ ). No interaction effects (group by time) were found in any outcome at any time point of the study period. Joint function significantly improved across time between t1 and t2 (WOMAC THR:  $-35.0\%$ ,  $d = 2.23$ ; TKR:  $-20.0\%$ ,  $d = 1.06$ ) and between t2 and t4 (THR:  $-45.5\%$ ,  $d = 1.57$ ). In HrQoL (SF36; physical component summary = pcs; mental component summary = mcs) participants improved between t1 and t2 (SF36-Score increase THR pcs:  $16.1\%$ ,  $d = 1.37$ ; TKR pcs:  $12.2\%$ ,  $d = 1.08$ ), t2 and t3 (THR pcs:  $24.5\%$ ,  $d = 2.13$ ; TKR pcs:  $16.7\%$ ,  $d = 1.34$ ; TKR mcs:  $9.9\%$ ,  $d = 0.84$ ) as well as t2 and t4 (THR pcs:  $37.8\%$ ,  $d = 2.63$ ; THR mcs:  $0.4\%$ ,  $d = 1.29$ ; TKR pcs:  $30.4\%$ ,  $d = 1.88$ ; TKR mcs:  $7.9\%$ ,  $p = 0.040$ ,  $d = 0.78$ ). Timed 10m walk significantly improved between t1 and t2 (THR: time required has decreased by  $25.7\%$ ,  $p = 0.000$ ,  $d = 2.63$ ; TKR  $30.3\%$ ,  $d = 3.10$ ) as well as active flexion (THR:  $md = 8.5^\circ$ ,  $d = 2.40$ ; TKR:  $md = 18.3^\circ$ ,  $d = 3.20$ ), passive flexion (THR:  $md = 5.8^\circ$ ,  $d = 1.77$ ; TKR:  $md = 17.9^\circ$ ,  $d = 3.06$ ), active extension (THR:  $md = 3.2^\circ$ ,  $d = 1.40$ ), passive extension (THR:  $md = 3.4^\circ$ ,  $p = 0.000$ ,  $d = 1.67$ ), active abduction (THR:  $md = 8.0^\circ$ ,  $d = 2.31$ ) and passive abduction (THR:  $md = 6.4^\circ$ ,  $d = 2.37$ ). Discussion: The strength training intensification has been realized without increase of perceived pain. However, compared to the overall effects of the in-patient rehabilitation no additional gain in function or HrQoL could be achieved. It remains open to what extent an even higher strength training intensity would lead to higher therapy effects in comparison to conventional programs following THR or TKR. Existing training protocols should further be analyzed regarding efficacy and dose-response relationships

## **THE RELATIONSHIPS BETWEEN CORE STABILITY AND LOW BACK PAIN IN WRESTLERS**

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Introduction Wrestling includes some lifting techniques from ground that may lead serious low back pain. The aim of this study was to investigate the relationships between core stability and low back pain in young national wrestlers. Methods Eighty-one wrestlers (mean age  $18.60 \pm 0.96$ ) from Turkish young national Greco-Roman (n: 46) and free-style (n:35) wrestling teams participated voluntarily in this study. Low back pain was evaluated by visual analog scale (VAS). Participants were asked to indicate their pain degrees at rest (VASrest), during activities of daily living (VAS-ADL) and sports activities (VAS-sport) on a 10-cm scale. Assessments included in core stability with prone bridge, side-bridge, back extension and trunk flexion tests. Results It was found that  $30.86\%$  of wrestlers have pain at rest,  $29.62\%$  of wrestlers have pain during activities of daily living and  $40.74\%$  of wrestlers have pain during sports activities. Both VASrest ( $r = -0.27$ ,  $p < 0.05$ ) and VAS-ADL ( $r = -0.003$ ,  $p < 0.01$ ) was correlated negatively with back extension test, and VAS-ADL was correlated negatively with back flexion test ( $r = -0.30$ ,  $p < 0.01$ ). Low back pain was not correlated with prone and side bridge tests. Discussion These results showed that low back pain affects core stabilization in wrestlers. Therefore core stability/strength program is suggested to prevent low back pain. References McGuigan MR, Winchester JB, Ericson T. (2006). *J Sports Sci Med*. 5:108-13. Utter AC, O'Bryant HS, Haff GG, Trone GA. (2002). *J Strength Cond Res*. 16(2):308-15. McGill SM. (2001). *Exerc Sport Sci Rev*. 29 (1): 26-31.

## **ALTER G: AN INNOVATIVE TECHNOLOGY IN PHYSICAL ACTIVE REHABILITATION OF SPINAL STENOSIS**

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Introduction Lumbal spinal stenosis causes back pain spreading as far as the legs and thereby constrains the activities of daily living. By walking in a flexed position patients try to extend the foramina intervertebralia. Claudicatio intermitens/ spinalis forces them to stop walking and sit down, because of pain, parasthesias or paresis (Horst et al., 2012). Loss of physical activity may lead to a decline of physical condition and slowly restrict independence (Schulte et al., 2006). The differential air pressure technology of AlterG treadmills reduces body weight in lower extremity up to 80% and facilitates normal postural control ([www.alterg.com](http://www.alterg.com)). Methods After completing physiotherapy, a 70-year-old left sided lower leg amputated man started extensive endurance training. 250m of walking were challenging. Therefore innovative body weight reducing AlterG treadmill training was initiated in April. Results Early therapy, visual analog scale (VAS) was set at 5.5. At the beginning of AlterG training, body weight was decreased by 40% up to 5% in November (VAS 0). As walking time increased in the air filled chamber (13-35min.), walking distance increased equally from 870m to 2.4km. Discussion One aim of functional rehabilitation is to decrease the pain (Schulte-Frei et al., 2012), keep the patient independent and thereby obtain his physical condition in order to prevent further (cardiorespiratory) diseases. One of the goals of using nearly unknown AlterG treadmills in rehabilitation of orthopedic patients is to restore normal walking mechanics (Chun and Mishra, 2010). The combination of physiotherapy and AlterG training

leads to absence of lower back pain, walking distance increases significantly, the patient feels safer while walking and his independence is ensured. Generally seen AlterG training improves postural control, increase safety while walking as well as economy of movements and thereby affect the lower back pain and needs to be seen as a revolutionary rehabilitation treadmill. References Horst F, Adler B, Schulte-Frei B, Horst H. Orthopädisch-traumatologische Grundlagen. In: Froböse I, Wilke C, Nellesen-Martens G, eds. Training in der Therapie. Grundlagen und Praxis. 3rd ed. München: Elsevier GmbH; 2012, 309-399. Schulte TL, Bullmann V, Lerner T et al. Lumbale Spinalkanalstenose (2006). Der Orthopäde, 35, 675-694. Schulte-Frei B, Horst H, Horst F. Trainingstherapie bei Verletzungen und Erkrankungen des Bewegungssystems. In: Froböse I, Wilke C, Nellesen-Martens G, eds. Training in der Therapie. Grundlagen und Praxis. München: Elsevier GmbH; 2012, 401-526. Chun, J, Mishra, D. Guidelines for using the AlterG: Patients with orthopedic problems. Available at <http://www.alterg.com/rehabilitation-treadmill-clinical-research>. Accessed March 5, 2012. <http://www.alterg.com/rehabilitation-equipment>

### LONG-TERM EXERCISE REDUCES OXIDATIVE STRESS IN THE HIPPOCAMPUS OF AGING RATS

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**Introduction** Exercise can exert beneficial effects on cognitive functions of older subjects and it can also play an important role in the prevention of neurodegenerative diseases. At the same time limited information is available on the nature of molecular pathways supporting the antioxidant effects of exercise in the brain of aging animals. **Methods** 12-month old, middle-aged female Wistar rats were subjected to daily moderate intensity exercise on a rodent treadmill for a period of 15 weeks which covered the early aging period unmasking already some aging-related molecular disturbances. The levels of reactive oxygen species (ROS), the amount of protein carbonyls, the levels of antioxidant intracellular enzymes superoxide dismutases (SOD-1, SOD-2) and glutathione peroxidase (GPx) were determined in the hippocampus. In addition, to identify the molecular pathways that may be involved in ROS metabolism and mitochondrial biogenesis, the activation of 5'-AMP-activated protein kinase (AMPK), the protein level of peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC-1a), nuclear respiratory factor 1 (NRF-1) and mitochondrial transcription factor A (mtTFA) were measured. **Results** Our results revealed a lower level of ROS associated with a reduced amount of protein carbonyls in the hippocampus of physically trained rats compared to sedentary controls. Furthermore, exercise induced an up-regulation of SOD-1 and GPx enzymes, p-AMPK and PGC-1a, that can be related to an improved redox balance in the hippocampus. **Conclusion** These results suggest that long-term physical exercise can comprises antioxidant properties and by this way protect neurons against oxidative stress at the early stage of aging, i.e. in the period of life when prevention is the most effective way to assure healthy brain aging.

### ELECTROMYOGRAPHIC AND POSTUROGRAPHIC INVESTIGATION OF PATIENTS WITH NON-SPECIFIC LOW-BACK PAIN

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**Introduction** Muscle atrophy of stabilising muscles may cause reduced robustness of postural stability (Hodges & Richardson). Compensation of this reduced robustness through superficial muscle recruitment may lead to rigid spinal stabilisation and further postural deficiencies. Consequential overuse of superficial lumbar muscles could be one cause of non-specific low-back pain (NSLBP). Aim of this study was to investigate whether (NSLBP) is accompanied by (1) compensatory increase of superficial lumbar muscles, (2) decrease of hip stabilising muscles' activity, and (3) poorer performance on a labile platform when standing on one leg (OLS). **Methods** 15 patients (PG, mean age: 45y (±13y), 9 females) with NSLBP were compared with 22 healthy controls (CG, mean age: 40y (±15y), 13 females). Based on the oscillation curve recorded from a labile platform (Posturomed®), five posturographic parameters were compared for postural performance: area of surface deflection, damping coefficient, time-to-minimum, curve continuity, and minimal acceleration coefficient. Simultaneous electromyographic (EMG) recordings of three bilateral muscles allowed comparison of relative submaximal voluntary contraction (% sMVC). **Results** (1) Both groups had normal low EMG activity for superficial back muscles with no significant differences. (2) PG exhibited significantly less activity of the contralateral gluteus medius (PG: 0.27% sMVC ± 0.24%, CG: 0.51% sMVC ± 0.36%, p<0.05) while standing on the non-dominant leg, and a tendency of decreased activity of the ipsilateral gluteus medius when standing on the dominant standing leg (PG: 0.85% sMVC ± 0.55%, CG: 1.54% sMVC ± 1.06%, p=0.18). (3) PG and CG performed equally well on the Posturomed® showing no consistent difference in any of the parameters. **Discussion** Results suggest reduced stabilising hip muscle activity with possible asymmetry in PG but no reliance on increased lumbar extensor muscles as compared to CG. The presented setup cannot provide direct information on activity of deep stabilising muscles but allows controlled provocation of the stabilising system to investigate changed motor patterns in NSLBP. Proposed parameters contradict previous findings but should be validated to strengthen their implication. **References** Hodges, P. W., & Richardson, C. A. (1996). Inefficient muscular stabilization of the lumbar spine associated with low back pain. A motor control evaluation of transversus abdominis. Spine (Phila Pa 1976), 21, 2640-2650.

### POSTURAL CONTROL OF ELITE DEAF FOOTBALL PLAYERS

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**Introduction** Childhood hearing impairment is a common chronic condition that may have a major impact on postural control. The aim of this study was to determine the postural control of the elite deaf football players and compare football players and sedentary controls. **Methods** Eighteen deaf national football players, 8 third division football players and 9 sedentary controls were evaluated using the Biodex Biosway Portable Balance System. Three adaptation trials and three test evaluations (a 20-second balance test at a stable platform) were applied to the players and controls. Postural stability was tested on two-legged stance with eyes open and closed and on the single limb stance with eyes open. Static postural stability was measured on the basis of three indices: overall, antero-posterior and medio-lateral. The limits of stability test was also performed. Statistical analysis was done using SPSS 15.0 software. Comparison of each parameter between groups was done by using appropriate post hoc test following Kruskal-Wallis test. P value 0.05 was considered as level of statistical significance. **Results** On the two-legged stance test, significant differences were found in overall stability and antero-posterior stability index scores between deaf sportsmen and third division football players (p<0.05). Antero-posterior stability scores were statistically significant different between deaf players and controls (p<0.05). According to limits of stability test, there were significant differences between deaf players and controls (p<0.05). No differences were found among players in single-limb stance test and other parameters of limits of stability test (p>0.05). As a result on two-legged stance test overall stability and antero-posterior stability scores were

better in deaf players compared to third division football players. Also deaf players obtained better antero-posterior stability scores than controls. In addition deaf players were successful compared to controls in the limits of stability test. Discussion These results showed that postural control can be improved by doing regular and systematic exercises in deaf people. References Hinman MR. (2000). Journal of Sport Rehabilitation.9(3):240-252. McGill SM. (2001). Exerc Sport Sci Rev. 29 (1): 26-31.

### PELVIC PAIN MANIFESTATION AND METHODS OF ITS REHABILITATION IN SPORTSWOMEN DURING PHYSICAL ACTIVITY

Kovalenko, T., Suhoruchko, A., Ulyanov, D., Shklyarenko, A.

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**Introduction** Chronic pelvic pain (CPP) is a long-term syndrome, over 6 months, which is difficult to rehabilitate; it disorganizes central regulation mechanisms. Under certain conditions, such as abnormal development of the locomotor system, excessive muscle loading can lead to trauma, inflammation and irradiation and therefore, sports working capacity decrease. Lumbar spine experiences hard muscle loadings which can lead to intervertebral joints and sclerotome inflammation or pelvic organs irradiation, causing CPP. Nowadays, high performance in sport is obtained by dynamic-static muscle loads which basically involve LMS elements (muscles, sheaves, joints). Goal Reevaluation of physical exercise and movements provoking pain, CPP area determination and development of preventive measures for its cutting short. Methods Direct impact on trigger points and functional blocks by means of ischemic compression and post-isometric relaxation of trigger points muscles having; impact on the local area under the trigger chain, reflecting correlation of trigger points with joint damage. Results 60 sportswomen with diagnosed CPP were examined in order to reveal and cure vertebrogenic, orthopedic disorders. Musculoskeletal system diagnosis was based on complaints, neurological, arthologic, manual and X-ray spine examination results which assessed spine, pelvis, shoulders, folds buttocks and joints, active and passive movements, palpation, to determine postural muscle imbalance, seals, trigger points, functional blocks presence. Survey showed that biomechanical disorders of the musculoskeletal system in 83% of athletes in the form of changes in the presence of trigger points and function blocks. The cause of CPP is the existing biomechanical disorders of the musculoskeletal system. 20 sportswomen had CPP complaints during warm-up, training exercises and twisting; 10 cases in spinal column latero-flexion in at L4-L5, L5-S1, and positive tests Pedal, Mennel showed sacroiliac joints blocking. CPP dependence from movements in the lumbar-sacral region was observed in 40 cases indicating its high frequency. Discussion The stable long-term treatment effect is achieved at trigger points alternating manipulation (recognition phenomenon). Manual therapies include three main stages: back and pelvis muscles relaxation; mobilization (passive joints movements within their physiological volume, they are short, fast and impulsive). Manual therapy diagnosis offers new approaches to chronic CPP syndrome differentiation and treatment and increases athletes rehabilitation effectiveness. Thirty examined patients, which is 75 per cent, showed pelvic pain dependence on movement in sacrolumbar region. So this fact reveals the high frequency of CPP.

### EFFECTS OF REHABILITATION TRAINING ON LUMBAR EXTENSION STRENGTH AND PAIN BETWEEN VERTICAL SPINE TRACTION EXERCISE GROUP AND NON-TRACTION EXERCISE GROUP IN KOREAN ADULT PATIENTS OF LOW BACK PAIN

Gun Do, K.

*sports medicine and exercise physiology*

**Introduction** Low back pain is a prevalent condition imposing a large socioeconomic burden(jeffrey et al.2011) and has been investigated in many studies(John,2003). However there is still a lack of knowledge concerning effects of high-tech machines with vertical spine traction exercise machine and pain scores in patients of low back pain. therefore, this study was aimed to assess the effect of rehabilitation training on lumbar extension strength and pain change between vertical spine traction exercise group and non-vertical spine exercise traction group in korean adult patients of Low back pain. Methods Subjects were recruited from KSP hospital and divided into a Vertical Spine Traction Exercise Group(VSTEG)(males: n=14, 62.71+5.1years,170.43+5.1cm, 67.21+10.2kg; females:n=15, 62.80+3.9years, 154.80+2.8cm, 58.07+7.66kg) and Non-Vertical Spine Traction Exercise Group (NVSTEG) (males: n=11, 62.80+3.9 years, 170.36+5.4cm, 69.91+10.6kg; females: n=14, 62.57+28years, 155,86+3.4, 61.07+7.87kg). Both group received resistance training twice a week in Medx lumbar extension machine(Ocala,FL) and SVTEG taken additional training in treadmill walking with Pneu-weight system machine(Pneu max inc). Both groups were tested on a MedX machine at baseline and after 8 weeks for lumbar extension strength at 0°, 12°, 24°, 36°, 48°, 60° and 72°. Statistics were Compiled using spss/windows(15.0). Results There were significant improvement of lumbar extension strength (p<.001) in both VSTEG and NVSTEG. VSTEG increase 65.12% and 53.98% in NVSTEG. VSTEG showed higher improvement than NVSTEG at all degrees except 48°. Both group showed significant decrease on pain rate in VSTEG(70.85%: from 5.73+1.79 to 1.67+1.29) and NVSTEG(47.02%: from 6.38+1.32 to 3.38+1.44) after 8week training. VSTEG appeared more pain decrease(%) than NVSTEG. Discussion Both Group showed improvement of lumbar strength, and differences were found between VSTEG and NVSTEG in strength. VSTEG in Isometric strength was higher(11.17%) than NVSTEG after 8weeks training. These data are in agreement with previous research(grave et al,1990) demonstrating that resistance training of the isolated lumbar extensor muscles can yield isometric torque gains over 8 week training. VSTEG in pain score indicated higher decrease(23.83%) than NVSTEG. This illustrated similar pattern for pain decrease in the two patient group(kim,2008). the morer pain decrease in VSTEG was considered by muscle relaxation in spine traction. Therefore, Resistance training with vertical spine traction machine is a viable alternative to low back pain patients. References Graves JE, Pollock ML, Foster D. (1990). Spine, 15,504-509 Irina, M., Thomas, L., Michael, O., Helmut, K.(2005). Eur spine journal 14:599-611. jeffrey J, Shane L, Bruce F.(2011). Sports health,3(6),534-542 John M M, Friar E U, James E.G, Graves and Lori L P.(2003).Journal of strength and conditioning association,17(2),356-361. Kim, Gun-Do, Han, Gil Soo, (2008). The korea Journal of Sports Science, 17(3), 721-731.

### ASSOCIATION OF TRUNK MUSCLE PROPERTIES WITH SAGITTAL SPINAL ALIGNMENT IN HEALTHY ELDERLY WOMEN

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**Introduction** It is well established that muscle mass decreases with age, which contributes to muscle weakness. Previous studies have reported that skeletal muscle quality, defined as the amount of non-contractile tissue in the muscle and quantified by muscle echo intensity on ultrasound images, also influences strength generation in healthy elderly subjects (Ikezoe et al., 2012; Fukumoto et al., 2012). However, the effect of trunk muscle mass and muscle quality on spinal alignment in healthy, elderly people remains unclear. The aim of this study was to investigate the relationship of trunk muscle properties, obtained from ultrasound images of muscle thickness and mus-

cle echo intensity, with sagittal spinal alignment in healthy elderly women. Methods Twenty healthy elderly women (mean age 85.9 (74-96) years) participated in the study. Standing sagittal spinal alignment, determined from the thoracic kyphosis angle, the lumbar lordosis angle and the sacral inclination angle, was measured using the Spinal Mouse® (Index Ltd.). Muscle thickness, including the rectus abdominis, external oblique, internal oblique, lumbar multifidus and erector spinae muscles was measured using B-mode ultrasound imaging with an 8-MHz transducer. Muscle echo intensity from the ultrasound images represented the muscle quality and an 8 bit gray-scale analysis was used as an index for the amount of non-contractile tissue. Increased echo intensity, related to the presence of non-contractile tissue in the muscle (e.g. increased intramuscular fibrous and adipose tissue) indicated changes in muscle quality. The mean echo intensity was expressed as a value between 0 (black) and 255 (white). Results Pearson correlation coefficient analyses showed that there was a significant negative correlation between thoracic kyphosis angle and rectus abdominis thickness. Lumbar lordosis and sacral inclination angles were significantly associated with lumbar multifidus and erector spinae thickness. No correlation was found between muscle echo intensity and sagittal spinal alignment. Discussion The results suggest that a decrease in rectus abdominis, lumbar multifidus and erector spinae thickness contributes to hyperkyphotic posture in healthy elderly women. In addition, changes in sagittal spinal alignment may be related to muscle mass rather than muscle quality. The findings may help in the development of exercise guidelines for the improvement of spinal alignment and prevention of hyperkyphosis progression in elderly women. References Ikezoe T, Asakawa Y, Fukumoto Y, Tsukagoshi R, Ichihashi N. (2012). *Geriatr Gerontol Int*, 12, 86-92. Fukumoto Y, Ikezoe T, Yamada Y, Tsukagoshi R, Nakamura M, Mori N, Kimura M, Ichihashi N. (2012). *Eur J Appl Physiol*, 112, 1519-1525.

### RESISTANCE TRAINING DECREASES TLR4 EXPRESSION VIA MYELOID DIFFERENTIATION FACTOR 88-DEPENDENT PATHWAY IN ELDERLY SUBJECTS

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RESISTANCE TRAINING DECREASES TLR4 EXPRESSION VIA MYELOID DIFFERENTIATION FACTOR 88-DEPENDENT PATHWAY IN ELDERLY SUBJECTS Introduction Age and sedentary lifestyle are risk factors implicated in the etiology of diabetes, hypertension, atherosclerosis, and other cardiovascular diseases (Wanderley et al 2013). Several studies have related this effect with the toll-like receptor 4 (TLR4) pathway, that is involved in the expression of inflammatory cytokines through the activation of the nuclear factor kappa-B (NF-kappaB). Regular exercise training induces positive adaptations in heart rate variability, body composition and fitness, as well as a reduction in low-grade chronic inflammation. Therefore, the aim of this study was to investigate the effect of a resistance training programme on the TLR4 pathway and on the production of inflammatory cytokines in the elderly. Methods Twenty subjects, aged 65-87 years, were randomized to either with or without resistance training programme practiced twice per week based on 3 sets of 15-30 repetitions at 40-60% of one repetition maximum (1RM) for the first 6 weeks and 6-12 repetitions by set at 60-80% of 1RM for the last 6. Peripheral blood mononuclear cells were isolated pre- and post-training programme, and used to analyze protein expression of TLR4, tumor necrosis factor-alpha and several interleukins as IL-10 and IL-6. Protein content of myeloid differentiation primary response gene 88 (MyD88), a protein with a central role in mediating signal transduction between TLR4 and NF-kappaB, was also measured. Results Data showed significantly lower TLR4-protein in whole blood samples from older resistance trained, compared to untrained, subjects. Moreover, physically active older adults had also significantly lower MyD88 expression than physically inactive subjects. These changes occurred concomitantly with lower pro-inflammatory cytokine production and higher levels of IL-10. Discussion Previous studies have shown that a period of chronic exercise training decreases both inflammatory cytokine production and the cell-surface expression of TLR4 in monocytes (Gleeson et al 2006). Thus, in resistance-trained older women TLR4 mRNA levels were significantly lower than in sedentary untrained older women (Flynn & McFarlin 2006). Our results confirm that a period of 12-wk of resistance training decreased TLR4 expression as well as reduced low-grade chronic inflammation in elderly subjects. Furthermore, this response seems to be mediated via the MyD88-dependent pathway. References Flynn MG, McFarlin BK. (2006). *Exerc Sport Sci Rev*, 34: 176-181. Gleeson M, McFarlin BK, Flynn M. (2006). *Exerc Immunol Rev*, 12: 34-53. Wanderley FAC, Moreira A, Sokhatska O, Palmares C, Moreira P, Sandercock G, Oliveira J, Carvalho J. (2013). *Exp Gerontol*, 48: 326-333.

15:00 - 16:00

## Mini-Orals

### PP-PM74 Training and Testing [TT] 9

#### UNSTABLE CHEST PRESS TRAINING DOES NOT MEAN BETTER PERFORMANCE UNDER STABLE CONDITIONS

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Introduction It has been shown [1] that power in concentric phase of chest presses performed on Swiss ball is higher in subjects with than without experience with instability resistance exercises. These differences can be mainly seen in peak and mean power in acceleration phase of lifting with higher weights ( $\geq 60\%$  of 1RM). However, question remains whether better performance under unstable conditions provides some benefits for higher power production on stable surface. The study compares power outputs in concentric phase of chest presses with back supported by either stable bench or unstable Swiss ball in athletes without and with experience with instability resistance training. Methods Subjects of two groups, first having an experience with resistance exercises on unstable surfaces ( $n = 16$ , age  $22.7 \pm 1.9$  y, height  $181.5 \pm 7.2$  cm, weight  $78.1 \pm 10.1$  kg) and second practising only conventional resistance exercises ( $n = 17$ , age  $22.2 \pm 2.2$  y, height  $184.6 \pm 9.7$  cm, weight  $81.3 \pm 8.4$  kg), performed in random order barbell chest presses on the bench and Swiss ball, respectively with previously established weight of  $70\%$  1RM under stable conditions. A system FITRO Dyne Premium based on precise analogue velocity sensor with sampling rate of 100 Hz was used to monitor basic biomechanical parameters involved in exercise. Force is calculated as a product of mass moved and the sum of an instant acceleration and gravitational constant. The acceleration is obtained by derivation of velocity, registered by rotating analogue sensor coupled with the barbell by means of nylon tether. Power is calculated as a product of force and velocity. Peak power ( $P_{peak}$ ) and mean power in acceleration ( $P_{mean acc}$ ) and entire concentric phase of lifting

(Pmean total) were analyzed. Results Power in concentric phase of chest presses on Swiss ball was significantly ( $p < 0.05$ ) higher in group with than without experience with instability resistance exercises (Ppeak:  $646.2 \pm 50.1$  W and  $601.7 \pm 48.2$  W; Pmean total:  $426.7 \pm 42.7$  W and  $386.3 \pm 38.2$  W; Pmean acc:  $495.1 \pm 43.8$  W and  $440.9 \pm 45.0$  W). However, there were no significant differences in power outputs between examined groups when chest presses were performed on the bench (Ppeak:  $657.4 \pm 47.9$  W and  $651.7 \pm 48.2$  W; Pmean total:  $438.1 \pm 39.9$  W and  $430.8 \pm 40.0$  W; Pmean acc:  $508.4 \pm 44.5$  W and  $501.6 \pm 44.7$  W). Discussion The ability to generate high power in concentric phase of unstable chest presses does not mean greater performance benefits on stable support base. These findings support the concept of power training specificity. References Zemková E, Kováčiková Z, Vilman T (2011). 6th International Posture Symposium. Smolenice Castle: 99.

### ENHANCEMENT OF PEAK AND MEAN POWER IN CONCENTRIC PHASE OF SQUATS WITH DIFFERENT WEIGHTS

Zemková, E., Vilman, T., Jeleň, M., Hamar, D.

*Faculty of Physical Education and Sport, Comenius University*

Introduction It has been shown that activation of stretch-shortening cycle during countermovement (CM) weight exercise enhances power production in concentric phase compared to lift from the rest. Such CM enhancement of power depends on weight lifted [1] with some optimal load at which maximal potentiation of power occurs. Usually, peak power is evaluated for this purpose without taking into attention the mean power in acceleration and entire concentric phase of lifting. The study compares the difference in peak and mean power of concentric-only and CM squats while lifting different weights. Methods A group of 16 fit men (age  $22.7 \pm 1.7$  y, height  $183.2 \pm 7.4$  cm, weight  $77.6 \pm 7.5$  kg) performed randomly in different days 3 repetitions of barbell squats without and with CM using maximal effort in concentric phase. Initial weight of 20 kg was increased by 10 kg or 5 kg (at higher loads) up to at least 85 % of previously established 1RM. A system FITRO Dyne Premium based on precise analogue velocity sensor with sampling rate of 100 Hz was used to monitor basic biomechanical parameters involved in exercise. Force is calculated as a product of mass moved and the sum of an instant acceleration and gravitational constant. The acceleration is obtained by derivation of velocity, registered by rotating analogue sensor coupled with the barbell by means of nylon tether. Power is calculated as a product of force and velocity. Peak power and mean power in acceleration and entire concentric phase of lifting were analyzed. The differences in power outputs ( $\Delta P$ ) during squats with and without CM at different weights were calculated. Results As expected, there was higher power output during CM than concentric-only squat. This potentiating effect of mean power in entire concentric phase of lifting was rather modest at lower weights ( $30.1 \pm 8.7$  W at 20 kg) and become more pronounced with increasing weights reaching a maximum of  $125.0 \pm 24.2$  W at 77 % of 1RM. From this point the  $\Delta P$  gradually decreased to  $106.8 \pm 21.4$  W at 100 kg. However, maximal enhancing effect of both peak and mean power in acceleration phase of lifting was achieved at 67 % of 1RM ( $127.7 \pm 23.4$  W) and 69 % of 1RM ( $124.3 \pm 22.1$  W), respectively. Discussion Maximal enhancement of mean power in entire concentric phase of squat occurs at higher weights (about 80 % of 1RM) than peak and mean power in acceleration phase of lifting (about 70 % of 1RM). Nevertheless, the differences in power produced during squats with and without CM (i.e.  $\Delta P$ ) for peak and mean values are rather small. References Zemková E, Hamar D (2011). 16th Annual Congress of the European College of Sport Science. Liverpool: 426.

### IS SKELETAL MUSCLE OXYGEN EXTRACTION MAXIMIZED AT MAXIMAL AEROBIC POWER? A HINT FROM THE 3 MIN ALL-OUT CYCLING TEST.

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Background: Cross country competitive mountain biking (MTB) requires several bouts of effort that are well above maximal aerobic power (MAP). At the start of a race, power output is very high until a sustained aerobic pace is established. The 3 min all-out cycling test (3MT) begins with an all-out effort that peaks well over MAP while, on the last 30 seconds of the test, subjects' power drifts slightly under their MAP. Previous researches on 3MT have investigated the pulmonary oxygen kinetics, lactate threshold and critical power. However, the oxygen flow in the skeletal muscle during and after a supra-maximal effort needs yet to be studied. The 3MT could be a valuable laboratory test that mimics the skeletal muscle oxygen behavior at the start of a MTB race. Using near infrared spectroscopy (NIRS) and monitoring deoxyhaemoglobin (HHb) or oxygen extraction, oxyhaemoglobin (HbO<sub>2</sub>), total haemoglobin (THb) or muscle blood flow and tissue saturation index (TSI%), it's possible to better understand oxygen kinetics in the skeletal muscle. Objectives: Determine whether skeletal muscle has during 3MT the ability to extract more oxygen and to use an increased blood flow in comparison with MAP. Also, determine if supra-maximal effort reduces tissue oxygen saturation index (TSI%) in the muscle. Methods: Eight world class elite competitive mountain bikers (age  $21 \pm 2.6$  years;  $VO_{2peak}$ :  $72.01 \pm 3.7$  ml x min<sup>-1</sup> x kg<sup>-1</sup>) conducted a MAP test and a 3MT during a single presence using their own bicycles and a power-measuring rear wheel. Pedaling power,  $VO_2$ , and lactate were measured. Deoxyhaemoglobin (HHb), TSI% and an indirect measurement of muscle blood flow (THb) were monitored by NIRS during both tests. Results:  $VO_{2peak}$  during the 3MT was attained at a test time of  $147.5 \pm 36.6$  sec.  $VO_{2peak}$  measures during the MAP test ( $72.01 \pm 3.68$  ml x min<sup>-1</sup> x kg<sup>-1</sup>) and during the 3MT ( $69.54 \pm 5.46$  ml x min<sup>-1</sup> x kg<sup>-1</sup>) were comparable ( $p = 0.20$ ). During the last 30 sec of the 3MT, pedaling power represented 93.6% ( $p = 0.08$ ) and  $VO_2$  93.3% ( $p < 0.05$ ) of MAP. During the 3MT, peak HHb was significantly lower than the one obtained during the MAP test. However, THb, O<sub>2</sub>Hb and TSI% did not reach higher peak values during the 3MT as compared to the MAP test. In addition, we observed a significant negative correlation between power output and THb during the 3MT ( $r = -0.98$ ,  $p < 0.001$ ), suggesting that skeletal muscle vasoconstriction occurs at higher power outputs. Conclusions: During the 3MT, muscular oxygen transport measured by NIRS never reached a higher peak than those observed during the MAP test. Despite the fact that the average power produced during the 3MT was higher than during the MAP, oxygen saturation of muscle was not lower, suggesting that the muscle cell has a protective mechanism.

### EFFECTS OF DIFFERENT PRESSURE LEVELS IN RESISTANCE EXERCISE WITH BLOOD FLOW RESTRICTION ON GROWTH HORMONE AND INSULIN-LIKE GROWTH FACOR-1 LEVELS IN MIDDLE-AGED WOMEN

Seo, D.I.1, So, W.Y.2, Chang, H.K.2

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Introduction According to the traditional explanation, muscle hypertrophy occurs primarily due to an overload stimulus produced by a progressive increase in mechanical load using at least 70% of an individual's concentric 1 repetition maximum (1RM) (ACSM, 2009). However, several previous studies have suggested that even low-intensity resistance exercise may have a positive effect, such as improving muscle mass and strength, on skeletal muscles (Loenneke et al. 2011). The purpose of this study was to examine how different between

3% and 5% reducing cuff length in low intensity of blood flow restriction (LI-BFR) exercise on growth hormone (GH) and insulin-like growth factor-1 (IGF-1) levels in middle-aged women. **Methods** Subjects were randomly assigned to 5 groups: a control group (CG; n = 8), a low intensity resistance exercise group (LI; n = 9), a high intensity resistance exercise group (HI; n = 9), a low intensity resistance exercise with 5% reduction in cuff circumference for blood flow restriction group (LI-5%BFR; n = 7), and a low intensity resistance exercise with 3% reduction in cuff circumference for blood flow restriction group (LI-3%BFR; n = 11). Subjects in all training groups completed pre- and post-training assessment of all variables, including GH and IGF-1 levels. **Results** A significant interaction effect ( $p < 0.05$ ) was observed for WHR: WHR was reduced in the HI group compared to the LI group. GH showed a significant interaction effect ( $p < 0.05$ ). Elevated GH was observed in the HI group and the LI-5%BFR group compared to the CG group ( $p < 0.05$ ). In addition, elevated GH was observed in the HI group compared to the LI group ( $p < 0.05$ ). Elevated IGF-1 was observed in the LI, HI, LI-5%BFR, and LI-3%BFR groups compared to the CG group ( $p < 0.05$ ). Moreover, increased IGF-1 was observed in the HI, LI-5%BFR, and LI-3%BFR groups compared to the LI group ( $p < 0.05$ ). For muscle strength, a significant interaction effect ( $p < 0.05$ ) was observed for biceps curls, triceps extensions, leg curls, and leg extensions; muscle strength showed improvement in the HI and LI-5%BFR groups compared to the CG group ( $p < 0.05$ ). Further, biceps curls, triceps extensions, leg curls, and leg extensions were increased in the HI and LI-5%BFR groups compared to the LI group ( $p < 0.05$ ). **Discussion** We demonstrated that use of portable cuffs reducing arm and thigh circumference by 5% was effective in improvement of GH, IGF-1, and muscle strength in middle-aged women. In particular, performance of low-intensity exercise with a 5% reduction of circumference with blood flow restriction resulted in similar increases in GH and IGF-1 levels compared to traditional high-intensity resistance exercise. We also demonstrated that using LI-5%BFR resulted in similar improvement in muscle strength compared to traditional high-intensity resistance exercise.

### **A TEST-DERIVED EQUATION TO ESTIMATE OXYGEN UPTAKE DURING INTERVAL TRAINING SESSIONS USING HEART RATE**

Sanna, I.I, Degortes, N.2, Pinna, M.1, Migliaccio, G.M.2, Tocco, F.1, Concu, A.1, Crisafulli, A.1

*University of Cagliari*

**Introduction.** Heart Rate (HR) monitoring represents a noninvasive tool to evaluate fitness (Strath et al. 2000) since, during incremental effort below the anaerobic threshold (AT), there is a direct relationship between HR and oxygen uptake (VO<sub>2</sub>). Thus, HR can be used to assess energy expenditure. The purpose of this study was to examine in middle distance runners the relationship between HR and VO<sub>2</sub> in (1) an incremental running test and (2) in an interval training (IT) session with the aim to test the validity of estimating of VO<sub>2</sub> from HR data during IT. **Methods.** Thirteen athletes performed an incremental test until exhaustion, and an IT session on a treadmill set at two different intensities: at 80% AT and at 120% AT speed. HR and VO<sub>2</sub> were continuously measured during the two tests (VO<sub>2</sub>real) by a portable gas analyzer. An incremental test-derived equation was used on the IT session to estimate VO<sub>2</sub> from HR data (VO<sub>2</sub>est). Bland and Altman statistics were carried out in order to evaluate the agreement between VO<sub>2</sub>real and VO<sub>2</sub>est. **Results.** The mean correlation between HR and VO<sub>2</sub> was  $r=0.92\pm 0.05$ . The Bland and Altman plot highlighted that limits of agreement of the difference between VO<sub>2</sub>real and VO<sub>2</sub>est were widespread. The limit of agreement at 80% of AT were +1384.33 and -1641.95 mL•min<sup>-1</sup>, while at 120% of AT were +1252.54 and -2411.5 mL•min<sup>-1</sup>. **Conclusion.** This study demonstrates that the use of HR monitoring to assess intensity of exercise during interval training session is unreliable. Indeed, it is known that HR response is affected by several potentially perturbing factors, such as cardiac drift, heat stress and dehydration, as well as CO<sub>2</sub> production (Crisafulli et al. 2006). This fact should be taken into account to correctly estimate energy expenditure by HR during training. **References.** Crisafulli A, Pittau G, Lorrain L, Carcassi AM, Cominu M, Tocco F, Melis F, Concu A. (2006). *Int J of Sports Med* 27, 55 – 59. Strath SJ, Swartz AM, Bassett DR, JR., O'Brien WL, King GA, and Ainsworth BE. (2000) *Med. Sci. Sports Exerc.* 32 (9), S465–S470.

### **KINEMATIC AND HEART RATE DEMANDS IN 4X4 VS 7X7 SMALL SIDED GAMES IN PROFESSIONAL SOCCER PLAYERS**

Romero Moraleda, B., Paredes, V., Morencos, E., Peinado, A.B., Butragueño, J., Castillo, A., Calderón, F.J.

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**Introduction** The small sided games (SSG) are one of the most common drills used by coaches for soccer training. In the past, SSG were mainly used for developing technical and tactical abilities. In recent years, there is a growing interest to investigate the effects of the SSG to improve the physical condition of the football player [1-5]. Therefore, the aim of this study was to compare the physiological load, indicated by the response of heart rate (HR) and kinematic variables during exercise SSG 4x4 and 7x7 in professional football players from the Spanish La Liga. **Material and methods** During the season 2011/2012, twenty professional players performed two types of SSG, 4x4 and 7x7, both on the same dimensions (40x25 m.). The response of kinematic variables and HR measured with global positioning system was analyzed using T test for two related samples. **Results** Players performed higher distances in the 4x4 vs 7x7 ( $p < 0.01$ ) but higher values of maximum speed in 7x7 vs 4x4 ( $p < 0.01$ ). On the other hand, the lower the number of players the higher the intensity when it is measured with HR. 7x7 SSG obtained heart rate values upper 85% of maximum HR ( $p < 0.01$ ), while performing 4X4 SSG the predominant intensity measured was 65 -85% of maximum HR ( $p < 0.01$ ). **Conclusion** SSG has shown that the presence of the ball increases the motivation of the players, and allows technical and tactical work simultaneously [6]. Previous studies have shown that this type of training may have a physiological load equal or similar to traditional interval aerobic workouts [1, 7, 8]. The results of this study show that kinematic variables and heart rate obtained significant differences in two small sided games exercises designed as 4x4 vs. 7x7. This is an important issue to consider when planning in terms of training objectives. **References:** 1. Hill-Haas, S. V., Dawson, B., Impellizzeri, F. M., & Coutts, A. J. (2011). *Sports Medicine*, 41(3): p. 199-220. 2. Abrantes, C. I., Nunes, M. I., Maçãs, V. M., Leite, N. M., & Sampaio, J. E. (2012). *The Journal of Strength & Conditioning Research*, 26(4), 976. 3. Aguiar, M., et al. (2012). *Human Kinetics*, 33, 103-113. 4. Brandes, M., A. Heitmann, and L. Mäller. (2012). *The Journal of Strength & Conditioning Research*, 26(5), 1353. 5. Casamichana, D., J. Castellano, A. Dellal. (2012). *The Journal of Strength & Conditioning Research*. 6. Flanagan, T. and E. Merrick. (2002). *Science and football IV*, 341. 7. Dellal, A., Chamari, K., Pintus, A., Girard, O., Cotte, T., & Keller, D. (2008). *The Journal of Strength & Conditioning Research*, 22(5), 1449-1457. 8. Owen, A., C. Twist, and P. Ford. (2004). *Insight*, 7, 50-53.

## FIELD TESTS TO EVALUATE THE GLIDE ABILITY IN MASTER SWIMMERS

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**Introduction** Passive drag, which depends on the individual morphology and body position, is a useful parameter to assess the hydrodynamics of the swimmer (Naemi, Easson et al. 2010). A proper streamlined position affects the performance during the glide (Zaïdi, Taïar et al. 2008). This position is associated to sensory-perceptive skills allowing the swimmers to feel the body segments and to assume the best alignment. The aim of this pilot study was to relate the results of two simple field tests generally used for evaluating the glide ability to the swimming performance in the 100 m front crawl and to passive drag in male master swimmers. **Methods** Ten male master swimmers ( $29.6 \pm 2.4$  years,  $69.9 \pm 4.0$  kg,  $178.4 \pm 3.7$  cm,  $22.0 \pm 0.8$  kg·m<sup>-2</sup>) participated to the study. Participants' passive drag (D) was calculated with Splash software (CC, Busto Arsizio, Italy) from speed variations, measured by Speed RT (APLab, Rome, Italy) and by a digital dynamometer, during passive pull with an elastic rope. To evaluate the glide ability, glide after push-off the wall (G) and glide after dive (DG) field tests were then administered, recording the elapsed time in reaching the distance of 8 m. Finally, the performance in 100 m front crawl in a short course pool was timed. Pearson correlation coefficient was then applied to relate the 100 m performance to D, G and DG and to relate D to G and DG. **Results** The performance on the 100 m front crawl is highly related to D ( $r = 0.93$ ,  $p < 0.001$ ), G ( $r = 0.95$ ,  $p < 0.001$ ) and DG ( $r = 0.94$ ,  $p < 0.001$ ). D is highly related both to G ( $r = 0.97$ ,  $p < 0.001$ ) and DG ( $r = 0.98$ ,  $p < 0.001$ ). **Discussion** G and DG field tests can be used as complementary routine to evaluate the technical component enhancement in swimming training. The relationship between the field tests and the passive drag pointed out the role of the swimmers' ability in assuming the best streamlined hydrodynamic position during gliding, independently of the lower limbs component of the push-off the block or the wall. Therefore, considering the simple protocol of administration and measurement, G and DG field tests are shown to be a suitable way for monitoring the development of the sensory-perceptive skills involved in gliding administration in master swimmers, which is particularly relevant for the overall performance during the start and turn phases. **References** Naemi, R., W. J. Easson and R. H. Sanders (2010). 'Hydrodynamic glide efficiency in swimming.' *Journal of Science and Medicine in Sport* 13(4): 444-451. Zaïdi, H., R. Taïar, S. Fohanno and G. Polidori (2008). 'Analysis of the effect of swimmer's head position on swimming performance using computational fluid dynamics.' *Journal of Biomechanics* 41(6): 1350-1358.

## COMPARATIVE EFFECT OF TWO WHOLE-BODY VIBRATION EXERCISE PROGRAMS ON THE NEUROMUSCULAR FUNCTION AND FITNESS IN YOUNG WOMEN

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**Introduction** Vibratory exercises are increasingly used in sport training and physical rehabilitation. This study aims to determine the comparative effects of two vibratory frequencies on the neuromuscular leg function in healthy young active females. **Methods** Twenty-four women (aged  $21.9 \pm 2.6$  years; weight  $59.9 \pm 7.1$  kg) were randomly assigned into 3 groups of 8 subjects: group 25 Hz (G25), group 30Hz (G30), and control group (CG). All intervention programs consisted of 30 training sessions within a 10-week period. The peak torque at 60°/s in concentric and eccentric actions were measured by an isokinetic dynamometer (Biodex System-3, Biodex Corp., Shirley, NY, USA). Fitness tests such Squat Jump, Counter Movement Jump, Stair-Climbing 10-stairs time, 10-m walking time, were also performed. The effects of the interventions were analysed by an adaptation of Analysis of Covariance adjusted by weight. **Results** Vibratory training at 25Hz induced a significant reduction of peak torque in concentric contraction at the velocity of 60°.sec<sup>-1</sup> and improved the stair-climbing capacity. All other variables remained unchanged in the three groups. **Discussion** The results of the present study suggest that 10-weeks of Whole Body Vibration (WBV) programs improved ballistic strength but not isokinetic strength. Some studies with similar frequencies (between 25 Hz and 40 Hz) reported an improvement on vertical jump after 4 and 8 months (Torvinen et al., 2003 Torvinen et al., 2004). Roelants et al., (2004) showed significant improvements of strength measured by isokinetic dynamometer at low (50°/s) and medium velocities (150°/s) in the knee extensors after 24 weeks at 35-40 Hz. Roelants et al., (2004) experimental subjects, were totally untrained whereas ours were female physically active. However, aquatic training (more isoinertial than vibration) improved in isokinetic dynamometry (Gusi et al., 2006). Therefore, young active women could require longer programs to enhance isokinetic dynamometry and the WBV is a non-specific technology to isokinetic strength. **References** 1. Torvinen S, Kannus P, Sievänen H, Järvinen T, Pasanen M, Kontulainen S, Järvinen T, Järvinen M, Oja P, Vuori I. (2002 – A). *Med. Sc. Sports Exerc.*, 34 (9): 1523-8. 2. Torvinen S, Kannus P, Sievänen H, Järvinen T, Pasanen M, Kontulainen S, Nenonen A, Järvinen T, Paakkala T, Järvinen M, Oja P, Vuori I. (2003). *J. Bone Miner. Res.*, 18 (5): 876-884. 3. Roelants M, Delecluse C, Goris M, Verschueren S (2004). *Int J Sports Med.*, 25(1):1-5. 4. Gusi N, Gusi N, Tomas-Carus P, Hakkinen A, Hakkinen K, Ortega-Alonso A. (2006) *Arthritis Rheum*, 55(1):66-73.

## EVALUATION OF RSA ON-FIELD IN SOCCER GOALKEEPERS

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**Introduction** The aim of this study was to identify a test assessing the ability of the goalkeeper to repeat high intensity actions (RSA) as well as his ability to repeat it several times without decreasing the execution time. **Methods** 9 participants to regional championship have been recruited in this study. Their average age  $23.7 \pm 7.1$  years, average body mass  $76 \pm 11.7$  kg, and height  $181 \pm 7.3$  cm. The protocol targeted the evaluation of the lower limbs explosive strength before and after the execution of the RSA, with different types of jumps namely: Squat Jump (SJ) Counter Movement Jump (CMJ), and Stiffness (ST). The RSA test consisted of 6 series of 4 technical actions typical of the goalkeeper with an interval of 20s between reps. The following parameters were measured: execution time of each sequence (T1-T6), best (BT) and worst (WT) time, total time (TT), ideal time (IT), decrement index (DSc), average heart rate (HR), and average value of blood lactate (BLa). To carry out the protocol a lactate analyzer (Arkray Lactate Pro) was used along with a heart rate monitor (Polar) and an Accelerometer (FreePower Jump). **Results** Results from the evaluation of the explosive strength before RSA test were: SJ  $0.43 \pm 0.05$ m, CMJ  $0.41 \pm 0.16$ m, ST  $0.34 \pm 0.12$ m. On its hand, post-exercise values were: SJ  $0.48 \pm 0.23$ m, CMJ  $0.40 \pm 0.05$ m, ST  $0.36 \pm 0.08$ m. Finally, values during the RSA test were: BT  $12.1 \pm 0.8$ s, WT  $29.9 \pm 48.8$ s, TT  $97.3 \pm 60.4$ s, DSc  $-7.9 \pm 7.6$ s, HR  $176.5 \pm 9.2$ bpm, BLa  $11.8 \pm 1.9$ mmol / L. **Conclusion** One of the limitations of this study was that it was no conducted in a standardized surface. Instead, several grounds were used: artificial, real grass, and beaten ground. Thus, the difference in terms RSA duration was probably to be of ascribed to this bias. In fact, a big difference between the best and the worst time was found, whereas values of explosive strength showed a less marked difference. BLa and heart rate values are in line with those already found in the scientific literature, thereby confirming the validity of the

test employed in the present investigation. References Evaluation of a specific reaction and action speed (RAS) test for the soccer goal-keeper. Knoop M, Fernandez-Fernandez J, Ferrauti A. J Strength Cond Res. 2012 Nov 17 Physical Characteristics, Physiological Attributes, and On-Field Performances of Soccer Goalkeepers. Gal Ziv, Ronnie Lidor, International Journal of Sport Physiology and Performance, 2011, 6, 509-524

### RELATIONSHIP BETWEEN JAVELIN THROW PERFORMANCE AND ABILITY OF MEDICINE BALL THROW AND MUSCLE OUTPUT IN UPPER LIMB

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**Introduction** The training for javelin throw is highly specific and requires precise technical development. Also, Javelin throw is required an explosive ability that elicit a stretch-shortening-cycle (SSC) in the upper limb. It is common SSC training to using medicine ball among the javelin throwers. Therefore, the purpose of this study was to clarify the relationship between javelin throw performance and ability of medicine ball throw and muscle output in upper limb. In addition, it was examine the correct upper limb training way of javelin throw. **Methods** The subjects were eight male javelin throwers (age: 20.8±2.4yrs, height: 177.8±4.6cm, body weight: 78.4±6.6kg, PB: 63.08±7.7m). The subjects performed using medicine ball throw (2kg). The ability of medicine ball throw test (Tauchi et al., 2005) was three concentric throw (CT) and three SSC rebound throw (RT) that was supine position on the bench inclined 30° in the horizontal position to throw the ball as quickly and as far as possible, and farthest throw was adopted from CT and RT respectively. The muscle output in extension and flexion action of elbow and shoulder were measured by using isokinetic dynamometer (Biodex system3) at angular velocity of 60, 120 and 180 deg/s, and highest peak torque was adopted from each angler velocities. In addition, javelin throw performance (JP) values were the total three throw same as competition rule with recorded best throw. **Results** The results were as follows: the ability of RT was significantly higher than CT ( $p < 0.01$ ). There were no significant correlation between JP and muscle output of elbow and shoulder. Similarly JP was not related to the CT and RT. However, significant correlation was observed between CT and muscle output of elbow in extension and flexion. Also RT was closely related to the muscle output of shoulder in flexion. **Discussion** The medicine ball throw was effective in SSC of upper limb for medicine ball training. Even though it was clearly the improvement of muscle output of upper limb, was unaffected of between JP and ability of medicine ball throw in upper limb directly. However, training for improve JP is must be performing the same as release movement. Therefore, the muscle output and correct medicine ball training of upper limb and coaching together is important to depending on the situation, to select the method of training, it is possible to prevent injury of elbow and shoulder joints. In addition, also important to develop javelin throw technique, it can be expectation of better javelin throw performance. **References** Komi PV (1984) Exercise and Sports Sci Reviews. 12, 81-121 Tauchi K, Kudo Y, Ohyama B K, Takamitsu K. (2005) Int J of Sports and Health Sci. 3, 286-295

### PHYSICAL FITNESS TEST RESULTS OF MILITARY PILOT APPLICANTS IN FINNISH AIR FORCE: YEAR 1998 VERSUS 2012

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**Introduction** According to recent empirical evidence the increase in overweight and decline in physical fitness of young men entering military service has become a challenge for the armed forces in Europe. Especially the aerobic fitness has declined during the last ten years among the Finnish conscripts. The aim of this study was to compare physical fitness capacity of military pilot applicants in 1998 and 2012 in Finnish Air Force (FINAF). **Methods** The study group consisted of two cohorts: applicants of 1998 (N = 164) and 2012 (N = 193). The FINAF pilot selection consists of five phases and both cohorts represent applicants who were selected to third phase after psychological and medical tests. All subjects must have reached the minimum level of 3,5 W max<sup>1</sup>/kg in ergometer and 8 points to pass to third phase. FINAF has used the same standardised physical fitness tests to evaluate applicants' physical fitness for 14 years. Aerobic fitness is evaluated with bicycle ergometer test and muscle endurance with five tests. The initial work load of the ergometer test is 20 W and it is increased by 20 W every minute until exhaustion. The work capacity in the ergometer test is measured as the average load (watts per weight) of the last minute (W max<sup>1</sup>/kg). The muscle fitness tests include: standing long jump-, pull-up-, sit-up-, back extension and push-up tests. Each test is valued with a scale from 0-3. Student's t-test was used to compare the levels of these variables between two groups. **Results** The average result of bicycle ergometer test was 4,2 (sd 0,47) W max<sup>1</sup>/kg and average result of muscle test battery was 12 pts in 1998 and 4,1 (0,47) W max<sup>1</sup>/kg and 12 Pts in 2012. The average weight and height of the candidates in 1998 selection were 70,2 (7,8) kg 178,6 (5,1) cm while in 2012 selection the average weight and height were 70,9 (7,8) kg and 178,0 (4,7) kg. No statistically significant differences were found between the two groups. **Discussion** Even though the aerobic fitness capacity has decreased and average weight has increased during the last years among the Finnish conscripts, this change is not seen in the military pilot candidates. **References** Rintala H. (2012) Military pilots' physical performance and occupational musculoskeletal disorders. Academic Dissertation, National Defense University, Helsinki Finland. Santtila M, Kyröläinen M, Vasankari T, Tiainen S, Palvalin K, Häkkinen A, Häkkinen K. (2006) Physical fitness profiles in young Finnish men during the years 1975-2004. Medicine and Science in Sports and Exercise 38, 1990-1994.

### INTERPRETATION OF TRAINING INTENSITIES BETWEEN ENDURANCE AND SPRINT SWIMMERS IN FRONT CRAWL

Invernizzi, P., Scurati, R., Bosio, A., Longo, S., Michielon, G.

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**Introduction** During a training session coaches often administer the athlete's pacing intensities through instructions such as: "swim slow or moderate or fast". The athletes' experience and perception of speed are crucial for accomplish the given task, which seems not easy to be executed (Stewart & Hopkins, 1997). Moreover, competitive and training background could influence the effort perception and pacing distribution throughout a training session. Therefore, the aim of this study was to assess endurance (EN) and sprint (SP) swimmers' interpretation of slow, moderate and fast intensities during a training session. **Methods** Eight EN (age 19±3 years, height 176±3 cm, body mass 67.5±3.6 kg, 2 females) and 8 SP (age 18±1 years, height 179±5 cm, body mass 70.6±6.8 kg, 1 female) elite front crawl swimmers were recruited. Firstly, the best 50 m performance was assessed. On another day, they were asked to swim three sets of 8 x 50 m front crawl interpreting three different speeds: slow (S), moderate (M) and fast (F). Within each speed, a rest of 2, 3 and 5 s was allowed between each of the 8 trials (S, M and F, respectively). A rest of 3.5 min was observed between sets. Speed (m·s<sup>-1</sup>), normalised speed to the best 50-m performance (%best), stroke frequency (SF, Hz), and stroke length (SL, m) were collected. ANOVA (2x3), Cohen's effect size (ES) and ICC were used to test differences between groups and speeds ( $p < 0.05$ ) and reliability. **Results** No differences between groups were

found at any speed. However, when expressed as %best, significant differences ( $p < 0.01$ ) were present between groups at each speed (S:  $73.5 \pm 2.3$  vs  $66.8 \pm 4.8$ ; M:  $79.5 \pm 3.4$  vs  $73.3 \pm 4.0$ ; F:  $84.9 \pm 4.1$  vs  $79.6 \pm 3.3$ , EN and SP, respectively, ES range: 1.35–6.72). SF was significantly different ( $p < 0.01$ ) between groups (S:  $0.59 \pm 0.06$  vs  $0.55 \pm 0.04$ ; M:  $0.70 \pm 0.08$  vs  $0.63 \pm 0.05$ ; F:  $0.78 \pm 0.04$  vs  $0.72 \pm 0.03$  Hz, EN and SP, respectively; ES range: 0.81–1.54), whereas SL did not differ between groups. Within each speed, ICCs were high (range: 0.89–0.99). Discussion Despite different competitive backgrounds, our swimmers showed similar absolute speed values. However, when normalised to %best, SP swam at slower %best with a lower SF than EN. Probably, our SP perceived that swimming closer to their best performance (that was significantly higher than EN) could have compromised the success of completing the 8x50 m swim at constant pace (especially at F), which was accomplished based on ICCs. Coaches should be aware that different competitive background could lead to different interpretation of intensities instructions. References Stewart AM, & Hopkins WG. Swimmers' compliance with training prescription. *Med Sci Sports Exerc* (1997); 29(10), 1389-1392.

### ANALYSIS OF MUSCULAR IMBALANCES AS INTRINSIC RISK FACTORS OF LOWER LIMB MUSCLE AND LIGAMENT INJURIES IN SPANISH 3RD DIVISION FOOTBALL PLAYERS

Rudé, A., López, J.L.

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Introduction Muscular imbalances in football appear due to the repeated unilateral actions players execute throughout their career. These muscular imbalances are considered one of the most predictable muscular and ligament injury risk factors. The aim of this study was to analyse the Bilateral Deficit (BLD), the Limb Symmetry Index (LSI) and the Quadriceps to Hamstring Ratio (Q/H) using MuscleLab® Technology (Ergotest, Norway). Methods The tests used were a counter-movement jump test (BLD); a 10 meters unilateral hop test (LSI); and a leg flexion and extension test (Q/H ratio), all monitored using MuscleLab® software (Alkner and Tesch, 2004). To obtain the strength deficits we used three equations: %BLD =  $[(BL - (Unil. Right + Unil. Left)) / BL * 100]$  (Acero et al., 2007) %LSI =  $[(weak\ current\ leg / strong\ current\ leg) * 100]$  (Gaunt and Curd, 2001) %Q/H conventional ratio =  $[(hamstring\ concentric / quadriceps\ concentric)]$  (Yeung et al., 2009) Results The BLD average was  $-9.6 \pm 10.1$ , the LSI average was  $96.6 \pm 2.1$ , and the Q/H ratio average was  $63.3 \pm 0.1$  on both legs. Discussion Overall, 82.4% of the players in our study displayed BLD and only 17.6% did not. Acero et al. (2007) found a BLD of between -21.51 and -23.11 in a study of 258 footballers. In our study, 88.2% of players had a lower BLD while 11.8% displayed a higher deficit than the previous study, the average being  $-9.6 \pm 10.1$ . This strength deficit is considered to indicate a risk of muscular injuries (Howard and Enoka, 1991). Regarding LSI, if the index is more than 90%, there is considered to be no injury risk (Anderson et al., 2006). The average with our players was 96.6, all of them being above 90%. Consequently, they exhibited no muscular injury risk. The strength difference between the two legs could be balanced because the non-dominant leg is used for balance in football. The Q/H ratio of each leg should be at least 75% for the risk of muscular and ligament injury to be ruled out (Dintiman et al., 2001). Overall, the average data of our players was  $63.3 \pm 0.1$  in both legs. Specifically, 82.4% were below 75% on their right leg, and 70.6% on their left leg. References Acero J, Albarracín J, Arias H. (2007). Proceedings of Progress in Motor Control VI International Society of Motor Control, Sao Paolo, Brazil. August 9-12. Alkner BA, Tesch PA. (2004). *Eur J Appl Physiol*, 93(3), 345-357. Anderson A, Irrgang JJ, Kocher MS, Mann BJ, Harrast JJ. (2006). *Am J Sports Med*, 34(1), 128-35. Dintiman G, Ward B, Tellez T. La velocidad en el deporte. (2001). Madrid: Editorial Tutor. Gaunt, BE, Curd DT. (2001). *J Orthop Sports Phys Ther*, 31, 145-151. Howard JD, Enoka RM. (1996). *J Bone Joint Surg*, 78A, 814-825. Yeung SS, Suen AM., Yeung EW. (2009). *Br J Sports Med*, 2009, 43, 589-94.

15:00 - 16:00

### Mini-Orals

#### PP-PM64 Sports Medicine [SM] 8

### EXUBERANT INFLAMMATORY REACTION AFTER AN INFILTRATION OF PLATELET-RICH PLASMA

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Background : PRP, obtained from centrifuged autologous blood, contains a large quantity of growth factors, which may enhance tissue healing processes. Local infiltration of PRP represents a relatively new treatment for tendinopathies. To date, no side effects have been reported after infiltration of PRP to treat tendinopathy. Case report : A 35-year-old patient had a right upper patellar tendinopathy which was resistant to all of the conservative treatments for more than 6 months. The patient was a type 1 diabetic (well controlled). He benefited from an intratendinous infiltration of 6 mL of PRP ( $8.105$  platelets/ $mm^3$ , almost no red or white blood cells) without local anaesthetic. Immediately following the infiltration, local cryotherapy was performed for 15 minutes. NSAIDs were avoided, but class-1 or -2 pain-killers were authorised if necessary. A standardised sub-maximal eccentric rehabilitation should be started 1 week after. However, the patient experienced local swelling with erythema, increased heating and pain which appeared just underneath the patella, but without biological inflammatory syndrome. A great Doppler signal in a thicker patellar tendon was observed by US, but there was no sign of local infectious disease demonstrated by either CT or MRI. However, the local inflammation did not decrease after a progressive 3-week treatment of local cryotherapy, local and oral NSAIDs and colchicine 1 mg. Thus, an insidious infection was suspected, even though there was neither evidence of biological inflammatory syndrome or sign of infectious lesion on imagery examination. An antibiotic therapy (rifampicine 600 mg + minocycline 100 mg) was initiated for 3 months. Finally, a 3-phase bone scintigraphy suggested the presence of a complex regional pain syndrome type 1 treated by a classical physical therapy and concomitant class-2 pain killers. The evolution was favourable after 6 months of symptomatic treatment, and the pain decreased to a level similar to that before the infiltration of PRP. Discussion/ Conclusions: This case report calls attention to potential side effects that are linked to this new therapy by infiltration of platelet rich plasma in case of tendinopathy, in particular when used in patients with type 1 diabetes. Thus, the balance between benefits and risks must be carefully evaluated before using this treatment in patients with type 1 diabetes. References: Platelet-rich plasma application in the management of chronic tendinopathies. *Acta Orthop Belg* 2013; 79: in press

### EXERCISES TO PREVENT THE SUSPENSION TRAUMA IN WORKERS USING HARNESS.

Pollastri, L., Lanfranconi, F., Bartesaghi, M., Vergani, H., Molteni, C., Scotti, V., Novarina, M., Miserocchi, M.

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**Introduction** Workers involved in tasks that need harness could face an unexpected fall that is barely not the major adverse effect: indeed, a prolonged orthostasis during work in harness may drive to a chain of events including unconsciousness known as "suspension trauma" (ST). Purpose of this study is to evaluate cardiovascular changes during work in harness and to evaluate whether a strategy based on specific exercises could prevent ST. **Methods** The SOSPEI project consisted of 2 experimental phases: on day 1, we evaluated the cardiovascular response to simulated working tasks being suspended in a full body harness (phase1); on day 2 we estimated the impact of the introduction of specific exercises (phase2) aimed to favor the venous return during the working session, in order to contrast the factors leading to ST. Forty volunteers were tested up to a maximum of 3 hours of suspension or until subjective distress of developing ST. We measured oxygen uptake (VO<sub>2</sub>), heart rate (HR) and by near-infrared spectroscopy (NIRS) muscle oxygenation ( $\Delta$ [HHb]) of the vastus lateralis muscle and cerebral O<sub>2</sub> saturation. Furthermore we evaluated the cognitive status and the neuro-muscular coordination. **Results** During phase1, 47,3% of volunteers showed hypertensive values for diastolic and systolic blood pressure. Moreover, despite a mild energy expenditure ( $34,8 \pm 9,56$  %VO<sub>2</sub>max) during work in harness, the individual perception of fatigue (evaluated by BORG's scale) was compatible with a work rate corresponding to 80% VO<sub>2</sub>max as during an incremental test on treadmill. In phase2, specific exercises aimed to improve the venous return were carried out while subjects were performing their work load in harness. Compared to the work tasks of phase1, the exercise strategy caused an increase of cerebral blood flow and a lower utilization of the cardiac reserve (6,2% Vs 10,3%). Furthermore the introduction of the exercises strategy led to a significant lengthening of the suspension time before subjective distress feeling. **Discussion** Exercise strategy to improve venous return alleviates the tolerance of work in harness but does not eliminate neither the fatigue distress nor hypertension, likely reflecting a stable increase in peripheral vascular resistances. This point represent a cardiovascular risk factor for workers in harness. **References** Seddon P. Harness suspension: review and evaluation of existing information. Contract Research Report (for the Health and Safety Executive), 2002 Jiskoot J, Clarys JP (1975).

### NEW APPROACH FOR CRITICAL PREVENTION OF OSGOOD-SCHLATTER DISEASE IN SOCCER

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**Introduction** The Osgood-Schlatter disease (OSD) is known as a typical sports injury at the period of growth. Repeated strong contraction of the large patellar tendon may cause softening and partial avulsion of the developing secondary ossification center of tibia tuberosity. Some researchers reported about the risk factors of OSD, for instance abnormal lower limbs alignment. Now it is impossible to prevent OSD with these risk factors. It is obvious that frequent huge contraction forces of patellar tendon induce OSD. Soccer coaches should have controlled the contraction force of patellar tendon with young soccer players in training. Accordingly, if one day a young soccer player has huge contraction forces of patellar tendon, the same training program should be avoided in a few days because of recovery from the damage of tibia tuberosity. It is important to reveal the extent of the contraction force in motion of soccer. The contraction forces must be associated with a knee extension torque. It was investigated the knee extension torque for each motion of soccer training. The purpose of this study was to reveal the risk motion that onset of OSD during soccer activity. **Methods** The subjects of the present experiment were 8 healthy adult males soccer players. Nine typical motions were performed in soccer. Motion data were collected three-dimensionally by a motion analysis system consisting of eight cameras at 200Hz, and ground reaction force data were collected using a force plate at 1000Hz. Knee extension torques were obtained by using an inverse dynamic technique. **Results** As for the peak value of knee extension torque, single leg drop landing ( $3.45 \pm 0.65$  Nm/kg) showed high value. This was followed by, stop motion ( $3.19 \pm 0.23$  Nm/kg), cutting ( $3.05 \pm 0.58$  Nm/kg), kick motion ( $2.91 \pm 0.40$  Nm/kg), double legs drop landing ( $2.75 \pm 0.93$  Nm/kg), approach ( $2.48 \pm 0.37$  Nm/kg), sprint ( $2.30 \pm 0.50$  Nm/kg), turn ( $2.12 \pm 0.41$  Nm/kg), squat ( $0.75 \pm 0.14$  Nm/kg). **Discussion** The knee extension torque of single leg drop landing is significantly higher than these soccer motions of approach, sprint, and turn. It was revealed that the motions of single leg drop landing, stop motion and cutting induce strong contraction of the patellar tendon, compared with approach, sprint, and turn. Classifying motion according to the knee extension torque value, and making the training program that considered the loading dose thought it was profitable for the prevention of the OSD. In this case, balance of intensity to become the point. For the early teens, perform the high intensity training that load hangs for a cardiopulmonary function because the growth of respiratory and circulatory systems becomes active, and it is thought that it becomes important that such a training of the load reduces it to the body of the period of growth. The future examination subject, pursue data and an approach method to be able to make use of on the field. **References** M. S. TURNER et al. (1981). J Bone Joint Surg, 63-B, 396-398

### A META-ANALYSIS OF INJURIES IN SENIOR MEN'S PROFESSIONAL RUGBY UNION

Williams, S., Trewartha, G., Kemp, S.P.T., Stokes, K.A.

*University of Bath*

**Introduction:** Rugby union has one of the highest reported incidences of match injuries amongst all professional team sports (e.g. Brooks et al., 2005). The majority of research within this field has focused on elite male cohorts; here we present the first meta-analytic review of these data. The aim of this study was to summarise the incidence and severity of injuries in senior men's professional rugby union, and determine overall effects of: Level of play; new versus recurrent injuries; playing position; type of injuries; location of injuries; severity of injuries; period of match; and mechanism of injuries. **Methods:** Electronic databases were searched using key words 'rugby union' and 'inj\*'. Fifteen papers addressing injuries in senior men's professional rugby union (1995 through to September 2012) were included in the review. A maximum of 10 of these papers provided incidence data that could be modelled via a Poisson mixed-effects generalised linear model, while up to nine studies provided severity data that could be modelled via a general linear mixed model. Magnitude based inferences were used to assess differences between factors. **Results:** The overall incidence of injuries in senior men's professional rugby union matches was 81 per 1000 player h (95% confidence interval [CI]: 63-105), and 4 per 1000 player h (95% CI: 3-5) during training. Estimated mean severity for match injuries was 20 d (95% CI: 14-27), and 22 d (95% CI: 19-24) for training injuries. A higher level of play was associated with a greater incidence of injuries in matches, with no clear difference in severity. New injuries occurred substantially more often than recurrent injuries, while the severity of recurrent injuries was, on average, 10 d (95% CI: 4-17) greater than new injuries. Trivial differences were found in injury incidence and severity between forwards and backs. Muscle/tendon and joint (non-bone)/ligament injuries were the two most prevalent injury groups, whereas fractures and bone stress injuries had the highest average severity. The lower limb was the body region with the highest injury incidence, while upper limb injuries were most severe. The third

quarter of matches had the highest injury rate, and injuries most commonly occurred as a result of being tackled. Discussion: This meta-analysis confirms match injury incidence rates in professional rugby union can be considered high in comparison to other team sports but similar to other collision sports. In order to markedly reduce overall injury burden, efforts should target lower limb injury prevention strategies and technique during contact, as these may render the largest effect. References Brooks et al. (2005). *Br J Sports Med*, 39, 757-66. Acknowledgement Funded by the Rugby Football Union

### EPIDEMIOLOGY OF MATCH INJURIES IN ELITE ENGLISH WOMEN'S RUGBY UNION – INITIAL FINDINGS.

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Introduction Participation in women's rugby has seen huge growth in recent years, but little evidence is available relating to the risk of injury. We conducted a longitudinal analysis of match injuries sustained by elite female rugby players. Methods A cohort design was employed to study match injuries sustained by adult female rugby union players during 166 matches (2320 player hours) in the English Premiership competition and separately whilst competing internationally for England (21 matches; 420 player hours) during the 2011/12 and 2012/13 seasons. Team medics reported all match time-loss (>24 hours) injuries on a weekly basis, detailing severity, location, diagnosis and injury mechanism. Incidence rates were calculated using match exposure details. Significant differences were assumed if the 95% confidence intervals (CI) did not overlap. Results Injury incidence in Premiership matches was 39 injuries per 1000 player hours (95% CI: 32, 48) with a mean severity of 44 days (median=15 days). Injury incidence in England international matches was 74 injuries per 1000 player hours (95% CI: 52, 105) with a mean severity of 81 days (median=39 days). In both cases, the tackle was the event resulting in the greatest proportion of injuries (Premiership=53%; England=42%) and the most days lost (Premiership=61%; England=59%). The lower limb was the body region most commonly injured and ligament injuries the most common type of injury in both Premiership and England matches. Discussion Injury incidence rate for female players during Premiership matches is significantly lower than their male counterparts (39 v 93 injuries per 1000 player hours [Kemp et al., 2011]); this might be because sex is a risk factor for injury or due to the amateur status of the women's game. In contrast, the overall incidence of injuries for England's women and men during international matches was very similar (74 v 78 injuries per 1000 player hours, respectively); however, total days absence was significantly higher for England women compared to men (5969 v 1789 days absence per 1000 player hours [Kemp et al., 2011]). The greater severity in women's rugby may be due to players sustaining more serious injuries; however, it may also be due to limited medical support and players balancing full-time careers with rehabilitation programmes. The tackle was associated with the greatest proportion of injuries and the lower limbs were most frequently injured. Consequently, if the injury burden is to be reduced then both the technique in the tackle and lower limb injury prevention/rehabilitation strategies should be targeted. References Kemp SPT et al. (2011). *England Rugby Premiership Injury and Training Audit 2010-2011 Season Report*. Acknowledgement Research funded by the Rugby Football Union.

### PREVENTION OF FALL-RELATED INJURIES IN 7-12 YEAR OLD CHILDREN: A CLUSTER RANDOMIZED CONTROLLED TRIAL

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Introduction To counteract the recently observed increase in forearm fractures in children worldwide, an educational program to improve fall skills was developed. In this eight week during program children learned basic judo techniques in their physical education (PE) classes. In this study the effectiveness of this educational program in decreasing the number and severity of fall-related injuries was studied. Methods A cluster randomized controlled trial was conducted in 33 primary schools. The intervention group received the educational program to improve falling skills during their PE classes while the control group received their regular PE curriculum. At baseline (October 2009) and follow-up (May 2010), a questionnaire was completed by the children about their physical activity behaviors. Furthermore, fall-related injuries were registered continuously during a school year. Differences between groups were analyzed using a generalized linear mixed model, adjusting for cluster effects and confounding. Results After receiving the intervention, children showed a reduced number of fall-related injuries per 1.000 hours of physical activity compared to children that did not receive the program (injury incidence density intervention group 0.14 [95% CI 0.09 – 0.18] vs control group 0.26 [95%CI 0.21 – 0.32]). However, because of major cluster effects the difference in injury incidence was not significant. Including habitual physical activity into the model revealed a trend suggesting that the educational program to improve fall skills was effective in decreasing falling-related injury risk, but only in the least active children. For injury severity, no differences were found between study groups. Discussion/Conclusion(s) The present study is one of few intervention studies on physical activity related injuries in children, and to our knowledge the first to target fall-related injuries in a school based setting. Our finding that the least active children might benefit most from this type of injury prevention is in line with findings of Collard et al who, in a comparable study, reported that their physical activity related injury prevention program showed larger effects for those children with low habitual physical activity levels. This is arguably due to the increased injury risk in the low active group as found in the current and previous research. While injury risk is high due to reasons yet to be established, preventive effects of a school-based injury prevention approach may have a large impact. This dilutes the overall effect when adjusting the analyses for the clustered design.

### PROSPECTIVE INJURY SURVEILLANCE OF WOMEN'S LACROSSE: A 2-YEAR STUDY

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Introduction Lacrosse is a fast-paced game that involves running, cutting, and jumping maneuvers while a cross (stick) is used to pass, catch, and shoot a ball (Lincoln et al., 2007). In the National Collegiate Athletic Association Injury Surveillance System data for women's lacrosse (Dick et al., 2007), the most frequently injured body part was the ankle, the most common type of injury was sprain, and the most common mechanism of injury was non-contact. There is not much literature with respect to injury characteristics in Japanese women lacrosse players. The purpose of this prospective study was to examine the specific injury characteristics in collegiate women's lacrosse for a 2-year season in Japan. Methods Injury data were collected from the Division I collegiate women's lacrosse team over a 2-year period (April 2010 to March 2012). The individual injury data items gathered were the number and incidence of injuries, the injured body part, the type and mechanism of injury, injury recurrence, and the days that elapsed until full participation in practice. The injury incidence rate was indicated as 1000 athlete-hours and 1000 athlete-exposures (1000 AHs and 1000 AEs, respectively). An injury was defined as an incident that occurred during practice and/or games and resulted in the player missing 1 day or more of participation in practice and/or games. Results The total AHs and AEs over the 2-year period were 27,621 and 13,437, respectively. The total number and incidence rate

of injury was 309 injuries and 11.19 injuries per 1000 AHs and 23.00 injuries per 1000 AEs, respectively. The most frequently injured body part was the ankle, followed by the knee and the thigh (2.24, 1.63, and 1.20 injuries per 1000 AHs, respectively). The proportion of lower extremity injuries was approximately 74% of all injuries. Sprains and muscle cramps/spasms (24.9% and 24.6%, respectively) were the two most common types of injury. The most frequent mechanism of injury was overuse (39.1%), contact (e.g., other players, the cross, and the ball; 24.9%), and non-contact (17.2%). Non-contact ankle sprain was found to be the most frequent injury pattern in women lacrosse players. Injury recurrence accounted for 26.1% of all injuries, and the most number of days required for the player to return to practice and/or games was between 3 and 7 days. Discussion An understanding of the specific injury characteristics of women lacrosse players may facilitate the development of an injury prevention program, which is 1 component of the comprehensive strategy for injury prevention based on the 4-step injury prevention model proposed by van Mechelen et al. (1992). References Lincoln AE et al. (2007). *Am J Sports Med*, 35, 207-215. Dick R et al. (2007). *J Athl Train*, 42, 262-269. van Mechelen W et al. (1992). *Sports Med*, 14, 82-99.

### JOGGERS OVER 40 YEARS: INCIDENCE OF INJURIES BY ANATOMIC REGION

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Introduction Jogging is gaining popularity without interruption since the seventies and runners older than 40 are increasing with it. PURPOSE: Verify if injuries over 40 are similar to those within a younger sample of joggers. Methods A questionnaire including 23 issues was submitted to more than 1000 registered joggers of a particular region in France. The majority of questions related to injury and personal approach of their running frequency over the last year. Results 597 valid responses, divided as 233 subjects (183 male; 50 female) under 40 and as 364 subjects (277 male; 87 female) over 40 were received (overall BMI  $22.78 \pm 2.38$  kg.m<sup>2</sup>). In the -40 sample more subjects perform less than 20 km/week compared to the +40 sample ( $P < 0.05$ ) and -40 runners are equally lesser involved in competition than the older group. The choice of underground and the level and frequency of warming-up are identical in both groups. The +40 group, however, will pay more attention to muscle elongation practice and hydration ( $P < 0.05$ ). That same group will use its running shoes for more than 1500 km while almost 99% of the -40 group will change earlier. 83.4% of all subjects were injured in the preceding year (NS between groups). Regardless the age the knee was the most occurring injury type (50.5%-40; 38.9% +40) followed by ankle strains, in majority (18.9%) in the younger group and by the pedis region in the older group (24.8%). Muscular lesions occurred most in the +40 group (26.1% versus 16.7%;  $P < 0.02$ ). Discussion Injuries in our sample are more frequent than in other studies (Macera et al., 1989; Rochongar et al., 1995) but in accordance with McKean et al. (2006) related to the knee in particular. In the +40 group, the foot ranked second and is ranked fifth localization in the -40 group. In accordance with Rochongar et al., we found no relation between lesions and the choice of underground. Conclusions The combination of more distance/week, more competition and longer use of shoes may be at the origin of the increase of foot lesions in the +40 group. References Macera CA, Pate RR, Powell KE, Jackson KL, Kendrick JS, Craven TE. (1989). *Arch Intern Med*. Nov 149(11), 2565-2568 Rochongar P, Pernes J, Carré F, Chaperon J. (1995). *Science and Sports*, 10, 15-19 McKean KA, Manson NA, Stanish WD. (2006). *Clin J sport Med*. 16(2) : 149-154.

### CAN THE FUNCTIONAL MOVEMENT SCREEN™ PREDICT INJURIES IN VETERAN SOCCER PLAYERS?

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Introduction The Functional Movement Screen™ (FMS™) consists of seven tests and aims to assess the quality of fundamental human movements. Its application is widely used to predict injuries. Despite the frequent practical use of the FMS™, only few studies have examined a possible relationship between the test result and the injury risk and none with regards to veteran soccer players. Therefore, the purpose of this study was to determine whether the FMS™ can be used to predict injuries in veteran soccer players. Methods 18 veteran soccer teams ( $n = 238$ ) were recruited for a prospective 9 months follow-up (1 season). The players (age:  $44 \pm 7$  years; weight:  $84 \pm 11$  kg, height:  $178 \pm 6$  cm) performed the FMS™ at the start of the study period. Player exposure hours and injuries were recorded according to the FIFA/UEFA consensus statement (Fuller et al., 2006). Only time-loss injuries were considered. Results The median FMS™-score was 12 (25th percentile: 10, 75th percentile: 14). No FMS™ Cut-off-score could be detected by using Receiver Operating Characteristic (ROC) curves (area under the curve [AUC]: 0.56,  $p = 0.17$ ). Univariate logistic regression, with "injured/non-injured" as the dependent and FMS™-Score as the independent variable, did not reveal a significant relationship ( $R^2 = 0.01$ ,  $p = 0.15$ ) as well. Taking injury incidences (injuries per 1000 h) into account and dichotomizing the group using the median FMS™-score (LOW:  $\leq 12$ ; HIGH:  $>12$ ) as cut point, no significant differences were found either (15.3; 95% confidence interval [CI]: [11.1 - 19.5] vs. 10.8 [7.3 - 14.3]; incidence rate ratio [IRR]: 1.41 [0.92 - 2.15];  $p = 0.11$ ). There is a tendency if the injury incidences of the 25th percentile (LOW25: FMS™-score  $\leq 10$ ) and the 75th percentile (HIGH75:  $\geq 14$ ) are compared (19.2 [13.1 - 25.2] vs. 11.9 [7.3 - 16.4]; IRR: 1.62 [0.98 - 2.66];  $p = 0.06$ ). The results did not differ if contact and non-contact injuries were analyzed separately. Discussion: The findings of this study suggest that the FMS™ is not able to predict injuries in veteran soccer players. However, the results of the comparisons of injury incidences indicate that there might be a tendency towards a higher injury risk associated with lower FMS™ score. Reasons for this results might be too sports unspecific tests or a too imprecise scoring system. References Fuller, C. W., Ekstrand, J., Junge, A., Andersen, T. E., Bahr, R., Dvorak, J., . . . Meeuwisse, W. H. (2006). Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Scandinavian Journal of Medicine & Science in Sports*, 16(2), 83-92. doi: 10.1111/j.1600-0838.2006.00528.x

### RADIOLOGICAL EVIDENCE OF THE CAM DEFORMITY IN ELITE MALE WATER POLO PLAYERS

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Introduction Symptomatic cam type femoroacetabular impingement (FAI) is a source of hip and/or groin pain & injury for the male athlete [1]. This study utilised Magnetic Resonance Imaging (MRI) to assess the evidence of the cam deformity in a cohort of elite male Water Polo players. Methods 3D weDESS MR images of both hip joints using a 3T system were obtained in thirty elite male Water Polo players (24 + 4.2, 17-38). Images were reformatted into a radial plane sequence to accurately visualise the femoral head neck junction (FHNJ). Alpha angle (AA) measures were performed at the superior (S), anterosuperior (A-S), anterior (A) regions of the FHNJ; AA  $> 60^\circ$  was deemed to indicate a cam deformity [2]. The AS FHNJ junction was also graded using a three point grading scale (1- no cam deformity, 2- minor cam deformity, 3- prominent cam deformity). Results The intra-rater reliability of the AA and grading scale were shown to be excellent (ICC 0.986) and good (Kappa 0.674). The mean + SD for AA's at the S, AS, and A regions were  $44.0 + 4.60$ ,  $65.2 + 12.90$  &  $60.4 + 9.40$ . AS

AA's were significantly ( $p > 0.05$ ) greater than AA's at the S and A regions. Overall, 62% (37/60) of the hips were shown to have the cam deformity (AS AA>600); 22/30 athletes were shown to have a cam deformity in one or both hips. Finally, a strong positive Pearson's correlation of 0.817 was recorded between the AS AA and grading scores. Discussion In agreement with previous research [3-6], this study found that the cam deformity was commonly bilateral, most pronounced at the AS FHJ and present around 60% of hips amongst young male athletes. This study highlights the relevance of cam type FAI as a potential source of hip and/or groin pain in the male Water Polo player. References 1. Ganz, R., et al., Femoroacetabular Impingement: A Cause for Osteoarthritis of the Hip. *Clinical Orthopaedics and Related Research*, 2003. 417: p. 112-120 10.1097/01.blo.0000096804.78689.c2. 2. Sutter, R., et al., How Useful Is the Alpha Angle for Discriminating between Symptomatic Patients with Cam-type Femoroacetabular Impingement and Asymptomatic Volunteers? *Radiology*, 2012. 31: p. 31. 3. Johnson, A.C., M.A. Shaman, and T.G. Ryan, Femoroacetabular Impingement in Former High-Level Youth Soccer Players. *Am J Sports Med*, 2012. 22: p. 22. 4. Gerhardt, M.B., et al., The prevalence of radiographic hip abnormalities in elite soccer players. *Am J Sports Med*, 2012. 40(3): p. 584-8. Epub 2012 Feb 15. 5. Pollard, T.C., et al., Genetic influences in the aetiology of femoroacetabular impingement: a sibling study. *J Bone Joint Surg Br.*, 2010. 92(2): p. 209-16. 6. Reichenbach, S., et al., Prevalence of cam-type deformity on hip magnetic resonance imaging in young males: a cross-sectional study. *Arthritis Care Res (Hoboken)*. 2010. 62(9): p. 1319-27.

### **KNEE JOINT POSITION SENSE IN SUBJECTS AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: A PRELIMINARY REPORT OF A LONGITUDINAL STUDY**

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**Introduction** ACL injury and/or reconstruction can affect both the reconstructed and intact knees in terms of a patient's joint position sense and quadriceps muscle activation. However, the changes actually caused by ACL reconstruction and their associated behavioural characteristics are unclear. This longitudinal study aimed at observing the behavioural changes in a year after reconstruction and at assessing the sensorimotor system at the knee joint. **Methods** We included 7 subjects (2 men and 5 women; mean age,  $20 \pm 1.4$  years; mean height,  $162.9 \pm 7.8$  cm; mean body weight,  $57.6 \pm 8.8$  kg) who underwent double-bundle ACL reconstruction surgery with a semitendinosus graft. In this study, we reproduced knee joint position and bilateral position-matching tasks to assess knee joint position sense at 6 and 12 months after ACL reconstruction. We used an electronic goniometer to acquire the knee joint angle during each task performed thrice, and the angles of deviation from the target angle/reference leg were determined as the reproducing/matching errors. **Results** In subjects who underwent ACL reconstruction of the right knee, the mean reproducing errors (Standard Deviation) at 6 and 12 months were  $0.8^\circ$  (2.3) and  $2.1^\circ$  (0.7), respectively, in the reconstructed knee and  $3.7^\circ$  (0.1) and  $1.6^\circ$  (0.0), respectively, in the other leg. In subjects who underwent ACL reconstruction of the left knee, the mean reproducing errors at 6 and 12 months were  $5.1^\circ$  (3.3) and  $4.6^\circ$  (2.3), respectively, in the reconstructed knee and  $3.5^\circ$  (0.5) and  $3.0^\circ$  (3.6), respectively, in the other leg. In subjects who underwent ACL reconstruction of the right knee, the mean matching errors at 6 and 12 months were  $7.6^\circ$  (0.5) and  $2.4^\circ$  (0.2), respectively, in the right reference leg and  $-1.4^\circ$  (6.2) and  $0.9^\circ$  (0.2), respectively, in the left reference leg. In subjects who underwent ACL reconstruction of the left knee, the mean matching errors at 6 and 12 months were  $0.8^\circ$  (3.4) and  $5.6^\circ$  (3.7), respectively, in the right leg and  $3.6^\circ$  (2.3) and  $2.5^\circ$  (3.2), respectively, in the left leg. **Discussion** The levels of the reproducing errors at 6 months and 12 months in both reconstructed and intact knees tended to remain the same in regardless of right- or left-knee reconstruction. As for the position-matching task, the reference limb seemed to change the results at 6 months, implying that the matching process may correlate between the 2 limbs. This effect tends to be lacking at 12 months, but it is plausible that both the reconstructed and the intact knees must be taken into account at the same time 1 year after the reconstruction. Reference Givoni N. (2007). *J Physiol*, 584, 111-119. Gokeler A. (2012). *Br J Sports Med*, 46, 180-192. Urbach D. (1999). *Med Sci Sports Exerc*, 31, 1691-1696.

### **ASSOCIATION BETWEEN THE STRESS FRACTURE AND BONE METABOLISM MARKERS IN FEMALE COLLEGIATE ATHLETES -FOCUS ON 'TRACP-5B' AS A NEW BONE METABOLISM MARKER-**

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**ASSOCIATION BETWEEN THE STRESS FRACTURE AND BONE METABOLISM MARKERS IN FEMALE COLLEGIATE ATHLETES — FOCUS ON 'TRACP-5b' AS A NEW BONE METABOLISM MARKER—** **Introduction** Many female athletes are indefinitely benched from competitions because of the 'female athlete triad' of amenorrhea (menstrual abnormality), stress fractures and bone loss (osteoporosis), and eating disorders. In general, women who suffer from amenorrhea and have low bone mineral density (BMD) (an indicator of bone strength) are at the highest risk for overuse injury of bone that leads to stress fractures (Louis et al., 1991). However, some athletes have achieved superior results in competitions without experiencing stress fractures despite low BMD, suggesting that it is difficult to predict the occurrence of stress fractures based on BMD alone. Recently, the importance of bone metabolism is increasingly being recognized as a factor influencing bone strength (Banfi et al., 2010). Therefore, we hypothesized that bone metabolism markers are important in predicting overuse injury of bone. The purpose of this study was to examine the usability of some bone metabolism markers, especially TRACP-5b, for prevention of overuse injury of bone. **Methods** The subjects were Japanese 142 elite female collegiate athletes who were divided into a stress fracture group and control group. After the measurement of BMD, bone alkaline phosphatase (BAP), N-telopeptide cross-link of type I collagen (NTx), and bone specific tartrate-resistant acid phosphatase (TRACP-5b) in blood samples were measured in the both groups. **Results** No significant differences were observed in the levels of BAP and NTx between the stress fracture group and control group. In contrast, the TRACP-5b levels were  $381.5 \pm 130.7$  mU/dL and  $324.1 \pm 99.9$  mU/dL in the both groups, respectively. A significant increase in TRACP-5b in female collegiate athletes levels was observed in the stress fracture group ( $p < 0.01$ ). **Discussion** Previous studies have demonstrated that TRACP-5b is particularly useful in understanding the physical condition of top-level female skiers (Lombardi et al., 2011). In our study, we conclude that TRACP-5b is a reliable bone metabolism marker compared with other markers, and our results demonstrate that TRACP-5b may be a useful bone metabolism marker for monitoring bone condition in female collegiate athletes. References Louis O, Demerleir K, Kalender W, Keizer HA, Platen P, Hollmann W, Osteaux M. (1991). *Int J Sports Med*, 12, 214-217. Banfi G, Lombardi G, Colombini A, Lippi G. (2010). *Sports Med*, 40(8), 697-714. Lombardi G, Colombini A, Freschi M, Tavana R, Banfi G. (2011). *Eur J Appl Physiol*, 111, 433-440.

**THE EPIDEMIOLOGY OF TIME-LOSS INJURIES IN ENGLISH COMMUNITY LEVEL RUGBY UNION**

Roberts, S.P.1, Trewartha, G.1, England, M.1,2, Shaddick, G.1, Stokes, K.A.1

1: University of Bath, (UK), 2: Rugby Football Union, (UK)

Introduction Research conducted to date on injuries to rugby union players has focussed primarily on elite and youth level. The majority of male senior players participate at community level, yet there is limited information on this group. Therefore, the aim of this study was to establish the incidence and nature of time-loss injuries in English community rugby and to assess differences between different levels of play. Methods Using a prospective cohort study design, injury information was collected from 46 and 67 and 76 English community clubs during rugby seasons 2009/10, 2010/11 and 2011/12, respectively. Club medical staff reported injury information for time-loss injuries occurring during match play and causing a player to miss at least one match. Clubs were subdivided into groups A (levels 3 and 4; mostly semi-professional), B (5 and 6; mostly amateur clubs) and C (7, 8 and 9; social and recreational clubs) for analysis. Logistic regression was used to obtain rates of injuries, together with 95% confidence intervals (CI). Significant differences in the rates of injuries were assessed by comparing the fit (via changes in deviance) of a series of models. Differences were deemed to be statistically significant if  $p \leq 0.05$ . Results The overall injury incidence was 16.9 injuries per 1000 player match hours with a higher incidence for group A (21.7; 95% CI 19.8 to 23.6) compared with group B (16.6; 95% CI 15.2 to 17.9) and C (14.2; 95% CI 13.0 to 15.5, both  $p < 0.001$ ) and a higher incidence in group B compared with C ( $p = 0.011$ ). There was no difference between forwards and backs. The mean time-loss was 6.6 matches absence, with knee and shoulder injuries resulting in a mean of 10.6 and 8.3 matches absence, respectively. Half of all time-loss injuries occurred to the lower limb, with knee and ankle joint/ligament injuries the most common diagnoses. Shoulder joint/ligament injuries were the most common and severe upper limb injuries. Contact events accounted for 80% of all injuries and tackle events accounted for 50%. Running was the most common non-contact injury event, of which 56% were hamstring injuries, and these injuries were predominantly sustained by backs (1.4; 95% CI 1.1 to 1.8) rather than forwards (0.5; 95% CI 0.3 to 0.7;  $p < 0.001$ ). There was a significantly higher injury rate in September and October (early season) compared with all other months ( $p < 0.001$ ). Discussion More time-loss injuries occur at higher levels of community rugby. Injury prevention strategies should focus on player education around the tackle event and exercises which strengthen the muscles in the shoulder, knee and ankle. Acknowledgement Research funded by the Rugby Football Union

15:00 - 16:00

**Mini-Orals****PP-PM17 Health and Fitness [HF] 11****A 16-WEEK AEROBIC INTERVAL TRAINING PROGRAM IMPROVES HEALTH RELATED QUALITY OF LIFE IN METABOLIC SYNDROME PATIENTS.**

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Introduction and Purpose: The SF-12 [1] is a short form survey with 12 questions all selected from the SF-36 Health Survey. This survey provides an overview of a person's perceived mental and physical health as well as their overall health-related quality of life perception. Some studies have used combined strength and endurance training to improve health-related quality of life in a healthy population [2]. The purpose of this study was to assess the effects of 16 weeks of aerobic interval training on health related quality of life (HRQoL) in people with metabolic syndrome. Methods: Forty-eight sedentary metabolic syndrome men ( $n=22$ ) and women ( $n=26$ ),  $52 \pm 9$  years old participated in a 16-week supervised cycle-ergometer high intensity interval training program (45 min, 3 times-week). Their HRQoL was assessed monthly using the SF-12 questionnaire. Two main component scores, mental (MCS) and physical (PCS) were differentiated in this cohort. Results: The scores progressively increased with the duration of the training program. After 16-weeks of aerobic interval training the Physical Component increased by 4.1 units while the Mental Component by 2.3 units compared to pre-training values (9% and 17%; respectively,  $P < 0.05$ ). The overall HRQoL score increased by (8%). The improvement in the metabolic syndrome factors (Z score changes) was highly correlated with the improvements in overall HRQoL ( $P=0.0024$ ). Conclusion: According to the SF-12 survey results a 16-week aerobic interval training program increased by (8%) the health related quality of life (HRQoL) in people with metabolic syndrome. The increase is more marked in the physical component and highly correlated with the biological improvement in the participant's health (Z score). This data suggest that the individual interpretation of the HRQoL is a good index of their biological health. References: 1. Ware J Jr., et al., A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care*, 1996. 34: p. 220-33. 2. Sillanpaa, E., et al., Combined strength and endurance training improves health-related quality of life in healthy middle-aged and older adults. *Int J Sports Med*, 2012. 33(12): p. 981-6.

**FOOD GROUP PREFERENCES AND ENERGY BALANCE IN MODERATELY OBESE POSTMENOPAUSAL WOMEN SUBJECT-ED TO A BRISK WALKING PROGRAM**

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The main objective of this study was to examine the effects of a 16-week walking program on food group preferences and energy balance of 156 sedentary postmenopausal women, 50 to 65 years-old, whose body mass index ranged from 29 to 35 kg/m<sup>2</sup>. Women were subjected to 3 sessions/week of 45 min-walking at 60 % of heart rate reserve. Total energy intake, TEI and food groups preferences (3-day dietary record), total energy expenditure, TEE (3-day physical activity diary), cardiorespiratory fitness, CRF (2-km walking test), anthropometry and body composition (bioimpedance) were measured before and after our walking program. The modest increase in TEE of  $151 \pm 24$  kcal/day (mean  $\pm$  SD) ( $p < 0.0001$ ) leads to body weight and fat mass losses as well as to waist girth reduction ( $p < 0.0001$ ). However, TEI remained unchanged despite a slight decrease in carbohydrate intake ( $-1.0 \pm 0.5$  % TEI;  $p < 0.05$ ) vs. a minor increase in protein intake ( $0.7 \pm 0.3$  % TEI;  $p < 0.05$ ). Analysis of food records revealed a decreased consumption of fruits ( $-0.18 \pm 0.08$  servings/day;  $p < 0.05$ ),

sweet and fatty foods ( $-0.23 \pm 0.09$  servings/day;  $p < 0.01$ ), but an increased oil consumption ( $0.32 \pm 0.08$  servings/day;  $p < 0.0001$ ) after walking. Women with the highest body weight loss showed the greatest reduction in fruits ( $-0.43 \pm 0.16$  servings/day;  $p < 0.05$ ), sugar and sweet foods ( $-0.098 \pm 0.22$  servings/day;  $p \leq 0.05$ ) as well as fatty foods ( $-0.31 \pm 0.21$  servings/day;  $p < 0.05$ ). Women characterized by the greatest fat mass loss showed the highest decrease in fatty food consumption ( $-0.20 \pm 0.19$  servings/day;  $p < 0.05$ ). A similar analysis taking into account tertiles of waist girth or CRF changes did not reveal changes in food group preferences. Our data indicate that moderate physical activity leads to minor changes in food group consumption but does not modify TEI, thus maintaining a negative energy balance in obese postmenopausal women.

### **NO DIFFERENCES IN ACUTE BLOOD PRESSURE AND HEART RATE RESPONSE BETWEEN HIGH INTENSIVE RESISTANCE TRAINING AND TRADITIONAL TRAINING.**

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**Introduction** Regular practise of physical activity would contrast obesity and several related disease<sup>1</sup>, but exercise should be enjoyable and useful to be part of person's lifestyle<sup>2</sup>. It has been recently demonstrated that High Intensity Resistance Training (HIRT) may increase resting energy expenditure after exercise and may reduce Respiratory Ratio hence improving fat oxidation<sup>3</sup>. The shorter exercise time commitment may help to reduce one major barrier to exercise that is the lack of time. The aim of this study was to verify the safety of High Intensity Resistance Training by the monitoring Blood Pressure (BP) and Heart Rate (HR) during one session of HIRT and compare it to the resistance protocols propose by ACSM Guidelines<sup>1</sup> (TT). **Methods** Twenty healthy volunteers performed one session of both type of RT: HIRT technique consists of 6 repetitions, 20" rest, 2/3 repetitions, 20" rest, 2/3 repetitions with 2'30" rest between sets<sup>2</sup>; TT consisted of 3 sets of 15 repetitions with 1'15" rest between sets. We measured Blood Pressure and Heart Rate during exercise and basal lactate after each session. **Results** Subjects shown similar HR response to both training (HIRT= $128,20 \pm 15,64$ ; TT=  $116,29 \pm 14,78$ ), also minimal and maximal value weren't significant different (HIRT=  $89,50 \pm 18,39$  and  $149,33 \pm 16,26$ ; TT= $84,33 \pm 15,23$  and  $150,00 \pm 16,12$ ). No difference was detected also in SBP (HIRT= $134,82 \pm 13,90$ ; TT=  $128,87 \pm 12,46$ ) or DBP (HIRT= $73,38 \pm 10,90$ ; TT= $73,94 \pm 9,66$ ). Interesting during HIRT session DBP reach lower peak than during TT ( $p < 0.05$ ). **Discussion** Different intensity of resistance training elicit similar cardiovascular response in our subjects young healthy subjctets. Furthermore, DBP, the most important BP parameter, reached lower level during HIRT than during TT. The results of this study suggest that HIRT could be a safe type of training. Further studies are needed to evaluate the efficacy and safety of HIRT in overweight subjects. **References** <sup>1</sup>Willis LH. *J Appl Physiol.* 2012 Dec 15;113(12):1831-7. <sup>2</sup>Garber CE. *Med Sci Sports Exerc.* 2011 Jul;43(7):1334-59. <sup>3</sup>Paoli A. *J Transl Med.* 2012 Nov 24;10:237.

### **WALK@WORKSPAIN: IMPACT OF "SITTING LESS AND MOVE MORE AT WORK" ON EMPLOYEES' CARDIOVASCULAR RISK FACTORS**

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**Introduction:** Sitting time represents an independent preventable risk factor for cardiovascular disease (CVD), even among individuals who meet physical activity recommendations (Katzmarzyk et al., 2009). However, approximately 80% of adults work in sedentary and light activity occupations (Tudor-Locke et al., 2011). This study investigated the impact a "sit less and move more" program had on employees' major CVD risk factors. **Methods:** Office employees from four Spanish universities engaged in the program over 19 weeks ( $n=264$ ; age  $42 \pm 10$  years; 171 women). The intervention group (IG,  $n=129$ ) used a pedometer, a diary and a website which provided strategies, motivational materials and interactive features to increase step counts and reduce sitting time at work. Following baseline measures, the intervention consisted of a (i) ramping phase to progressively increase baseline step counts to 10,000 by integrating active working tasks, short and long walking routes at work, (ii) a maintenance phase to sustain the increased volume of step counts through researcher support. An additional campus in each university acted as a control group (CG,  $n=135$ ). Outcome measures were completed at baseline, post-intervention and two months follow-up. Measures included waist circumference, body mass index (BMI) and, systolic and diastolic blood pressure. ANOVA was used to analyse differences within and between groups. **Results:** The IG significantly decreased waist circumference at post-intervention ( $-1.7$ cms,  $p < .05$ ) and two months follow-up ( $-2.1$ cms,  $p < .05$ ). When compared to controls, the IG showed a significant higher decrease on waist circumference post intervention and at follow up ( $-1.0$ cms,  $p < .05$ ;  $-0.7$ cms,  $p < .01$  respectively). There were no significant changes for blood pressure and BMI, but average BMI values did decrease relative to the controls at post intervention, with these decreases maintained at follow-up ( $-0.09$  kg/m<sup>2</sup>). **Discussion:** A workplace program aiming to reduce sitting time and increase step counts successfully reduced abdominal fat and showed a trend towards reducing BMI. Walk@WorkSpain may be an effective intervention strategy for improving some CVD risk factors in office workers. **References:** Tudor-Locke C, Leonardi C, Johnson WD, Katzmarzyk PT. (2011) *J Occup Environ Med*,53,1382-7. Katzmarzyk PT, Church TS, Creig CL, Bouchard C. (2009) *Med Sci Sports Exerc*,14,118-123.

### **THE EFFECT OF 8-WEEKS AEROBIC TRAINING ON QUALITATIVE AND QUANTITATIVE PARAMETERS OF STROKE VOLUME**

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**Introduction** During the increase of exercise intensity the stroke volume (SV) is changing. It increases until the plateau is reached. Data published about this issue are controversy and there is a lack of researches on recreational sports participants. The aim of this study was to analyse changes of the dynamic in SV after 8- weeks of aerobic training and to estimate the changes in some quantitative parameters. **Methods** Sample consists of 18 female recreational sports participants ( $32.3 \pm 5.3$  years). Participants had an intermediate training three times per week on 85% of their VO<sub>2</sub>max with an exercise to rest ratio of 1:1. Once a week, a continues exercise of 8 to 12 km run on 70 – 87 % of their maximal heart rate (HRmax) was performed. Exercise sessions were monitored with Polar (RS400sd, Finland), VO<sub>2</sub>max was measured with on line breath by breath technology (CosmedK4b2). Intensity was calculated using Edwards methodology (Janssen, Dallmeijer, & van der Woude, 2001) and stroke volume was calculated with Stringers formula (Stringer, Hansen, & Wasserman, 1997). **Results** There was an increase of stroke volume in first and second minute of test ( $p < 0.05$ ). HR at SVmax decreased. SV dynamic did not

show any changes. A significant final speed increase was found ( $4.41 \pm 4.62\%$ ;  $p < 0.01$ ). Discussion There were no qualitative changes in stroke volume after 8-weeks of endurance training. This was a consequence of non-significance of the changes in dynamic of SV. This results agree with literature (Astrand, et al., 1964; T. Rowland, 2009), showing a dynamic of plateau in stroke volume. There was an increase of SV in first two minutes of the test ( $p < 0.05$ ) what may reveal quantitative changes. An increase of endurance abilities was found, what can be a consequence of the training intensity. Speed, time and distance were significantly higher on the end compared to first test, as was concluded by Škof & Milić (2010). Low increase of aerobic abilities can be explained by the high endurance capacity of the participants. It seems that 8-weeks aerobic training can induce quantitative changes but not qualitative changes. Further investigations should include also sedentary population. References Astrand P. O, Cuddy T. E, Saltin B, Stenberg, J. (1964). *J Appl Physiol*, 19, 268-274. Janssen T. W, Dallmeijer A. J, Van der Woude L. H. (2001). *J Rehabil Res Dev*, 38(1), 33-40. Stringer W. W, Hansen J. E, Wasserman K. (1997). *J Appl Physiol*, 82(3), 908-912. Škof B, Milić R. (2010). *Zdravstveno varstvo: revija za teorijo in prakso preventivnega zdravstvenega varstva*, 49(3), 124 - 131.

### STAIR CLIMBING TO PROMOTE BALANCE, GAIT, STRENGTH, RESTING HEART RATE AND SUBMAXIMAL ENDURANCE IN HEALTHY COMMUNITY-DWELLING SENIORS

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Introduction Stair climbing has been shown to induce a health-related additional energy expenditure and increase leg strength as well as maximal oxygen uptake in young adults (Gottschall et al., 2010). Data on effects of regular stair climbing on selected fall-risk factors and cardio-circulatory outcomes in seniors are lacking. Thus, the present study aimed at examining the effects of a guided stair-climbing intervention on resting heart rate and submaximal endurance as well as strength, balance and gait in seniors with particular emphasis on differences between the 1- and 2-step ascending strategies. Methods 48 healthy seniors were randomly assigned (strata: age, gender, BMI) to either a 1-step strategy (INT1), a 2-step strategy (INT2) or a control group (CON). Nine seniors dropped out (health complaints, insufficient training compliance). Thus, 39 seniors (females: n=22, males: n=17; age: 70.5 (SD 5.1) y; BMI: 25.8 (3.1) kg/m<sup>2</sup>) completed the 8-week training intervention (3 sessions per week, attendance 83%). The amount of stairs climbed per session progressively increased from 256 to 640 stairs. The overall climbed altitude (INT1: 1659 (349) m, INT2: 1556 (235) m,  $p=0.38$ ) and total vertical work (INT1: 1144 (290) kJ, INT2: 1126 (201) kJ,  $p=0.85$ ) was similar for both groups. We assessed standing balance, spatio-temporal gait, maximal and explosive strength as well as submaximal endurance before and after the training period. Results We found relevant decreases in heart rate ( $p=0.04$ ,  $\eta^2=0.16$ ; INT1: -8 min<sup>-1</sup>, INT2: -10 min<sup>-1</sup>, CON: -1 min<sup>-1</sup>), perceived exertion ( $p=0.01$ ,  $\eta^2=0.22$ ; INT1: -1.2 (10-point Borg scale), INT2: -2.5, CON: +0.2) and lactate concentration ( $p=0.06$ ,  $\eta^2=0.14$ ; INT1: -0.4 mmol/L, INT2: -0.5 mmol/L, CON: +0.1 mmol/L) during submaximal uphill (8% inclination) walking. Moreover, resting heart rate was significantly reduced in INT2 (-8min<sup>-1</sup>,  $p=0.02$ ,  $\eta^2=0.20$ ). A large effect for center-of-pressure path length displacement during right leg stance ( $\eta^2=0.14$ ,  $p=0.10$ , INT1: -14%, INT2: -9%, CON: +1%) was found. Spatio-temporal gait parameters did not relevantly change. Large effects in favor of INT1 and INT2 were present for peak force during leg press ( $\eta^2=0.16$ ,  $p=0.04$ ) as well as rate of torque development during right leg plantar flexion ( $\eta^2=0.14$ ,  $p=0.06$ ). Conclusion Independent of the ascending strategy, a guided stair climbing intervention beneficially affects cardio-circulatory endurance, resting heart rates and selected strength parameters. The transfer to standing balance and gait characteristics seems restricted. References Gottschall JS et al. (2010) *J Strength Cond Res*, 24, 2558-2563.

### EFFECTS OF WHOLE BODY VIBRATION TREATMENT AFTER ECCENTRIC TRAINING ON PHYSIOLOGICAL "DOMS" MARKERS AND PAIN PERCEPTION

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Introduction Unusual physical exercise or eccentric training may cause damage onset muscle soreness (DOMS) between the next 24-72 hours following exercise. This muscle damage could impair physical performance. The aim of this study was to analyze the use of a whole body vibration platform (WBMV) as a new recovery method after eccentric training. Methods Moderate trained participants (n=20) were randomly divided in two groups: control group (CG) and experimental group (EG). Both groups performed a lower limb eccentric strength training session with 4 exercises (quads and hamstrings) performing 4x5rep / rec2' 120% 1RM. EG group used after training a tilting WBV platform (Galileo Fitness Novotec Medical, Germany), that oscillates through the medial axis. The WBV treatment was as follows: 3x1min / rec 30sec at 14,5Hz, 16,5Hz and 22,5 Hz respectively. Amplitude was 4mm and knee flexion was 90 degrees. Before, after training (or vibratory treatment), 24h and 72h, pain perception (VASpain scale), and blood samples were taken. Urea, CK and GOT (Coulter CPA) were determined. SPSS 19.0 was used to perform statistical analysis. ANOVA test was carried out to determine differences between groups. Results EG showed at 72h lower urea (ml/gr) values than CG ( $32,00 \pm 12,72$  vs  $59,50 \pm 6,13$ )  $p < 0.05$ , as well as in pain perception (0-100 units) ( $34,00 \pm 11,40$  vs  $65,00 \pm 21,21$ )  $p < 0.05$ . Not significant differences were found in other parameters or measuring times. Discussion These new findings may attribute the use of a WBV platform as a recovery method after eccentric training, with significant impact especially after 72h after finishing exercise. Urea plasma values decreases can be explained by an increase in local blood flow as consequence of WBV treatment (Di Loreto, C., et al., 2004). With blood flow increased, athletes are able to eliminate waste product faster and reduce recovery time and muscle soreness. (Verschuere et al., 2004). This way pain perception is also reduced (Dawson, A et al., 2012). References Di loreto, C., Ranchelli, A., Lucidi, P., Murdolo, G., Parlanti, N., de Cicco, A., Tsarpela, O., Annino, G., Bosco, C., Santeusano, F., Bolli, G.B. & de feo, P. (2004). Effects of whole-body vibration exercise on the endocrine system of healthy men. *JEndocrinol Invest* 27, 323-7. Dawson A, List T, Ernberg M, Svensson P. (2012). Assessment of proprioceptive allodynia after tooth-clenching exercises. Verschuere, S.M., Roelants, M., Delecluse, C., Swinnen, S., Vanderschuere, d. & Boonen, s. (2004). Effect of 6-month whole body vibration training on hip density, muscle strength, and postural control in postmenopausal women: a randomized controlled pilot study. *J Bone Miner Res* 19, 352-9.

### WALK@WORKSPAIN: DOES IT IMPROVE JOB PRODUCTIVITY IN OFFICE EMPLOYEES?

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Introduction Presenteeism (time of impaired performance while at work due to health reasons) is highly prevalent due to increasing chronic health problems (Goetzal et al, 2004). Lack of physical activity (PA) is a risk factor for presenteeism (Cancelliere et al, 2011) but

evidence on the effectiveness of workplace PA programs to decrease health-related productivity losses is scarce. We evaluated the impact a 'sit less and move more' program (Work@WorkSpain) had on employees' job productivity. Methods A sample of 264 employees (age 42±10 years; 171 women) from four universities engaged the program (19 weeks). The intervention group (IG, n=129) used a pedometer, a diary and a website that provided strategies, motivational materials and interactive features to increase step counts and reduce sitting time at work. An additional Campus in each University acted as a control group (CG, n=135), maintaining habitual behaviour. Measures of work performance (Work Limitations Questionnaire, WLQ) were completed at baseline, post-intervention and two months follow-up. The WLQ identified three subscales, reflecting ability to meet job demands for (i) output, (ii) time management and (iii) mental-interpersonal skills. Resulting scale scores were transformed to a 0-100 continuum that represented the rate of difficulty in performing job demands (from low to high). An estimated percent of productivity loss (WLQ Index) was calculated. Paired and independent samples t-tests evaluated differences within and between groups at pre, post-intervention and follow-up. Results Job productivity significantly decreased in both groups, but the IG showed a significant less rate of decline ( $p < .05$ ). The IG perceived less difficulty than controls in performing (i) job's time and scheduling demands (-10;95%CI: [-17;-2]), (ii) cognitive and interpersonal tasks (-9;95%CI: [-16;-2]) and (iii) meeting demands for quantity, quality and timelessness of completed work (-6;95%CI: [-11;-1]). This effect significantly increased at two months follow-up (-11;95%CI: [-19;-3]; -10;95%CI: [-17;-3]; -8;95%CI: [-14;-2] respectively). As a result, the IG enhanced job productivity at post-intervention and follow-up by 1.7% and 2% when compared to controls ( $p < .05$ ). Conclusion Office employees engaging in Walk@WorkSpain showed less health-related productivity losses than controls. Workplace programs to reduce sedentary behaviour may be effective at decreasing presenteeism costs. References Goetzl RZ, Long SR, Ozminkowski RJ, et al. *J Occu Environ Med* 2004; 46:398-412 Cancelliere C, Cassidy JD, Ammendolia C, et al. *BMC Public Health* 2011;11:395

### PSYCHO-PHYSIOLOGICAL RESPONSES TO A STANDARDIZED EXERCISE PROGRAM INDOORS VS. NATURAL ENVIRONMENT: PRELIMINARY RESULTS FROM A PILOT STUDY. PART II: MOTIVATION TO EXERCISE

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**Introduction** Environmental setting can influence psychological responses and motivation to exercise (Marsh et al., 2006). Being outdoors in natural environments has been associated with vitalization (Ryan et al., 2010), which may improve individuals' attitude towards physical activity and elicit active lifestyles. As a pilot study, we have investigated the impact of a standardized exercise program in two different environmental settings (indoors vs. outdoors in a natural environment) on explicit and implicit cognitions towards physical activity. **Methods** Healthy adults, 7 males and 7 females (age 48.5±7.3 yr; BMI 25.4±2.5; VO<sub>2</sub>max 39.8±7.7 ml/min/kg), undertook two exercise sessions within 1-week, each consisting in 25-min biking (60.1±7.9 %HRR) followed by 20-min circuit strength training with rubber bands (49.7±9.6 %HRR). The subjects were randomized to the indoor or the outdoor group. Connectedness with nature scale (CNS), an adjusted version of the leisure time exercise questionnaire (LTEQ) and an implicit association test (IAT) were administered before the intervention. Enjoyment, perceived restorativeness of the environment, affect and intention to exercise in the following 10-weeks were measured in concomitance with each exercise session, along with ratings of perceived exertion and heart rate values. Two- and ten-weeks after the intervention, the subjects were asked to complete the LTEQ and IAT again. Statistics consisted of bivariate correlation and linear mixed model. Results CNS was positively correlated ( $p < .05$ ) with the individuals' fitness and initial LTEQ (preliminary measurements). During the exercise sessions, the outdoor group reported higher ratings of enjoyment, perceived restorativeness of the environment and positive affect (all  $p < .01$ ), as compared to the indoor group. When adjusted for the LTEQ values, a significant main effect of 'group' was found for intention ( $p < .05$ ), in favor of the outdoor group. No significant changes in the LTEQ and the IAT over the follow-up period were found, but this might be imputed to a sensitive drop-off. **Discussion** The results indicate that experiences of exercise in natural environments may improve motivation to be physical active. Though, more studies on larger samples are needed. **References** Marsh, A.P., Katula, J.A., Paccchia, C.F., Johnson, L.C., Koury, K.L., & Rejeski, W.J. (2006). *Med Sci Sports Exerc*, 38(6), 1157-1164 Ryan, R.M., Weinstein, N., Bernstein, J., Brown, K.W., Mistretta, L., & Gagne, M. (2010). *J Environ Psychol*, 30(2), 159-168

### PSYCHO-PHYSIOLOGICAL RESPONSES TO A STANDARDIZED EXERCISE PROGRAM INDOORS VS. NATURAL ENVIRONMENT: PRELIMINARY RESULTS FROM A PILOT STUDY. PART I: AFFECT & PERCEIVED RESTORATIVENESS OF THE ENVIRONMENT

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**Introduction** Physical activities in contact with nature, such as walking in green areas, have been associated to positive mental states. Anyway, the effects of 'green exercise' on mental health are still debated (Thompson Coon et al., 2011). Especially, experimental studies investigating complex exercise programs comparing indoor vs. outdoor-natural settings are missing. As a pilot study, we investigated psychological responses in individuals undertaking a standardized exercise program indoors (gym-hall) vs. outdoors in natural environment. **Methods** Healthy adults, 7 males and 7 females (age 48.5±7.3 yr; BMI 25.4±2.45; VO<sub>2</sub>max 39.8±7.7 ml/min/kg), undertook two exercise sessions within 1-week, each consisting in 25-min biking (60.1±7.9 %HRR) followed by 20-min circuit strength training with rubber bands (49.7±9.6 %HRR). The subjects exercised at 15:30, randomized to the indoor or the outdoor group. Mood was measured one week before the intervention (BASELINE; no exercise for at least 48-hours) by Physical Activity Affect Scale (PAAS). Affect was then measured by PAAS before (PRE) and after (POST) each exercise session. Ratings of perceived exertion (RPE) and enjoyment were measured after both the biking and the strength bouts. Perceived restorativeness of the environment (fascination and being away) was measured after completion of each exercise session. A linear mixed model was used to investigate possible PRE-POST effects and differences across groups (indoor vs. outdoors) for the four components of affect (positive affect, negative affect, fatigue, and tranquility). The individuals' mood ratings at BASELINE were set as a covariate in the model. Correlation between affect and the other exercise parameters (enjoyment, RPE, fascination and being away) was eventually studied. Results A significant main effect of 'group' was found for positive affect ( $p < .01$ ), with higher values reported by the outdoor group. No difference was found for RPE across the groups. On the other hand, the outdoor group reported higher ratings of enjoyment, perceived fascination and being away, which on turn were correlated with positive affect ( $p = .05$ ,  $p = .05$ , and  $p = .01$ , respectively). **Discussion** These results provide further confirms on the positive effects of exercising in natural environments on people's mental states, as compared to indoor settings. More studies on larger sample and including different environmental variables are recommended. **References** Thompson Coon J, Boddy K, Stein K, Whear R, Barton J, & Depledge MH (2011). *Environ sci technol*, 45(5), 1761-1772

### VITALITY BEACH- HEALTH PROMOTION IN THE SAND

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**Introduction** A variety of health promotion programs to recreate from work related stresses are supported by German health insurances. Own pilot studies led to the conclusion, that prevention programs conducted in the sand or at the beach will show positive effects on different physical dimensions e.g. cardiovascular fitness. In addition results of Davies & Mackinnon (2006) indicated higher energy exposures when walking in sand compared to other surfaces. However, up to now there is no intervention which examined effects of training in the sand to gain health related effects on physical fitness and to reduce occupational stresses. Therefore, the aim of this randomized controlled trial was to analyze health benefits of an indoor beach prevention program for middle aged employees. **Methods** N= 49 people (24 men; 25 woman; 38.3 ± 10.3 y) were randomized into two training groups (n=33) and a control group (n=16). The intervention (12\* 90 min sessions; once a week) includes strength, endurance, balance and coordination training following a standardized protocol. A standardized running course was used to evaluate coordination and endurance (time and heart rate); a spine check was done with a Medi-Mouse®; a short version of the Star Execution Balance Test (SEBT) analyzed balance performance and flexibility and the SF12-questionnaire examined physical and psychological well-being. The collected data were analysed by using a 3-way ANOVA (group, variable, repeated measurement) within common limits of significance ( $p \leq .05$ ). **Results** The training group improved their strength in the spine check whereas the control group did not ( $p=.002$ ,  $F=11.7$ , partial eta square =.295). In addition they improved balance and mobility in all measured directions of the SEBT ( $p \leq .01$ ) and decreased the running time (t1: 44.8 ± 8.9 sec; t2: 35.7 ± 5.9 sec;  $p=.000$ ,  $F= 54.9$ , partial eta square=.764) of the running course with a constant heart rate. Moreover the women of the intervention group increased their psychological well-being ( $p=.000$ ,  $F=14.9$ , partial eta square =.304). **Discussion** The program showed health related benefits in different dimensions. The main outcomes are improved physical fitness for back strength, improved flexibility and balance. We suppose that the decreased running time of the course indicates improved coordination under cardio vascular stress. In addition the program was well accepted by the participants. Therefore the intervention should be integrated into the health promotion catalogues of the health insurances. However, the limitations of this study are that there were no measurements of lasting effects and if the improved fitness is able to compensate work related stresses. **References** Davies, S. E. H. & Mackinnon, S. N. (2006). The energetics of walking on sand and grass at various speeds. *Ergonomics*, 49:7, 651-660.

### INFLUENCE OF DIFFERENT PHYSICAL INTERVENTIONS IN BIOCHEMICAL VARIABLES OF WOMEN PARTICIPANT OF HEALTH UNITS IN RIO CLARO – SP – BRAZIL.

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**Introduction** Physical exercise (PE) is important in promoting health and preventing some diseases. Among other pathologies benefited by the PE practice is dyslipidemia, which is a disorder in the lipid metabolism that can affect the levels of lipoproteins into the bloodstream. **Objective** Analyze the effect of two PE interventions on the participants rates of glucose, cholesterol, HDL, LDL and triglycerides. **Methods** Both interventions were realized on health units in the city of Rio Claro: a) Group 2 days weekly (G2; n=14; 58.71 ± 9.71 years), with duration of 60 minutes/day composed by aerobic exercise (AE) (25 minutes) and resistance exercise (RE) (15 minutes), and an advice to perform PE on other days of the week; b) Group 3 days weekly (G3; n=14; 57.93 ± 8.78 years), with duration of 90 minutes/day also composed by AE (50 minutes) and RE (15 minutes), without any kind of advice in the end of class. In both groups the remaining time was used to warm-up and stretching exercises. For biochemical variables analysis it was collected 5 mL of blood, with participants fasted for at least 12 hours, pre and post six months of intervention. All samples were collected by nursing techniques and data analyzed by laboratory technicians (UNESP). Statistical analysis used a t Test for paired-samples ( $p < 0.05$ ). **Results** It was found significant difference in G2 for the variables: Cholesterol Pre: 171.14 ± 18.70 mg/dL, Post: 141.71 ± 18.54 mg/dL;  $p=0.002$ , HDL Pre: 47.57 ± 13.08 mg/dL, Post: 56.14 ± 10.69 mg/dL;  $p=0.046$ , LDL Pre: 132.78 ± 19.86 mg/dL, Post: 93.58 ± 12.83 mg/dL;  $p<0.001$ . The G3 showed significant difference for the variables: Glucose Pre: 106.00 ± 33.86 mg/dL, Post: 89.57 ± 28.47 mg/dL;  $p=0.005$ , LDL Pre: 134.85 ± 31.58 mg/dL, Post: 105.42 ± 28.19 mg/dL;  $p<0.001$ . **Discussion** Both interventions promoted benefits to participants, agreeing with other studies (Monteiro et al., 2007; Yoshida et al., 2010). Worth noting that even G2, that used a lower daily duration and weekly frequency than G3, also promoted significant improvements in the variables. The lack of control of participant's diet may have influenced the results, especially in variables that were not found significant improvements. Thus, the results demonstrate the effectiveness of a physical program, with two or three days/week, in the control and reduction of lipid profile. In terms of public health, that can represent savings in the spending on population health. **References** Monteiro HL, Rolim LMC, Squinca DA, Silva FC, Ticianeli CCC, Amaral SL. (2007). *Rev Bras Med Esporte*, 13(2), 107-12. Yoshida H, Ishikawa T, Suto M, Kurosawa H, Hironatori Y, Ito K, Yanai H, Tada N, Suzuki M. (2010). *J Atheroscler Thromb*, 17(11), 1160-66.

### ASSOCIATIONS OF MUSCULAR AND CARDIORESPIRATORY FITNESS WITH C-REACTIVE PROTEIN CONCENTRATION IN YOUNG ADULT MEN

Vaara, J.P.1,2, Vasankari, T.3, Fogelholm, M.4, Häkkinen, K.2, Santtila, M.5, Kyröläinen, H.1,2

1: National Defence University, Finland, 2: University of Jyväskylä 3: The UKK Institute for Health Promotion Research 4: University of Helsinki 5: Personnel Division of Defence Command, Finland

**Introduction** Serum high sensitive C-reactive protein (CRP) is an inflammatory marker, which is associated with the pathogenesis of atherosclerosis (Gonzalez et al. 2003). Cardiorespiratory fitness (CRF) is inversely associated with CRP (Kuo et al. 2007). However, little is known on the association of muscular fitness and CRP. Therefore, the aim of the present study was to assess the relationships of muscular and cardiorespiratory fitness with CRP in young adult men. **Methods** 686 men (25.5±5.0 yrs.) participated. Muscular endurance (MEI) consisted of push-ups, sit-ups and repeated squats (repetitions in one minute) and maximal strength (MSI) in leg extension and bench press (N). The muscular fitness test scores were divided by body weight. CRF was determined by a cycle ergometer test until exhaustion (predicted  $\dot{V}O_{2max}$ ) and waist circumference (WC) was measured. CRP was analyzed from blood samples after an overnight fast and log transformation was used in the analysis. Pearson correlation coefficient and multinomial regression models with  $\beta$ -coefficients were used. **Results** CRP was inversely correlated with CRF ( $r=-0.47$ ), MEI ( $r=-0.46$ ), MSI ( $r=-0.29$ ), and positively with WC ( $r=0.46$ ) ( $p<0.001$ ). In the multinomial regression model, after adjustments for age and smoking CRP was inversely associated with CRF ( $\beta= -0.25$ ,  $p<0.001$ ), MEI ( $\beta= -0.14$ ,  $p<0.05$ ) and positively with WC ( $\beta=0.22$ ,  $p<0.001$ ). No significant association between CRP and maximal strength was observed. **Discussion** In addition to aerobic fitness and waist circumference, muscular endurance was beneficially associated with serum high

sensitivity c-reactive protein. Similar association was not, however, evident for maximal strength. These findings indicate that also muscular endurance training may be advantageous in order to prevent low-grade systemic inflammation. References Gonzalez MA, Selwyn AP. (2003). *Am J Med*, 8(115):599-106. Kuo HK, Yen CJ, Chen JH, Yu YH, Bean JF. (2007). *Int J Cardiol*, 114(1):28-33.

**15:00 - 16:00**

## Mini-Orals

### PP-PM08 Health and Fitness [HF] 2

#### THE RELATIONSHIP BETWEEN DIETARY HABITS, BODY MASS INDEX, AND PHYSICAL FITNESS AMONG JAPANESE PRESCHOOL CHILDREN

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**Introduction:** Studies have shown that children's physical fitness levels have declined because of a decrease in amount of physical activities. It has also been reported that thinner children tend to be in less favorable physical condition. A close link has been found between fitness levels and dietary habits, which is relevant to obesity and thinness. The purpose of this cross-sectional study is to examine the relationship of dietary habits, body mass index, and physical fitness among Japanese preschool children. **Method:** 144 Japanese preschoolers (70 boys and 74 girls, aged 4 to 6 years old) were given our fitness tests. Their parents were also asked to answer six questions regarding their children's dietary habits. **Results:** 138 subjects completed all the tasks, which provided the necessary data for this study. Based on their body mass indexes, the subjects were classified into five categories as follows: 1 very thin, 39 thin, 95 average, 3 overweight, and 0 obese. They were also graded into five categories, A through E, according to the norm-referenced criteria of physical fitness: 1 A, 8 B, 23 C, 70 D, and 36 E. **Discussion:** No connection was observed between physical fitness and body mass index. Those who were graded into the upper three categories (A, B and C) were grouped into one as the upper level group. The comparison of three groups (A-B-C, D, and E) indicated that lower fitness levels tend to be related to poorer dietary habits. On the other hand, the children in the upper level group demonstrated better eating habits. They tend to eat a variety of food, including a wide range of vegetables. They enjoy helping out in meal preparation and also liked dinner time at the table. Skipping breakfast was not common in any group. Many parents, however, were aware of some other problems in their eating habits. The children who were more physically fit were those who had a better attitude toward meal time, and whose parents work together to achieve better dietary habits in their children.

#### POSTURE OF BOYS AS A RESULT OF WATER GYMNASTICS AND SWIMMING

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**BACKGROUND** Based on an analysis of habits of children aged 12-14, it has been found that they spend 56% of their time sitting and during this time, their backs are bent forward more than 20° and/or rotated by more than 45° (Saarni, 2007). Body posture is treated as a dynamic stereotype formed in the process of individual development, physical education and exercise (Shklyarenko et al., 2011). The goal of the research was to identify changes in body posture of boys as a result of the water gymnastics and swimming program. **METHODS** The research was conducted based on a sample of 35 boys aged 11.4 ± 2.2. Their posture was assessed in compliance with the Napoleon Wolanski method. An expert assessment of the following regions was conducted prior to and after the exercise program: head posture, shoulder posture, shoulder blade posture, chest posture, spinal column posture, stomach posture, leg and feet posture. The combined program of water gymnastics and swimming was implemented during a period of 24 weeks, three times per week, with sessions lasting for 60 minutes. For the analysis of the initial and final testing, a T-test for dependent samples has been used/ marked differences are significant at  $p < .0500$ . **RESULTS** The analysis of research findings showed that significant changes in posture assessment occurred: assessment of head posture (AOHP  $p = .000$ ), assessment of shoulder posture (AOSP  $p = .000$ ), assessment of shoulder blade posture (AOSBP  $p = .000$ ), assessment of chest posture (AOCP  $p = .000$ ), assessment of spinal column posture (AOSCP  $p = .000$ ), assessment of stomach posture (AOSTP  $p = .000$ ), assessment of leg posture (AOLP  $p = .000$ ), assessment of feet posture (AOFPP  $p = .000$ ) and general assessment of posture (GAOPW  $p = .000$ ). **CONCLUSIONS** The problem of poor posture of children is one of the more important problems of the modern way of life. Based on the research findings it may be concluded that the continued combined water gymnastics and swimming program does have a significant impact on improvement of posture of boys of this age. **REFERENCES** Saarni, L. (2007). Are Desks and Chairs at School Appropriate? *Ergonomics*, 50 (19): 1561-1570. Shklyarenko, A., Kovalenko, T., Ulyanov, D., Yahnik, Y., Suhoruchko, A. (2011). Comparative Evaluation of Body Posture Functional Status in Children aged 8-11, 12-14 and 15-16. Book of Abstracts of the 16th Annual ECSS Congress Liverpool/UK.

#### PHYSICAL SELF-PERCEPTION OF CHILDREN FOLLOWING A 12-WEEK RESISTANCE EXERCISE PROGRAM

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**Introduction** Psychological benefits of regular cardiovascular (CV) exercise, resistance training (RT) exercise, or a combined (CV+RT) program have been regularly studied in adults. A combined program of CV and RT exercise has been shown to increase self-efficacy in preadolescent girls (Annesi et al., 2005). An exercise program of only RT improved self-concept in adolescent males and females (Velez et al., 2010). Middle childhood (8-10 yr) remains relatively understudied in this area. Therefore, the aim of the current study was to analyse whether or not physical self-perceptions of children would change following a 12-week (wk) resistance exercise program. **Methods** Twenty-four children from an after school program participated in the 12-wk study. Pre-testing in wk1 consisted of the Physical Self-Perception Profile for Children (PSPPC), which contains 6 subscales: general self-worth (GSW), physical self-worth (PSW), perceived sport

competence (SPORT), perceived bodily attractiveness (BODY), perceived physical strength (STRENGTH), perceived level of physical conditioning (CONDITION). Boys ( $n=11$ ,  $9.0 \pm 0.9$  yr) and girls ( $n=13$ ,  $9.3 \pm 0.7$  yr) were randomly assigned by sex into control (CON,  $n=12$ ) or experimental (EXP,  $n=12$ ) groups. After a familiarization session with the child-sized resistance training equipment, the EXP received 12-wk of resistance exercise 2 d/wk. Training sessions were 45 min and consisted of 5-min warm up followed by 2 sets x 15 repetitions of 7 exercises performed at a 3:0:2 tempo concluding with 5-min cool down. Child to instructor ratio was 4:1. Post-testing of PSPP-C for CON and EXP occurred in wk12 after completion of the exercise program. A  $2 \times 2$  repeated measures analyses of variance (ANOVA) was used to analyze PSPP-C. Bonferroni pairwise post hoc analyses examined differences in the subscales of the PSPP-C. Alpha level was set at  $p < 0.05$ . Results There was no difference ( $p > 0.05$ ) between CON and EXP pretests of PSPP-C. A significant interaction ( $p = 0.37$ ) existed between CON and EXP groups. Post hoc analyses showed significant gains ( $p < 0.05$ ) for EXP in all 6 subscales from pre to post. Only the SPORT subscale improved for the CON group ( $p = 0.02$ ). Discussion Children who participate in a 12-wk resistance exercise program display enhanced physical self-perception compared to a control group. The CON and EXP began the program with similar PSPP levels. Regular resistance exercise improved all 6 subscale scores, not just STRENGTH, in the EXP. Children who participate in regular resistance exercise may have an increased awareness of their own levels of physical conditioning and strength. References Annesi, JJ, et al. (2005). *Res Q Exerc Sport* 76(4), 468-476. Velez, A, et al. (2010). *J Strength Cond Res* 24(4), 1065-1073.

## DEVELOPMENTAL PATHWAYS OF FITNESS, AND NOT BASELINE, PREDICT FITNESS STATUS AT THE END OF CHILDHOOD.

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Introduction It is generally described that children fitness levels increase along childhood. Complementary to this idea is the notion that the tracking of children's fitness is good to moderate during this developmental time, and that baseline (initial values) of fitness are determinant on fitness development. The importance of developmental pathways has been recently reinforced by a theoretical argument that predicts that healthy lifestyle trajectories will evolve through either a positive or negative spiral of engagement or disengagement, respectively, in various physical activity behaviors across childhood that are reciprocally linked to motor skill, perceived competence and fitness development (Stodden et al., 2008). The main goal of this study is to test the hypothesis that different developmental pathways of physical fitness do occur during childhood (6-to-9 years-old), and to test their correlation with baseline fitness status. Methods This longitudinal study design included 507 primary school children who were assessed annually for four years on seven physical fitness tests. Childhood individual trajectories (baseline and slope values) on each of the fitness tests were determined along the four years of the study. Participants were divided into three groups according to individual fitness trajectories over time: Slow Rate of Change (Slow RC Change), Average Rate of Change (Average RC), and High Rate of Change (High RC). An ANOVA  $3 \times 2$  (Group x Sex) with Bonferroni post hoc tests was used to test for the differences on rate of change between the constituted groups, and sex. Correlations between slope and test values were used to analyze the possibility of fitness performance prediction along the four years of the study. Results Results showed (1) significant differences on the rate of change between all groups ( $p < .001$ ) for all variables tested (Slow RC < Average RC < High RC); (2) no effect from sex differentiation ( $p > .15$  for all cases); and no positive correlation between baseline values and final values on physical fitness. Discussion The fact that differential pathways of fitness development were found throughout childhood adds to the established knowledge, and can be used as fundament for children's fitness programs. The level of fitness, even if not satisfactory early in childhood, can be changed, and it is the pathway, not the baseline, that shows to be of major importance for children to achieve a fit state. In conclusion, children show different rates of change in fitness development over childhood; and having a positive developmental trajectory of fitness predicts a fitter state at the end of childhood, independent of the initial values at 6-years-of-age. References Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Robertson, M. A., Rudisill, M. E., Garcia, C., et al. (2008). A developmental perspective on the role of motor skill competence in physical activity: an emergent relationship. *Quest*, 60, 290-306.

## ADIPOSIY INDICATORS IN YOUTH FROM A LOW SOCIOECONOMIC REGION

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Introduction BMI has been often used as an adiposity indicator in population-based studies (GONZALEZ et al. 2010). However, studies with children and women recommended that BMI should be used in conjunction with other estimates of body composition (i.e. skinfolds) in order to maximize the adiposity estimation in children. (WILSON et al. 2011) Purpose To analyze the power of different skinfolds to predict adiposity in youth with low socioeconomic status. Methods We measured body mass (BM), body mass index (BMI), waist circumference (WC), body fat (FAT) and skinfold at subscapular (SB), suprailiac (SI), middle axillary (MA), abdominal (ABD), biceps (BI), triceps (TRI) and middle calf (MC) regions in 232 youth aged 10-15 living in a low socioeconomic status island in Brazil. In addition, we calculated trunk adiposity (TrkA: SB + SI + MA + ABD divided by four), peripheral adiposity (PA: BI + TRI + MC divided by three) and total adiposity (TA: SB + SI + MA + ABD + BI + TRI + MC divided by seven). Results All skinfolds were subjected to principal component analysis (PCA). That revealed only abdominal skinfold with an eigenvalue exceeding 1, which explained 87% of the variance. This variance has increased by 95% when we added the next two components, i.e., supra-iliac and middle axillary skinfolds. The second PCA was constituted by TrkA, TA, PA, BMI, WC, BM and FAT, but it was explained only by TrkA (77% of the variance). Discussion Skinfold thickness is cheap and more direct measure of adiposity in children than BMI (OLDS, 2009). Our results recommend abdominal, supra-iliac and middle axillary, as well as trunk adiposity (i.e., mean of subscapular, suprailiac, middle axillary, abdominal) as the best body adiposity indicators in boys and girls from a low-socioeconomic region. References Gonzalez AM, Hartge P, Cerhan JR, Flint AJ, Hannan L, MacInnis RJ, et al. (2010) *New England Journal Medicine*, 363, 23, 2211-2219 Wilson HJ, Dickinson F, Griffiths PL, Azcorra H, Bogin B, Varela-Silva MI. (2011) *American Journal of Human Biology*, 23, 6, 780-789 Olds TS. (2009) *European Journal of Clinical Nutrition*, 63, 8, 934-9346 #supported by FAPESP process number 2010/20749-8

## DEMOGRAPHIC CHARACTERISTICS, OBESITY INDICES AND PHYSICAL FITNESS OF OVERWEIGHT/OBESE ELEMENTARY SCHOOL AGED CHILDREN IN CYPRUS

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**Introduction** Childhood obesity has reached epidemic levels in developed countries (Manus et al., 2012). Environmental factors, lifestyle preferences, and cultural environment play essential roles in the rising prevalence of obesity worldwide (Leal & Chaix, 2011). The aim of the present study was to assess the correlations among demographic characteristics, obesity indices and physical fitness level of elementary school children in Cyprus, aged 6 to 12 years old. **Methods** A cohort of 763 healthy pupils, aged  $10.21 \pm 1.59$  yrs, participated in the study and were divided according to their gender (372 boys, 391 girls) and their obesity level (normal, overweight, obese) as defined by IOTF criteria (Cole et al., 2000). Demographics characteristics were collected and anthropometrical and physical fitness measurements were obtained. Results 72.9% of pupils presented normal values of body weight, 18.9% were overweight and 8.3% obese. Pearson correlation revealed negative correlations among BMI and Multistage-Fitness Test ( $r = -.182$ ,  $p < .001$ ), Flexed Arm-Hang Test ( $r = -.342$ ,  $p < .001$ ), Standing Long-Jump test ( $r = -.129$ ,  $p < .001$ ), Handgrip-strength test ( $r = .440$ ,  $p < .001$ ), Sit-Ups test ( $r = -.165$ ,  $p < .001$ ) and Sit-and-reach test ( $r = .110$ ,  $p < .01$ ). Percent body fat presented negative correlation with cardiovascular endurance ( $r = -.325$ ,  $p < .001$ ), muscle strength ( $r = -.452$ ,  $p < .001$ ) and abdominal strength ( $r = -.245$ ,  $p < .001$ ) while significant correlation observed between lean body mass and handgrip test ( $r = .753$ ,  $p < .001$ ). Students who live in an apartment presented 68.5% normal weight, 20.5% were overweight and 11% obese versus 73.3%, 18.6% and 8.1% respectively of those living in a detached house. **Discussion** The results of this study revealed the prevalence of obesity in Cyprus and support that elevated body mass makes obese children less active with reduced cardiorespiratory fitness in any demographic environment they live. Indeed, the increased body mass with the negative correlations of BMI and body fat percentage with physical fitness, leading obese children be less active with reduced cardiovascular endurance as compared to the non-obese children (Sallis et al., 2000; Christodoulos et al., 2004). Thus, the promotion of lifelong physical activity and healthy eating habits are essential to school age yet to ensure the physical health in adulthood. **References** Christodoulos AD, Douda HT, Polykratis M, Tokmakidis SP. (2006). *Br J Sports Med*, 40(4):367-71. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. (2000). *Br J Sports Med*, 32:1-6. Leal C, & Chaix B. (2011). *Obes Rev*, 12, 217–230. McManus AM & Mellecker RR. (2012). *J Sport Health Sci*, 1(3), 141–148. Sallis FJ, Prochaska JJ, Taylor CW. (2000). *Med Sci Sports Exerc*, 32(5):963-975.

## HABITUAL PHYSICAL ACTIVITY IS ASSOCIATED WITH ACE I/D GENOTYPE IN 12 YEAR OLD BOYS

Mäestu, J.1, Lätt, E.1, Rääsk, T.1, Laas, K.1, Jürimäe, T.1, Sak, K.2, Jürimäe, J.1

1: University of Tartu, 2:ASPER

**Introduction** There is only very limited data on specific gene interactions with habitual physical activity levels. Most studies in the field have considered physical activity rather as a covariate for the gene effects on other phenotypes, rather than the dependent variable itself. The aim of was to investigate the association between ACE I/D polymorphism and physical activity in 12 year old boys. **Methods** In total, 265 boys (calendar age  $12.04 \pm 0.77$  years) were investigated. Body composition and cardiovascular fitness on cycle ergometer were measured in addition to 7-day accelerometry based physical activity (PA). Also, several possible cofactors (screen time, participating in sport clubs) that might have association with PA were considered. Results Sedentary PA was significantly lower in DD subjects compared to I allele carriers, while light PA was significantly higher in DD subjects compared to II subjects. Using the model with three genotypes, there was a trendline effect on light PA ( $F(2,256)=2.49$ ;  $p=0.085$ ;  $\eta^2=0.015$ ). A significant main effect of the D allele was found on total PA ( $F(1,256)=5.453$ ;  $p=0.020$ ;  $\eta^2=0.021$ ). Adding screen time as a covariate did not change ACE I/D polymorphism effect on total PA levels ( $F(2,256) = 3.326$ ;  $p=0.041$ ;  $\eta^2=0.025$ ). Carriers of the D allele had significantly higher light PA ( $F(1,256)=4.710$ ;  $p=0.031$ ;  $\eta^2= 0.20$ ), with screen time as covariate. **Discussion** No association with ACE genotype or allele effect were found on higher PA levels (ie. moderate and vigorous PA) that are considered as most positive for the decrease of cardiovascular health risks in children. However, carrying the D allele of the ACE I/D genotype had a main effect on total PA with screen time as covariate. PA and sedentary activity predict independently chronic disease risk and mortality, and should therefore be considered as separate constructs (Ekelund et al. 2012). It should be considered that studying the effects of PA on health not only moderate to vigorous activities are important, but the full range of activity range should be taken into account (Pate et al. 2008). As we were able to demonstrate ACE genotype effect on the amount of sedentary, light and total PA, the prevention strategies focused at this period of life should take into account that sedentary lifestyle in children is related to gene effects. In conclusion, ACE I/D polymorphism is associated with different levels of PA in healthy boys, accounting with confounding factor screen time. **References** Ekelund U, Luan J, Sherar LB, Esliger DW, Griew P, Cooper A (2012). *JAMA*, 307, 704-712 Pate RR, O'Neill JR, Lobelo F (2008). *Exerc Sport Sci Rev*, 36, 173-178

## THE RELATIONSHIP BETWEEN BODY IMAGE SATISFACTION, BODY COMPOSITION AND METHODS IN CONTROLLING WEIGHT

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**Introduction** Body image dissatisfaction is common in adolescent. Studies have shown that female adolescents believe they are fat even though their BMI is normal. The engaging in methods to control weight may promote harmful behaviors that often result in unhealthy physical appearance. The physical activity performed in an excessive and intensive manner has been identified as one of the most relevant behaviors in controlling weight. The aim of this study was to investigate the differences in body fat percentage and also the methods used in controlling weight in different aged adolescent females. Relationships between the variables of interest were also investigated. **Methods** 624 (218 group-15y, 211 group-16y and 195 group-17y) adolescent female ( $15.96 \pm 0.81$ , weight =  $57.7 \pm 9.9$  Kg, height =  $1.61 \pm 0.05$  m, BMI =  $22.1 \pm 3.7$ ; no significant differences between groups) were recruited from Viana do Castelo student population. The subjects were accessed on both body weight and composition (Tanita BC-418), and were asked to complete a physical activity questionnaire. ANOVA with Bonferroni adjustment was performed to detect group differences. Spearman coefficient of correlation was used to assess the relationship between body image satisfaction (BIS), body weight and composition, and methods used in controlling weight. Significance was set at  $p < 0.05$ . Results Significant differences were found between groups in percent of fat in both left and right leg [ $F(2, 617) = 28.761$  and  $21.981$ ,  $p < 0.001$ ], and left and right arm [ $F(2, 617) = 41.138$  and  $72.666$ ,  $p < 0.001$ ], but not in whole body percent of fat and trunk percent of fat. Post-hoc analysis with Bonferroni adjustment indicated that the younger group has higher percent of fat in segments ( $p < 0.001$ ) than their counterparts. No significant differences were found between groups in relation to methods used

in controlling weight. However, adjusting the sample to BMI level (<19; 19–24; >24), it was found significant differences between groups in such parameters IF (2, 616) = 36.097 and 15.205,  $p < 0.001$ , for Diet and exercise]. The Diet and Exercise were mainly used by the group BMI>24. Moderate to strong negative correlation were found between BIS and both body weight and composition ( $r = -0.49$  to  $-0.65$ ,  $p < 0.05$ ). Also moderate negative correlations were found between BIS and Diet and Exercise ( $r = -0.39$  and  $-0.23$ ,  $p < 0.05$ ) as methods used in controlling weight. Conclusion The group-15y showed higher percent of body segments fat than their counterparts. Age differences were found to affect BIS. However, BIS seems to be influenced by both BMI and percent of fat in body segments. Findings also show that the principal methods in controlling weight, diet and exercise, are mainly used by overweight adolescents (BMI > 24), independently of age.

### EFFICACY OF A PAEDIATRIC HOME-BASED PHYSICAL ACTIVITY PROGRAM ACCORDING TO 2008 GUIDELINES

Galvani, C.1,2, Rossi, M.2, Magnoni, D.3, Casolo, F.2, Faina, M.1,4

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1Laboratorio di Fisiologia, Università Cattolica del Sacro Cuore, Milano, Italia; 2Scienze Motorie, Università Cattolica del Sacro Cuore, Milano, Italia; 3Medico Pediatra, Varese, Italia; 4Istituto di medicina e scienza dello sport, CONI, Roma, Italia Introduction Participation in vigorous physical activity (VPA) during childhood should be encouraged as it is superior to moderate physical activity (MPA) for attenuating cardiometabolic risk factors in youth (1). As the home environment is closely associated with reduced levels of physical activity (PA) (2), the aim of this study was to objectively measure PA behaviour in a sample of 6 to 11 yr-old children in order to investigate if they fulfilled PA guidelines (3) following a home-based PA program. Methods 14 healthy children (age,  $9.5 \pm 2$  yr; BMI,  $19.4 \pm 1$  kg/m<sup>2</sup>) were monitored during a whole week in winter with a Actiheart (AH) monitor (Cambridge Neurotechnology, UK). The AH is able to measure acceleration and heart rate, for objectively measuring time spent in sedentary or light (SLPA, <3 METS) to moderate (3-6 METS) and vigorous (>6 METS) PA. Children were asked to comply with a 90 min of daily PA program with at least 60 min of MPA per day. Activities were chosen from the play and chores categories of the Compendium of PA for youth (4). Compliance was assessed by asking the mothers directly about children degree of adherence to instructions. A one-way ANOVA was used to compare compliant (CD) and non-compliant days (NCD) and significance was set at  $p < 0.05$ . Results Data analysed through the Branched model showed that children significantly exceeded 60 min of moderate-to-vigorous PA (MVPA) (MVPA  $144.7 \pm 106.2$  min/day,  $p < 0.0001$ ). However, the between intensity comparison revealed a significant higher amount of time spent in MPA than in VPA (MPA  $130.1 \pm 91.5$  min/day; VPA  $14.6 \pm 23.5$  min/day,  $p < 0.0001$ ). Besides, a significant difference was detected between CD and NCD for time spent in VPA (VPA: CD  $20 \pm 27.7$  min/day; NCD  $8.2 \pm 15.7$  min/day,  $p < 0.05$ ). No differences were detected for SLPA (SLPA: CD  $1276.6 \pm 90$  min/day; NCD  $1316.8 \pm 119.9$  min/day, ns) and for MPA (MPA: CD  $143.4 \pm 74.2$  min/day; NCD  $114.9 \pm 107$  min/day, ns). Discussion This study's data indicate that i) children significantly exceed 60 min of MVPA per day, ii) they spent a higher amount of time in MPA than in VPA and iii) the developed home-based PA program allows a significant increase in VPA. Getting children to make VPA part of their daily routines is important, especially considering that there is a marked reduction in PA over the adolescent years (5). References (1) Hay, Arch Pediatr Adolesc Med. 2012, 166:1022-9. (2) Page, Int J Obes (Lond). 2005, 29:1070-6. (3) HHS. U.S. Department of Health and Human Services; 2008. (4) Ridley, Int J Behav Nutr Phys Act. 2008, 10:5-45. (5) Riddoch, Med Sci Sports Exerc. 2004, 36:86-92.

### DEVELOPMENT OF PHYSICAL FITNESS AND THE RELATIONSHIP WITH EXECUTIVE FUNCTIONING IN CHILDREN WITH INTELLECTUAL DISABILITIES.

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Introduction The relationship between physical fitness (PF) and cognition has been studied in several populations such as typically developing children (TD children), and elderly with or without cognitive impairments (e.g Colcombe & Kramer, 2003). In TD children, positive relationships between aerobic fitness and executive functioning (EF) were found (Chaddock et al., 2012), an important predictor for academic achievement. The aim of this study was to examine the development of physical fitness in children with intellectual disabilities (ID), aged 8-12, as well as the possible relationship between PF (aerobic fitness and strength) and EF. Methods From 2009 until 2012, 61 children with ID (45 boys, 16 girls; age range 8-11 in the year of enrollment; IQ range=56-79) participated in a longitudinal study. Items of the Eurofit including aerobic fitness (shuttle run, 10x5m shuttle run) and strength (handgrip, standing broad jump) were measured annually. In 2012, EF was assessed with the Stroop test (inhibition), Self-ordered pointing task (working memory), the Trailmaking test (set-shifting) and the Tower of London (planning). The development of the children's PF was modeled in MLwiN by comparing the likelihood ratio test statistic of a model with and a model without age. To examine the relationships between PF and EF, regression analyses were conducted controlling for age and sex. Results Multilevel models showed a positive development of physical fitness between age 8 and age 12 ( $p < .01$ ), with developmental accelerations between 8-9 for running speed (2.3 s), between 11-12 for aerobic endurance (.7 stages) and explosive strength (6.8 cm), whereas the development of handgrip strength was linear (2 kg/y). Significant positive relationships were found between one or two of the aerobic fitness items and several domains of EF: planning, set-shifting, working memory and inhibition ( $p = .018$  to  $p = .048$ ,  $R^2 = .12$  to  $.18$ ). For strength, only a significant relationship was found between handgrip and planning ( $p = .004$ ,  $R^2 = .22$ ). Discussion Children with ID develop PF in a positive way, including developmental accelerations. Mainly aerobic components of PF were related to EF, which underlines that boosting children's aerobic fitness will not only be beneficial for their health, but it might be important for their cognitive development as well. References Chaddock L, Hillman C, Pontifex M, Johnson C, Raine L, Kramer A.F. (2012). J Sports Sci, 30(5), 421-430. Colcombe S, Kramer A.F. (2003). Psychol. Sci, 14, 125-130.

### MEASUREMENT OF PHYSICAL ACTIVITY IN YOUNGSTERS: INFLUENCE OF OBESITY AND ACCELEROMETER PLACEMENT

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Aim To evaluate the effect of obesity and accelerometer placement on measurement of physical activity. Method A total of 36 youths, 18 girls and 22 boys, were included (mean age  $17.9 \pm 1.2$  years). They were stratified as normal weight if BMI<25 and as obese if BMI>25. A treadmill test (4km/h, 6km/h and 8km/h) was performed with accelerometers positioned around the waist and on the ankle. Accelerometer (Actigraph model 7164) data were compared between the groups using Mann-Whitney's test for both waist and ankle accelerometer data output for all speeds. Results Mann-Whitney's test results were non-significant between the two groups when the accelerometer was placed around the ankle and around the waist for 4km/h and 6km/h. Accelerometer data output when placed around the waist

during 8km/h showed significant differences ( $p < 0.0001$ ) between the groups with mean values  $\pm$ SD of  $164 \pm 92$  (BMI < 25) and  $342 \pm 157$  (BMI > 25). Conclusion In this pilot study we showed that level of obesity influence data output during jogging when the accelerometer is placed around the waist. No differences were shown when the accelerometer was placed around the ankle. Placement of the accelerometer around the ankle may provide more reliable measurements of physical activity when lean and obese youngsters are compared.

### **ASSESSMENT OF MUSCULOSKELETAL CONDITIONS AND THEIR IMPACTS IN THE ADOLESCENT POPULATION: ADAPTATION AND VALIDATION OF THE NORDIC MUSCULOSKELETAL QUESTIONNAIRE**

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**INTRODUCTION** Valid and reliable instruments measuring injury prevalence and their impacts in the adolescent population are scarce. The Extended Nordic Musculoskeletal Questionnaire (NMQ-E) is a reliable 99-item instrument that measures the point, 6-month and life prevalence and impacts of musculoskeletal symptoms over 9 body regions (Dawson and al. 2009). An adapted version of the NMQ-E would be a useful tool to assess the prevalence of disorders in the adolescent population. The purpose of this study was: (1) to adapt the NMQ-E to the adolescent population and (2) to assess the validity and reliability of the adapted version of the instrument. **METHODS** Based on the results of a translated (French) and adapted NMQ-E administered to 61 adolescents, a final 27-item dichotomous questionnaire was developed. The questionnaire measured the 6-month prevalence of musculoskeletal symptoms and the impact of these symptoms on school and work attendance and on sports and leisure activities. Among the adolescents who agreed to participate; thirty-nine (mean age:  $13.7 \pm 1.8$ ) formed the reliability cohort and thirty-four (mean age:  $14.2 \pm 2.3$ ) formed the criterion validity cohort. Reliability was measured by test-retest with a mean time interval of  $28 \pm 8$  hours. Criterion validity was assessed by comparing the adapted NMQ-E answers to the participants' clinical records. Validity and reliability were calculated using proportions of observed agreement (Po) and the Cohen kappa statistic (k). **RESULTS** The mean Po for the test-retest was 0.92 for the 6-month symptom prevalence items, 0.99 for the impact of symptoms on school and work items and 0.96 for the impact on sports and leisure activities items. Kappa values for the reliability assessment ranged between 0.82 and 1.00 for the 27 dichotomous variables. The criterion validity kappa obtained for the agreement between participants' clinical records and questionnaires was  $k = 0.72$ . **DISCUSSION** Kappa values for the reliability and the criterion validity are considered of moderate to perfect agreement beyond chance (Viera and al. 2005), indicating that there is only minor variations between tests and good agreement between questionnaire items and clinical records. Finally, the present results indicate that the adapted version of the NMQ-E is an appropriate self-administered musculoskeletal disorder screening tool for the adolescent population. However, items related to the impacts of symptoms would benefit from additional validation using school and sport attendance records. **REFERENCES** Dawson A, Steele E, Hodges P and Stewart S. (2009). *J of Pain*, 10(5): p. 517-26. Viera A J and Garrett J M. (2005). *Fam Med*, 37(5): p. 360-3.

### **MULTIDISCIPLINARY INTERVENTION TO PROMOTE A PHYSICALLY ACTIVE BEHAVIOUR AND HEALTHY NUTRITION FOR THE MANAGEMENT OF CHILDHOOD OBESITY**

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**Introduction** Obesity is attributed mainly to environmental factors, and authors (Davison & Birch, 2002) indicate that due to changes in physical activity behaviour. In developed countries time spent on physical activity tasks decreases, whereas that devoted to sedentary behaviours (Agarwal 2008). The aim of this study was to determine whether physical exercise training, associated with a family nutrition and physical activity education programme could induce changes in indices of adiposity (BMI z score and fat distribution) in sedentary overweight children. **Methods** The intervention design is a longitudinal prospective study with post-test at 9 months. A total of 86 (56 boys and 30 girls, range 8-14 years) sedentary and overweight children, as defined by the International Obesity Task Force Criteria, and their parents participated in the study. Consisting of physical activity training for children and nutrition and physical activity behaviour, that involves parents and child participation. **Results** At the end of the program, BMI z score was significantly reduced in  $0.2 \pm 0.29$  units ( $p < 0.001$ ). Fat percentage was modified only in boys' lower extremities ( $P < 0.01$ ). **Discussion** This intervention shows that a 9 months children and family intervention, of the treatment of childhood obesity based on friendly uncompetitive physical activity, can induce a positive change in the reduction of BMI z score in sedentary obese children. In terms of fat percentage results are less encouraging and it is suggested that a more intense children and family dietary habits approach should be introduced, and to increase its effectiveness a more individually-tailored exercise. Whether or not these changes can be maintained in the future remains to be analyzed one year after the intervention period ends. **References** Agarwal, RK. (2008). *Indian Pediatrics*, 45, 443-445. Davison, K. K., & Birch, LL. (2002). *International Journal of Obesity and Related Metabolic Disorders*, 26, 1186-1193.

**15:00 - 16:00**

## **Mini-Orals**

### **PP-PM01 Adapted Physical Activity [AP] 1**

#### **OBESITY IN CHILDREN AND ADOLESCENTS WITH DOWN SYNDROME: AGREEMENT BETWEEN BODY MASS INDEX AND BIOELECTRICAL IMPEDANCE ANALYSIS**

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**Introduction** The prevalence of obesity in children and adolescents has increased, causing various problems health in children and adolescents. In individuals with Down syndrome (DS) the same has been observed (Murray e Ryan-Krause, 2010; van Gamen-

Oosterom et al., 2012; Loveday et al., 2012). However, there is a not criterion widely accepted to classify obesity in DS. The aim of this study was to verify the agreement of the prevalence of obesity classified by body mass index (BMI) and excess body fat determined by bioelectrical impedance analysis (BIA) in children and adolescents with DS. Methods The BMI was assessed in 41 children and adolescents with DS, aged from 5 to 20 years and obesity were classified according to the criteria of Cole and Lobstein (2012). The percentage of body fat (%BF) was estimated by BIA (BIA 310 Bioimpedance Analyzer) and excess fat was classified according to Williams et al. (1992). Results Using the criteria of BMI 65.9% were classified as obese, and by %BF measured by BIA 31.7%. A moderated (Kappa = 0.452 for girls) and regular (Kappa = 0.333 for boys) agreement were found between BMI groups and %BF. Discussion Some authors report that the use of BMI in individuals with SD may have a limitation in the classification of obesity (Bandini et al., 2012). Regarding to the BIA it can be used, however, Loveloy et al. (2012) highlights that there is lack of an equation for best results. Although, BMI and BIA are useful tools for epidemiological studies, currently there is no consensus regarding to the reference values to identify the risks associated with obesity in children and adolescents with DS. Therefore, the lack of reference values for the correct analysis of the results by the method of BIA is difficult in its applicability, especially for DS. This suggests that other assessment techniques are applied to determine more adequate the results. References Murray J, Ryan-Krause. (2010). *Pediatr Nurs*;36(6):314-319. Bandini LG, Fleming RK, Scampini R, Gleason J, Must A. (2012). *J Intellect Disabil Res*; Sep 14. Cole TJ, Lobstein T. (2012). *Pediatric Obesity*;7(4):284-294. Loveday SJ, Thompson JMD, Mitchell EA. (2012). *Acta Paediatrica*;101:e491-e495. Van Gasteren-Oosterom BM, van Dommelen P, Schönbeck Y, Oudesluys-Murphy AM, van Wouwe JP, Buitendijk SE. (2012). *Pediatrics*;130:e1520-1526. Williams DP, Going SB, Lohman TG, Harsha DW, Srinivasan SR, Webber LS, Berenson GS. (1992). *Am J Public Health*,82(3):358-363.

### **OBESITY INDICATORS IN DOWN SYNDROME: AGREEMENT BETWEEN BODY MASS INDEX AND SKINFOLDS THICKNESS**

Bertapelli, F., Gonçalves, E.M., Barbeto, V.J.O., Krahenbuhl, T., Ramalho, L.C.B., Samur-San Martin, J.E., Barbeto, C.J.O., Gorla, J.I., Guerra-Júnior, G.

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Introduction: Obesity is associated with cardiovascular and metabolic complications in children with Down Syndrome (DS). However, the criteria's for obesity classification in this population remains unclear. The aim of this study was to verify the agreement between established criteria for obesity classification by body mass index (BMI) and percentage of body fat (%BF) estimated by model based in skinfold thickness in children and adolescents with DS. Methods: The sample consisted of 76 individuals with DS with age from 6 to 18 years. Measures of weight and height were done for BMI (kg/m<sup>2</sup>). Triceps and subscapular skinfolds to estimate the body fat percentage (%BF) predicted by equation developed by Slaughter et al. (1988). BMI was classified according Cole & Lobstein (2012) and the %BF was classified according to Williams et al. (1992). The classifications were compared by contingency table 2 x 2 and the agreement was verified by Kappa index, according to the criteria of Svanholm et al. (1989). Results: The obesity prevalence estimated by BMI was 60.5% and %BF was 40.8%. A moderated agreement was found between BMI groups and %BF (Kappa = 0.591 and 0.467 for boys and girls, respectively). Discussion: Anthropometry is widely used to assess obesity, because it is easy and inexpensive. The results between the cutoffs of BMI and %BF were discrepant regarding the diagnosis of obesity. Among individuals with DS, studies shows limitations in the use of BMI (Bandini et al., 2012) and of %BF estimated by skinfolds method (González-Agüero et al., 2011). The preliminaries results of this study demonstrated that BMI and %BF should be used with care to identify the prevalence of obesity in children with DS. References Bandini LG, Fleming RK, Scampini R, Gleason J, Must A. (2012). *J Intellect Disabil Res*, Sep 14. Cole TJ, Lobstein T. (2012). *Pediatr Obes*, 7(4), 284-294. González-Agüero A, Vicente-Rodríguez G, Ara I, Moreno LA, Casajús JA. (2011). *Res Dev Disabil*. 32(5): 1764-9. Slaughter MH, Lohman TG, Boileau RA, Horswill CA, Stillman RJ, Van Loan MD, Bembien DA. (1988). *Hum Biol*, 60(5), 709-723. Svanholm H, Starklint H, Gundersen HJ, Fabricius J, Barlebo H, Olsen S. (1989). *APMIS*, 97(8), 689-698. Williams DP, Going SB, Lohman TG, Harsha DW, Srinivasan SR, Webber LS, Berenson GS. (1992). *Am J Public Health*, 82(3), 358-363.

### **DOES WHOLE BODYVIBRATION TRAINING AFFECT CROSS-SECTIONAL SOFT TISSUES IN ADOLESCENTS WITH DOWN SYNDROME?**

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Introduction Adolescents with Down syndrome (DS) have lower levels of bone and lean body mass and higher levels of fat mass than their counterparts without disabilities(1). Whole Body Vibration training (WBV) has showed increments in the cross-sectional muscle area of females with low bone mineral density(2). Therefore, the aim was to elucidate the effects of 20-week of WBV on cross-sectional muscle and subcutaneous fat at tibia and radius in adolescents with DS. Methods Twenty-six adolescents with DS (12 to 19 years) and twenty-five sex-age-matched controls were randomly assigned to WBV (15 DS; 13 non-DS) or control (11 DS and 12 non-DS) groups. WBV was performed squatting on the platform in sets for a total duration of 10 min 3 days per week with a vibration dose from 1.8 to 2.6 g and for a total of 20 weeks. Peripheral quantitative computed tomography scans were taken at 66% of the length of the tibia and the radius; cross-sectional muscle and fat areas were registred (mm<sup>2</sup>). Repeated measures of ANOVA adjusting by height, weight and Tanner stage were used to analyze possible group by time interactions on these variables. Adjusted values at pre- and post-training moments were recorded and percentages of change were calculated. Student's t tests for independent variables were used to evaluate the differences in percentages of change between WBV and control groups within each condition group. Results No significant group by time interactions were found for any of the studied variables after the training period. In the non-DS group, WBV group showed a higher percentage increase in cross-sectional muscle area of the tibia and in cross-sectional fat area of the radio than the control group. Within the DS, the WBV group showed a higher percent declination in cross-sectional muscle area and a higher percent increase in fat cross-sectional area of the tibia than the control group (all p>0.05). Discussion A 20-week WBV might not be enough by itself to achieve significant improvements on cross-sectional muscle or fat areas at tibia and radius in adolescents with DS. However, some improvements towards increases in muscle and decreases in fat areas were observed in non-DS group against the observed in DS group. Other important factors such as possible changes on diet and/or physical activity patterns during the training period should be taken into account before stating strong conclusion on this regard. References 1 González-Agüero, A et al. (2011). *Res Dev Disabil*. 2 Gilsanz, V et al. (2006). *J Bone Miner Res*.

**EFFECTS OF AN EXERCISE PROGRAM IN ADOLESCENTS WITH DOWN SYNDROME**

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**Introduction** Obesity and low cardio respiratory fitness are present in most adolescents with Down syndrome, which can be explained by the combined sedentary behavior and the characteristics of the disability, such as hypotonia, low HRmax and cardiovascular disease (Balic et al., 2000; Dodd & Shields, 2005). **Objective** To investigate the effects of a training program on maximal oxygen consumption (VO<sub>2</sub>max - ml/kg/min), test duration (TD - seconds) and percentage body fat (% FAT). **Methods** The study included 41 adolescents (25 boys and 16 girls), mean age 15.4 (± 2.9) years, divided into 3 groups: AT (aerobic training, n = 16), RT (resistance training, n = 15), CON (control group, n = 10). Evaluations were performed before and after training: maximal exercise test on a treadmill using the spirometer K4b<sup>2</sup> (Cosmed) with protocol validated by Fernhall et al. (1990), and assessment of %FAT by plethysmography with the equipment Bod Pod® (Life Measurement Inc., Concord, CA). Training consisted of 12 weeks (3 X week for AT group and 2 X week for RT group), with 40 minutes per session, preceded by 10min of warm-up. The AT performed treadmill/cycling exercise at 50-70% of reserve HR monitored by hearth rate monitors. The resistance training consisted of 9 exercises with 2 sets of 12 RM. Descriptive statistics and t test were used (level of significance p <0.05). **Results** AT and RT showed no significant changes before and after training in VO<sub>2</sub>max values (AT: 30.5 ± 6.2 and 30.0 ± 5.8, p = 0.4; and RT: 31.6 ± 5.9 and 31.9 ± 5.3, p = 0.74) and % FAT (AT: 29.2 ± 11.0 and 29.3 ± 10.4, p = 0.99; and RT: 22.9 ± 10.9 and 22.1 ± 12.2, p = 0.28), while CON reduced VO<sub>2</sub>max values (28.1 ± 3.8 and 21.3 ± 4.3, p <0.01) and increased % FAT (31.3 ± 7.2 and 34.3 ± 8.3, p = 0.04). TD only showed improvement for AT (815.9 ± 139.4 and 901.5 ± 61.1, p <0.01). **Conclusion** The 12-week training program did not cause significant changes in VO<sub>2</sub>max and % FAT, however showed improvement in TD for AT. Adolescents who did not participate in the program had significant decreases in VO<sub>2</sub>max values and increased the percentage of body fat, showing that exercise seems to maintain the fitness of adolescents with Down syndrome. **References** Balic M, Mateos E, Blasco C. Physical fitness levels of physically active and sedentary adults with Down syndrome. *Adapt Phys Activity Q*; 17, 310-21, 2000. Dodd KJ, Shields N. A systematic review of the outcomes of cardiovascular exercise programs for people with Down syndrome. *Arch Phys Med Rehabil*; 86, 10, 2051-8, 2005. Fernhall B, Millar A, Tymerson G, Burkett L. Maximal Exercise Testing of mentally retarded adolescents and adults: reliability study. *Arch Phys Med Rehabil*; 71, 1065-8, 1990.

**EFFORT TO INCREASE PHYSICAL ACTIVITY AMONG COMMUNITY WORKERS IN HORNAFJORDUR, ICELAND**

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**Introduction** Sedentary lifestyle is common in the world today and at the same time the prevalence of obesity and diabetes type 2 is increasing. This may lead to poorer public health and a greater risk of lifestyle diseases. Employers are concerned about rising costs related to the health of their employee. Health promotion can lower health related costs, as studies have shown that interventions emphasizing physical activity (PA) can be effective in increasing or maintaining levels of PA. The aim of the study was to examine the effectiveness of two different types of health promotion in increasing PA and improve health among community workers in the town Hornafjörður in Iceland. **Methods** Community workers were invited to participate and 125 accepted, where 103 completed the study. Baseline measurements took place at the beginning of the study period. Participants were reevaluated after a 6 month intervention and again 6 months after the intervention ended. Outcome measures included measurements of body composition (BMI, waist circumference and skinfolds), endurance (6 min submax bicycle test), resting blood pressure, blood parameters (total cholesterol, HDL and LDL cholesterol, triglyceride, blood sugar), quality of life (questionnaire), and PA (accelerometer). After the first measurements, the participants were randomly divided into three groups: two intervention groups and a control group. Both interventions emphasized PA. One research group received individual-based intervention with regular reminding and the other group received group-based intervention with standardized counselling once every month. **Results** No significant difference was found between groups in any of the changes in the outcomes variables. The blood pressure lowered significantly during the study period for all three groups; systole from 127 to 121 mmHg (p=0.01) and diastole from 77 to 71 mmHg (p<0.001), whereas LDL cholesterol levels increased; 2,9 to 3,1 mmól/L (p=0.01). PA decreased over time for all three groups; moderate-to-vigorous PA from 37 to 32 min/day (p=0.03). Other parameters did not change significantly. **Discussion** It is clear that neither intervention was effective in changing PA of the employees or health indicators. In order to affect participants an intervention may need to include a component based on theories of behavioural changes, be more holistic and a clear part on the workplace's culture (Marshall, 2004; Pelletier, 2009; Griffin et al 2010). **References** Marshall, A. L. (2004). *Journal of Science and Medicine in Sport*, 7(Suppl. 1), 60-66. Pelletier, K. R. (2009). *Journal of Occupational and Environmental Medicine*, 51(7), 822-837. Griffin, S. F., Wilcox, S., Ory, M. G., Lattimore, D., Leviton, L., Castro, C., o.fl.. (2010). *Health Education Research*, 25(2), 325-342.

**DOES WHOLE BODY VIBRATION TRAINING AFFECT BONE STRENGTH INDEXES IN ADOLESCENT WITH DOWN SYNDROME?**

Matute-Llorente, A.1,2, González-Agüero, A.1,3, Gómez-Cabello, A.1,2, Julián-Almárcegui, C.1, Gómez-Bruton, A.1,2, Vicente-Rodríguez, G.1,2, Casajús, J.A.1,2

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**Introduction** Adolescents with Down syndrome (DS) are characterized by low bone mineral density, a non-regular bone acquisition during growth (González-Agüero et al., 2011) and higher risk of suffering bone fractures (González-Agüero et al., 2012). Whole Body Vibration (WBV) training has showed improvements in bone mass in children with disabling conditions (Ward et al., 2004). Therefore, the aim of this study was to elucidate the effects of 20 weeks of WBV training on bone strength indexes in adolescents with and without DS. **Methods** Twenty-six male and female adolescents with DS (12 to 19 years) and twenty-five sex-age-matched controls were randomly assigned to WBV (15 DS; 13 non-DS) or control (11 DS and 12 non-DS) groups. Peripheral quantitative computed tomography (pQCT) scans were taken at tibia and radius; cortical thickness (CRT\_THK; mm), resistance to fracture load (FRC\_LD; N) in X and Y axes, stress strain index (SSI; mm<sup>3</sup>) in X and Y axes, bone strength index (BSI; mg<sup>2</sup>/mm<sup>4</sup>) and polar strength strain index (SSIPol; mm<sup>3</sup>), were calculated from these measurements. WBV was performed squatting on the platform in sets for a total duration of 10 min 3 days per week for a total of 20 weeks (from 1.8 to 2.6 g). Repetead measures of ANOVA adjusting by height, weight and Tanner stage were used to analyze possible group by time interactions on bone strength indexes. **Results** No significant group by time interactions were found for any of the studied variables after 20 weeks of training (all p>0.05). **Discussion** A 20-week WBV training 10 min 3 times per week with a vibration dose from 1.8 to 2.6 g might not be enough to provoke a significant improvement on bone strength indexes at tibia and radius in adolescents with and without

DS. This suggests that the protocol used was not effective to achieve improvements in bone strength indexes in adolescents. Further studies with longer trainings and different intensities should be performed in order to elucidate the effects that WBV may have at different training intensities. References González-Agüero, A. et al. (2011). Osteoporos Int, 22(7): 2151-2157. González-Agüero, A. et al. (2012). Osteoporos Int. Ward, K. et al. (2004) J Bone Miner Res, 19(3): 360-369

### EXERCISE VS. RELAXATION - A NEUROCOGNITIVE PERSPECTIVE IN INTELLECTUAL DISABILITY

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Introduction Today, exercise is well accepted to promote health. Recent neurophysiological and behavioural studies emphasise the benefits of exercise on cognitive performance. Although, neurocognitive processes are well identified (e.g. transient hypofrontality theory [1]) these studies were mainly set up for healthy individuals. Within intellectual disability, underlying neurocognitive processes remain widely unclear and thus characterize the primary aim of this study. Method Comparing 10 min moderate cycling ( $61.82 \pm 7.83$  W at  $70.09 \pm 5.83$  rpm) to 10 min familiar relaxation ('snoezelen' [2]), 11 right-handed adolescent ( $16 \pm 1.34$  years,  $167.27 \pm 10.01$  cm,  $69.36 \pm 7.80$  kg) volunteered to participate. According to the American Association on Intellectual and Developmental Disabilities, participants were characterized as intellectually disabled with the ability to distinguish between colours and shapes. Both, the exercising and relaxation condition were embedded in ability-modified cognitive performance assessments. Randomly flashing lights served as stimulus source. Reaction times and equivalent neurophysiological parameters were recorded. A 32 active electrode EEG enabled analyses of low-resolution brain electromagnetic tomography (LORETA) and event-related potential waveforms, in particular the N2 component. Results Moderate cycling revealed a decrease in fronto-electro cortical activity, that was most pronounced in the medial frontal gyrus ( $p < 0.001$ ). In addition, reaction time decreased ( $p < 0.01$ ) and was mirrored in decreased N2 latency ( $p < 0.01$ ) after exercise. However, relaxation revealed no significant changes. Discussion Based on the transient hypofrontality theory, decreased fronto-electro cortical activity is suggested to display a rearrangement of cortical resources, associated with cognitive states. A decrease in reaction time, mirrored in decreased N2 latency indicates immediate control of action. Taken together, the findings of this study support exercise programs in intellectually disabled adolescent to positively influence neurocognitive performance. References [1] Dietrich A. Transient hypofrontality as a mechanism for the psychological effects of exercise. Psychiatry Res 2006; 145(1):79-83. [2] Hogg J, Caveat J, Lambe L, Smeddle M. The use of 'snoezelen' as multisensory stimulation with people with intellectual disabilities: a review of research. Research in Developmental Disabilities 2001; 22:353-72.

### COMPARATIVE STUDY OF FOOTPRINTS IN YOUNG PEOPLE WITH DOWN SYNDROME

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Introduction: Musculoskeletal disorders of the locomotive apparatus are common in young people with Down syndrome, especially in the feet (Miller, 1995; Mik, 2008). Early diagnosis by examination of podiatric footprints can help prevent orthopedic manifestations (Galli, 2012). Calculating podiatric indexes through the footprint allows classification according to foot type (Razeghi, 2002). Our objective was to analyze, measure and classify footprints on the basis of podiatric indices (gold standard) in young people with Down syndrome. Methods: In this cross-sectional comparative study we analyzed 86 footprints from two groups, 21 healthy subjects, 11 men ( $20.45 \pm 2.16$ ) and 10 women ( $20.00 \pm 1.70$ ), and 22 young people with Down's syndrome, 11 men ( $23.82 \pm 3.12$ ) and 11 females ( $24.82 \pm 6.81$ ). Footprints were recorded in standing position using an optical pedoscope and a digital camera system. We calculated the Hernández-Corvo index, the Chippaux-Smirak index, Clarke's angle and the Stahelli index using the program Photoshop CS5 (Stahelli, 1997). We then compared the results of both samples and analyzed the concordance between types of feet and right and left feet by Chi-square test. Results: Footprints in individuals with Down syndrome showed flatfoot and/or pronated Hernández-Corvo index: 38.6%, Chippaux-Smirak: 50%; Stahelli: 70.4% and Clarke's angle 59.1%. In healthy subjects showed cavus feet Hernández-Corvo index 57.1%; Chippaux-Smirak index 59.5%; Stahelli index 81%; and Clarke's angle 57.1% showed normal foot. Difference between the two groups were statistically significant ( $p < 0.01$ ) in Chippaux-Smirak index, Stahelli index, and Clarke's angle, whereas the Hernández-Corvo index does not meet the conditions of applicability for Chi-square test. The correlation between the right and left foot was not significant. Conclusions: Young people with Down Syndrome had a higher percentage of pronation and lower percentage of cavus feet than the control group. References Galli PM. 2012. Foot-ground interaction during upright standing in children with Down syndrome. Res Dev Disabil 33:1881-1887. Mik G, Gholve PA, Scher DM, et al. 2008. Down syndrome: orthopedic issues. Curr Opin Pediatr 20:30-36. Miller PR, Kuo KN, Lubicky JP. 1995. Clubfoot deformity in Down's syndrome. Orthopedics 18:449-452. Razeghi M, Batt ME. 2002. Foot type classification: a critical review of current methods. Gait Posture 15:282-291. Stahelli L, Chew D, Corbett M. 1997. The longitudinal arch: a survey of eight hundred and eighty-two feet in normal children and adults. J Bone Joint Surg Am 69:426.

15:00 - 16:00

## Mini-Orals

### PP-PM23 Neuromuscular Physiology [PH] 1

#### THE EFFECT OF THREE WEEKS OF SHORT-TERM SPRINT INTERVAL VERSUS CONTINUOUS ENDURANCE TRAINING ON PERIPHERAL FATIGUE FOLLOWING MATCHED-WORK HIGH INTENSITY EXERCISE

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Introduction A short period of sprint interval training (SIT) improves performance comparable to that observed in continuous endurance training (ET). Both elicit rapid oxidative muscular adaptations (Burgomaster et al., 2005), but adaptations of contractile muscle function at

rest and during fatigue following SIT have yet to be established. The aim of this study was to examine the effects of 3 weeks of a low volume (SIT) and high volume (ET) regime on aerobic performance, muscle function and muscular fatigue. Methods Thirty-one men were pair matched (peak VO<sub>2</sub>), assigned to SIT (n=15, 21±1 years, 80±11 kg) or ET (n=16, 22 ± 2 years, 78±7 kg), and performed 9 (SIT) or 15 (ET) training sessions over 21 days. Each session consisted of either four or five repeats of 30 s 'all out' cycling with 4 min recovery (SIT) or 40 to 50 min continuous cycling at ~62% peak VO<sub>2</sub> (ET). Total training volume (in kJ) was significantly lower in SIT (~11% of ET). Participants performed a time to exhaustion trial (80% peak power) pre and post training (TTE<sub>pre</sub> and TTE<sub>post</sub>, respectively), and a trial of equal work to that achieved in TTE<sub>pre</sub> (ISO). Maximal isometric knee extension (MVC) and potentiated twitch force of the quadriceps (POT) in response to supramaximal electrical stimulation of the femoral nerve were assessed pre- and post-exercise for two trials (TTE<sub>pre</sub> and ISO). Results A comparable improvement in peak VO<sub>2</sub> (~7%) and TTE (~56%) was found in both groups (P>0.05). In the unfatigued state, neither training regime increased MVC (P>0.05). Both SIT and ET attenuated fatigue, measured as the exercise-induced reduction in MVC (SIT -26±10% to -12±12%; ET -34±8% to -19±10%, P<0.05) and POT (SIT -37±14% to -33±18%; ET -49±13% to -41±16%, P<0.05), with no difference between the two training regimes. Maximal rate of force development during POT slowed following the exercise trials, but less so after both training regimes (TTE<sub>pre</sub> -51±19 % vs. ISO -41±26%, P<0.05). Discussion Both training regimes improved aerobic exercise performance and fatigue resistance during a matched work exercise trial. These data suggest that the previously reported comparable improvements in muscle oxidative capacity and metabolism elicited by SIT and ET have physiological relevance to muscular performance and fatigability. Given the substantially lower training volume performed in SIT, this study provides further evidence that it is a time-efficient strategy to induce exercise performance improvements. References Burgomaster KA, Hughes SC, Heigenhauser GJ, Bradwell SN, Gibala MJ. (2005). *J Appl Physiol*, 98, 1985-90.

### MUSCLE METABOLIC DETERMINANTS OF EXERCISE TOLERANCE ABOVE AND BELOW CRITICAL POWER

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**Introduction** The *W'* represents a fixed amount of work that can be completed above the critical power (CP) and is depleted at the point of task-failure during severe-intensity exercise. When severe-intensity exercise is interspersed with recovery intervals, *W'* is reconstituted at a rate dependent upon the intensity of the recovery interval (Chidnok et al., 2012: *Med Sci Sports Exerc*, 44: 996-76); however, the intramuscular bases for this intensity-dependent *W'* recovery have yet to be investigated. We tested the hypotheses that: 1) muscle metabolites linked to the fatigue process would recover after exhaustion during recovery exercise performed CP, and 2) that these changes would influence the capacity to continue exercise. **Methods** Eight male subjects participated in this investigation. Initially, subjects completed four constant-work-rate single-leg knee-extension exercise bouts until the limit of tolerance to establish the parameters of the power-duration relationship (i.e., CP and *W'*). In three subsequent visits, subjects completed an exercise bout predicted to lead to exhaustion in 180 s followed by a work-rate reduction to either severe intensity exercise (above CP), heavy intensity exercise (below CP), or a 10 min passive recovery period, in a random order. The muscle metabolic responses to exercise were assessed using 31P magnetic resonance spectroscopy (31P-MRS). Data were analyzed using two-way repeated measures ANOVA. **Results** The tolerable duration of exercise during the recovery from exhaustive exercise was significantly greater in CP conditions (600 ± 0 s vs. 39 ± 31 s, respectively) (P<0.05). During passive recovery and CP recovery exercise, muscle [PCr] and pH did not recover, remaining at ~37 ± 8% of the initial baseline and 6.6 ± 0.2, respectively. **Discussion** These results indicate that the recovery of intramuscular metabolites in the recovery from exhaustive severe intensity exercise can be differentiated according to whether the recovery exercise is performed below or above the CP. The CP therefore represents an important intramuscular metabolic threshold which dictates the ability to maintain intramuscular homeostasis and the capacity to tolerate high-intensity exercise. **References** Chidnok W, DiMenna FJ, Bailey SJ, Vanhatalo A, Morton RH, Wilkerson DP, Jones AM (2012). *Med Sci Sports Exerc*, 44, 966-76.

### EFFECTS OF ENDURANCE EXERCISE ON MUSCULAR SIZE AND NEUROTROPHIN IN SENESCENCE-ACCELERATED MICE

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**Introduction** Aging-related decline in muscular function (sarcopenia) is characterized by decreases in muscular size, strength and velocity. Many factors have been thought to be involved in the aging related muscular atrophy, and the decrease in the number of motor neurons would be one of the important factors, because the innervation greatly affects the survival of muscle fibers (Larson et al., 1995). It has been reported that endurance exercise effectively prevents the loss of motor neuron during aging (Kanda et al., 1998), and also causes increased expressions of neurotrophins in skeletal muscle, serum, and other tissues (Cuppini et al., 2007). Although neurotrophins have been regarded as important in the function and survival of neurons, their roles in the progress and prevention of aging related muscular atrophy remain unclear. The present study investigated the effects of endurance exercise on muscular size, number of motor neurons and protein expressions of a neurotrophin, brain-derived neurotrophic factor (BDNF) and its receptor, during aging of senescence-accelerated mice (SAMP8). **Method** SAMP8 mice were randomly assigned to pre-exercise (PE), exercise (E) and sedentary (S) groups. At the age of 35 wk, the mice in PE were sacrificed and the specimens of the gastrocnemius muscle and spinal cord were obtained. The mice in E were endurance-exercised (5-degree inclined treadmill running; 20 m/s; 30 min; 3 sessions/wk) until the age of 51 wk. Thereafter, the mice in both E and S groups were sacrificed and the tissues were excised. The number of motor neurons innervating the muscle was measured by using a retrograde-transported fluorescent marker. The protein expressions of BDNF and its receptor TrkB were quantified with Western blotting. **Results** Muscle-fiber cross sectional area was significantly (P<0.05) larger in E group than in other groups. The expression level of BDNF within the muscle tended to be higher (P=0.068) in E than in S group. However, muscle-fiber composition (%ST), number of motor neurons, expression of BDNF within neurons and that of TrkB in both the muscle and neurons showed no significant differences between groups. **Discussion** The present results suggest that endurance exercise has partial effect in preventing the aging-related muscular atrophy and this effect is independent of the number and function of motor neurons. Exercise with much higher intensity, e.g., resistance exercise, may be required to cause bigger effects on both muscles and motor neurons. However, the interpretation of the present results would be limited by the use of senescence-accelerated mice. **References** Larsson L, Ansved T. *Prog. Neurobiol.* (1995)45:397-458 Kenro Kanda, Ken Hashizume. *Neuroscience Research* 31 (1998) 69-75 R.Cuppini, S.Sartini, et al. *Archives Iraliennes de Biologie*, 145: 99-110,2007

### INFLAMMATORY RESPONSES AFTER DIFFERENT VELOCITIES OF ECCENTRIC EXERCISE

Conceição, M., Libardi, C.A., Chacon-Mikahil, M.P.T.C., Nogueira, F.R.D., Vechin, F.C., Bonganha, V., Cavaglieri, C.R.  
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**Introduction** Eccentric exercise (ECC) induces muscle damage (MD), mainly when fast ECC is executed (Chapman, et al., 2006). After MD, is initiated a cascade of inflammatory events, including increases in concentrations of pro- and anti-inflammatory cytokines (Peake et al., 2005). Thus it is possible that the superior magnitude of MD may also induce a greater systemic inflammatory response. A study showed that women presented differences in inflammatory response compared to men (Stupka et al, 2000), since the estrogen (17 $\beta$ -estradiol) could promote a protective effect, attenuating the inflammatory response (Tiidus, 2003). No previous studies compared the inflammatory responses after different velocities of ECC in women. The present study aimed to verify MD and inflammatory response following different velocities of ECC in women. **Methods** Nine women (Ecc30, 23.8 $\pm$ 2.0 years; 57.8 $\pm$ 7.0 Kg; 1.6 $\pm$ 0.5 m) performed 30 maximal eccentric actions at 30°/s. Another ten women (Ecc210, 22.2 $\pm$ 3.9 years; 56.4 $\pm$ 6.0 Kg; 1.6 $\pm$ 0.5 m) performed the ECC at 210°/s. Changes in maximal voluntary isometric contraction (MVIC), range of motion (ROM), muscle soreness and creatine kinase (CK) and concentrations of tumor necrosis factor-alpha (TNF- $\alpha$ ), interleukin-6 (IL-6) and interleukin-10 (IL-10) were compared by a mixed model analysis of variance with repeated measures. Results It was found a group vs. time interaction for CK with greater values for Ecc30 (P< 0.001). A group effect (with greater decreases for Ecc30) for ROM (P< 0.001) and a time effect for ROM (P= 0.004), soreness (P< 0.001), TNF- $\alpha$  (P= 0.004), IL-6 (P=0.001) and IL-10 (P= 0.041) were found. **Discussion** Our results showed that slow ECC demonstrated higher serum CK compared with fast ECC. This is divergent compared to Chapman, et al., (2006). Also, all cytokines enhanced after both velocities of ECC. Although previous studies suggested that voluntary ECC does not cause inflammation (Malm & Yu, 2012); our results indicate that ECC induced changes in MD markers and promoted both pro- and anti-inflammatory systemic cytokines responses in women independent of ECC velocity. **Conclusion** In conclusion, the ECC induced MD and promoted both pro- and anti-inflammatory response; however, the responses are similar between fast and slow ECC. **References** Chapman, D., et al (2006). *Int J Sports Med*, 27(8), 591-598. Peake, J., Nosaka, K., & Suzuki, K. (2005). *Exerc Immunol Rev*, 11, 64-85. Stupka, N., et al (2000). *J Appl Physiol*, 89(6), 2325-2332. Tiidus, P. M. (2003). *Exerc Sport Sci Rev*, 31(1), 40-44. Malm, C., & Yu, J. G. (2012). *Histochem Cell Biol*, 138(1), 89-99.

### COMPARISON IN ECCENTRIC EXERCISE-INDUCED MUSCLE DAMAGE OF THE ELBOW FLEXORS AMONG 9-10 AND 14-15 YEARS OLD BOYS AND 20-25 YEARS OLD MEN

Nosaka, K., Chen, H.L., Chen, T.C.

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**Introduction** Many studies have examined eccentric exercise-induced muscle damage, but little is known about the muscle damage in children. To the best of our knowledge, only two studies compared muscle damage between preadolescent boys and adult men. Marginson et al. (1) reported that decreases in maximal voluntary contraction torque of the knee extensors and jump height, and increases in muscle soreness after 8 sets of 10 plyometric jumps were significantly smaller for boys (9-10 y) than adult men (20-29 y). Gorianovas et al. (2) reported similar findings after 100 drop jumps; however, no previous studies have used arm eccentric exercise to investigate muscle damage in children. The present study compared changes in several indirect markers of muscle damage after maximal eccentric exercise of the elbow flexors among pre-adolescent and adolescent boys, and adult men after two exercise bouts separated by 3 weeks. **Methods** Untrained pre-adolescent (9-10 y) and adolescent (14-15 y) boys, and adult (20-25 y) men (n=13/group) performed two bouts of 5 sets of 6 maximal isokinetic (90°/s) eccentric contractions of the elbow flexors of the non-dominant arm on a dynamometer, in which the elbow joint was forcibly extended from 90° to 0° (full extension). Changes in maximal voluntary isokinetic (60°/s) concentric contraction torque (MVC-CON), optimum angle, range of motion, upper arm circumference (CIR), visual analog scale for muscle soreness, plasma creatine kinase activity and myoglobin concentration, and ultrasound echo-intensity before, immediately after and 1-5 days after the first and second exercise bouts were compared among the groups by a two-way repeated measures ANOVA. Results MVC-CON before exercise was smaller (P<0.05) for 9-10 y (8.9  $\pm$  1.9 Nm) compared with 14-15 y (25.1  $\pm$  3.9 Nm) and 20-25 y (35.3  $\pm$  4.6 Nm). Changes in all variables after the first bout were smaller (P<0.05) for 9-10 y than 20-25 y as well as for 14-15 y than 20-25 y, and all changes except CIR were also smaller (P<0.05) for 9-10 y than 14-15 y. After the second bout, changes in all variables were smaller (P<0.05) than those after the first bout for all groups, but the changes were significantly (P<0.05) different among the groups in the same way as that of the first bout. No significant difference in the magnitude of the repeated bout effect was evident among the groups. **Discussion** These results indicate that the magnitude of muscle damage is significantly less for pre-adolescent than adolescent boys and adult men, and for adolescent boys than adult men after the first and second eccentric exercise. It appears that the magnitude of eccentric exercise-induced muscle damage increases with development of muscles, and changes in muscle characteristic with development account for the difference in the muscle damage. **Reference** 1) Marginson et al. *J Appl Physiol*. 99:1174-81, 2005. 2) Gorianovas et al. *BioMed Res Int*. 218970, 2013.

### EFFECT OF A PRE-EXERCISE GLYCOGEN REDUCTION PROTOCOL ON THE RECOVERY OF NEUROMUSCULAR FUNCTION FOLLOWING MILD EXERCISE-INDUCED MUSCLE DAMAGE

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**Introduction** High-intensity exercise is associated with glycogen depletion and short-term neuromuscular fatigue. In contrast, eccentric contractions cause exercise-induced muscle damage (EIMD) and delayed neuromuscular recovery. Temporal neuromuscular responses for those with EIMD and lowered glycogen are unclear. Therefore we examined the effect of muscle glycogen reduction on the recovery of neuromuscular function during mild EIMD. **Method** Fifteen men (22 $\pm$ 4 yr, 179 $\pm$ 7 cm, 76 $\pm$ 15 kg) performed a single-leg glycogen depleting cycling protocol (Pilegaard et al., 2002) the evening before a maximal isokinetic eccentric bout. Neuromuscular function was measured by isometric maximal voluntary contraction (MVC) and electrical stimulation (resting twitch, 20 and 50 Hz): at baseline; post-cycling; and post-eccentric upto 48-h. Cycling began with the control leg supported, whilst the glycogen reduction (GR) leg undertook: 20-min cycling at ~75% VO<sub>2</sub>max power; eight 90-s sprints, with 90-s rests (5% steps from 90 to 55% VO<sub>2</sub>max); and an all-out cycle at ~85% VO<sub>2</sub>max power. Next morning, 100 single-leg, maximal eccentric knee extensions (1.57 rad range of motion at 1.57 rad/s) were completed for the GR, and then control. Two-way, repeated measures ANOVA compared recovery of neuromuscular function between conditions from baseline, with differences located using Bonferonni paired t-tests. Results Glycogen reduction cycling reduced MVC force by: -23.2% (GR: P=0.0001), and -5.4% (control: P=0.002). Post eccentric exercise, MVC loss was similar between legs at: 0- (GR: -23.9%; control: -

19.4%), 12-h (GR: -10.6%; control: -9.7%) and 24-h (GR: -15.8; control: -13.5%;  $P>0.05$ ). By 48-h MVC remained impaired in the GR leg only (-7.4%,  $P=0.003$ ). Cycling decreased resting twitch force in the GR (-46.7%,  $P=0.001$ ), whilst potentiating force for the control (20.9%,  $P=0.05$ ). Eccentric exercise lowered twitch force more for GR (-41.3%), than the control leg (-13.7%,  $P=0.02$ ). At 12-h twitch force was recovered in both legs. Similarly, eccentric exercise reduced 20- (GR: -28.3%; control: -29.1%) and 50 Hz forces (GR: -16.2%; control: -19.25%), with full recovery by 12-h. Discussion Reduced muscle glycogen delayed the recovery of voluntary force, but not neuromuscular responses, during mild EIMD. Prolonged voluntary force loss, coupled with preserved twitch contractile capacity, suggests peripheral fatigue mechanisms. As greater immediate neuromuscular decline was associated with reduced glycogen in mild EIMD, more severe eccentric protocols may expand insight upon glycogen state and neuromuscular responses. References Pilegaard H, Keller C, Steensberg A, Helge J, Pedersen BK, Saltin B, Neufer D. (2002). *J Physiol*, 541(1), 261-271.

## THE REDUCTION IN MAXIMAL FORCE CAPACITY CAN LIMIT THE TIME TO TASK FAILURE OF A SUSTAINED CONTRACTION

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The reduction in maximal force capacity can limit the time to task failure of a sustained contraction Introduction A common manifestation of muscle fatigue is a decrease in the force capacity assessed by maximal voluntary contraction (MVC) performed within a few seconds after failure of a sustained contraction (Enoka et al. 2011). Nonetheless, MVC force after failure remains generally greater than the target force of the sustained contraction, suggesting that task failure was not related to the decrease in maximal force capacity (Booghs et al. 2012). However, the short rest period between the end of the fatiguing task and the subsequent MVC likely allows some recovery of the maximal force capacity. The aim of this study was to evaluate the decrease in maximal force capacity at failure and a few seconds after a submaximal sustained voluntary contraction performed at two contraction intensities. Methods Seven subjects performed isometric contractions with the abductor pollicis brevis muscle until failure at an intensity of 25% and 50% of MVC force, in separate sessions. The fatigue task ended when subject was unable to maintain the required force level for 5s. Before, at failure (without stopping the sustained contraction), and after 5s of rest, subjects performed a MVC during which a train of 3 stimuli (100 Hz) was applied to the median nerve to calculate the central activation ratio (CAR). Results The time to failure was longer for the task performed at 25% ( $282\pm 72$ s) than at 50% MVC ( $117\pm 30$ s;  $p<0.05$ ). The MVC force decreased ( $p<0.05$ ) by  $53.5\pm 13.5\%$  and  $47.5\pm 10.1\%$  at failure for the 25% and 50% MVC tasks, respectively, but had partially recovered (about 70% of initial values) 5s after failure. The CAR reached 100% before fatigue, decreased to  $95.4\pm 5.2\%$  and  $94.2\pm 5.0\%$  ( $p<0.05$ ) at failure for the 25% and 50% MVC tasks, respectively, and fully recovered after 5s. Discussion At failure, MVC force decreased by about 50% for both contraction intensities, indicating that the decrease in maximal force capacity likely contributed to task failure for the 50% but not the 25% MVC task, the remaining force capacity being greater than the target force in the latter case. However, MVC force had recovered to 70% of initial values and central fatigue (assessed by CAR) had completely disappeared 5s after failure, masking the influence of the force deficit on task failure for the higher intensity. These results indicate that assessing maximal force capacity at the end of a fatiguing contraction without rest may provide more relevant information on mechanisms responsible for task failure, and further support that mechanisms underlying task failure vary with the intensity of the sustained contraction. References Booghs C, Baudry S, Enoka R, Duchateau J. *Exp Physiol* 97:918-29, 2012. Enoka R, Baudry S, Rudroff T, Farina D, Klass M, Duchateau J. *J Electromyogr Kinesiol* 21:208-19, 2011.

## IS SPASTICITY EXACERBATED WITH ACUTE NEUROMUSCULAR FATIGUE IN STROKE PATIENTS?

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Introduction Spasticity and fatigue are two disabling and persistent symptoms affecting many stroke survivors. However, the effects of neuromuscular fatigue on spasticity have never been studied on a population of hemiparetic patients. This question is particularly relevant since in the clinical context, patients, who exhibit spasticity of rectus femoris, frequently report some difficulties to flex their knee during swing phase of the gait cycle, when they are tired. Therefore, the main aim of this study was to assess the effects of neuromuscular fatigue on stretch reflex-related torque and EMG of spastic knee extensors in hemiparetic patients. We hypothesized that repetitive concentric contractions of knee extensor muscles and the resulting fatigue would increase hyper-excitability of the stretch reflex. Methods Eighteen patients performed passive (stretch reflex) and dynamic (voluntary strength) evaluations before (PRE) and immediately after (POST) a fatigue protocol using an isokinetic dynamometer. Electromyographic activity of rectus femoris, vastus lateralis and biceps femoris was simultaneously recorded. PRE and POST test consisted of i) passive evaluation at three different velocities, ii) isometric and iii) concentric maximal voluntary contractions (MVCs) of the knee extensor muscles. The voluntary isokinetic fatigue protocol consisted of 40 maximal repetitive concentric contractions of knee extensor muscles at  $60^\circ/\text{sec}$ . Immediately after the fatigue protocol, subjects reproduced the initial assessment for the passive and dynamic trials. Results During the fatigue protocol, the mean normalized peak torque and the neuromuscular efficiency of the knee extensors muscles significantly decreased. The torque developed by the knee extensors muscles during isometric contractions decreased in the fatigued state. The peak resistive torque and the normalized RMS values of VL and RF during passive stretching movements were not modified by the fatigue protocol during all stretching velocity. Discussion Results showed that fatigue induced by isokinetic repetitive maximal knee extension do not influence spasticity of quadriceps muscle in patients after stroke. They also highlighted that although patients exhibited decline in strength development after localized muscle fatigue, mainly produced by excitation-contraction coupling failure (Remaud et al., 2005), the modifications in muscles properties following stroke seem preserve stretch reflex components (Knorr et al., 2012). References Remaud A, Cornu C, Gue A. (2005). *J Athl Train*, 40, 281-287. Knorr S, Rice CL, Garland SJ. (2012). *Disabil Rehabil*, 34, 2291-2299.

## EFFECTS OF A ONE-MONTH MUSCLE OVERLOAD ON THE MEDIAL GASTROCNEMIUS MOTONEURONS

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Introduction Various models of chronic neuromuscular activity, as workload training, tendon transfer, or paresis and peripheral nerve damage lead to muscle overload. Chronic increases or decreases in the activation of motor units mostly induce biochemical changes, especially in muscle fibers and innervating them alpha-motoneurons. Less knowledge is available on adaptation in electrophysiological properties of motoneurons. The aim of this study in adult rats was to investigate whether 5 weeks of the functional muscle overload

results in alterations of electrophysiological properties of motoneurons (MNs). Methods Rats were subjected to chronic overload of the medial gastrocnemius (MG) muscle by bilateral tenotomy of its synergists (lateral gastrocnemius and soleus (LGS), and plantaris). As the result of this operation, only the MG muscle was able to evoke a foot plantar flexion during daily locomotor activity. To assure that the operated MG muscles were regularly voluntarily activated, rats were subjected to extensive voluntary activity on a running wheel and additionally to a training program on a treadmill for 5 weeks, 5 days a week. The intracellular recordings from spinal MNs were made in deeply anesthetized animals. The MG or LGS MNs were identified by antidromic stimulation of the respective nerve branches. Results The basic electrophysiological properties of MNs were considerably modified by the muscle overload, mostly in fast-type MNs. 5 weeks of the compensatory muscle overload evoked substantial changes in membrane and rhythmic properties primarily of fast-type MNs innervating the MG muscle (a decrease in rheobase current and a spike generation threshold, as well as a leftward shift of the frequency-current relationship). The measured properties of slow-type MNs remained unaltered. Motoneurons innervating the unloaded muscles exhibited reverse modifications of their membrane properties, but adaptations in overloaded MG MNs were more pronounced than in unloaded LGS MNs. Discussion Either voluntary wheel running or endurance treadmill training produce adaptations in the electrophysiological properties of MNs pools that involve alterations in membrane properties resulting in increased excitability. It has been revealed that the functional muscle overload by removal of its major synergists has no effect on the size of the cell body of MNs and the level of their oxidative potential, but results in an increase in the muscle fiber size, a shift toward "slower" physiological properties. Our data point on higher excitability of fast-type MNs and are in line with the above observations. Alterations in MNs' electrophysiological properties lead to changes in discharge patterns of MUs, what in turn may influence force developed by muscle fibers.

### MUSCLE FATIGUE FOLLOWING SUSTAINED CONTRACTIONS WITH IDENTICAL TORQUE-TIME INTEGRAL

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*INSERM 1093*

Introduction Central and peripheral mechanisms of neuromuscular fatigue are intensity-dependent. In most of studies on muscle fatigue, the intensity of the submaximal fatiguing contractions is fixed, while the duration is determined by the time to exhaustion (Smolander et al., 1998). It has been shown that low intensity prolonged contractions induced central fatigue, contrary to high intensity contractions (Yoon et al., 2007). In contrast, other studies found greater peripheral fatigue for low intensity contractions (Fuglevand et al., 1993). However, in these studies the intensity-duration combination, quantified by the force- or torque-time integral, was not controlled and could in part explain the diversity of the results. Therefore, the aim of this study was to compare neuromuscular alterations following isometric sub-maximal contractions at different intensities and durations, but with a similar torque-time integral. Methods Sixteen participants performed three isometric sustained contractions at different intensities (25 %, 50 %, and 75 % of Maximal Voluntary Contraction (MVC) torque in knee extension) with different durations but similar torque-time integral value. MVC torque, maximal voluntary activation level (VAL), M-wave amplitude and potentiated doublet amplitude were assessed before and immediately after the sustained contractions. EMG activities of the vastus lateralis (VL) and rectus femoris (RF) muscles were recorded during the sustained contractions. Results MVC torque reduction after the exercise was similar in the three conditions (-23.4 ± 2.7 %). VAL decreased significantly in a similar extent (on average: -3.1 ± 1.3 %) after the three sustained contractions. Potentiated doublet amplitude was similarly reduced in the three conditions (-19.7 ± 1.5 %), but VL and RF M-wave amplitudes remained unchanged. EMG activity of VL and RF muscles increased during the three contractions (VL: 54.5 ± 40.4 %; RF: 53.1 ± 48.7 %). Discussion The three submaximal isometric contractions of the knee extensor muscles with different intensity-duration combinations but with similar torque-time integral induced a similar level of fatigue with identical central and peripheral alterations. Further studies are required to determine whether the level of fatigue is dependent on the value of torque-time integral of the contraction. References Fuglevand AJ, Zackowski KM, Huey KA, Enoka RM. (1993). *J Physiol*, 460, 549–572. Smolander J, Aminoff T, Korhonen I, Tervo M, Shen N, Korhonen O, Louhevaara V. (1998). *Eur J Appl Physiol*, 77(5), 439–44. Yoon, T., Schlinder Delap, B., Griffith, E. E., & Hunter, S. K. (2007). *Muscle & nerve*, 36(4), 515–24.

### MUSCLE DAMAGE INDUCED BY AN ULTRA-ENDURANCE TRIATHLON AFFECTS SLOW FIBRES AND IS RELATED TO DEHYDRATION

Barrero, A.1, Cadefau, J.A.1, Irujo, A.1, Chaverri, D.1, Guerrero, M.2, Carmona, G.2, Cussó, R.2, Iglesias, X.1, Rodríguez, F.A.1

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Introduction Ultra-endurance triathlon (UET) races (3.8-km swim, 180-km cycle, 42.2-km run) induce muscle damage (Neubauer et al., 2008). Fast (FM) and slow myosin (SM) assessment in blood 48 h after exercise is a useful marker for the detection of skeletal muscle damage (Guerrero et al., 2008). This study aimed to assess muscle damage after an UET race as indicated by FM, SM and creatine kinase (CK) serum levels and to relate them to the hydration status. Methods 11 well-trained non-professional ultra-endurance triathletes (mean ± SD: age 37.2 ± 4.6 years, body mass 74.3 ± 6.7 kg, height 174 ± 6 cm, BMI 24.5 ± 1.9 kg/m<sup>2</sup>, VO<sub>2</sub>max 67.5 ± 4.2 mL/(kg•min)) competed in the Extreme Man Salou-Costa Daurada UET 2011. Venous blood samples were collected up to 30 min before and 48 h after finishing the race. ELISA method was used to determine myosin concentration in serum. Body mass (BM) and bioimpedance (BIA) bioelectrical variables (Z-Metrix®, Biopar-Hom Co, France) were obtained before, 30 min post-race, and 48 h after. Total (TBW), intracellular (ICW), and extracellular body water (ECW) content was estimated using the instrument software. Results Race time was 759±SD 64 min. Initial SM levels (1016±228 •g/l), FM levels (1091±374 •g/l), and CK activity (202±87 U/l) largely increased post-race (170±93%, 16±37% and 600±476%, respectively, p<0.001). SM increase was closely related to the increase in CK (r=0.72, p=0.013). BM (74.0±6.8 kg) decreased post-race (-5.8±1.9%) and 48 h after (-1.4±1.2%) (ANOVA, p<0.001), as well as TBW, ECW and ICW (-8.5±2.9%, -10.8±3.7% and -7.0±2.8, respectively, p<0.001), with no further changes 48 h after. BM decrease was closely related to the reduction in TBW, ECW, and ICW (r=0.98, 0.95, and 0.85, respectively, p≤0.001). The increase in SM levels was related with the decrease in TBW (r=0.71, p=0.014) and ICW (r=0.74, p=0.01), but not in ECW (r=0.56, p=0.08). Discussion While CK increased activity is believed to be a reliable marker of muscle damage, elevated SM levels suggest specific damage in slow muscle fibres, which are largely predominant in ultra-endurance athletes. Our results, beyond confirming fibre muscle damage induced by an UET race, strongly suggest that cellular structural damage predominantly affects slow fibres, and that muscle damage is influenced by hydration status. References Guerrero M, Guiu-Comadrell M, Cadefau JA, et al. (2008). *Br J Sports Med*, 42(7): 581-584. Neubauer O, König D, Wagner K-H, et al. (2008). *Eur J Applied Physiol* 104(3): 417-426.

## HOW TO MEASURE CARDIORESPIRATORY FITNESS IN CHILDHOOD AND ADOLESCENCE

Schlenker, L., Schmidt, S., Albrecht, C., Woll, A., Bös, K.

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**Introduction** Cardiorespiratory fitness is considered as the most important health related physical ability and it is a powerful marker of health (Ortega et al., 2008). Therefore it is important to measure the cardiorespiratory fitness accurately. Field tests offer a feasible alternative to expensive labor procedures. In this study we compared three different commonly used field-based endurance tests for children and adolescences, using maximal oxygen uptake (VO<sub>2</sub>max) as criterion reference. **Methods** A sample of 23 boys from 11 to 14 years ( $m = 12,31$ ) performed three endurance tests. 1. The 6-minute-endurance-run (6-MR) around a volleyball court. Total distance (m) was recorded (Bös & Wohlmann, 1987). 2. The 20m Shuttle Run Test (20m SR), where the children had to run back and forth on a indoor 20 m course. The starting speed of 8.5 km/h was increased each minute with 0,5 km/h. Test duration (sec) was recorded (Leger et al., 1988). 3. A bicycle ergometer test on a SRM system. The initial workload of 25 W was increased every 2 minutes by 25 W. The physical work capacity (watt/kg) at the heart rate of 170 bpm (PWC 170) was assessed. In addition VO<sub>2</sub>max was determined via Cortex Metamax 3B gas analysis system. Pearson correlation coefficients were calculated. **Results** The children achieved a mean distance of 1288 (+/- 101) meters in the 6-MR, the mean test duration in the 20m SR was 510 (+/- 99) seconds and the mean result of the PWC 170 test was 2,61 (+/-0,64) W/kg. The results of the 6-MR showed the highest correlations with VO<sub>2</sub>max ( $r=0.81$ ;  $p<0.01$ ) followed by the results of the 20m SR ( $r=0.66$ ;  $p<.01$ ) and the PWC 170 ( $r=0.63$ ;  $p<.05$ ). **Discussion** When using VO<sub>2</sub>max as criterion reference, the 6-MR appears to be the most appropriate method for assessing cardiorespiratory fitness for the group of 11 to 14 year old boys. The 20m SR seems to be a less suitable method. Due to its complex test protocol, it seems to be more appropriate for older participants. As a submaximal test, the great benefit of the PWC 170 test is its independence from personal motivation. Yet, on the negative side, the test results are influenced by the widely differing individual heart rates. Thus, the PWC 170 test renders itself useful only in terms of a rough assessment of cardiorespiratory fitness. **References** Bös, K. & Wohlmann, R. (1987). *Lehrhilfen für den Sportunterricht* (36), 10, 145-156. Leger, L., Mercier, D., Gadoury, C, Lambert, J, (1988). *J Sports Sci*, 6 (2), 93-101. Ortega, F. B., Ruiz, J. R., Castillo, M. J., & Sjostrom, M. (2008). *Int J Obes (Lond)*, 32(1), 1-11.

**15:00 - 16:00**

### Mini-Orals

#### PP-PM34 Physiology [PH] 1

### IMPAIRED IMMUNE FUNCTION AFTER MILD HYPOTHERMIA AND PROLONGED COLD EXPOSURE

Dolci, A.1, Brierley, J.1, Fortes, M.1, Lloyd-Jones, E.2, Walsh, N.1, Oliver, S.1

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The aim was to assess the effect of mild hypothermia and prolonged cold exposure on immune function of healthy humans. As cold exposure is known to activate the sympathetic nervous system and HPA axis, which are known to have immunosuppressive effects, we hypothesized that mild hypothermia would impair immune function, as assessed by clinically relevant immune measures, which included saliva flow rate and IgA secretion rate, bacterial-stimulated neutrophil degranulation and vaccine-stimulated cytokine production (IFN- $\gamma$  and IL4). In a repeated measures design 19 males completed a cold trial and a thermal neutral control trial in a random order. During the cold trial they were immersed in 13°C water until rectal core temperature reached 36°C. Following this they completed a seated and semi-nude cold air exposure (0°C) for up to 3 hours or until core temperature reached 35°C. Core temperature was lowest 21 (31) minutes into the cold air exposure (35.17 (0.33)°C (mean (SD))). Immediately after the lowest core temperature there was an increase in circulating leukocytes (30%,  $P < 0.001$ ), neutrophils (42%,  $P = 0.002$ ), lymphocytes (22%,  $P = 0.008$ ) and monocytes (35%,  $P < 0.001$ ). After 3-hour cold-air exposure the general leukocyte mobilization was followed by divergent changes in leukocyte subpopulations, where circulating neutrophils increased further (97%,  $P < 0.01$ ), monocytes returned to control values and circulating lymphocytes were lower than control values (-16%,  $P < 0.01$ ) until 3 hours after cold exposure. Bacterial-stimulated neutrophil degranulation and vaccine-stimulated IL4 were unchanged after cold exposure. In contrast, immediately after the lowest core temperature there were decreases in vaccine-stimulated IFN- $\gamma$  production (-44%,  $P = 0.04$ ), saliva flow rate (-59%,  $P = 0.06$ ) and IgA secretion rate (-52%,  $P = 0.01$ ), which suggest temporary immune suppression. Moreover, despite rewarming and feeding, vaccine-stimulated IFN- $\gamma$  production did not return to control values within the 3-hour recovery, which suggests more prolonged immune suppression, specifically, impaired antimicrobial capacity. As cortisol (39%  $P = 0.05$ ), adrenaline (150%  $P = 0.04$ ) and noradrenaline (357%  $P < 0.001$ ) were all increased on the cold trial it is plausible that these stress hormones are responsible for the alterations in circulating leukocytes and immune suppression observed. In conclusion this study shows that mild hypothermia causes immune suppression in healthy individuals, which might explain the increased incidence of infection reported after cold exposure.

### WHOLE BODY CRYOSTIMULATION AS A DAILY RECOVERY STRATEGY DURING INTENSIFIED TRAINING IN ELITE-LEVEL SYNCHRONIZED SWIMMING

Schaal, K., Le Meur, Y., Rebeyrol, J., Louis, J., Petit, O., Hellard, P., Casazza, G., Hausswirth, C.

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**INTRODUCTION:** Elite athletes frequently undergo periods of intensified training (IT) within their normal training program. Optimizing recovery during IT is particularly important in order to avoid excess fatigue that could undermine the intended training adaptations of IT. After demonstrating the effectiveness of whole body cryostimulation (WBC) as a short term recovery aid between two exhaustive exercises (1), we investigated whether daily WBC during IT influenced key factors to speed-up recovery (sleep and food intake) and whether it could prevent early physiological signs of an overreached state (2,3). **METHODS:** After 1 week of normal training (BASE), 10 elite synchronized swimmers performed two 12-day IT periods in randomized order, using WBC daily (ITWBC), or not (ITCON). The IT were separated by 9 days of light training. 3 exercise test sessions were performed: at BASE and after each IT. After obtaining resting heart rate variability

(HRV) samples, swimmers performed a 400m time trial to quantify the lactate ([La-b]), heart rate (HR400), salivary alpha amylase [AAs]400 (as an indicator of sympathetic activity) and cortisol ([Cs]400) response to maximal exercise. Swimmers wore a wrist actigraph nightly to monitor sleep patterns throughout the experiment. Energy intake (EI) was measured during each period. Fasted, waking saliva samples were obtained on the first and last day of BASE and each IT to measure [Cs] and leptin ([Ls]) concentrations. Results: ITCON resulted in significantly increased HRV indices of parasympathetic activity (R-to-R interval, SD1, HFnu), and decreased sympathetic activity (LFnu) while this did not occur with ITWBC. Significant decreases in mean swim speed ( $-1.1 \pm 0.5\%$ ), [La-b]400 ( $-11 \pm 6\%$ ) and [AAs]400 ( $-25 \pm 16\%$ ) were observed from BASE to ITCON, while no significant changes were found after ITWBC. Change in swim speed was inversely correlated with changes in HRpeak, [La-b]peak and [Cs]peak ( $r = -0.95, -0.65$  and  $-0.81$ ). Sleep fragmentation index increased with both IT, suggesting decreased sleep quality, but actual sleep quantity was preserved with ITWBC and decreased with ITCON ( $435 \pm 7$  and  $413 \pm 9$  vs  $433 \pm 10$  min for BASE). No changes in EI were observed during either IT despite a 25% increase in exercise energy expenditure ( $2244 \pm 162$ , ITWBC:  $2250 \pm 262$ , ITCON:  $2273 \pm 371$  kcal/day); body fat mass and [Ls] decreased during the study. CONCLUSIONS: Daily WBC during IT effectively prevented the appearance of several signs of fatigue accumulation, including parasympathetic hyperactivity at rest, suppressed sympathetic activation during exercise and decreased performance. WBC also helped maintain sleep quantity, but did not help increase food intake in response to intensified training in elite synchronized swimmers. 1 Schaal K et al (2013) Appl Physiol Nutr Metab. doi: 10.1139/apnm-2012-0155 2 Le Meur Y et al (2013) J Appl Physiol. doi: 10.1152/jappphysiol.01254.2012 3 Le Meur Y et al (under review, Med Sci Sport Exerc)

## 6 WEEKS OF HIGH INTENSE INTERVAL TRAINING IMPROVES MITOCHONDRIAL RESPIRATORY CAPACITY BUT NOT VO2MAX

Dohlmann, T., Hindsø, M., Larsen, S., Dela, F., Helge, J.W.

*University of Copenhagen*

**Introduction** Alteration in mitochondrial respiratory capacity has been linked to several conditions that are associated with a sedentary lifestyle, such as obesity and insulin resistance. It is well known that endurance training can diminish these conditions, but some high intensity interval training (HIIT) protocols have shown similar improvements in insulin sensitivity, in spite of the reduced training volume. However it is sparse with literature regarding HIIT and the effect on mitochondrial respiratory capacity. The aim of this study was to investigate the effects of a low volume HIIT protocol on mitochondrial respiratory capacity and VO<sub>2</sub>max in sedentary overweight adults. **Methods** 8 healthy sedentary men (n=2) and women (n=6) (age  $40 \pm 3$  yrs, BMI  $32 \pm 2$ , VO<sub>2</sub>max  $2383 \pm 115$  ml·min<sup>-1</sup>) were recruited for this study. They underwent 6 weeks of supervised HIIT on a cycle ergometer (18 sessions of 7x1min exercise bouts interspersed with 1min rest periods). Muscle biopsies were taken from m. vastus lateralis before and after training. Mitochondrial respiratory capacity was measured ex vivo in permeabilized muscle fibers using high resolution respirometry (Oxygraph-2k, Oroboros, Innsbruck, Austria). The respiratory protocol investigated maximal coupled state 3 respiration (complex I + II linked substrates) with the following substrates (malate, glutamate, octanoyl carnitine, succinate and ADP; GMSO3), as well as state 4o (oligomycin; LEAK). Body composition was measured by DXA and VO<sub>2</sub>max using an incremental cycle test to exhaustion. **Results** Mitochondrial respiratory capacity increased significantly following training; GMSO3 respiration increased by 13% ( $57 \pm 4$  to  $64 \pm 5$  pmol O<sub>2</sub>·mg<sup>-1</sup>·s<sup>-1</sup>) and LEAK respiration increased by 24% ( $21 \pm 2$  to  $25 \pm 2$  pmol O<sub>2</sub>·mg<sup>-1</sup>·s<sup>-1</sup>). The present training protocol didn't elicit a significant improvement in VO<sub>2</sub>max (4%,  $P = 0.37$ ), but time to fatigue during the VO<sub>2</sub>max test was significantly increased by 18% post training ( $P < 0.001$ ). BMI and body composition were not changed following training. **Discussion** Interestingly the present training protocol induced a significant improvement in mitochondrial respiratory capacity, but not in whole body VO<sub>2</sub>max, thus implying that the training stimulus was adequate to improve the respiratory capacity locally. The observed improvement in mitochondrial function and time to fatigue suggest that the HIIT training may induce positive metabolic effects that can attenuate the development of lifestyle diseases, independently of VO<sub>2</sub>max. The project is funded by the EU FP7 program

## MITOCHONDRIAL RESPIRATORY CAPACITY IN SKELETAL MUSCLE DOES NOT CHANGE AFTER HIGH INTENSITY INTERVAL TRAINING IN PATIENTS WITH TYPE 2 DIABETES

Bjerre Andersen, N., Skaaby, S., Pedersen, H.P., Nielsen, M.B., Petersen, H.H.H., Helge, J.W., Dela, F.

*University of Copenhagen*

**Introduction:** High intensity interval training (HIIT) has been shown to effectively increase biomarkers (citrate synthase (CS) activity) of mitochondrial content in skeletal muscle in healthy subjects (1). Whether this finding also translates into increased oxidative respiratory capacity remains to be shown. In addition, the effect of HIIT in insulin resistant muscle has never been elucidated. **Methods:** Eight patients with type 2 diabetes (T2DM) (age  $58 \pm 2$  yrs; BMI  $32 \pm 1$  kg/m<sup>2</sup>; HbA1C  $7.2 \pm 0.3\%$ ; maximal oxygen uptake (VO<sub>2</sub>max):  $27 \pm 1$  ml/min/kg) and four healthy controls (CON) (age  $53 \pm 2$  yrs; BMI  $29 \pm 1$  kg/m<sup>2</sup>; HbA1C  $5.5 \pm 0.1\%$ ; VO<sub>2</sub>max:  $31 \pm 3$  ml/min/kg) performed 8 supervised one-legged training sessions on a bicycle ergometer (10 x 1 minute HIIT alternating with 1 min rest; workload > 60% of one-legged VO<sub>2</sub>-peak; heart rate > 80 % of maximal heart rate). This protocol significantly improved skeletal muscle insulin sensitivity (2). 40 hrs after last training session a muscle biopsy from v. lateralis was taken. Mitochondrial respiratory capacity was measured (Oroboros 2k, Innsbruck, Austria) in freshly prepared permeabilized fibers, and O<sub>2</sub> flux was recorded during state 2 (using Glutamate and Malate for complex I respiration (GM2)), state 3 (addition of ADP (GM3) and finally with further addition of Succinate for respiration with dual electron input to complex I+II as substrates (GMS3)). Differences were tested by 2 way ANOVA for repeated measures. **Results:** Mitochondrial respiration was similar ( $P > 0.05$ ) in trained (T) vs. untrained (UT) muscle at all three respiratory states in T2DM (GM2:  $9 \pm 3$  vs.  $9 \pm 2$ ; GM3:  $48 \pm 7$  vs.  $43 \pm 5$ ; GMS3:  $82 \pm 8$  vs.  $79 \pm 6$  pmol O<sub>2</sub>/sec/mg muscle, respectively) and in CON (GM2:  $9 \pm 1$  vs.  $8 \pm 1$ ; GM3:  $49 \pm 5$  vs.  $47 \pm 7$ ; GMS3:  $97 \pm 9$  vs.  $94 \pm 14$  pmol O<sub>2</sub>/sec/mg muscle, respectively). Likewise, respiratory rates were similar ( $P > 0.05$ ) between T2DM and CON. **Conclusion:** We confirm that mitochondrial respiration is similar in T2DM and CON. The accumulated 80 minutes of effective exercise cannot improve mitochondrial respiratory capacity. There is an apparent discrepancy between literature reports on HIIT induced CS activity and mitochondrial respiratory capacity. 1. Hood, M.S., et al. Low-Volume Interval Training Improves Muscle Oxidative Capacity in Sedentary Adults. Med Sci Sports Exerc 2011, 43(10):1849-56. 2. Skaaby, S., et al. High Intensity Interval Training Improves Insulin Mediated Glucose Clearance in Skeletal Muscle in Patients with Type 2 Diabetes. Abstract at the present ECSS 2013 congress.

### MITOCHONDRIAL RESPIRATION CHANGING AFTER REPEATED-CYCLING-SPRINTS PERFORMED UNDER CLASSIC ACIDOSIS AND INDUCED-ALKALOSIS.

Delfour-Peyrethon, R.1,2, Thomas, C.1,4, Hanon, C.1, Granata, C.3, Bishop, D.3

*INSEP*

1 INSEP, (Paris-France) 2 MIP, (Nantes-France) 3 ISEAL, (Melbourne-Australia) 4 University of Evry Val d'Essonne, (Evry-France) Introduction It has previously been demonstrated, in humans, that three maximal cycling bouts were sufficient to increase maximal stimulated respiration in human mitochondria after 110min of recovery (Tonkonogi et al.). In line of this result, we aimed to specifically investigate the role of acidosis on different mitochondrial respiration state alterations. Methods On two separate weeks, height active males performed a 3x30sec Wingate Test either under acidosis, after placebo ingestion, or 90min after sodium bicarbonate ingestion (0.3g.kg<sup>-1</sup> NaHCO<sub>3</sub>; randomized, double-blind fashion). Each sprint was separated by 20min of passive recovery. Blood samples were taken before exercise and during recovery for pH and bicarbonate concentrations ([HCO<sub>3</sub><sup>-</sup>]). Mitochondrial respiration was recorded by Oroboros systems using permeabilized fibers from muscle biopsies, performed on the Vastus Lateralis at rest and 24h after exercise (Pesta and Gnaiger). Results NaHCO<sub>3</sub> supplementation was effective to increase pH and [HCO<sub>3</sub><sup>-</sup>] pre-exercise and until the end of the sprints compared to placebo (pHend 7.27±0.1 vs 7.14±0.1; [HCO<sub>3</sub><sup>-</sup>]end 14.1±4.8 vs 9.9±3.6 respectively). There were no performance differences (maximal power, mean power, fatigue index) between acidosis and alkalosis conditions. Maximal respiration (Vmax) was significantly lower (-32.5%; P<0.01) 24h after exercise in alkalosis condition, whereas Vmax was maintained with placebo. Furthermore, submaximal respiration state 2 and 4 were not impaired in both conditions after 6h and 24h of recovery. Discussion In conclusion, our results suggested that Vmax was significantly decreased 24h after an acute repetition of all-out cycling sprints performed under induced alkalosis in humans, but not under classic acidosis. These difference responses could be due to an inhibition of activating mitochondrial respiration signal(s), such as Reactive Oxygen Species, under alkalosis conditions. References M. Tonkonogi, B. Walsh, T. Tiivel, V. Saks, K. Sahlin. (1999) Eur J Physiol 437:562–568. Pesta D. and Gnaiger E. (2011) Mitochondrial Bioenergetics: Methods and Protocols. rt authors here

### BRACHIAL ARTERY CHARACTERISTICS IN WELL-TRAINED ROCK CLIMBERS

Thompson, E.B., Farrow, L., Hunt, J.E.A., Lewis, M.P., Ferguson, R.A.

*Loughborough University*

Introduction Rock climbers represent a trained cohort in which high-force intermittent isometric forearm muscle contractions are performed. Subsequently the forearm vasculature is subjected to repeated ischaemia and distorted haemodynamic signals. Adaptation of the peripheral vasculature, such as an augmented post occlusion reactive hyperaemia has previously been observed in rock climbers (Ferguson and Brown, 1997), however the effects within upstream conduit arteries is unknown. Therefore, the aim of this study was to investigate brachial artery function and structure in well-trained rock climbers in comparison to age-matched sedentary control participants. Methods 8 well-trained rock climbers (CLIMB) (age; 24 ± 3 yrs, height; 180 ± 11 cm, body mass; 72 ± 8 kg, isometric handgrip strength; 46 ± 8 kg) with a minimum of 3 years climbing experience were compared against 8 controls (CON) (age; 23 ± 2 yrs, height; 175 ± 7 cm, body mass; 73 ± 12 kg, isometric handgrip strength; 37 ± 9 kg). Brachial artery characteristics were assessed using Doppler ultrasound. Artery diameter and blood flow were measured at rest and following 5-mins of ischemia (peak diameter) and ischemic exercise (maximal dilation) to calculate flow mediated dilation (FMD; i.e. function) and dilatatory capacity (DC; i.e. structure). Independent t-tests were used to compare the differences between the two groups and significance was accepted at P < 0.05. Data are presented as mean ± SD. Results Resting (4.30 ± 0.26 vs. 3.79 ± 0.39 mm), peak (after 5 minutes ischaemia; 4.67 ± 0.31 vs. 4.12 ± 0.45 mm) and maximal (after ischaemic exercise; 5.14 ± 0.42 vs. 4.35 ± 0.47 mm) diameters were greater (P < 0.05) in CLIMB than CON, respectively, despite no difference in FMD (9.2 ± 2.6 vs. 8.7 ± 2.9 %). Peak reactive hyperaemic blood flow (1136 ± 504 vs. 651 ± 221 ml/min) was greater (P < 0.05) in CLIMB compared to CON. Discussion These data demonstrate that well-trained rock climbers exhibit greater arterial diameters compared to sedentary control participants. Moreover, there was no difference in FMD between groups. These results are in accordance with the 'athlete's artery' paradigm (Green et al., 2012) of an enlarged arterial lumen despite being functionally 'normal'. The present data, together with the observations of resistance vessel adaptations (Ferguson and Brown, 1997) clearly demonstrate an enhanced peripheral vasculature in rock climbers and offer a unique insight into vascular adaptation with chronic training in intermittent blood flow restricted conditions. References Ferguson R A and Brown M D. (1997). Eur J Appl Physiol, 76, 174-180. Green D J, Spence A, Rowley N, Thijsen D H J and Naylor L H. (2012). Exp Physiol, 97(3), 295-304.

### GHRELIN LEU72MET POLYMORPHISM AFFECTS A RELATIONSHIP BETWEEN HDL CHOLESTEROL AND CARDIORESPIRATORY FITNESS LEVEL IN MIDDLE AND OLDER ADULTS.

Kono, S.1, Iemitsu, M.1, Murakami, H.2, Fujie, S.1, Sanada, K.1, Kawano, H.3, Gando, Y.3, Kawakami, R.2, Tanaka, N.2, Miyachi, M.2

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BACKGROUND Ghrelin (GHRL) Leu72Met polymorphism is associated with metabolic syndrome risk factors, such as body fat, fasting blood glucose, and HDL cholesterol level. Habitual exercise brings higher cardiorespiratory fitness and results in improvement of metabolic syndrome risk factors. However, the effect of GHRL Leu72Met on the relationship between cardiorespiratory fitness level and metabolic syndrome risk factors remains unclear. PURPOSE The aim of present study was to clarify whether GHRL Leu72Met polymorphism affects change in metabolic syndrome risk factors that is associated with cardiorespiratory fitness level in the healthy Japanese adults. METHODS Healthy 829 Japanese men and women participated in this study. As an index of cardiorespiratory fitness, we measured peak oxygen uptake (VO<sub>2peak</sub>) during an incremental cycle ergometer exercise test. The study subjects were divided into 4 groups according to fitness level and age, younger High-Fit and Low-Fit groups (age < 40 yr) and middle-aged/older High-Fit and Low-Fit (age ≥ 40 yr), that the division of fitness groups based on the median value of VO<sub>2peak</sub> in each sex and decade. GHRL Leu72Met polymorphism was determined by real-time PCR with Taqman probe. All subjects measured body composition by using DXA, blood pressure and blood profiles, as the metabolic syndrome factor risks. RESULTS Body mass index, body weight, % body fat, triglycerides, fasting glucose and HbA<sub>1c</sub> were lower and HDL cholesterol and VO<sub>2peak</sub> were higher in High-Fit subjects compared with in Low-Fit subjects. However, there were no significant differences in metabolic syndrome parameters between LeuLeu and LeuMet+MetMet genotypes in GHRL Leu72Met polymorphism. In the middle and older age subjects, HDL cholesterol level in the LeuLeu genotype is significantly higher than that in the LeuMet+MetMet genotype (P<0.05) in the High-Fit group. However, in the Low-Fit group, there was no significant difference between two

genotypes. Additionally, in the younger subjects, there were no significant differences between ghrelin genotype and fitness levels. CONCLUSION These results suggest that GHRL Leu72Met polymorphism affects the change in HDL cholesterol that is associated with higher cardiorespiratory fitness level in the healthy middle and older adults. GRANTS Supported by KAKENHI of the Japan Ministry of Education, Culture, Sports, Science and Technology (MI, MM).

### THE ERGOGENIC EFFECT OF OXYGENATION ON HYPOXIA-INDUCED CENTRAL FATIGUE DEPENDS LINEARLY ON THE PIO<sub>2</sub> AND THE IMPROVEMENT IN SAO<sub>2</sub>

Losa-Reyna, J.1, Torres-Peralta, R.1, Ponce-González, J.G.1, Morales-Alamo, D.1, Perez-Suarez, I.1, Calle-Herrero, J.1, Lundby, C.2, Calbet, J.A.1

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Introduction Rapid oxygenation relieves fatigue during maximal exercise in severe hypoxia. The ergogenic effect of re-oxygenation has been observed when the level of hypoxia during exercise is high (inspiratory PO<sub>2</sub> (PIO<sub>2</sub>)<86 mmHg) but not in moderate hypoxia (PIO<sub>2</sub>=104 mmHg). Thus there must be threshold values for PIO<sub>2</sub>, P<sub>ET</sub>O<sub>2</sub> and SaO<sub>2</sub> at which oxygenation relieves fatigue. Methods To determine if such thresholds exist and to explore if re-oxygenation at exhaustion in hypoxia restores VO<sub>2</sub>max, ten healthy young men (age = 21.0 ± 2.0 yr, VO<sub>2</sub>peak = 3.6 ± 0.3 L/min; mean ± SD) performed six incremental exercise test to exhaustion (20W/min). The first two test were performed in random order in normoxia or hypoxia (PIO<sub>2</sub>=74 mmHg) and femoral venous and arterial blood gases were determined. The next four incremental exercise tests were composed of an initial incremental phase in severe hypoxia (PIO<sub>2</sub>=74 mmHg) (HYP1) until exhaustion (Exh1). At Exh1, subjects were strongly encouraged to continue the exercise (HYP2) when at the same time PIO<sub>2</sub> was changed swiftly to either 74 (placebo), 82, 91 or 99 mmHg. After 2 min the load was increased by 20 W/min until exhaustion (Exh2). At Exh2, the PIO<sub>2</sub> was increased to 142 mmHg (normoxia; NX3) and after 2 min of additional exercise, the load was increased by 20 W/min until exhaustion (Exh3). Results In HYP1, VO<sub>2</sub>peak was uniformly reduced by 33% (P<0.05). There was a placebo effect, i.e., an ergogenic effect of a sham increase in PIO<sub>2</sub> (42±20; range 16-88 seconds). Exercise performance (W<sub>peak</sub>, time to exhaustion and work performed) was increased significantly when at Exh1 the PIO<sub>2</sub> was increased from 74 to 99 and 142 mmHg, respectively. The improvement in work (ΔW) was predicted by the equation ΔW= (1.76\*ΔSaO<sub>2</sub>) + (0.16\*P<sub>ET</sub>O<sub>2</sub>) -11.04 KJ (R<sup>2</sup>=0.99, P<0.001), where the change in SaO<sub>2</sub> and the level of P<sub>ET</sub>O<sub>2</sub>, explained 97% and 2% of the variance in work added at exhaustion in hypoxia with oxygenation, respectively. Increasing PIO<sub>2</sub> at exhaustion transiently reduced pulmonary ventilation and increased P<sub>ET</sub>CO<sub>2</sub>, but this effect was only significant for the highest PIO<sub>2</sub> (142 mmHg). Conclusions Fatigue is caused by a predominantly centrally mediated mechanism during exercise in hypoxia as demonstrated by the existence of a placebo effect. The ergogenic effect of re-oxygenation depends linearly on the improvements elicited on SaO<sub>2</sub> and PaO<sub>2</sub>. Regardless of the level of hypoxia at exhaustion, re-oxygenation allows restoring VO<sub>2</sub>peak and the ability to continue exercising. The gain in exercise capacity following re-oxygenation depends on the severity of peripheral fatigue, such that when the level of hypoxia is moderate, oxygenation does relieve fatigue but the gain in exercise capacity is small since peripheral fatigue will be the predominant source for terminating the exercise task. Granted by DEP2009-11638

### AN EXPLORATION OF AFTERLOAD DEPENDENT RELAXATION AS A COMPONENT OF VENTRICULAR ARTERIAL INTERACTION USING SPECKLE TRACKING ECHOCARDIOGRAPHY AND PULSE WAVE ANALYSIS AT REST AND DURING EXERCISE

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Introduction Optimal LV relaxation is essential for exercise performance. The onset of LV relaxation is dependent on the timing of the arterial load and is termed 'afterload-dependent relaxation' (ADR). ADR requires effective ventricular-arterial interaction (VAI). However, the classic measure of VAI, the ratio of arterial (E<sub>a</sub>) and ventricular (E<sub>es</sub>) elastances, may not reflect ADR as E<sub>es</sub> is a global measure of LV systolic function and E<sub>a</sub> does not take into account the timing of arterial load. Speckle tracking echocardiography (STE) allows for regional quantification of LV mechanics throughout the cardiac cycle and pulse wave analysis (PWA) provides the timings associated with the arterial pressure waveform. We hypothesise that the combination of STE and PWA will be a better method to capture ADR compared to E<sub>a</sub>/E<sub>es</sub>. In order to test this hypothesis, STE, PWA and E<sub>a</sub>/E<sub>es</sub> were measured at rest and during exercise. Methods 11 (8 male) healthy participants (28±9yrs) underwent simultaneous STE and PWA at rest and during sub-maximal exercise on a supine cycle ergometer. E<sub>es</sub> was derived using a single beat method which employs a normalised elastance value at end diastole that is adjusted for individual hemodynamics. E<sub>a</sub> was calculated by the ratio of end-systolic pressure to stroke volume. Results During exercise there were significant increases in heart rate (54±7 vs 86±11 bpm, p<0.000), end diastolic volume (115±31 vs 125±31 ml, p<0.04) and ejection fraction (57±4 vs 62±4 %, p<0.003). While there was a significant decrease in E<sub>a</sub>/E<sub>es</sub> (0.59±0.95 vs 0.41±0.45 mmHg/ml, p<0.000), it was not accompanied by significant changes to E<sub>a</sub> or E<sub>es</sub>. However, the timing of the reflected wave (Tr) was shortened from 159±19 to 142±9 ms (p<0.002) and this was paralleled by reductions in time to peak (TTP) in diastolic; apical rotational velocity (517±94 vs 384±73 ms, p<0.000); basal circumferential strain rate (507±54 vs 444±69 ms, p<0.01); apical circumferential strain rate (543±44 vs 466±43 ms, p<0.000) and longitudinal strain rate (518±37 vs 436±33 ms, p<0.000). Discussion In line with our hypothesis, STE and PWA captured significant changes in arterial and LV diastolic function that were not reflected in E<sub>a</sub> or E<sub>es</sub>. A shortened Tr accompanied by reductions in TTP of key diastolic LV mechanical variables may suggest that early arrival of arterial systolic load is beneficial for LV relaxation. Consequently, STE and PWA have the potential to be able to quantify ADR and if used in conjunction with E<sub>a</sub>/E<sub>es</sub>, may provide a comprehensive analysis of VAI throughout the cardiac cycle.

### THE CLINICAL UTILITY OF AN ACCELEROMETER FOR MEASURING HABITUAL PHYSICAL ACTIVITY IN PATIENTS WITH RHEUMATOID ARTHRITIS: A LONGITUDINAL STUDY.

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*University of the Witwatersrand*

This study aimed to assess changes in disease activity, as well as changes in objectively measured physical activity levels (using actigraphy) in response to commencement of Disease Modifying Anti Rheumatic Drug (DMARD) therapy in drug-naïve patients with rheumatoid arthritis (RA). Eighteen RA patients completed this study as did 18 age, sex and body mass index matched healthy control participants. At baseline, and again after three months, Actical accelerometers were fitted on the dominant hip of each participant for two weeks; and RA patients completed disease activity and functionality questionnaires. After three months of drug therapy, patients had significant improvements in disease activity as assessed by the clinical disease activity index (p<0.001) and functional ability as assessed

by the health assessment questionnaire ( $p < 0.001$ ). In parallel with these changes, the average activity counts in sedentary thresholds decreased after three months in the RA patients ( $p = 0.010$ ), while average activity counts within higher intensity thresholds increased. At baseline, RA patients showed diurnal differences in physical activity compared with healthy controls. RA patients were less physically active than control participants in the morning ( $p = 0.048$ ), and in the late afternoon ( $p = 0.016$ ), yet these diurnal patterns were no longer different after the DMARD intervention. Multiple regression showed that the change in the level of moderate activity between baseline and follow up was most highly associated with a change in C-reactive protein ( $\beta = -0.922$ ,  $p = 0.026$ ). The decreases in sedentary activity and increases in moderate activity were most strongly associated with decreased morning stiffness of the joints ( $\beta = 0.694$ ,  $p = 0.035$  and  $\beta = -0.927$ ,  $p = 0.024$  respectively). In conclusion, DMARD therapy significantly improved disease activity in patients with RA, and these improvements were paralleled by improvements in physical activity. Actigraphy data were also significantly correlated with multiple, well-validated disease activity measures showing the validity of actigraphy as an objective outcome measure of RA.

### OXYGENATION AND NEUROMUSCULAR RESPONSES DURING SIMULATED UPWIND SAILING EXERCISE ON A LASER ERGOMETER

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**Introduction** During upwind sailing, Laser sailors place their feet under a hiking strap and the middle of the thigh on the edge of the boat in order to increase up-righting moment by extending parts of the upper body further outside the boat (i.e. hiking). Our study aims to explore muscle oxygen extraction and muscle activation pattern by combining Near-infrared Spectroscopy (NIRS) and Electromyography (EMG) measurements from the M. Vastus Lateralis during an upwind sailing test (UST) on a sailing ergometer. The sailing ergometer, which measures hiking moment accompanied with a computerized biofeedback-system allows us to impose a certain quasi-isometric UST. **Methods** Ten male high-level Laser sailors ( $18.5 \pm 2.0$  yrs;  $180.9 \pm 4.7$  cm;  $72.3 \pm 4.8$  kg) performed a left (IsomQL) and right (IsomQR) leg maximal voluntary isometric knee-extensor strength test at  $120^\circ$  knee angle as well as an UST (18 bouts of 90s hiking at constantly varying intensity interspersed with 10s to tack). Deoxygenated hemo- and myoglobin concentration (deoxy[Hb+Mb]) and reoxygenated [Hb+Mb] (reoxy[Hb+Mb]) were expressed relative to occlusion amplitude performed before protocol (NIRS). Mean Power Frequency (MPF) and Root Mean Square (RMS) were calculated for each bout as mean of the final 10 s and expressed relative to the MPF or RMS value during the first bout (EMG). Repeated measures ANOVA was conducted to investigate significant changes in deoxy[Hb+Mb], reoxy[Hb+Mb], MPF and RMS throughout bout 1, 5, 10, 15 and 18. Pearson correlation coefficient was used to test the relationship between MPF at bout 18 (MPF18) and maximal voluntary isometric knee-extensor strength. **Results** Muscular responses to UST can be divided into 3 phases: (1) a significant initial increase in deoxy[Hb+Mb] and RMS as well as a decrease in reoxy[Hb+Mb] and MPF (bout 1-10;  $p < 0.01$ ); (2) a significant steady state phase (bout 10-15;  $p < 0.01$ ); (3) a clearly visible, though not significant, increase in deoxy[Hb+Mb] and RMS and decrease in reoxy[Hb+Mb] and MPF (bout 15-18). Significant correlation were found between MPF18 on the one hand and IsomQL ( $R = 0.727$ ;  $p = 0.027$ ) and IsomQR ( $R = 0.809$ ;  $p = 0.008$ ) on the other hand. **Discussion** Sailors show three distinct phases in muscle oxygen extraction and muscle activation pattern during UST. Quick muscle oxygen restoration during tacking, changes in muscle activation pattern (i.e. more accurate recruitment of slow-twitch fibres) and maximal voluntary isometric knee-extensor strength seems to be crucial determinants which delay muscle fatigue during hiking in upwind sailing.

### SAMPLING TIME INFLUENCES THE DETERMINATION OF MUSCLE WATER AND ELECTROLYTE CHANGES AFTER DEHYDRATING EXERCISE

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Universidad de Castilla-La Mancha

During prolonged dehydrating exercise contracting skeletal muscle is highly perfused maintaining intracellular water content whereas intravascular water content (i.e., blood) markedly declines. After exercise, osmotic forces shift fluid from the intracellular space (i.e., muscle) to defend the intravascular fluid space; (1)). Thus, it is possible that sampling muscle before fluid re-equilibration may lead to the conclusion that water in previously active muscle is preserved (2) to aid on substrate recovery or waste product elimination despite whole body dehydration. **Purpose:** To determine if sampling time (i.e., by muscle biopsy) affects the measurement of muscle water content and electrolytes (i.e. sodium and potassium) of previous active muscle after whole body dehydration. **Methods:** Seven aerobically-trained cyclists ( $VO_{2max}$ :  $53 \pm 3$  ml/kg/min) exercised during 150 minutes ( $65\% VO_{2max}$ ) in a hot-dry environment ( $33^\circ\text{C}$ ; 30% rh, 2.5 m/s air flow) dehydrating by  $4.6 \pm 0.3\%$ . Blood samples were drawn at baseline and after 15, 60, 120 and 150 min of exercise to calculate plasma volume (PV) changes. Muscle samples were taken before exercise, right after dehydrating exercise, 1 hour and 4 hours after exercise to measure muscle water content (i.e.,  $H_2O_m$ ) and electrolytes. **Results:** At the end of exercise, PV declined by  $-18\%$  ( $P < 0.05$ ) whereas it was progressively recovered after 60 min of supine rest ( $-10\%$ ;  $P < 0.05$ ) and 4 h of rest (i.e.,  $-3\%$ ;  $P < 0.05$ ). Muscle water content and electrolytes concentration right after exercise were similar to pre-exercise. However, after 60 min of supine rest, muscle water content decreased from  $398$  to  $354$  mL/100g dm ( $P < 0.05$ ) remaining low after 4 hours of rest ( $357$  mL/100g dm). Muscle sodium and potassium concentration increased after 60 min of supine rest ( $9.4$  to  $11.1$  and  $46.1$  to  $47.2$  mmol/L respectively;  $P < 0.05$ ) remaining at those concentrations after 4 hours of rest ( $11.6$  and  $47.5$  mmol/L, respectively). **Conclusion:** Exercise-induced whole body dehydration also results in water deficit in contracting skeletal muscle. For accurate assessment of the effects of dehydration on muscle water content and electrolyte concentration, supine recovery for at least one hour is required to reach fluid re-equilibration. **References** 1. Hamouti, N. et al. (2012). 'Comparison between blood and urinary fluid balance indices during dehydrating exercise and the subsequent hypohydration when fluid is not restored' EJAP Aug 11. Ahead of print. 2. Costill, D. L. et al. (1981). 'Muscle water and electrolyte distribution during prolonged exercise.' JSM 2(3): 130-134.

### THERMOREGULATORY RESPONSES AND FLUID BALANCE DURING MEDICAL RESPONSE FORCE DEPLOYMENT

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1: DSO National Laboratories, Singapore, 2: Medical Response Force, Singapore, 3: National University of Singapore, Singapore, 4: Nanyang Technological University, Singapore

**INTRODUCTION** Physical activity undertaken in uncompensable heat stress imposes risk of heat injuries and compromises work tolerance (Taylor, 2006, Cheung et al, 2000). Many past studies on uncompensable heat stress were done in laboratories. This study evaluated the thermoregulatory responses and fluid balance of Medical Response Force deployment during day and night. **METHODS** Sixty-two male

military personnel (Mean $\pm$ SD; 21 $\pm$ 1 years; 1.71 $\pm$ 0.06 m; 68.6 $\pm$ 11.7 kg; BMI: 23.3 $\pm$ 3.6; body surface area: 1.79 $\pm$ 0.16 m<sup>2</sup>) participated in day and night trials wearing different protective suits: semi-permeable Paul Boyle suit (NT) and impermeable Tyvek suit (T). Each trial was over two 1 h work-rest cycles (Day: 35 min work/25 min rest; Night: 45 min work/15 min rest). Core temperature (Tc), skin temperature (Tsk) and heart rate (HR) were measured continuously. Sweat loss was calculated based on change in nude body mass before and after each trial, fluid intake and urine output. RESULTS WBGT for day and night trials were 31.0 $\pm$ 0.3 °C and 25.7 $\pm$ 0.2 °C respectively (p<0.001). There was no difference in mean Tc (38.0 $\pm$ 0.3 °C), Tsk (35.5 $\pm$ 0.8 °C) and HR (119 $\pm$ 16 bpm) between the day and night trials, and between the two suits (p>0.05). NT resulted in higher mean Tsk compared to T in the day trial (NT: 36.3 $\pm$ 0.5 °C; T: 35.4 $\pm$ 0.8 °C; p<0.001). Mean HR was higher in NT compared to T during the 2nd work-rest cycle in both the day (NT: 128 $\pm$ 17 bpm; T: 111 $\pm$ 19 bpm; p<0.05) and night trials (NT: 113 $\pm$ 15 bpm; T: 103 $\pm$ 15 bpm; p<0.001). Mean sweat loss rate was also higher for NT as compared to T in both day (NT: 0.77 $\pm$ 0.27 L/h; T: 0.56 $\pm$ 0.35 L/h; p<0.05) and night trials (NT: 0.62 $\pm$ 0.25 L/h; T: 0.38 $\pm$ 0.13 L/h; p<0.001). NT replaced higher % of the sweat loss with fluid intake as compared to T in both the day (NT: 43 $\pm$ 22 %; T: 29 $\pm$ 22 %; p<0.05) and night trials (NT: 38 $\pm$ 24 %; T: 22 $\pm$ 23 %; p<0.05). CONCLUSION This study validated that the Medical Response Force work-rest cycle was safe in both day and night deployments. Higher Tsk and sweat rate of NT compared to T during the day was due to higher work rate during the 2nd work-rest cycle, as supported by the HR data. Therefore, it was metabolic heat production that contributed more to heat strain when working under uncompensable heat stress rather than the heat dissipation properties of the suits studied. Fluid replacement was impractical and inadequate when wearing the two suits. Thus, a fluid replacement regime should be implemented to prevent risk of excessive dehydration, especially during extended training or operation. REFERENCES Taylor, NA (2006). *Ind Health* 44, 331-344. Cheung, SS, McLellan, TM & Tenaglia, S (2000). *Sports Med* 29, 329-359.

### SYSTEMATIC REVIEW AND META-ANALYSIS OF TRAINING MODE, IMAGING MODALITY AND BODY SIZE INFLUENCES ON THE MORPHOLOGY AND FUNCTION OF THE MALE ATHLETE'S HEART

Utomi, V., Oxborough, D., Whyte, G., Somauroo, J., Sharma, S., Shave, R., Atkinson, G., George, K.

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**Introduction** The athlete's heart (AH) remains a popular topic of study. Controversy related to training-specific cardiac adaptation and continuing developments in imaging technology and scaling prompted this systematic review and meta-analysis. **Methods** A systematic review and mixed-random effect meta-analysis of the means of left (LV) and right (RV) ventricular structures and function as well as left atrial diameter (LAD) was conducted on 92 records. Using inverse-variance pooled mean estimates, the impact of endurance vs. resistance training and echocardiography vs. cardiac magnetic resonance (CMR) imaging were explored between groups. The relationships between LV, RV and LAD with body surface area (BSA) were assessed via multiple meta-regression models. **Results** All LV structural parameters were higher in athletes compared with controls. LV end-diastolic dimension and volume were higher in endurance compared to resistance athletes 54.8mm (54.1-55.6) vs. 52.4mm (51.2-53.6) & 171ml (157-185) vs. 131ml (120-142). RV end-diastolic volume, mass and LAD were higher in endurance athletes than controls. LV end-diastolic volume was larger when using CMR than echocardiography 171ml (157-185) vs. 131ml (120-142). Meta-analysis regression models demonstrated positive and significant associations between BSA and LV mass, RV mass and LAD. **Discussion** Both athlete groups present with a similar qualitative cardiac adaptation on a continuum, with greater cardiac dimensions in endurance athletes reflecting a greater overall training volume. The use of CMR resulted in a higher LVEDV than echocardiography and this agrees with previous comparative studies (Prakken et al 2008 & LaGerche et al 2011). Our research was limited by lack of proper allometric scaling in most studies. Nevertheless the positive correlation between BSA and measures of cardiac structure highlights the need to take account of individual variability in body size at individual study level (Dewey et al 2008). Morphological features of the male AH were noted in both athlete groups. The previously described training-specific pattern of concentric hypertrophy was not discerned in resistance athletes. These data should inform current knowledge of the AH and prompt ongoing research. **References** Lagerche A, Heidbuchel H et al. 2011. *Med Sci Sports Exerc*, 43, 974-81. Prakken N, Teske A et al 2011. *Br J Sports Med* 2011;1(46):348-54. Dewey F, Rosenthal D et al. 2008. *Circulation*. 2008;117(17):2279-87. Do not insert authors here

### EFFECTS OF REMOTE ISCHEMIC PRECONDITIONING ON HIGH-INTENSITY CYCLE PERFORMANCE

Kilding, A.E., Sequira, G., Wood, M.R.

*AUT University*

**Introduction** Sport-specific warm-ups are a standard component of most athletes' pre-competition routines. However, additional 'priming' methods may exist that may serve to optimize subsequent performance. Remote ischemic pre-conditioning (RIPC) is a passive intervention that involves brief periods of ischemia and reperfusion to induce a local and systemic effect that may serve to enhance physical performance. We aimed to determine the effect of RIPC on VO<sub>2</sub>max and 4 km laboratory time trial (TT) cycling performance. **Methods** An acute, single-blind, crossover design was adopted. After familiarization, 8 well-trained cyclists (age: 27.0  $\pm$  7.0 yrs) completed two incremental VO<sub>2</sub>max tests and two 4 km TT's, on a cycle ergometer, on separate days. Prior to each test, participants underwent RIPC or sham-IPC. RIPC involved 3 x 5 min bouts of thigh blood flow occlusion, interspersed with 5 min of reperfusion. Sham-IPC involved negligible occlusion for the same duration. To make inferences about true (population) values of the effect of RIPC on physiology and performance, the uncertainty in the effect was expressed as 90% confidence limits (CL) and as likelihoods that the true value of the effect represents substantial change. **Results** There was no substantial difference in VO<sub>2</sub>max between RIPC and sham-RIPC trials (-0.1  $\pm$  1.9%). However, there was a tendency for mean power output during the RIPC 4 km TT to be higher than during the sham-RIPC TT (2.2  $\pm$  2.0%; effect size: 0.18  $\pm$  0.15). **Discussion** While acute RIPC prior to incremental cycling appears to have minimal effect on aerobic capacity, the observed tendency for improved TT performance, albeit small, suggests that RIPC has potential to be a performance enhancer for well-trained athletes prior to high-intensity exercise.

15:00 - 16:00

## Mini-Orals

## PP-PM66 Training and Testing [TT] 1

**THE RELIABILITY OF TWO DIFFERENT SPRINT TESTS PERFORMED ON A NON-MOTORIZED TREADMILL**

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**Introduction** The non-motorized treadmill (NMT) system initially reported by Lakomy (1984) has been used extensively to assess sprinting performance. However, there has been limited research into the reliability of different sprint tests (i.e., single or repeated sprint (RS) tests) using such systems. Therefore, the aim of this study was to determine the reliability of two different sprint tests on a NMT. **Methods** 17 male sport students (age:  $27.3 \pm 5.5$  yrs; height:  $1.78 \pm 0.05$  m; BMI:  $24.2 \pm 2.1$ ) participated in the study. After a standardized 10 min warm-up, subjects performed two non-randomized consecutive testing sessions separated by one week: a 10 s all-out sprint and 2 h later, a RS test consisted of 6 X 4 s all-out sprints, with 20 s passive recovery, on a NMT. Parameters analyzed included velocity, power output, step length and frequency and heart rate (HR). Additionally, blood lactate (La) values and oxygen uptake (VO<sub>2</sub>) were analyzed in eleven subjects. Reliability was obtained using intraclass correlation coefficient (ICC). **Results** The 10-s sprint showed moderate to high reliability for all the values analyzed (velocity: 0.911 (0.772-0.967); peak power: 0.881 (0.723-0.955); mean power: 0.855 (0.453-0.954); step length: 0.853 (0.644- 0.944), and step frequency: 0.823 (0.577-0.932)). The RS test also showed moderate to high reliability values (mean velocity: 0.963 (0.903-0.986); peak power 0.936 (0.835-0.976); mean power: 0.939 (0.771-0.980). Moreover, we found a moderate to high intraday reliability between velocity in the 10-s sprint and the first sprint of the RS on day one (0.927 (0.728-0.976)) and day two (0.895 (0.739-0.961)). **Results** also showed significantly higher ( $p < 0.01$ ) physiological load (i.e., VO<sub>2</sub>, La and HR) during the RS test compared to the 10-s sprint. **Discussion** and **conclusions** The present study showed that both tests, 10-s and RS, seem to be reliable in a group of sport students. We can suggest that because of its specificity (i.e., sprint) and laboratory conditions, the NMT could be a useful tool for testing and training. Regarding the differences between tests, the RS test is more demanding than the 10-s, but also seems to be more reliable. **References** Lakomy, H.K.A. (1984). An ergometer for measuring the power generated during sprinting. *Journal of Physiology*, 33: 354. Lakomy, H.K.A. (1987). The use of a non-motorized treadmill for analysing sprint performance. *Ergonomics*, 30: 627-637.

**TRUNK MUSCLE ACTIVITIES DURING ABDOMINAL BRACING: COMPARISON AMONG MUSCLES AND EXERCISES**

Maeo, S., Takahashi, T., Takai, Y., Kanehisa, H.

*National Institute of Fitness and Sports in Kanoya*

**Introduction** Abdominal bracing is considered an effective exercise technique for spine stabilization training, and is often adopted in rehabilitation and/or fitness programs (Monfort-Panego et al. 2009). However, there is little information on how muscular activities during the task differ among the muscle groups located in the trunk and from those during other trunk exercises. The present study aimed to clarify muscular activity levels during abdominal bracing with respect to muscle- and exercise-related differences. **Methods** Ten healthy young adult men performed five static (abdominal bracing, abdominal hollowing, prone, side, and supine plank) and five dynamic (V-sit, curl-up, sit-up, and back extensions on the floor and on a bench) exercises. Surface electromyogram (EMG) activities of the rectus abdominis (RA), external oblique (EO), internal oblique (IO), and erector spinae (ES) muscles were recorded in each of the exercises. The EMG data were normalized to those obtained during maximal voluntary contraction of each muscle (% EMGmax). **Results** The % EMGmax value during abdominal bracing was significantly higher in IO ( $60 \pm 11\%$ ) than in the other muscles (RA:  $16 \pm 1\%$ , EO:  $28 \pm 4\%$ , ES:  $19 \pm 2\%$ ). In comparison to other exercises, the % EMGmax values for RA, EO, and ES were significantly lower in the abdominal bracing than in the V-sit and sit-up for RA and EO and back extension for ES muscle. However, the % EMGmax value for IO during the abdominal bracing was significantly higher than those in most of the other exercises including dynamic movements. **Discussion** Dynamic exercises involving spine flexion and extension are usually preferred for strengthening the trunk muscles (Hibbs et al. 2008). For non-athletes or patients with lower back pain, however, these are considered as advanced exercises which induce high loads to the lumbar spine. From a clinical point of view, therefore, static exercises are usually recommended for rehabilitation and/or fitness programs at the expense of muscular activity (Monfort-Panego et al. 2009). In IO muscle, nevertheless, abdominal bracing showed greater activity than most of the other exercises including dynamic ones. These results indicate that abdominal bracing is one of the most effective techniques for inducing a higher activation level in IO muscle even compared to dynamic exercises involving trunk flexion/extension movements. **References** Hibbs AE, Thompson KG, French D, Wrigley A, Spears I (2008). *Sports Med* 38: 995-1008 Monfort-Panego M, Vera-Garcia FJ, Sanchez-Zuriaga D, Sarti-Martinez MA (2009). *J Manipulative Physiol Ther* 32: 232-244

**SWIMMING ECONOMY ASSESSMENT AROUND THE MAXIMAL LACTATE STEADY STATE**

Pelarigo, J.G.1,2, Figueiredo, P.1,3, Ribeiro, J.1, Sousa, A.C.1, Pimenta, R.A.1, Padilha, M.B.1, Denadai, B.S.4, Fernandes, R.J.1,2, Greco, C.C.4, Vilas-Boas, J.P.1,2

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**Introduction** Parameters related to swimming economy such as energy cost of locomotion (C, Kcal.kg<sup>-1</sup>.km<sup>-1</sup>) are not widely used to evaluate long-distance swim tests. However, C may be more sensitive to changes in speed as compared with more traditionally used parameters, such the measurement of oxygen uptake (Fletcher et al., 2009). Therefore, the objective of this study was to analyze swimming economy along the 97.5%, 100% and 102.5% of the maximal lactate steady state intensity (MLSS). **Methods** Ten female long-distance swimmers ( $17.5 \pm 1.8$  yrs,  $61.1 \pm 5.6$  kg,  $1.69 \pm 0.06$  m) performed, in different days, three to five 30min sub-maximal continuous tests to determine velocity, caloric equivalent (kcal.L<sup>-1</sup>) and oxygen uptake (VO<sub>2</sub>) corresponding to the 97.5%, 100% and 102.5%MLSS (Pelarigo et al., 2011). The VO<sub>2</sub> and the C values were analyzed along the continuous tests in seven moments (4thmin and 25, 33, 50, 66, 75 and 100% of the test duration) and compared between the different intensities by ANOVA repeated measures. The C was calculated as = VO<sub>2</sub> (L.min<sup>-1</sup>) \* caloric equivalent (Kcal.L<sup>-1</sup>) \* velocity<sup>-1</sup> (m.min<sup>-1</sup>) \* body mass<sup>-1</sup> (Kg) \* K<sup>-1</sup> (1000m.Km<sup>-1</sup>). **Results** The C values showed

similar adjustments in relation to the effect of time at intensities correspondent to 97.5% (mean:  $2.89 \pm 0.03$ ), 100% (mean:  $3.04 \pm 0.04$ ) and 102.5%MLSS (mean:  $3.18 \pm 0.03$ ). In relation to the effect of intensity, there were significant difference between 97.5% and 102.5%MLSS in all moments of the test, representing an increase of 8.5 to 11.7% among the values of C. Discussion Although swimming economy showed to be stable along the test at the three swimming intensities, when comparing the different intensities the swimming C was higher with increasing velocity, which suggests to be one of the fatigue determinant factors. References Fletcher, JR et al. (2009). *J Appl Physiol*, 107, 1918-1922. Pelarigo JG et al. (2011). *J Sci Med Sports*, 14, 168.e1-168.e5. Acknowledgments This research was supported by grants from Capes Foundation, Ministry of Education of Brazil (BEX: 0536/10-5). PTDC/DES/101224/2008 (FCOMP-01-0124-FEDER-009577).

### CAN STRENGTH TRAINING ALTER THE PACING STRATEGY DURING A 10-KM RUNNING RACE?

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**Introduction** Previous studies have indicated that the pacing strategy (PS) has a significant impact on endurance performance. It has been hypothesised that PS is centrally-controlled in order to protect the athletes from harmful changes to homeostasis and to prevent premature fatigue. In turn, current research indicates that endurance performance may also be improved by the addition of strength training (ST). However, the influence of ST on PS remains unknown. Therefore, the aim of this study was to investigate the impact of ST on PS during a 10-km running race. **Methods** Sixteen male, endurance runners were allocated to an experimental (EG, n=8) or control group (CG, n=8). The EG performed an 8-wk ST. Before and after the experimental period, the subjects performed: a) a maximal incremental treadmill test to determine the maximal oxygen uptake (VO<sub>2</sub>max) and peak treadmill velocity (PTV); b) a maximum dynamic strength test for the half-squat exercise (IRM), and c) a 10-km running race on a 400-m outdoor track to determine PS. Dependent variables were compared using 2-way ANOVA (group and moment as factors). A 2-way ANOVA with repeated measures (distance × moment) followed by a LSD post hoc was used to compare the running speed each 400 m within groups. The level set for significance was  $\alpha = 0.05$ . Results IRM and PTV were increased after training ( $p < 0.05$ ). However, there were no differences for VO<sub>2</sub>max ( $p > 0.05$ ). After the ST period, all athletes completed the 10-km time trial in shorter times ( $43:31 \pm 05:25$  vs  $42:22 \pm 04:36$ min:s); this approached statistical significance ( $p = 0.061$ ). An U-shaped profile of the speed vs distance curve pre and post training for both the groups was observed. However, for the post-training curve in EG there was a smaller reduction ( $p < 0.05$ ) and a large increase in speed during middle and last part (end spurt) of the race, respectively, compared to pre training. **Discussion** Our data revealed that IRM and PTV were improved after ST, while VO<sub>2</sub>max maintained unchanged. These mechanical variables have been associated with neuromuscular characteristics and so-called "muscle power factors", respectively. Interestingly, IRM and PTV gain were accompanied by a more sustainable PS, with a smaller speed reduction throughout the race and a more pronounced end spurt after ST. It seems reasonable to hypothesize that increased IRM and PTV could allow runners to sustain higher intensities by reducing the relative force generated at the same absolute running intensity. These findings clearly show that peripheral system has a crucial role on PS adopted during a long-distance running. **Acknowledgments** FAPESP (2011/02769-4)

### EFFICACY OF THE INJURY PREVENTION PROGRAM '11 +' ON ANTERIOR CRUCIATE LIGAMENT INJURY RISK FOR ADOLESCENT FEMALE SOCCER PLAYERS.

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**Introduction** Anterior cruciate ligament (ACL) injury is one of the most severe injuries. To reduce these injuries, FIFA recommended the injury prevention program '11 +'. This program is useful in the prevention of injuries (Soligard et al.). However, it is unclear how this program helps reduce injuries. Recently, Myer et al. suggested the non-contact ACL injury risk prediction algorithm (Nomogram). This method employs the clinically obtainable measures of knee valgus motion, knee flexion range of motion, body mass, tibia length and quadriceps-to-hamstrings (Q/H) ratio. This predicts high knee adduction moment (KAM). So, the aim of this study was to examine that the '11 +' program could reduce risk of ACL injury using clinical based measurement. **Methods** Sixteen adolescent female soccer players participated (Age; 12-14 years). The players performed '11 +' every training session for 4 months. Before and after the intervention, two-dimensional (frontal and sagittal plane) knee kinematics data during drop vertical jump (DVJ) were captured with digital video camera (Myer et al.). Knee valgus motion and knee flexion range of motion were calculated from video frame at the initial contact, and the video frame at maximum knee valgus motion and maximum knee flexion. Body mass, tibia length and Q/H ratio were measured. Using these parameters, the points of the predicts high KAM were calculated by Nomogram in both knees. A paired t-test were used to determine the effect of the intervention ( $p < 0.05$ ). **Results** Total points of Nomogram were significantly higher after intervention than before intervention in both knees (before vs. after intervention in right and left knees; 71.9 and 68.8 points vs. 79.7 and 76.4 points,  $p < 0.05$ , this indicated the prediction of high KAM was increased). Analyzing the contents of total point, the points of tibia length were significantly higher after intervention than before intervention in both knees (31.9 and 41.4 vs. 31.5 and 42.2,  $p < 0.05$ ). The points of knee valgus motion was low after intervention comparing to before intervention, but not significantly in both knees (18.5 and 14.1 vs. 15.6 and 10.0). **Discussion** The results of this study, predicts risk of ACL injury rose after intervention. The reason of this results caused by lengthening the tibia, because the subjects of this study was adolescent. Otherwise, noting to knee motion, knee valgus motion were reduced. Knee valgus motion is one of the risk factor of ACL injury. This suggests that 11 + has possibility of prevention ACL injury. **References** Soligard T et al. (2008). *BJM*, 337, a2469. Myer GD et al. (2011). *Br J Sports Med*, 45, 238-244.

### VALIDITY OF A VIDEO-BASED JUMP ASSESSMENT ON THE SAND IN BEACH VOLLEYBALL

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**Introduction** Quick actions and different jumping abilities are the most important conditioning factors in beach volley. Blocking and attacking actions required a specific jump patterns on the sand. Hence, jumps and other movement are different from its indoor counterparts because the compliance and friction of the surface. Bishop (2003) found a 5% decrease of performance in block jump in comparison to rigid surface (but  $r = 0.93$ ;  $p < 0.01$ ) and Giatsis et al. (2004) a 13.9% of decrease in SJ (but  $r = 0.89$ ;  $p < 0.01$ ). Difficulties to display a contact

mat or a force platform on the sand are evident. The aim of the study was to test the validity of a video-based protocol to assess the jump in blocking actions on the sand. Methods 17 national-standard beach volleyball players (12 male and 5 female) performed 3 trials of CMJ and block jump on a rigid surface (BJR), and a block jump on the sand (BJS). Chronojump Bosco System was used to assess flight time in jumps on a rigid surface. High-speed video camera was used to assess flight time in jumps on the sand. A frame by frame video analysis was carried out by two expert observers. Intra- and interobserver reliability was assessed using the percentage of error method. Coefficient of variation (CV) was calculated to assess the stability of measures. Pearson product-moment correlation was calculated to assess the relationship between the different jump protocols. Results The average of CV for BJS, CMJ and BJR was 3.25%, 3.85% and 2.22%, and mean flight times were  $0.56 \pm 0.06$ ,  $0.55 \pm 0.15$  and  $0.61 \pm 0.05$ , respectively. Players jumped 8,2% less on the sand on average. We found a significant relationship between BJS and CMJ ( $r=0.58$ ;  $p<0.05$ ), between BJS and BJR ( $r=0.83$ ;  $p<0.01$ ), and between BJR and CMJ ( $r=0.92$ ;  $p<0.01$ ). Discussion Intra- and interobserver reliability was  $<5\%$  and considered acceptable (James, Taylor and Stanley, 2007). Reliability of BJS attending CV value is considered between moderate and large (Hopkins et al., 1999). According to the findings of Bishop (2003), around 5% decrease, and Giatsis et al. (2004), around 13% of decrease, players jumped less on the sand. However, Bishop tested the same action with another methodology with some reliability missing data. Observing the correlation between BJS and BJR on different surfaces, we could conclude that this is an easy, accessible, reliable and valid test to assess the jump flight time on the sand. References Bishop D (2003). *J Sports Med Phys Fit*, 43(4), 418-423. Giatsis G, Kollias I, Panoutsakopoulos V, Papaikakovou G (2004). *Sport Biomech*, 3(1), 145-158. Hopkins WG, Marshall SW, Batterham AM, Hanin J (2009). *Med Sci Sport Exerc*, 41(1), 3-13. James N, Taylor J, Stanley S (2007). *Int J Perf Anal Sport*, 7, 1-11.

## EFFECT OF WALL INCLINATION AND CLIMBING ABILITY ON PHYSIOLOGICAL RESPONSE IN FEMALE CLIMBERS

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Introduction Watts (2004) counts sport climbing among activities with moderate energy expenditure. The average oxygen consumption ( $\dot{V}O_2$ ) is around  $20-34 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  and maximum oxygen uptake is around  $30-45 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ . The wall inclination, the climbing speed and the climbing ability are considered as main determinants of the oxygen consumption (Mermier et al., 1997; Watts and Drobish, 1998; Bertuzzi et al., 2007). The aim of the study was to compare the effect of wall inclination and climbing ability on physiological response during climbing with a determined speed in female climbers. Methods Eleven female climbers ( $24.9 \pm 4.1$  years,  $56.7 \pm 5.8$  kg,  $164.5 \pm 5.8$  cm) volunteered to participate in the study. The females were divided according to their actual climbing ability on recreational ( $n=6$ ) and elite ( $n=5$ ) climbers. The physiological response on the same route configuration at three different wall inclinations - positively angled ( $100^\circ$ ), vertical ( $90^\circ$ ) and overhanging ( $80^\circ$ ) was tested at a determined speed ( $25 \text{ steps}\cdot\text{min}^{-1}$ ). The portable gas analyser was used to assess physiological response during climbing. Results We found a significant effect ( $p < 0.01$ ) of the wall inclination on the oxygen consumption ( $100^\circ - 31.5 \pm 2.4 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ;  $90^\circ - 33.5 \pm 2.4 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ;  $80^\circ - 34.6 \pm 2.3 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) and significant difference ( $p < 0.01$ ) between recreational and performance climbers. There was not found any interaction between the inclination and the climbing ability. The average difference in oxygen consumption between recreational and elite climbers was  $3.3 \pm 0.6 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ . Discussion We confirmed that the wall inclination and the climbing ability are main determinants of oxygen consumption during climbing when the climbing speed is held constant. Therefore, we agree with Mermier et al. (1997) that the climbing in steeper inclination is more energy demanding. The lower climbing ability was associated with higher oxygen consumption which might be connected with a worse economy of movement in recreational climbers. Oxygen consumption can, thus, be used as a parameter for quantitative evaluation of climbing technique. References Bertuzzi M.C.R., Franchini E, Kokubun E, Kiss M. D. P. A. M. (2007). *Eur J Appl Physiol*, 101,293-300. Mermier CH. M., Robergs R.A., McMinn M.S, & Hexward H.V. (1997). *Br J Sports Med*, 31, 224-228. Watts P. B. & Drobish K. M. (1998). *MSSE*, 30(7), 1118-1122. Watts, P.B. (2004). *Eur J Appl Physiol* 9, 361-372.

## INFLUENCE OF REGRESSION MODEL ON THE RELATIONSHIP BETWEEN LACTATE THRESHOLD USING THE MAXIMAL-DEVIATION METHOD AND PERFORMANCE WELL-TRAINED ATHLETES

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Introduction The lactate threshold calculated by the maximal-deviation method (LTD<sub>max</sub>) has been suggested to be more highly correlated with performance than the lactate threshold values determined by other methods (Machado et al, 2011). However, the influence of the choice of the regression model on the LTD<sub>max</sub> method in well-trained athletes remains unclear. Therefore, the aim of this study was to investigate the relationships between endurance performance and the LTD<sub>max</sub> calculated by an exponential-plus-constant and a third-order polynomial model. Methods 20 well-trained male runners participated in this study (age:  $29.1 \pm 6.6$  years; 10-km race time:  $31.5 \pm 1.2$  km/h). All subjects completed a maximal incremental running test at 1% slope on a treadmill, starting at 9 km/h without previous warm up. The velocity increased by 1.5 km/h every 4 minutes with 1 minute between the stages used for blood lactate determination. Lactate-speed data were fitted by an exponential-plus-constant and a third-order polynomial equation. The LTD<sub>max</sub> was determined for both regression equations. Results The exponentially-derived and the polynomially derived LTD<sub>max</sub> were  $17.4 \pm 0.9$  and  $17.2 \pm 0.9$  km/h, respectively. Exponentially-derived LTD<sub>max</sub> had a higher correlation ( $r=0.71$ ) and smaller standard error of estimate (SEE) ( $0.22$  km/h) with performance than the polynomially-derived equivalent ( $r=0.61$ ;  $SEE=0.26$ ). Discussion These results suggest that the exponentially-derived LTD<sub>max</sub> is a better performance predictor than the polynomial equivalent in well-trained male athletes, in agreement with the results reported by Machado et al. (2012) in recreational female runners. Therefore, the exponential regression should be used when calculate the lactate threshold by the maximal-deviation method in well-trained male athletes. Acknowledgments This study has been supported by the Basque Government Scholarship (BF108.51) and by the Department of Physical Education and Sport, University of the Basque Country, UPV/EHU. References 1. Machado FA, de Moraes SM, Peserico CS, Mezzaroba PV, Higino WP. The D<sub>max</sub> is highly related to performance in middle-aged females. *Int J Sports Med* 2011;32:672-6 2. Machado FA, Nakamura FY, De Moraes SM. Influence of regression model and incremental test protocol on the relationship between lactate threshold using the maximal-deviation method and performance in female runners *J of Sports Sci* 2012;30:1267-74

## INTENSITY DOSE-RESPONSE EFFECTS ON BONE MINERAL DENSITY AND ISOKINETIC STRENGTH IN MIDDLE-AGED AND ELDERLY ADULTS

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**INTENSITY DOSE-RESPONSE EFFECTS ON BONE MINERAL DENSITY AND ISOKINETIC STRENGTH IN MIDDLE-AGED AND ELDERLY ADULTS** Linda L. Lin<sup>1</sup>, Michael S. Lo<sup>2</sup>, Min- Hwei Hsieh<sup>3</sup>, Yi-Ju Chen<sup>4</sup>, 1:National Cheng Kung University, (Taiwan); 2:Kun Shan University, (Taiwan); 3:Chang Gung Medical Foundation, (Taiwan); 4: Chi-Mei Medical Center(Taiwan) Introduction Physical activity and exercise have been recommended as a strategic intervention to promote optimal bone mineral density (BMD), muscle mass and to decline the risks of bone loss during middle and later life. Recent studies focused on the influences with different dose of exercise. The purpose of this study was to explore the effects of resistance training on bone mineral density and lean body mass with same training volume but different intensities in middle-aged and elderly adults. Methods Participants were 23 men and 37 women (52-68-year-old) volunteers, assigned to 6 groups (male of control group, n=8, 64.3±3.4yrs; male of moderate-intensity group, n=8, 64.1±3yrs; male of high- intensity group, n=7, 63.8±2.3yrs; female control group, n=10, 58.7±2.5yrs; female of moderate-intensity group, n=13, 60.4±5.9yrs and female of high- intensity group, n=14, 57.5±2.4yrs). The training program consisted of gradual increase in weight-resistance exercise 2 sessions per week under supervision, and the pre-test (0 week) and the post-test (25 weeks) data, including bone mineral density and body composition and elbow, knee extensors and flexors isokinetic strength's peak torque were measured by dual-energy X-ray absorptiometry (DXA) and Biodex System 4 PRO. Results The leg BMD had significant difference between gender (men showed significantly higher than women), the arm lean mass had significant difference among groups (high and moderate groups showed significantly higher than control group) (p<.05). Most of the upper body strength ( biceps, triceps) and the lower body strength ( quadriceps, hamstring) had shown significant differences between gender, among groups, like the antagonist muscle: triceps' peak torque at 180°/s: high- intensity group improved 22.9%, moderate-intensity group increased 22.2%, then control group decreased 5.2%(p<.05), high speed velocity of quadriceps at 180°/s, high- intensity group improved 12.7%, moderate-intensity group increased 9%, and control group was 0.2%(p<.05). There were no significant differences between exercise groups. Discussion The high and moderate intensity programs were designed to produce similar total workloads in subjects with similar strength values. After 24 weeks of training leg bone mineral density and arm lean mass were increased. The high speed isokinetic strength of the antagonist muscle of limbs improved more. Furthermore, it had also shown the similar responded and effect of bone mineral density and isokinetic strength between middle-intensity with high repetitions and high-intensity with low repetitions but male show a greater response at the depend variable than female.

## EFFECTS OF PARTIAL REDUCTION IN STRENGTH TRAINING REGIMEN ON PERFORMANCE AND MUSCLE MASS

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**Introduction** The maintenance of strength and power performance and muscle mass is important for sports and daily physical activities. However, sometimes we have to interrupt (detraining, DE) or reduce strength training (ST) stimuli due to injuries or training schedule. It has been shown that DE causes a progressive loss of previous adaptations (Henwood and Taaffe, 2008; Tokmakidis et al., 2009). Nevertheless, the effects of a reduction in ST are still scarce (Tucci et al., 1992; Garcia-Pallares et al., 2010). The magnitude of these effects may depend on training volume and frequency (Fleck, 1994). Therefore, the aim of the study was to investigate the effects of reduced ST programs and DE on maximum strength (1RM), vertical jump (VJ) performance, and muscle cross sectional area (CSA). **Methods** Thirty three males (23.1±2.8 yr, 1.73±0.06 m, 71.9±6.2 kg) were divided into 3 groups: reduced training volume (RTV, 2x6-8RM, 2x/wk), reduced training frequency (RTF, 4x6-8RM, 1x/wk), and DE. Initially, all groups were submitted to an 8-wk ST program (3-5x6-15RM, 2-3x/wk). After the ST, the RTV and RTF groups reduced volume and frequency; respectively, over the next 8 weeks of training while the DE group detrained. Half-squat 1RM, VJ height, and quadriceps CSA (MRI) were measured before and after ST and after the reduced training period. A mixed models analysis was used to compare 1RM, VJ, and CSA changes between groups pre-ST, post-ST and post-reduced training. **Results** Pre-ST there were no significant differences between groups. After 8 wk of ST, we found significant (p<0.01) increases of 27.9±10.7%, 26.7±7.8%, and 28.4±6.0% in lower limbs 1RM for RTV, RTF, and DE groups, respectively. VJ (4.5±1.4%, 4.8±1.9%, and 4.2±1.3%) and CSA (6.9±3.9%, 6.1±3.6%, and 5.8±5.5%) also increased similarly between RTV, RTF, and DE; respectively. After the reduced training period, there was a small increase in 1RM for RTV (3.0±3.4%) and RTF (3.5±2.7%) while DE showed a decrease (17.1±14.0%) in strength (p<0.001). VJ performance (-0.5±1.5%; +0.5±0.9%) and CSA (-2.2±4.1%; -1.3±1.8%) did not change significantly for RTV and RTF but only for DE (VJ -4.0±0.9%; CSA -4.7±7.0%). **Discussion** According to our results, after 8 wk of ST, a partial reduction in training volume or frequency associated with moderate to high intensity stimulus was able to maintain lower limbs performance and muscle mass. On the other hand, a similar period of detraining resulted in significant losses in these variables. **References** Fleck SJ *Streng Cond J*, 16(1), 22-28. Garcia-Pallares J et al. *Med Sci Sports Exerc*, 42(6), 1209-14. Henwood TR, Taaffe DR (2008) *J Gerontol*, 63(7), 751-758. Tokmakidis SP et al. *Clin Physiol Func Imag*, 29(4), 316-9. Tucci JT et al. *Spine*, 17(12), 1497-501.

## LOW VOLUME WEIGHTED STEPPING IMPROVES LOWER LIMB MUSCLE STRENGTH, POWER AND FUNCTIONAL ABILITY IN OLDER FEMALES.

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**Introduction.** Lower limb muscle power independently predicts functional status in elderly women (Foldvari et al., 2000). Weighted stair climbing has been shown to improve muscle power and functional ability in older adults, in a practical, time-efficient manner (Bean et al., 2002). However older adults present a high risk of falling on staircases (Studenski et al., 1994). Weighted stepping, on and off a single step, may be a safer alternative in older cohorts, yet little is known about the training effects of such an intervention. Thus, the aim of this study was to evaluate the effects of a six-week weighted step intervention on aerobic fitness, muscular strength and power, and functional ability in sedentary older women. **Methods.** Eleven healthy older females (mean, SD; age: 67.4, 3.53 years, stature: 1.59, 0.05m, body mass: 67.64, 10.89kg) completed baseline testing (TS1), a six-week control period followed by re-test (TS2), and a six-week individually prescribed weighted step intervention followed by post-test (TS3). Training consisted of 54 exercise sessions, divided into three sessions/day on three days/week. Participants performed four sets of 10 step-up repetitions as quickly as possible, wearing a weighted vest with progressively increasing load from 0% to 10% body mass. Aerobic fitness (submaximal cycle test), power output (modified Wingate test), quadriceps muscle strength (maximum isometric voluntary contraction), and functional fitness (stair climb, chair rise, 4m walk) were

assessed. Results. Repeated measures ANOVA did not detect any changes in body mass, chair rise time, 4-m walk time or aerobic fitness. Significant improvement in stair climb time (12.3%  $p < 0.001$ ), stair climb power (10.4%,  $p = 0.024$ ), peak power output (12.3%,  $p = 0.001$ ) and quadriceps muscle strength (13.2%,  $p = 0.007$ ) were observed as a result of the training. Conclusion. These results show, for the first time, that short-term stepping exercise with an external load can significantly improve lower limb muscle strength, power and functional ability in older females by 10-13%. Since ageing is associated with declines in muscle strength and power by 12-15% per decade after 50 years of age (Macaluso & De Vito, 2004), the observed training improvements suggest that a weighted stepping intervention could potentially prolong independence by at least 10 years. References. Foldvari M, Clark M, Laviolette L, Bernstein M, Kaliton D, Castaneda C, Pu C, Hausdorff J, Fielding R, Singh, M. (2000). *J Gerontol*, 55(4), 192-199. Bean J, Herman S, Kiely D, Callahan D, Mizer K, Frontera W, Fielding R. (2002). *J Am Geriatr Soc*, 50, 663-670. Studenski S, Duncan P, Chandler J, Samsa G, Prescott B, Hogue C, Bearlon L. (1994). *J Am Geriatr Soc*, 42, 297-302. Macaluso A, De Vito G. (2004). *Eur J Appl Physiol*, 91, 450-472.

### EFFECTS OF A PRE-EXERCISE GLYCOGEN REDUCTION PROTOCOL ON NEUROMUSCULAR RESPONSES DURING MAXIMAL ECCENTRIC KNEE EXTENSIONS

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**Introduction** Eccentric exercise is followed by a transient loss of force, muscle soreness and impaired muscle glycogen homeostasis (Widrick et al., 1992). Where concentric exercise may reduce muscle glycogen, it does not induce muscle damage. Glycogen repletion is crucial for the recovery of muscle function in subsequent bouts; yet the neuromuscular consequences of performing eccentric exercise in a glycogen reduced state are less clear. **Method** Thirteen men ( $22 \pm 3$  yr,  $179 \pm 6$  cm,  $76 \pm 15$  kg) completed a single-leg glycogen depleting cycling protocol with dietary manipulation (Pilegaard et al., 2002), the evening before a bout of maximal eccentric contractions. The control leg was supported whilst the glycogen reduction (GR) leg completed: 20-min cycling at a  $\sim 75\%$   $VO_{2max}$  power; eight 90-s sprints at a 1:1 work-to-rest ratio (5% decrements from 90 to 55%  $VO_{2max}$ ); and exhaustive cycling at  $\sim 85\%$   $VO_{2max}$  power. Early the following morning, single-leg eccentric exercise was performed for the GR, then control condition. The bout involved 100 maximal eccentric knee extensions at 1.57 rad/s. Peak torque and electromyography (EMG) were recorded through each 1.57 rad range of motion, with EMG processed for root-mean square (RMS) and median frequency (MDF). To ensure analysis at constant angular velocity, measures were averaged for each contraction as three, 0.26 rad epochs mid-range of motion. Epochs corresponded to short (first), medium (second) and long (third) muscle lengths. Paired samples t-tests were used to compare: peak torque, work done, RMS and MDF during contraction one and one-hundred. Results Torque decreased at short muscle length in both conditions (GR: -19.3%,  $P = 0.02$ ; control: -18.4%,  $P = 0.01$ ), and at medium (-15%,  $P = 0.08$ ) and long muscle lengths (-21.7%,  $P = 0.02$ ) for GR. GR resulted in a -11.2% decrement in work done ( $P = 0.002$ ), yet was sustained from repetition one to one-hundred in the control condition. There was a trend towards decreased RMS in the GR (-9.6%,  $P = 0.07$ ), without change in the control. However, MDF increased at short (13.2%,  $P = 0.01$ ) and long lengths (17.9%,  $P = 0.016$ ) in the GR leg. **Discussion** These findings suggest neuromuscular modulation to maximal eccentric knee extensions may be altered according to muscle glycogen availability. Similar amplitude, but higher signal frequency, suggests increased motor unit firing rates to compensate for torque loss when performing eccentric contractions with GR. It appears neuromuscular mechanisms are sensitive to glycogen state in the knee extensors. References Pilegaard H, Keller C, Steensberg A, Helge J, Pedersen BK, Saltin B, Neuffer D. (2002). *J Physiol*, 541(1), 261-271. Widrick J, Costill D, McConnell G, Anderson D, Pearson D, Zachwieja J. (1992). *J Appl Physiol*, 72, 1999-2004.

### PROJECT ACE : REFINEMENT OF A VOLUNTEER-LED ACTIVE AGEING INTERVENTION USING QUALITATIVE METHODS

de Koning, J., Stathi, A., Withall, J.

*University of Bath*

**Introduction** Interventions to stimulate physical and social activity by older adults are of great public health value for the growing, inactive and often socially isolated older population. Project ACE emerged from the AVON Network for the Promotion of Active Ageing in the Community programme (AVONet; Stathi et al., 2012; Life Long Health and Wellbeing-Phase 2) which synthesised existing evidence and identified the potential physical and psychological benefits of volunteering initiatives and of staying engaged and socially connected in the neighbourhood. The ACE programme uses paid coordinators to support older volunteers ('Activators') to engage older adults who are not socially integrated ('Participants') into physical and social activities in their communities. This pilot study aimed to refine the ACE programme and highlight possible challenges and recommendations for its successful implementation. **Methods** Qualitative data was gathered from older volunteers ( $n = 9$ ), managers of volunteers ( $n = 4$ ) and older receivers of social volunteering services ( $n = 28$ ) who live in the city where the ACE programme will be implemented. Interview topics included the feasibility and attractiveness of the ACE programme, possible challenges and recommendations for successful implementation. Framework analysis was used to analyse and interpret the data, and practical considerations drawn. **Results** The ACE programme was generally praised for its potential to meet older people's needs of feeling competent, socially involved and independent. However, a number of challenges, recruitment in particular, were raised. Specific recommendations were offered which were considered to refine the intervention programme content, recruitment strategies and implementation plan. **Conclusions** The ACE programme offers a timely, accepted and needed initiative for older adult physical activity promotion. The most prominent challenge, that of adequate recruitment of Participants, might be minimised through the use of local media and a focus on 'out and about', rather than 'physical activity'. Activator training using manuals and certificates, and support through peer meetings are highly important. The structure of meetings between Activators and Participants must be flexible and should ideally be matched for interests. Discretion must be used to judge readiness for Participants to come together in small groups. Finally, as well as organising the Participant-Activator meetings and groups, coordinators should be available to be contacted by telephone by Activators desiring to discuss Participant issues and in need of extra motivation. References Stathi, A.S. et al., 2012. Promoting physical activity in older adults: A guide for local decision makers. University of Bath.

### CAN THE BPAQ PREDICT BONE MINERAL DENSITY IN MIDDLE-AGED AND OLDER MEN?

Bolam, K., Beck, B., Adlard, K., Skinner, T., Cormie, P., Galvão, D., Spry, N., Newton, R., Taaffe, D.

*The University of Queensland, Australia; Griffith University, Australia; Edith Cowan University, Australia; Sir Charles Gairdner Hospital, Australia; University of Newcastle, Australia.*

**Introduction** Regular physical activity plays an important role in the regulation of bone mass and is therefore a vital element in the prevention of osteoporosis. A limitation of traditional measures to assess the role of physical activity has been the inability to account for critical

bone-specific loading. As a result, the Bone-specific Physical Activity Questionnaire (BPAQ) [1] was developed to account for this loading and is a useful tool to predict indices of bone strength in young adult adults. However, its ability to predict bone strength in middle-aged and older adults, a population at increased risk for the development of osteoporosis, as well as in clinical populations where bone is adversely affected by treatment is unknown. Therefore, the purpose of this study was to evaluate the ability of the BPAQ to predict bone mineral density (BMD) in healthy middle-aged and older men, and men with prostate cancer (PCa) undergoing androgen suppression therapy (AST), which has well established negative effects on BMD. Methods Participants were 110 men from two distinct groups: group 1 comprised 36 community-dwelling men aged 50 years and over, while group 2 comprised 71 men with PCa receiving AST. The BPAQ was self-administered. Values were entered into the on-line calculator so that past (pBPAQ - all activities since 1 year of age), current (cBPAQ - activities in the previous 12 months only), and total BPAQ score (tBPAQ - average of pBPAQ and cBPAQ scores) could be calculated. BMD (g/cm<sup>2</sup>) of the whole body (WB), hip (total hip and femoral neck-FN), and lumbar spine (L2-4) were assessed by DXA (Hologic, QDR4500). Results In healthy men, relationships were found between tBPAQ and pBPAQ with hip and WB BMD ( $r = 0.28-0.45$ ,  $p < 0.05$ ), whereas in men with PCa only pBPAQ was associated WB BMD ( $r = 0.24$ ,  $p = 0.044$ ). In stepwise regression analysis, body mass and tBPAQ predicted 30% of the variance in hip BMD of healthy men ( $p = 0.003$ ), cBPAQ predicted 25% of the variance at FN ( $p = 0.002$ ), and body mass, age and tBPAQ predicted 47% of the variance in WB BMD ( $p < 0.001$ ). In men with PCa, BPAQ was not an independent predictor of BMD. Discussion We found that current and total physical activity as indicated by the BPAQ predicted BMD at the hip and whole body in healthy middle-aged and older men but not men on AST. As a result, although the BPAQ appears to be a useful predictor of bone status in healthy men, adverse effects of treatments such as AST on bone may override the clinical utility of physical activity measures such as the BPAQ. References 1. Weeks BK, Beck BR. Osteoporos Int 2008;19:1567-1577 sert authors here

## COMPARABILITY OF ACCELEROMETER- AND IPAQ-DERIVED PHYSICAL ACTIVITY AND SEDENTARY TIME IN SOUTH ASIAN WOMEN

Babakus, W.S., Thompson, J.L., Duda, J.L.

*University of Birmingham*

Introduction Accurate measurement of physical activity (PA) and sedentary time (ST) is essential in developing effective intervention strategies to improve health outcomes. There is no generally accepted standardised method of assessing PA and ST, although self-report questionnaires and objective methods (e.g., accelerometry) are widely used (Kurtze et al., 2008). There is limited research documenting objectively measured PA/ST in South Asian (SA) women and no published evidence of the validity of self-report methods of PA/ST assessment of SA in the United Kingdom (UK) (Babakus & Thompson, 2013). The purpose of the study is to assess the comparability of accelerometer and IPAQ derived PA/ST measures among SA women in the UK. Methods 140 SA women wore an ActiGraph accelerometer for 7 consecutive days; a sub-sample ( $n = 51$ ) completed the IPAQ-Short form (IPAQ-SF) and a brief structured interview to determine ease of use, understanding of terms used in the IPAQ-SF, and cultural contextualisations of PA/ST in daily life. Metabolic equivalent minutes per week (METminwk) were calculated for accelerometer and IPAQ-SF derived moderate-to-vigorous PA (MVPA) and ST. Interview data were analysed using content analysis (Kondracki et al., 2002). Results Mean age and BMI for the full sample were  $46.5 \pm 14.3$  yr and  $28.3 \pm 5.0$  kg/m<sup>2</sup>, respectively. Accelerometer and IPAQ-SF derived mean METminwk for MVPA were  $397.0 \pm 259.7$  and  $367.1 \pm 1102.2$ , respectively. Accelerometer and IPAQ-SF derived mean METminwk for ST was  $530.0 \pm 86.7$  and  $370.5 \pm 228.8$ , respectively. Mann-Whitney U tests indicate no significant difference ( $p > 0.05$ ) between the full and sub-sample in age, BMI, or accelerometer and IPAQ-SF derived MVPA and ST. Spearman correlations indicated no significant associations between accelerometer and IPAQ-SF mean METminwk for MVPA ( $r_s = -.332$ ,  $p = .113$ ), or ST ( $r_s = .096$ ,  $p = .649$ ). Major themes from the interview included: 1) lack of cultural context and terminology for participation in leisure-based PA; 2) inability of participants to equate their own PA with examples of intensity levels from the IPAQ-SF; 3) inability to recall sitting time; and 4) limited general knowledge of real-life examples of activities that are of moderate or vigorous intensity. Discussion Results indicate that the IPAQ-SF may not accurately measure PA/ST in UK SA women. These findings are supported by qualitative evidence indicating several issues with interpretation and recall of PA/ST. Further validation of the IPAQ-SF with a larger sample is needed to determine its suitability within this population. References Babakus & Thompson (2012). Int J Behav Nutr Phys Act, 9:150. Kondracki et al. (2002). J Nutr Ed Behav, 34(4), 224-230. Kurtz et al. (2008). BMC Med Res Meth, 8:63.

**15:00 - 16:00**

## Mini-Orals

### PP-PM80 Training and Testing [TT] 15

#### EVALUATION OF A NEW FORCE/VELOCITY TEST AND ITS RELATION TO MUSCLE MASS AND AGE CATEGORY IN HANDBALL.

Sánchez, A., Mónico, M., Romero, R., Drobnic, F.

*INEFC*

Introduction The capacity to support a level of work of high intensity for short periods of time is one of the most successful physiology characteristics in sport activities and is not easy to evaluate in the training with modifies the maximum level realized in the first phases of the test. A new evaluation model is proposed of the maximum potency and its relation with the fatigue that the condition of physical maturation allows us to establish as regards the category or with the corporal composition measured by means of corporal densitometry or conventional anthropometry by external measurements. A relation is established between this measurement in 4 age categories, <17 to, <16 to, <15 y <14 in handball teams of Fc Barcelona, each one of them with 17 athletes. Method The designed test consists of four sprints in the Monark LE cycloergometer of 10 seconds of duration (life) followed (consecutively) by 50 seconds of rest. The loads of displacement corresponds to 75 g/kg first period, 50 g/kg second, 25 g/kg and 500 g fourth. Before the exercise a warm up of at least 5 minutes is performed to a variable rate. Determine the maximum RPM reached on each series in which the maximum power achieved is established and a work area under the curve of strength/speed. Lactate removal is obtained from the lobe of the ear after 5 minutes of the test. To evaluate the corporal composition by means of densitometry a Lunar System iDXA is used. The Drinkwater formula is used to establish the muscular and fat percentage of every subject. Results The values of Maximal Power Developed (MPD) in watts correspond

to the categories of <14, <15, <16 y <17, years to 600(123), 802(183), 904(300) and 1105(344), work area to 602(125), 744(149), 819(150) y 900(125). The muscle percentage according to Drinkwater is of 43,9(3), 43,3(2,5), 42,6(4,6) and 46,3(3,2) and the fat percentage is of 8,0(3,5), 7,8(1,5), 9,6(3,5) and 8,1(2,3) while the fat percentage according to Yuhász is 10,4(3,9), 9,5(1,7), 11,0(3,5), 9,0(2,4) and through IDXA 17,6(4,2), 17,4(3,1), 19,5(7,7) y 15,9(4,2). The R between the values of power and work area in relation to the muscle mass as the Drinkwater (0.815 and 0.839) or the upper extremities or lower extremities mass alone (0.840 and 0.900). Lactate levels do not discriminate the groups being the average of all of them of 7.3 (2.3). Discussion Test easy and practical to perform. Subjects are involved during all the periods of exercise. Results discriminate the categories by the work area under the shape F/V. Data correlates well with muscular values by the standard anthropometrics or by IDXA. References Martin AD, Spent LF, Drinkwater DT, Clarys JP. *Med Sci Sports Exerc.* 1990 ;22(5):729-33. Doré E, Bedu M, França NM, Diallo O, Duché P, Van Praagh E. *Med Sci Sports Exerc.* 2000 Feb;32(2):493-8. Ratel S, Bedu M, Hennegrave A, Doré E, Duché P. *Int J Sports Med.* 2002 Aug;23(6):397-402

### TRANSMISSION OF PLATFORM VIBRATIONS THROUGH CABLES AND ITS EFFECT ON UPPER-BODY MUSCLE ACTIVITY

Tankisheva, E.1, Boonen, S.2, Druyts, H.1, Verschuere, S.1

1: KUL (Leuven, Belgium), 2: UZ Leuven (Leuven, Belgium)

**Introduction** Vibration acts on the human body by transmitting mechanical loading from different vibration sources. Vibration has been reported to stimulate the activity of lower-limb muscles (Cardinale and Lim, 2003). Only a few studies have reported low or no effects on upper body muscle performance during vibration stimulation (Hazell et al., 2007). We tested a new vibration device with a cable-pulley resistance system attached to a vibration platform, in an attempt to channel the vibration indirectly from the platform to the upper body and potentially broaden the impact of training to the whole body. The aim of the study was to evaluate the vibration transmission through the cables to the upper body and the relationship between vibration parameters and muscle activation during different static and dynamic arm exercises. **Methods** Fifteen clinically healthy participants performed 3 different arm exercises – biceps curl, triceps curl, and lateral raise. Vibration transmission to the upper body was assessed over a wide range of accelerations (from 1.90 to 5.98 g) and frequencies (25 to 40 Hz). Additionally, muscular activity of biceps brachii, triceps brachii, deltoid, upper and lower trapezius was recorded. **Results** The results showed a significant attenuation of the platform accelerations transmitted through the vectran cables to the upper body. Handle vibration ranged between 27 – 44 % of the acceleration delivered by the platform. Vibration increased the muscle activity of biceps brachii, triceps brachii, deltoid and upper trapezius muscles significantly only during biceps curl exercises. No frequency and/or acceleration effect was found on the size of the muscle response. **Discussion** The outcome of this study indicates the potential of a whole body vibration platform with a cable-pulley resistance system to stimulate the muscle activity of some arm muscles. The vibration delivered by the platform that reached the handle ranged between 27 % – 44 % and might be affected by the different angles of the cables, the orientation and the distance of the handle with respect to the platform. The subjects performed commonly used exercise as biceps curl which resulted in a significant increase in arm muscle activity during vibration stimulation. Different vibration parameters delivered by the platform did not evoke different muscle response probably because of the different vibration approach, the limited vibration transmission at the handle and the high variance in the EMG response. The specific vibration parameters used in the present study seem safe and suitable for the specific arm exercises. References Cardinale M, Lim, J. (2003), *J Strength Cond Res*, 17(3), 621-624 Hazell TJ, Jakobi JM, Kenno KA. (2007), *Appl Physiol Nutr Metab*, 32(6), 1156-1163

### THE CMJ AS A MEASURE OF CONTROL FOR INDOOR TRAINING ON HIGH-LEVEL MIDDLE AND LONG DISTANCE RUNNERS

Balsalobre-Fernández, C., Tejero-González, C.M., del Campo-Vecino, J.

*Autonomous University of Madrid*

**Introduction** The counter movement jump (CMJ) has been used for monitoring the training process in track&field sprinters because of its ability to identify states of peak performance and fatigue (Jiménez-Reyes & González-Badillo, 2011). However, its use for controlling the training process of high-level middle and long distance runners is poorly studied. **Purpose** Compare the value of the CMJ measured at the start of the indoor season with the value of the CMJ measured during the preparatory period in a group of high-level middle and long distance runners. **Methods** Sample The sample consists of a group of 15 middle and long distance runners (3 women), average age 24.9 years (SD = 5.1), with personal bests ranging from 1:48 to 1:54 min (men) / 2:02 to 2:06 min (women) (800m), 3:39 to 4:04 min (1500), 8:03 to 8:36 min (3000m) and 14:09 to 15:03 min (men) / 15:58 (women) (5000). Variables CMJ height was measured in cm once a week during the preparatory period (November 2012-January 15th 2013) and at the beginning of the indoor competitive period (January 15th-31st 2013). **Instrumental** To measure the CMJ, an Optojump infrared platform (Microgate, Italy) was used. **Procedure** The CMJ vertical jump was measured once a week. This jump was always performed the same day of the week, at the same time of the day and under the same conditions. 3 trials were executed and the best was recorded. In total, 540 CMJ were analyzed. **Statistical Analysis** We proceeded with nonparametric statistics, Wilcoxon test (one-sided), using the statistical software IBM SPSS Statistics 20 (IBM Corp., USA). **Results** The Wilcoxon test found statistically significant differences ( $Z = -2.05$ ,  $p = 0.020$ ) between the average CMJ at the beginning of the indoor competitive period ( $29.7 \pm 4.6$ ) and the average CMJ during the preparatory period ( $29.0 \pm 3.9$ ). The CMJ average was 2.4% higher at the beginning of the indoor competitive period than during the preparatory period. **Conclusion** Our results indicate that one of the consequences of the preparatory training for the indoor season of high-level middle and long distance runners is the significant improvement of the CMJ. Its assessment may be very useful to control the training process for the indoor season of such athletes. References Jiménez-Reyes, P., & Gonzalez-Badillo, J. J. (2011). Monitoring training load through the CMJ in sprints and jump events for Optimizing performance in athletics. *Culture, Science and Sport*, 7 (18), 207-217.

### REPRODUCIBILITY OF AN ALL-OUT TETHERED FIELD TEST FOR ANAEROBIC PARAMETERS DETERMINATION IN SLALOM KAYAK

Manchado-Gobatto, F.B., Ferrari, H.G., Messias, L.H.D., Reis, I.G.M., Terezani, D.R., Gobatto, C.A.

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**Introduction** The slalom kayak is performed in down water course designated by gate placement, magnitude of waves, velocity of water flow (Shephard, 1982) and requires important participation of anaerobic metabolism (Zamparo et al., 2006). The aims of this study were to present an all-out tethered field test analyzing their reproducibility for anaerobic parameters determination of slalom kayakers. **Methods** Six well trained athletes (national Brazilian team level, K1 category,  $23 \pm 2$  yrs) were submitted to two 30 seconds all-out tethered

specific test performed on a lake, separated for 24hrs between them. The kayakers paddled tied using an elastic cord attached to the kayak and a load cell coupled in a wood structure at the border of lake connected to the data acquisition system with signs collection at 1000hz, aimed the measurement of the paddling force. Blood samples were collected at the end of the test (1 to 10 min) for quantify the blood lactate. The peak force (PF), mean force (MF), time to peak force (TPF), peak lactate (PLac) and time to peak lactate (TPLac) were obtained. The reproducibility was tested by paired t-Student test and Pearson product-moment ( $P \leq 0.05$ ). Data are showed as mean  $\pm$  standard error of mean. Results There was not statistical difference between the 1st and 2nd test for all parameters evaluated (PF=147.4 $\pm$ 10.3N and 134.1 $\pm$ 9.4N; MF=105.5 $\pm$ 8.6N and 95.8 $\pm$ 6.9N; TPF=9.5 $\pm$ 0.5s and 9.8 $\pm$ 0.4s; PLac=7.3 $\pm$ 0.1mM and 6.8 $\pm$ 1.1mM and TPLac=7 $\pm$ 1min and 6 $\pm$ 1min). Significant correlations between PF ( $r=0.87$ ), MF ( $r=0.85$ ) and PLac ( $r=0.95$ ) were observed. The coefficient of variation between tests for PF, MF, TPF, PLac were respectively 6.6%, 8.1%, 9.1% and 8.9%. Discussion Field tests have less control of the experimental conditions than laboratory tests, on the other hand their ecological validity is greater. Tethered field tests have been purposed in different sports modality to anaerobic evaluation (Papoti et al., 2008; Lima et al., 2011), but not yet tested in slalom kayak. Despite the field conditions, the parameters obtained by all-out kayak tethered test in two efforts showed similar values and high relationship. Furthermore, low coefficient of variation (<10%) were observed for all measurements. Thus, we conclude that the specific all-out tethered test can determine anaerobic parameters of slalom kayakers and was reproductive for the group of high performance athletes evaluated. References Lima MC, Ribeiro LF, Papoti M, Santiago PR, Cunha SA, Martins LE, Gobatto CA. (2011). *Int J Sports Med*, 32, 529-34. Papoti M, Martins LE, Cunha, SA, Zagatto AM, Gobatto CA. (2007). *J Strength Cond Res*, 21, 538-42. Shephard RJ. (1982). *Sports Med*, 4, 19-33. Zamparo P, Tomadini S, Didonè F, Grazzina F, Rejc E, Capelli C. (2006). *Int J Sports Med*, 27, 542-46. Financial support: FAPESP (2012/06355-2) and CNPq (472277/2011-1).

### GAS EXCHANGE AND OXYGEN UPTAKE KINETICS DURING SUB-MAXIMAL EXERCISE IN SWIMMING

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**Introduction** The heavy exercise intensity domain includes the exercise intensities between ventilatory threshold (VT) and maximal lactate steady state (MLSS). Oxygen uptake (VO<sub>2</sub>) is an important determinant of exercise performance and the dynamic transition of VO<sub>2</sub> kinetics provides a unique window into understanding metabolic control (Poole et al. 2008). Recently, Reis et al (2012) indicated that VO<sub>2</sub> kinetics of the primary phase is associated with performance during high-intensity swimming. The aim of this study was to determine the relationship between VO<sub>2</sub> kinetics in heavy-intensity swimming, aerobic parameters and swimming performance. **Methods** Twelve male swimmers completed an incremental test composed by 5x250 and 1x200 m front crawl for VT, respiratory compensation point (RCP) and maximal oxygen uptake (VO<sub>2</sub>max) determination, as well as the respective swimming velocities. For MLSSv estimation, athletes performed 30-min at constant velocity at 87.5, 90 and 92.5% of vVO<sub>2</sub>max. In two complementary days, 6-min bouts were performed separated by one hour of passive rest between each repetition, two in one day 2.5% below MLSSv and the other two in another day 2.5% above MLSSv. All tests were completed with aquatrainer swimming snorkel®. Best 400 and 800 m races were recorded (respectively, T400 and T800). Results VT (45.9  $\pm$  7.0 ml.kg<sup>-1</sup>.min<sup>-1</sup>) and RCP (51.3  $\pm$  7.6 ml.kg<sup>-1</sup>.min<sup>-1</sup>) were significantly different than VO<sub>2</sub>max (58.04  $\pm$  7.0 ml.kg<sup>-1</sup>.min<sup>-1</sup>). Mean VO<sub>2</sub> at MLSSv (49.3  $\pm$  9.2 ml.kg<sup>-1</sup>.min<sup>-1</sup>) was not significantly different from RCP ( $p < 0.01$ ). MLSSv (1.30  $\pm$  0.04 m.s<sup>-1</sup>) and RCPv (1.31  $\pm$  0.08 m.s<sup>-1</sup>) were also not significantly different. T400 was correlated with VO<sub>2</sub> time constant of the primary phase (tp) at infra MLSSv ( $r = 0.64$ ,  $p < 0.03$ ). T800 was also correlated with tp in both 97.5% and 102.5% of MLSSv (respectively  $r = 0.75$ ,  $p < 0.01$  and  $r = 0.58$ ,  $p < 0.05$ ). vVO<sub>2</sub>max was significantly correlated both with T400 and T800 ( $r = -0.70$  and  $r = -0.72$ ,  $p < 0.01$ ). **Discussion** Our results are in line with Deckerle et al. (2003) study which evidenced that MLSS and RCP are physiologically related. The correlations between tp below and above MLSSv and performance show that the primary phase of VO<sub>2</sub> kinetics presents a clear relation with performance and aerobic capacity. vVO<sub>2</sub>max seems to be a good predictor of middle and long-distance swimming performance. References Deckerle, J., Baron, B., Dupont, L., Vanvelcenaher, J., Pelayo, P. (2003). *Eur J Appl Physiol*; 89: 281-288. Poole, D.C., Barstow, T.J., McDonough, P., Jones, A.M. (2008). *Med Sci Sports Exerc*; 40(3): 462-474. Reis, J.F., Alves, F.B., Bruno, P.M., Vleck, V., Millet, G.P. (2012); *J Sci Med Sport*. 15(1): 58-63.

### THE EFFECTS OF FLOAT-EQUIPPED AQUA TRAINING SWIMWEAR ON WATER JOGGING.

Akiharu, S.1, Kenji, Y.1, Saori, S.2, Nozomu, S.2, Yumiko, T.2, Takahiro, K.2, Makoto, O.2

*\*/Graduate school of sports system, Kokushikan University\*\*/( HUMAN SCIENCE RESEARCH CENTER, WACOAL CORP)*

**Introduction** It is widely reported that water exercise is an effective form of continuous exercise therapy for sufferers of knee joint pains and lower back pains. In addition, there are also reports of the effectiveness of water exercise performed in the comparatively greater buoyancy of deep-sea water (which has a relative weight of 1.05 times). This research was carried out with the aim of revealing what kind of physiological effects can be observed when aqua training swimwear with 60g floats attached to both sides of the chest (hereafter referred to as Swimwear X) was worn during aqua walking exercise. **Methods** The subjects were 12 healthy adult females (aged 43.9years). For the measurements, we used Swimwear X, and swimwear without floats attached (hereafter referred to as Swimwear C). The water walking was performed in an indoor pool 16m in length, at a rate of about 27m/min, over two round trips. Heart rate was measured during standing rest, submerged rest, and immediately after the water walking was finished. Walking times, muscle activity, and oxygen absorption amount were also measured. Additionally, forward tilt of the body immediately prior to foot landing was calculated from a video taken during the exercise. Results There was no significant statistical difference observed between Swimsuit X and Swimsuit C in terms of walking speed in the water, step/pace, or heart rate immediately after the exercise. Swimsuit X showed a tendency of not assuming a forward bent posture during the period prior to foot landing. Additionally, Swimsuit X showed less muscle activity of the biceps femoris muscle group. **Discussion** It is thought that Swimwear X was worn during aqua walking is an effective form of continuous exercise therapy for sufferers of knee joint pains and lower back pains. References Akiharu Sudo. (2003). Changes in the blood pressure and the intramuscular oxygen hemodynamic when the body is immersed in Kume Island deep ocean water, ECSS, 9th, Zamparo P.Pendergast DR, Termin A, Minetti AE. (2005). Economy and efficiency of swimming at the surface with fins of different size and stiffness. *European Journal of Applied Physiology* 96 (4).

## RELIABILITY OF DIFFERENT JUMP AND MAXIMAL STRENGTH TESTS

Westphal, M., Raeder, C., Fernandez Fernandez, J., Wiewelhoeve, T., Ferrauti, A.

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**Introduction** Vertical jump and maximal strength tests are well established measurement tools for the assessment of performance in athletes. However, the reliability of drop jump (DJ), countermovement jump (CMJ), multiple rebound jumps (MRJ), repeated countermovement jumps (RCMJ), maximal voluntary isometric contraction (MVIC) and one repetition maximum (1RM) might be questioned in population with a lower level of performance (i.e., recreational athletes). Therefore the 1st aim of this study was to analyze the reliability of different jump and maximal strength tests in sport students. Moreover, we examined the correlation between two major reactive strength indices in vertical drop jumps (i.e., the jump efficiency coefficient (EKA) and the reactive strength index (RSI)). **Methods** Thirty-eight sport students participated in two non-randomized consecutive testing sessions within one week: DJ, CMJ, MRJ, RCMJ, MVIC and 1RM. Reliability was obtained using intraclass correlation coefficient (ICC), standard error of measurement (SEM) and systematic bias ( $\Delta$ ). Correlation analyses were conducted by Pearson's correlation coefficient. Results All tests showed moderate to high reliability, with CMJ (0.917 (0.840-0.957)), MRJ (0.903 (0.813-0.950)), RCMJ (0.949 (0.894-0.974)), MVIC (0.916 (0.838-0.956)), 1RM (0.959 (0.921-0.979)), EKA for MRJ (0.926 (0.858-0.961)) and RSI for MRJ (0.914 (0.836-0.955)) showing high values. On the other hand, DJ (0.891 (0.791-0.943)), EKA for DJ (0.876 (0.762-0.935)) and RSI for DJ (0.861 (0.734-0.928)) showed moderate values. The correlation analyses between EKA and RSI in the DJ showed values of 0.995 and 0.993, for testing day 1 and 2, respectively. Correlation between EKA and RSI of MRJ showed values of 0.994 and 0.998 for testing day 1 and 2, respectively. **Discussion** The test battery conducted in the present study illustrates a reliable method for jump and strength performance assessment. However, results also showed that the use of the DJ seems not to be appropriate for non-highly trained population. If the aim is to test reactive strength performance, the use of the MRJ should be recommended. In addition, if the aim is to measure jump efficiency, both reactive strength indices, EKA and RSI, seem to be practical as were highly correlated. Nevertheless, the present results are based on non-highly trained subjects. We can speculate that differences can be expected when testing other populations. **References** Ball, N. B. & Zanetti, S. (2012). *J Strength Cond Res*, 26 (5), 1407-1412. Bland, J. M. & Altman, D. G. (1986). *Lancet*, 1-9. Hopkins, W. G. (2000). *Sports Med*, 30 (1), 1-15. Voß, G., Witt, M. & Werthner, R. (2007). Aachen: Meyer & Meyer. Weir, J. P. (2005). *J Strength Cond Res*, 19 (1), 231-240.

## ARE CHANGES IN BODY COMPOSITION ASSOCIATED WITH JUMPING HEIGHT AND STRENGTH OVER A SEASON IN NATIONAL LEVEL BASKETBALL, HANDBALL, AND VOLLEYBALL PLAYERS?

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**Introduction** Body composition assessment throughout the season in team sports is crucial, though the extent to which total fat (FM) and fat-free mass, including total-body water (TBW) and fluid distribution, predicts power and strength, remains unclear. Additionally, most of the studies investigated body composition changes at the whole body level, such as height and weight, skinfolds, or other anthropometric indicators. Therefore we aimed to analyze the relationship between changes in molecular and tissue-level body components with jumping height and strength in national level players over a season. **Methods** At the beginning and at the competitive periods, measures of total FM, lean-soft tissue (LST), and bone mineral (Mo) estimated by dual energy X-ray absorptiometry were obtained in 63 basketball, handball, and volleyball players (20±5yrs), 40 males and 23 females. Skeletal muscle (SM) was estimated from appendicular LST using Kim et al. model (2004). TBW and extracellular water (ECW) were assessed by deuterium and bromide dilution, respectively, and intracellular water (ICW) was calculated as TBW minus ECW. A refractometer was used to test urine specific gravity (USG). Jumping height was assessed with a squat (SJ), countermovement (CMJ), and countermovement Abalakov (CMJA) jumps while maximal lower strength was tested in a leg press. Changes were expressed as a percentage from the baseline values. Comparison of means and multiple regression analysis were performed. Results Jumping height improved ( $p < 0.05$ ) by 8.3±13.9%, 6.3±8.5% and 7.5±12.0%, respectively for the SJ, CMJ, and CMJA and maximal strength increased by 12.5±20.8%. Weight, Mo, LST, SM, TBW, and ECW increased (1.8±2.9%; 2.4±3.5%; 3.0±2.7%; 3.2 ±4.0%; 1.7±5.5%; 3.0±8.6%, correspondingly) while %FM decreased (3.6±2.2%) but no changes were found in ICW (-1.5±7.9%). Among the changes in the several body components, only ICW was related with differences in SJ ( $r = 0.282$ ;  $p = 0.033$ ), CMJ ( $r = 0.401$ ;  $p = 0.013$ ), and maximal strength ( $r = 0.303$ ;  $p = 0.016$ ). These associations remained significant after adjusting for gender, age, and changes in USG (strength:  $\beta = 72.030$ ,  $p = 0.045$ ; SJ:  $\beta = 0.371$ ,  $p = 0.033$ ; CMJ:  $\beta = 0.383$ ,  $p = 0.012$ ). **Discussion** This observational study with a follow-up from the beginning to the main stage of a season revealed that players improved body composition, maximal strength, and jumping height. Though no mean differences were observed in intracellular water, changes in this body component explained improvements in strength and jumping height, regardless of age, gender, and hydration status. If these findings are confirmed through well-design experimental studies in highly-trained athletes, a regular assessment and tracking of the intracellular water compartment should be incorporated throughout a season to avoid reductions in this water pool. **References** Kim J, Heshka S, Gallagher D, Kotler DP, Mayer L, Albu J, Shen W, Freda PU, Heymsfield SB. *J Appl Physiol* 2004; 97: 655-660.

## SPRINT AND AGILITY PERFORMANCE IN YOUNG FEMALE SOCCER PLAYERS

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**Introduction** Linear sprint and agility performance are important skills in soccer, and the amount of sprinting may be of vital importance in soccer matches. Studies have revealed that elite players perform better in linear sprint and agility than sub-elite players, and fitness testing of youth soccer players may provide important information for coaches. However, there are few studies in young female soccer players on linear sprint and agility performance. Thus, the purpose of this study was to test these abilities in 14-16 year-old female soccer players, and compare the results with male soccer players at the corresponding age. **Methods** 46 young local soccer players, 24 female with mean age ( $\pm$  SD) 15,4 ( $\pm$  0,73), and 22 males with mean age 15,2 ( $\pm$  0,87) were tested in linear sprint and agility performance. The linear sprint-test was a 20 m track with 10 m split time recording (Brower Timing System, UT, USA). The agility test was a 20 m standardized course. Results Results for the female players shows mean 1,91 s ( $\pm$  0,10) (min 1,75 s, max 2,11 s) in 10 m linear sprint, and mean 3,41 s ( $\pm$  0,17) (min 3,08 s, max 3,82 s) in 20 m linear sprint for female players. Mean results on linear sprint for males was 1,84 s ( $\pm$  0,12) (min 1,62 s, max 2,04 s), and 3,22 s ( $\pm$  0,23) (min 2,86 s, max 3,72 s). Mean results for agility test was 8,10 s ( $\pm$  0,32) (min 7,51 s, max 8,81 s) for females, and 7,61 s ( $\pm$  0,39) (min 6,90 s, max 8,41) for males. **Discussion** Findings from the study showed difference in linear sprint and agility performance as shown in earlier studies. Difference between gender was 3,5 % in 10 m linear sprint,

6,4 % in 20 m linear sprint, and 6,1 % in agility performance. However, individual results show that the best results from female players are on approximately the same level or even higher than mean results from the male players. Results from the present study may be of interest for coaches in youth female soccer, and studies on sprint and agility training among youth female soccer players has to be followed up. References Hoare DG, Warr CR. Talent identification and women's soccer: an Australian experience. *J Sports Sci* 2000; 18: 751-758 Vescovi JD, Rupf R, Brown TD, Marques MC. Physical performance characteristics of high-level female soccer players 12-21 years of age. *Scand J Med Sci Sports* 2011; 21: 670-678 Vescovi JD, McGuigan MR. Relationship between sprinting, agility and jump ability in female athletes. *J Sports Sci* 2008; 26: 97-107

### **THE RELATIVE AGE EFFECT IN ENGLISH LOWER-LEAGUE YOUTH SOCCER PLAYERS: A PRELIMINARY CROSS-SECTIONAL STUDY**

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The relative age effect (RAE) is a phenomenon characterised by a higher propensity of player birth dates in the early months of the selection year. This preliminary study examined the birth date distribution in a large sample of U9-U18 soccer players representing teams in the English professional leagues. We also examined if the players' birth date resulted in any anthropometrical or physical differences. Birth dates of 767 players representing teams from 13 lower-league clubs were collected from chronologically-grouped squads, and categorised into quartiles from the start of the selection year (Q1 = Sep-Nov; Q2 = Dec-Feb; Q3 = Mar-May; Q4 = Jun-Aug). 542 players' somatic maturation was estimated (age at peak height velocity: APHV), together with endurance (Multi-stage fitness Test), sprint (20m), repeated sprint (10 x 20m), agility (T-Test), and counter-movement jump assessments. A greater proportion of players with Q1 birth dates ( $p < 0.01$ ) was observed in all age-groups (U18: 48.4%; U16: 44.8%; U15: 58.6%; U14: 46.2%; U13: 42.9%; U12: 44.9%; U11: 36.2%; U10: 37.2%; U9: 54.3%). Due to the low frequency of Q3 and Q4 birth dates, players were categorised into semesters to examine if relative age resulted in any physical advantages. There were few differences in anthropometric and physical fitness measures between players born in the first (S1) and second (S2) semesters of the selection year. Although not statistically significant, U9, U10, and U12 players born in S2 tended to have a lower APHV (effects size [ES]: 0.6-0.7). In some squads, S2 players tended to have lower sprint (U9; ES: 0.54), agility (U12; ES: 0.77), and repeated sprint capacities (U9; ES: 0.91), and a lower body mass (U9 & U13; ES: 0.65). There were no between-semester differences in the physical fitness and APHV measures of the U14-U18 players. The RAE demonstrated in this population supports previous work in elite-youth soccer. We also observed a strong RAE as early as U9, although this should be interpreted with caution given the smaller sample in younger age groups ( $n=35-65$ ). We observed few between-semester differences in physical attributes, but pre-pubescent players born in S2 were likely to mature earlier. However, the birth date bias did not result in any physical advantages in adolescent and post-adolescent players. Longitudinal research is required to determine if the relative age of elite-youth players provides a physical advantage during development.

### **OPTIMISATION OF THE STIMULATION PARAMETERS FOR FES TRAINING: A PRELIMINARY STUDY ON ABLE-BODIED SUBJECTS**

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Introduction Aerobic exercise can be broadly beneficial to health and quality of life in humans with spinal cord injury (SCI) (Jacobs et al. 2001, Ditor et al. 2003). However, exercise must meet certain criteria to induce significant benefits. One solution for SCI patients is Functional Electrical Stimulation (FES) during rowing, that couples volitional arm and electrically controlled leg exercise. Despite its beneficial effects, FES has not gained widespread clinical popularity because of the rapid muscle fatigue that it can engender (Peckham and Knutson 2005). The stimulation pattern needs to be adequately adapted to produce high force while minimizing fatigue. Hence, our aim was to explore the differences between two stimulation programs on torque production and fatigue. This preliminary study has been performed in healthy subjects. Methods 15 subjects regularly involved in a physical activity were included in this study, composed of two experimental sessions interspersed with at least 72 hours. Each session corresponded to a stimulation program applied during 30 minutes. The first program, called "constant-frequency trains" (CFTs), consisted in 6 seconds ON – 6 seconds OFF stimulation trains (450  $\mu$ s, 40 Hz, no ramp) during 30 minutes. The second program, "variable-frequency trains" (VFTs), consisted in 10 minutes of CFTs followed by 20 minutes of 6 seconds ON – 6 seconds OFF (frequency: 20 Hz, pulse width: 450  $\mu$ s, no ramp but preceded by a 80-Hz doublet). The torque evoked by each contraction was recorded. Results Our results showed significantly greater decreases in evoked torque after the CFTs program in comparison with VFTs (-71•7.3 % and -36•5.5 % respectively,  $P < 0.05$ ). MVC was also more decreased after CFTs (-36•7.4% vs. -32•6.9%). Total work during the 30 minutes was greater when VFTs were applied. Discussion The present results have shown that a stimulation program with VFTs reduces fatigue allows for higher force contractions during the entire session compared to CFTs. This might be explained by the "catch-like" phenomenon, i.e. the tension enhancement observed after an initial brief interpulse interval is added to the beginning of a subtetanic train of pulses (Burke et al. 1970). Therefore, this experimental VFTs program might provide a more optimal stimulus for FES-row training and thereby result in greater exercise-induced adaptations. It now has to be tested on SCI FES-rowers. References 1. Jacobs PL, Nash MS, Rusinowski JW (2001) *Med Sci Sports Exerc.* 33: 711-717. 2. Ditor DS, Latimer AE, Ginis KA, Arbour KP, McCartney N, Hicks AL (2003) *Spinal Cord.* 41: 446-450. 3. Peckham PH, Knutson JS (2005) *Annu Rev Biomed Eng* 7: 327-360. 4. Burke RE, Rudomin P, Zajac FE 3rd (1970) *Science.* 168: 122-124.

### **THE INFLUENCE OF UNILATERAL TRAINING ON CROSS EDUCATION AND ASYMMETRY IN USE OF LIMBS IN YOUNG BASKETBALL PLAYERS**

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Introduction Cross education and functional asymmetry in limbs use are phenomena that are based on neurological responses at the CNS level affected by external stimuli. Primary aim of this study was to analyze how the unilateral training affects on trained and untrained limb and to which extent leads to a reduction of asymmetry determined in the initial testing. Methods The study included 15 male basketball players in age category U15 by FIBA regulations. Explosive strength of the arm extensors was measured by modified Throwing Gate Test using Newtest Powerlimer 300 device (Tossavainen, 2003). For vertical jump is used modified run-up vertical jump test (Young et al. 1999). Each limb was tested with three attempts in tests. It was conducted 24 training sessions in the time period of 8 weeks, with

the focus on the weaker limb in initial testing. Every workout has treated each of tested variables with one exercise for three sets and with similar movement tasks like in tests. For data analysis are used Mixed Design ANOVA, asymmetry index (AI% Chavet et al. 1997), and % differences between same limbs on initial and final testing. Results Effects of unilateral training on trained upper limb were 15.05% and for untrained 10.36%. Improvement for trained lower limb was 12.54% and 8.69% for untrained. AI in initial testing for upper limbs was 6.42%, and for lower - 10.73%, and AI in final testing for upper limbs was 2.52% and for lower - 6.69%. Discussion In accordance with the primary aim of the research it was found that unilateral training except that significantly affect on the trained limb, also significantly affects on untrained limb for arm extensors and for run-up jumping ability with positive influence on decreasing of asymmetry. The results are consistent with research in the area of cross education and asymmetry in limb use (Zhou 2003; Chavet et al. 1997), but most studies differ in methodology and test conditions, so that any comparison should be taken with a certain amount of restraint. This study offered a possible model approach in solving practical problems in practice and where competition requires more bimanual and bipedal efficiency as is the case in basketball. Existing research does not intend to deal with the physiological causes of these phenomena, but only for the purpose of practical application in specific sport training. References Chavet P, Lafortune MA, Gray JR. (1997). Asymmetry of lower extremity responses to external impact loading. *Human Movement Science, Amsterdam*, 16, 391-406. Tossavainen M. (2003). Testing Athletic Performance in Team and power Sports. *Newtest Oy*. Young W, Wilson G, Byrne C. (1999). Relationship between strength qualities and performance in standing and run-up vertical jumps. *J of Sports Med and Physical Fitness*, 39 (4), 285-293. Zhou S. (2003). Cross education and neuromuscular adaptations during early stage of strength training. *J of Exercise Sci and Fitness*, 1(1), 56-60.

### ENERGY COST AT VO<sub>2</sub>MAX SWIMMING INTENSITY: COMPARISON BETWEEN METHODS

Fernandes, R.J.1,2,3, Sousa, A.1,2, Ribeiro, J.1,2, Pelarigo, J.G.1,2, de Jesus, K.1, Vilas-Boas, J.P.1,2,3, Figueiredo, P.4

1: Faculty of Sport, University of Porto, 2: CIFI2D, 3: LABIOMEPE, 4: Higher Education Institute of Maia

Introduction Energy cost (C) has been described as a bioenergetical predictor of human locomotion (di Prampero, 1986), and considered a fundamental parameter applied to swimming training (Fernandes et al., 2006). However, C has been traditionally assessed through the oxygen consumption (VO<sub>2</sub>) (sometimes including the blood lactate concentrations - [La-] – contribution), and scarcely considering other ventilatory parameters. The purpose of this study was to compare C at maximal oxygen consumption (VO<sub>2</sub>max) swimming intensity by means of two methods. Methods Ten male senior swimmers (17.9±3.1yrs, 69.3±6.1kg and 1.8±4.8m) performed a 7x200m front crawl incremental protocol until exhaustion (cf. Fernandes et al., 2006). Capillary blood samples for [La-] analysis were collected from the ear-lobe at 3 and 5min after the last step. Gas exchange parameters were assessed breath by breath (averaged 5s) using a portable and telemetric gas analyzer (K4b2, Cosmed, Italy). C was calculated in the last step by means of two methods: (i) using the net VO<sub>2</sub> and [La-] values, by considering the ratio between energy expenditure and correspondent velocity (VLmethod); and (ii) through the calorific unit cost (CUCmethod) (Kcal.kg<sup>-1</sup>.km<sup>-1</sup>) = VO<sub>2</sub> (L.min<sup>-1</sup>) \* calorific equivalent (Kcal.L<sup>-1</sup>) \* velocity<sup>-1</sup> (m.min<sup>-1</sup>) \* body mass<sup>-1</sup> (kg) \* K<sup>-1</sup> (1000m.Km<sup>-1</sup>) (Fletcher et al., 2009). Comparison between groups was done using Paired T-Test (p≤0.05). The method agreement was assessed by the Bland-Altman plot. Results Mean (±SD) values for VLmethod and CUCmethod were significantly different: 87±0.08 and 0.94±0.10kJ/m, respectively (p<0.05). The Bland-Altman plot showed that the mean difference was close to zero (0.05), and the corresponding limits of agreement (average ± 1.96 SD) ranged between -0.05 and 0.166, indicating a small difference (in 95% of the subjects) between the two methods. Discussion The main finding of this study was that expressing C corresponding to a very high swimming intensity differs accordingly to the method used. The CUCmethod, by taking into consideration the respiratory exchange ratio, is more variable and influenced by other factors (such as pre-exercise diet, resting muscle glycogen content and muscle fibre composition, Fletcher et al., 2009). Still, the VLmethod, by reflecting only the quantity of ATP used in the exercise, already considering the error associated with [La-] analysis, seems to be less sensitive to external factors. References Fernandes R et al (2006). *J Sports Med Phys Fitness*, 46. di Prampero (1986). *Int J Sports Med*, 7. Fletcher et al (2009). *J Appl Physiol*, 107. Acknowledgements SFRH/BD/72610/2010 and PTDC/DES/101224/2008 (FCOMP-01-0124-FEDER-009577)

15:00 - 16:00

## Mini-Orals

### PP-BN01 Biomechanics [BM] 1

#### SPECIFIC MUSCLE-TENDON ARCHITECTURE IN ELITE KENYAN DISTANCE RUNNERS

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Graduate school of Sport and Exercise Sciences

Introduction The superior success of Kenyan endurance runners has stimulated large amount of interest to explore valid reasons for their performance. Reliable physiological studies conducted on the Kenyan runners have not shown any superior genetic make-up and biochemical advantages in Kenyan runners (Saltin 2003). Consequently, Saltin (2003) suggested that one of the possible reasons for their high mechanical efficiency could be the special biomechanical make-up of these runners in their structures and function of muscle-tendon complex (MTC). More concretely, the question could be asked and answered, partially at least, if elite Kenyan runners possess a particular type of MTC and especially its Achilles tendon (AT), to store and utilize elastic energy during running. Therefore, the purpose of this study was to examine the lower-leg muscle-tendon architecture in elite Kenyan distance runners. Methods 13-elite Kenyan (KENYANS) and Japanese (JAPANESE) distance runners participated in this study. The achievement rates of their personal best record to the world records were calculated (Kenyan 97.0±2.3%, Japanese 88.1±2.3%). The following parameters were measured at a standing position by ultrasonography and caliper: AT length to gastrocnemius muscles (LAT\_GAS), AT length to soleus muscles (LAT\_SOL), AT cross-sectional area (CSA), AT moment arm and the length of lateral malleolus to metatarsale fibulare for foot gear ratio. The relative LAT\_GAS and LAT\_SOL were calculated by dividing each tendon length by shank length. Results/ Discussion The absolute LAT\_GAS and LAT\_SOL were significantly greater in KENYANS than in JAPANESE but not relative values. As compared to Japanese runners, AT moment arm was greater and foot gear ratio was smaller in KENYANS significantly. These results are in disagreement with previous studies which reported that the shorter AT moment arm is, the better the running economy and greater AT stretching (Scholz et al, 2008; Raichlen et al, 2011). However, the ankle joint stiffness was greater and less AT stretching during hopping (Sano et al, 2013) and running (Sano et al, in press)

for KENYANS. Longer AT moment arm can be advantageous for the lever ratio of the force production and might be related to the energy consumption of running. References Scholz MN et al. (2008) J Exp Biol 211:3266-3271. Raichlen DA et al. (2011) J Hum Evol. 60:299-308. Sano K et al. (2013) Eur J Appl Physiol. In Press. Saltin B. (2003) New Studies in Athletics. 18:15-24.

### INFLUENCE OF GENDER ON CORE STABILITY STRATEGIES DURING LATERAL REACTIVE JUMPS

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**Introduction** Insufficient function of the core seems to occur more often in females resulting in higher injury incidences among female athletes. Additionally recent literature suggests that deficits in trunk proprioception in the frontal plane (Zazulak et al., 2007) and increased lateral trunk lean are associated with increased knee abduction loading (Jamison et al., 2012). Frontal plane biomechanics seem to be important regarding lower limb injury and a better understanding of the role of the core during lateral movements is needed. Thus the aim of the present study was to assess the differences in pelvic and trunk control between male and females in response to perturbations during lateral movements. **Methods** 3D full body kinematics were recorded (Vicon) for 12 men and 12 women performing lateral reactive jumps (LRJ) with their right leg on a motor driven plate. The lateral jump was performed under three different conditions, either without any perturbation (stable), or with a 10 cm perturbation to the right (sliding) or to the left (counteracting) at the time of landing. Trunk, hip, pelvis and knee kinematics at the time of the maximal pelvis abduction angle occurring in the first 50% of stance were compared between males and females by means of an analysis of variance with conditions treated as a repeated measure. Results Male athletes demonstrated greater pelvic tilt to the left ( $-5.9 \pm 5.0^\circ$  vs.  $-0.3 \pm 7.3^\circ$ ,  $p=0.011$ ) and hip internal rotation ( $6.3 \pm 6.2^\circ$  vs.  $-4.5 \pm 7.8^\circ$ ,  $p=0.001$ ). Females showed more trunk rotation to the left ( $-2.4 \pm 7.7^\circ$  vs.  $4.0 \pm 7.4^\circ$ ,  $p=0.039$ ) as well as greater knee abduction ( $4.7 \pm 6.5^\circ$  vs.  $-7.7 \pm 6.4^\circ$ ,  $p<0.001$ ). Additionally the comparison of the time curve of lateral trunk lean revealed that females move their trunk in the new movement direction after weight acceptance (lateral trunk lean at toe off:  $-1.7 \pm 3.4^\circ$  vs.  $1.8 \pm 3.6^\circ$ ,  $p=0.025$ ). **Discussion** Results suggested that perturbation during LRJ is compensated differently between genders. Male athletes adjust their pelvic tilt with respect to the new movement direction (Houck et al., 2006) and thus seemed to initiate push off more efficiently. The data suggests that female athletes relied on a strategy that resulted in greater trunk rotation and an active motion of the trunk in the frontal plane after weight acceptance. In addition the greater knee abduction angle displayed by the females is known as a risk factor for lower limb injuries. From a core stability perspective different control strategies are applied by males and females and with respect to lower limb injury females might be at a disadvantage. References Houck JR, Duncan A, De Haven DE (2006). Gait & Posture, 24, 314-322 Jamison ST, Pan X, Chaudhari AMW (2012). J Biomech, 45, 1881-1885 Zazulak BT, Hewett TE, Reeves PN (2007). Am J Sports Med, 35, 1123-1130

### TRANSTIBIAL AMPUTEES FAVOUR THE INTACT LIMB WHEN LANDING FROM A COUNTERMOVEMENT JUMP

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**Introduction** Transtibial amputees (TTA) are encouraged by health professionals to engage in recreational sports to gain from the health and mechanical benefits associated with exercise. However they may be prone to injury and long-term joint damage if bilateral strength differences and asymmetrical loading patterns are evident in dynamic movements. Therefore, symmetry during vertical jump landings between amputees' intact and prosthetic limbs was assessed to determine the role of each limb in controlling the downward momentum of the centre of mass. **Method** Six unilateral TTA and ten nondisabled (ND) participants completed 10 maximal vertical jumps the highest of which was analyzed. Data were collected using 2 Kistler force platforms synchronized with a 9-camera Vicon motion analysis system. Thirty four reflective markers were attached to anatomical landmarks. Joint moments and powers were calculated using standard inverse dynamics. Symmetry between the limbs was assessed through the symmetry index (SI) (Herzog et al., 1989). Results Quasi-unilateral landings onto the intact limbs were performed at touch-down. Individual asymmetries were evident in the peak vertical force magnitudes (SI=51-140%); duration from touch-down to peak vertical force (SI=52-157%); ankle joint angles at touch-down (SI=100-538%) and range of motion (SI=147-200%); knee (SI=66-179%) and hip (SI=87-132%) extensor moments and work done at the ankle (SI=155-199%) and hip (SI=83-204%). High peak vertical forces experienced by both limbs (mean  $25.25 \pm 4.89 \text{ N} \cdot \text{kg}^{-1}$  intact,  $14.61 \pm 8.28 \text{ N} \cdot \text{kg}^{-1}$  prosthetic) relative to the low landing heights compared to the ND participants indicate a potential risk of injury during landing. **Discussion** Although the exact force threshold which induces injury is unknown, the higher forces and moments experienced on the intact side indicated that jump landings may potentially lead to injury or progressive joint degeneration, especially considering that TTAs are predisposed to osteoarthritis at the intact knee and hip (Melzer et al., 2001). The peak vertical forces occurred almost simultaneously despite a delay in touch-down on the prosthetic side. From an injury perspective, the integrity of biological material is subject to both the magnitude of an external perturbation and the time over which it is applied. Therefore, the shorter durations to the peak vertical force due to limited prosthetic ankle's range of motion and absent plantarflexors may potentially increase the risk for injury and skin breakdown on the prosthetic side. References Herzog W, Nigg B, Read L, Olsson E. (1989). Med Sci Sp Exer, 21(1), 110-114. Melzer I, Yekutieli M, Sekunik S. (2001). J Rheumatol, 28, 169-172.

### CHANGES IN THE LENGTH-RATE OF FORCE DEVELOPMENT RELATIONSHIP AFTER ISOMETRIC EXERCISE AT A LONG MUSCLE LENGTH

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**Introduction** Maximal isometric exercise at a long length has been shown to cause muscle damage and a disproportionately larger drop in maximal force at short versus long muscle lengths (Philippou et al., 2003). This disproportionate loss of strength results in a shift of the length (angle)-force relationship towards longer lengths (Brockett et al., 2001). We hypothesized that this shift could have a detrimental effect on muscle's ability for maximum rate of force development (RFD) at short muscle lengths. Therefore, the aim of this study was to investigate whether there is a muscle-length dependent impairment of RFD following this type of exercise. **Methods** Seven non-weight trained male volunteers (age:  $27.0 \pm 2$  yrs, height:  $174.7 \pm 2$  cm, mass:  $74.4 \pm 4$  kg) performed 50 maximal isometric contractions of the elbow flexors at a lengthened position (i.e., with the shoulder held at  $45^\circ$  of extension from the neutral position and the elbow joint at  $40^\circ$  of flexion), on an isokinetic dynamometer. Peak isometric force (PIF) and time to peak isometric force (TPIF) of the elbow flexors were measured at five different elbow flexion angles, i.e.,  $20^\circ$ ,  $40^\circ$ ,  $90^\circ$ ,  $110^\circ$  and  $130^\circ$ , in random order, and maximum RFD was determined as the PIF/TPIF ratio. Measurements were done before and for 4 consecutive days post-exercise, and included also creatine kinase (CK)

activity, muscle soreness (DOMS) and elbow joint range of motion (ROM). Analyses of variance were used for statistics. Results Isometric exercise at a long muscle length induced significant changes in the indirect indicators of muscle damage; Serum CK activity was increased on day 1 post exercise ( $P<0.01$ ), DOMS ratings were peaked on day 2 post exercise ( $P<0.05$ ) and ROM declined and remained significantly decreased for the whole testing period ( $P<0.01$ ). Before exercise, maximum RFD was higher at the elbow angle of 40° compared with 110° and 130° ( $P<0.001$ ). During the post-exercise period, maximum RFD was significantly decreased at all the angles tested ( $P<0.05-0.001$ ). The percent changes in RFD post-exercise were also significant over time but not between angles ( $P<0.05-0.001$ ). Discussion This study demonstrated that RFD following isometric exercise-induced muscle damage was affected proportionately at the various lengths measured. This finding suggests that RFD impairment is not muscle-length dependent and that contributing factors, other than the shift of the length-force relationship (Prasartwuth et al., 2006), may play a major role for the impairment of length-RFD relationship after muscle damaging isometric exercise. References Brockett CL, Morgan DL, Proske U. (2001). *Med Sci Sports Exerc* 33:783–790. Philippou A, Maridakis M, Bogdanis GC. (2003). *J Sports Sci*, 21, 859–865. Prasartwuth O, Allen TJ, Butler JE, Gandevia SC, Taylor JL. (2006). *J Physiol*, 571, 243–252.

## EVALUATION OF ACL INJURY RISK FACTORS IN YOUNG FEMALE HANDBALL PLAYERS

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Introduction The anterior cruciate ligament (ACL) injury is one of the most severe and costly. Women athletes have a higher propensity to ACL injury. The goal of this pilot study was to detect the risk of injury in a youth female handball players using kinetic and kinematical parameters. Methods 14 players of the youth regional level draft participated in the study. Landing was monitored in two Drop Jump from a height of 40 cm. The system used for this purpose combined a 4-camera ViconMotus 9.1 equipment and two Kistler force platforms. Collected data included tibia length, knee medial-lateral displacement, knee flexion ROM and asymmetry of vertical impulse between both lower limb. The QuadHam ratio was obtained in isokinetic knee extension/flexion movements at 240°/s. The algorithm proposed by Myer et al. in 2010 was used for the prediction of probability of dynamic knee valgus during landing. Results Shapiro-Wilk test ( $p>0.05$ ) showed a normal distribution of kinetic and kinematical variables. Players presented higher impulse forces of dominant leg compared to non-dominant during eccentric phase of jump ( $p<0.05$ ). In 57% of the cases differences were higher than 15%. 71% of the girls presented a probability to valgus moment during landing higher than 85%. Discussion The main finding of this study was that more than 70% of subjects showed a probability above 85% to risky knee valgus moment during landing, highly related to prediction of ACL non-contact injuries (Hewett, 2005). Additionally bibliography defines strength deficit between limbs as a risk factor to future ACL injury (Hewett, 2005). In this pilot study more than 50% of the players had an impulse deficit above 15%. This results agreed with others studies where the lack of neuromuscular control in similar aged female was demonstrated (Zazulak, 2007). We would recommend to apply this test to other groups for an early prediction of possible ACL knee injuries because of the extremely high risk injury factor found in our sample. In the same direction, prevention protocols for the improvement of neuromuscular control should be included in training plans to reduce the probability of ACL injury (Myklebust, 2007). References Hewett TE, Myer GD, Ford KR, Heidt RS Jr, Colosimo AJ, SG McLean SG, van den Bogert AJ, Paterno MV, Succop P. (2005). *Am J Sports Med*. 33(4), 492–501. Myer GD, Ford KR, Brent JL, Hewett TE. (2012). *J Strength Cond Res*. 26(8), 2265–2271. Myklebust G, L Engebretsen, IH Braekken, A Skjøelberg, OE Olsen, Bahr R. (2007). *Instr Course Lect*. 56, 407–18. Zazulak BT, Hewett TE, Reeves NP, Goldverg B, Cholewicki J. (2007). *Am J Sports Med*. 35(7), 1123–1130.

## INDIVIDUALLY SHAPED FORCE-VELOCITY RELATIONS EFFECT MUSCLE STRESS DURING ISOKINETIC LEG PRESS MOVEMENTS WITH MVC

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Introduction Various studies use isokinetic movements to evoke fatigue (e.g. Babault et al., 2006; De Ruyter et al., 1999; James et al., 1995). Based on simulated maximal concentric isokinetic leg press movements we demonstrate how individual differences in the force-velocity relation of muscles affect the amount of stress the muscle is exposed to. Methods According to Siebert et al. (2007) we determined individual neuromuscular properties (INP) for the knee extensors of nine healthy male subjects ( $m = 79.1 \pm 6.9$  kg,  $age = 23.0 \pm 1.86$  yrs,  $h = 1.83 \pm 0.09$  m). For simulations two datasets (subject A and B) with equal maximal isometric muscle force  $f_{iso}$  ( $\pm 2.3\%$ ) but different curvature  $a/f_{iso}$  ( $\pm 67.0\%$ ) of the force-velocity relation were selected. The model was parameterized with INP as well as with individual or equal anthropometric lengths. After vertically accelerating a point-like 15 kg mass, a maximal isokinetic leg press movement at 0.4 m/s constant external velocity (EV) was simulated. The motion lasted 0.8 s and ranged from 70 to  $126 \pm 1$  deg. The calculated force-, velocity- and power-time relations of the model muscles were compared inbetween the two subjects. Results The nine subjects' mean values were  $f_{iso} = 21190 \pm 5264$  N,  $a/f_{iso} = 0.3 \pm 0.14$ , and optimal contraction velocity  $v_{opt} = 0.4 \pm 0.1$  m/s. During constant EV the contraction velocity (CV) varied by  $32.8 \pm 1.0\%$ , the muscle force in subject A varied from 118.7 to 258.6% of  $f_{opt}$  and in B from 91.1 to 218.6%. The integrated power- and force-time relations showed a 9.4% greater value for force and a 16.7% greater value for power in B. The effects of individual anthropometry were  $<1.0\%$  in force and  $<5.5\%$  in power, those of acceleration period and muscle activation were overall  $<1.7\%$ , and  $<0.14\%$ , resp., and thereby play a minor role. Discussion We show that during a constant EV the CV changes and that the muscles power- and force-output is influenced by the individual shape of the force-velocity relation. Related to their individual optimal values, muscles operate in different sections of the force-velocity relation and thus are differently stressed. Throughout the movement the muscle B produces more force and power than A. We demonstrate that for submaximal dynamic tasks (cf. training loads) a normalization condition given in %  $f_{iso}$  is not sufficient if equal muscle stress is intended. References Babault N, Desbrosses K, Fabre M, Michaut A, Pousson M. (2006). *J Appl Physiol.*, 100(3), 780–785. De Ruyter CJ, Jones DA, Sargeant AJ, De Haan A. (1999). *Europ J Appl Physiol Occup Physiol.*, 80(4), 386–393. James C, Sacco P, Jones DA. (1995). *J Physiol.*, 484(1), 237–246. Siebert T, Sust M, Thaller S, Tilp M, Wagner H. (2007). *Hum Mov Sci.*, 26, 320–341.

## BIOMECHANICS OF RUGBY SCRUMMAGING: KINEMATIC AND KINETIC ANALYSIS ACROSS ENGAGEMENT CONDITIONS

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**Introduction** Biomechanical studies of the rugby union scrum have typically been conducted using scrum machines (Milburn, 1990; Preatoni et al., 2013), but a biomechanical analysis of rugby union scrummaging (team A against team B) is still lacking. The aim of this study was to analyse kinematic and kinetic variables during contested scrummaging in three different engagement conditions designed in part to modify the loading conditions on players: Crouch-Touch-Pause-Engage (CTPE, in use prior to 2012/13 season), Crouch-Touch-Set (CTS, current) and Touch-Held (TH, test). **Methods** Sixteen forward packs (n=128 players) from two playing categories (International and Professional Club) performed repeated scrum trials, outdoors on natural turf, following instruction in each of the experimental conditions. Two scrums per condition per team (8 teams, 48 scrums in total) were analysed. Exerted forces between teams' front rows were estimated by using pre-calibrated pressure sensors positioned on the right and left shoulders of front row players in team A. Inertial Measurement Units (IMU) were placed on the forehead and C7 of each team's front row players, and both the overall and single axes accelerations were computed. Multiple camera views allowed the recording and subsequent analysis of player movements, in the primary transverse and sagittal planes of motion. A control system (Preatoni et al., 2012) executed pre-recorded audio commands to players with consistent timings and synchronised data streams. **Results** Biomechanical variables across the conditions were divided by scrum phases. In general the TH technique reduced the biomechanical loading on players, while there was no difference between conditions in terms of body motions relating to stability. Prior to engagement the TH condition showed a lower set-up distance between front rows versus both CTPE (29%) and CTS (30%). During Engagement, closing speed was reduced in TH compared with CTPE (22%) and CTS (19%). During Initial-Engagement, peak force was lower in TH as opposed to CTPE (24%) and CTS (24%) and overall acceleration peak on C7 was lower ( $p<0.05$ ) in TH compared with CTPE (20%) and CTS (16%). The average force did not differ between conditions during the Sustained scrummaging phase. **Discussion** In this study the biomechanical demands of contested rugby scrummaging were measured for the first time. The findings are stimulating in terms of injury prevention and performance analysis, proposing biomechanical solutions to minimise potential injury risk and a novel method to evaluate different scrum techniques. **References** Milburn PD. (1990). *J Sports Sci*, 8, 47-60. Preatoni E et al. (2012). *P I Mech Eng P - J Sports Eng Tech*, 226(3/4), 266-273. Preatoni E et al. (2013). *Scand J Med Sci Spor*, doi: 10.1111/sms.12048.

## VALIDITY OF A TWO-DIMENSIONAL MOTION ANALYSIS TECHNIQUE FOR QUANTIFYING DYNAMIC KNEE VALGUS DURING SINGLE LEG DROP LANDING

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**Introduction** Landing with dynamic knee valgus is considered a risk factor of non-contact anterior cruciate ligament (ACL) injury. To identify athletes at a higher risk, we developed a two-dimensional (2D) video-based screening test to determine hip abductor function as well as dynamic rearfoot and knee valgus (Kagaya et al. 2009). However, validity of our analysis technique for quantifying dynamic knee valgus remains unclear. The purpose of this study was to validate the accuracy of the indices for dynamic knee valgus derived from knee-in distance (KID) and hip-out distance (HOD) using the 2D-video images. **Methods** Twenty healthy university students (10 female, 10 male) agreed to participate in this study. Their mean age was  $21.1\pm 1.7$  years, height and weight were  $166.8\pm 10.2$  cm and  $58.7\pm 9.0$  kg, respectively. Subjects were asked to step off a 30-cm box and land on one leg. This procedure was recorded simultaneously using a 2D video camera in the frontal plane and the Vicon motion capture system. KID was measured as the distance from hallux to the point where the line connecting the center of the patella and the anterior superior iliac spine (ASIS) intersects the floor. HOD measured as the distance from hallux to the projection of ASIS on the floor. Pearson's correlations examined associations between KID normalized by height (KID/H) as well as HOD normalized by height (HOD/H) and three-dimensional knee valgus (3D-valgus) or 3D tibial internal rotation (3D-IR). Statistical significance was established at a level of  $p<0.05$ . Informed written consent was obtained from all subjects and approved by the Research Ethics Committee of School of Nursing and Rehabilitation Sciences at Showa University. **Results** Significant correlation was found between the KID/H and 3D-valgus ( $r=0.73$ ,  $p<0.01$ ). However, association was not significant between KID/H and 3D-IR ( $r=0.03$ ). A positive moderate correlation between HOD/H and 3D-valgus ( $r=0.50$ ,  $p<0.05$ ), as well as a negative moderate correlation between HOD/H and 3D-IR ( $r=-0.51$ ,  $P<0.05$ ) was also observed. **Discussion** McLean et al.(2005) reported that an excellent regression relationship was obtained to make a comparison between 2D analysis and 3D analysis of the knee valgus during side jump. Nagano et al.(2008) also reported that there was a significant regression relationship between 2D analysis and 3D analysis among the knee valgus in continuous jump landing task. They measured the knee valgus by the angle on the frontal plane. However, we analyzed it by the distance of KID and HOD. As a result, KID was a reliable alternative for the 3D-valgus and the HOD was for the 3D-valgus and tibial external rotation. The 2D video-based screening test is expected to have practical application in the field of sports. **References** Kagaya, Y., et al. (2009). *Jpn J Phys Fitness Med*, 58, 55-62(In Japanese). McLean, S.G., et al. (2005). *British J Sports Med*, 39, 355-362. Nagano, Y., et al. (2008). *Sports Biomech*, 7, 342-350.

## THE NUMERICAL ANALYSIS OF NASAL PROTECTOR FOR SPORTS ACTIVITIES

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**Introduction** In recent years a significant increase in the number of facial fractures in sports activities is noticed, being the nasal bone one of the most affected (Antoun, 2008). The use of nasal protector is recommended by researchers; however, there is no standardization about its material or geometry. Particularly about the material, clinical experience has shown that the combination of both flexible and rigid blades of copolymer of ethylene and vinyl acetate (EVA) offers comfort and safety for the athlete. **Methods** The numerical study of generated by the impact of a ball on the nasal bone in models with and without EVA protector. A cranial facial model was built with images obtained from computerized tomography (Deuffhard, 2006). The nose protection was modelled with two layers of EVA with a total thickness of 3 mm, following the soft tissue geometry. For the inner layer, 2 mm of flexible EVA was assigned; while the outside layer was made with 1 mm of rigid EVA. The finite element analysis was performed using the commercial software LS Dyna (Coto et al, 2012). The bone and rigid EVA were represented as linear elastic materials, the soft tissue and flexible EVA as hyperelastic materials. The impact of

a rigid sphere on the frontal region was simulated, with constant speed of 20 m/s. The impact event was analysed within the time interval of 9.1 ms. The model with no protector was used as control. The distributions of maximum principal stresses in the face bones were analysed. Discussion In the model without the protector the maximum principal stress in the nasal bone has exceeded its limit of rupture of 0.13 MPa (Hodgson,1967). In the model with the protector, stresses remained below this critical value. Based in these numerical results, the nasal protector made of a combination of flexible and rigid EVA proved to be effective in the face protection. References Antoun JS, Lee KH.(2008) *J Oral Maxillofac Surg*;66(3):504-8. Deuffhard P. (2006)*Notices of the AMS*, 53(9):1012-1016. Coto NP, Dias RB, Driemeier L, Meira JB,Noritomi PY, Oliveira GR.(2012) *Dent Traumatol*,28(2):108-113. Hodgson VR.(1967). *Am J Anat*;120:113-22

### **ANALYSIS OF SPINE MOVEMENT IN TRIATHLON WITH RESPECT TO BACK PAIN**

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**Introduction** Back pain is reported by approximately 30% of athletes. The lifetime incidence of low-back pain in triathlon has been reported to be 68%. The two main mechanisms of long-term pain include sports-related injuries and overuse. In order to better understand underlying mechanism the purpose of the present investigation was to evaluate triathlon specific motion patterns regarding the range of motion of different parts of the spine and to quantify the occurrence and the duration of exposure during training and competition. **Methods** We analyzed range of motion of different parts of the spine during the sub-disciplines cycling and running in 4 competitive triathletes (n=2 male, n=2 female), and during swimming in 1 athlete. 8 high-frequency cameras captured the trajectories of 18 light reflecting markers which had been fixed on the skin at different points on the subject's spine and front side. Using the software Simi Motion 13 angles were used to describe the ranges of motion of the cervical, thoracic and lumbar spine with respect to flexion, extension, and lateral flexion. The data was evaluated by assorting certain angles of risk according to the classification of DIN EN 1005-4. **Results** The most important findings include the following: nearly during the whole time of cycling, extension of the cervical spine statically remained in the red range (< 0°, range: -21° - -28°). Furthermore, flexion of the total spine was in the yellow range (20° - 60°) in 3 subjects during the whole time of cycling, while lateral flexion of all parts of the spine remained in the green range. During nearly all runs, flexion of total spine was in the red range (< 0°). Flexion of the cervical spine inter-individually varied broadly, while lateral flexion of all parts of the spine remained in the green range. During the whole time of swimming the crawl, cervical flexion was in the red range (< 0°), and during 50% of the time, cervical lateral flexion also was in the red range (> 10° or < -10°). **Discussion** The analysis of spine movements indicate, that triathlon specific body positions during training and competition imply an increased risk for back pain mainly in the area of the cervical spine. This is in line with clinical findings of a nearly 50% lifetime incidence of neck pain in triathletes. The total stress of the spine is composed of the type of discipline, duration, intensity, and individual style of all training units and competition. Further factors, like vibration forces while cycling and the impact while running are of importance as well and should be considered in further research to evaluate back-specific risk areas in triathlon. The results of this investigation underline the necessity of specific spine stabilizing training programs in addition to the discipline specific training units. **Acknowledgement** The study was supported by the Federal Institute for Sport Science, Germany (IIA1-080102B/11-14).

### **INVESTIGATE THE ELBOW JOINT LOADING DURING WII BOXING SPORTS GAME**

Hung, S.P., Tsai, Y.P., Hsu, H.M., Kuo, L.C., Lin, H.T.

*Kaohsiung Medical University*

**Introduction** The Wii sports• has becoming popular in the world. Not only it is fascinated by adolescents but people of all ages. However, few previous studies were discussed the possible side-effect of this exercise. From the previous reports, there were some symptoms, such as delayed onset muscle soreness and acute muscle and tendon injury, coming out after playing Wii games. The purpose of this study is to investigate the elbow joint loading during playing Wii boxing game in the practice and game modes. **Methods** Five subjects aged from 18 to 25 yrs without any upper extremity injuries or diseases in the last six months were recruited in this study. The subjects played the WiiTM boxing game in both practice and game modes. Fourteen reflective markers were attached on the subject's anatomical positions and using Qualisys• motion capture system to record the boxing motion. The Euler parameter and inverse dynamic analysis were applied for calculating angular velocity, joint reaction force and moment, and joint power. **Results** From the analysis results, the joint force in elbow is about 60-80 N, the maximum loading is along the longitudinal axis. The joint torque is about 15-20 N-m, the peak value is occurred in longitudinal axial rotation. The joint torque, joint acceleration and joint power of the elbow in game mode were higher than in practice mode. Especially the joint power of elbow in the game mode is almost two times higher than in the practice mode. **Discussion** Due to the keen competition in the game mode, the subjects punched more quickly and powerfully. From the previous study, the punch force and the joint acceleration are positive correlation (Wu, 2008). Therefore, in order to have better boxing performance, the subject shoulder accelerate the joints as fast as possible in upper extremity, that results higher joint loading both in shoulder and elbow. In this study, we also found that the subject afforded higher elbow joint loading during playing Wii Box in the game mode than in the practice mode. This study also found that the peak loading of the elbow joint was not very high. However, the repetitions and action frequency during the game were much higher than normal exercises. Subjects do the intensive activities, and it may cause higher risk of damage (Sparks D et al., 2009). The improper use of force and suddenly changed motion (joint acceleration) might cause the injury in the musculoskeletal system easily. Therefore, before playing Wii game especially like Boxing, the player need warm-up, and doing the stretch after the game. Moreover, know the biomechanical loading could help us to prevent injury during playing Wii game. **References** Nett MP, Collins MS, Sperling JW. (2008). *Skeletal Radiol*, 37, 481-483. Lin HT, Nakamura Y, Su FC, Hashimoto J, Nobuhara K, Chao EYS. (2005). *Biome Eng*, 127, 525-530. Wu GG. (2008). Master thesis, NCKU. Sparks D, Chase D, Coughlin L. (2009) *Informatics in Primary Care*, 17, 55-57.

### **RISK FACTORS OF KNEE INJURY DURING CROSSOVER AND CUTTING MANEUVER IN FEMALE BASKETBALL ATHLETES**

Lee, H., Tseng, T., Lee, Y.

*National Taiwan Normal University*

**Introduction** Female basketball players suffer ACL injuries at a 4 to 6 fold greater rate than male players. Most ACL injuries in female athletes were noncontact injuries, typically during deceleration, lateral pivoting, or landing tasks that are often associated with high external knee joint loads and high anterior knee shear forces. The purpose of this study was to determine ACL injury risk factors between cutting and cross over step maneuvers in female basketball athletes. **Methods** 12 healthy female basketball players participated in this

study (age: 20.3yrs). Subjects were instructed to land with both feet on separated force plates, then immediately performed cutting or cross over step to the dominant side and kept running for 3 meters. Subjects performed 5 successful trials in each step maneuver with 30 s of rest between trials to minimize the potential effects of fatigue. The motion capture system consisted of 10 digital cameras (200Hz) were used to collect 3D trajectories from 28 reflective markers. The 2 force platforms collected GRF data at 1000 Hz and were time synchronized with the motion capture data. One-way ANOVA with significance level of 0.05 was used to compare biomechanical measures of the supporting leg between two different step maneuvers. Results The peak anterior tibial shear force of the cutting step supporting leg was significantly greater ( $p=.006$ ) than the cross over step supporting leg. The peak knee valgus moment of cutting step supporting leg was significantly greater ( $p=.003$ ) than cutting step stepping leg. Discussion Knee anterior tibial shear forces and valgus moments are the primary predictors of ACL injury risk. Physiologic valgus moments on the knee can increase anterior tibial translation and loads on the ACL by several-fold (Pollard et al., 2010). Quadriceps force could generate anterior tibial shear force and apply stress and strain to the ACL when the knee is near fully extension (Li et al., 1999). If anterior tibial shear force generated by the eccentric quadriceps contraction was excessive, the hamstring may not provide adequate force to counter anterior tibial shear force. The risk of ACL injury will be high at this moment (Brazen et al., 2010). The current findings indicate that female basketball players might have higher risk of knee injury during cutting step than cross over step maneuver. Future studies should focus on investigating the best jump landing and stepping strategy, and on analyzing better ways to coordinate lower extremity joints to reduce non-contact ACL injury risks. This work is particularly supported by NSC (100-2628-H-003-013-MY2) and 'Aim for the Top University Plan' of the National Taiwan Normal University and the Ministry of Education, Taiwan, R.O.C References Li G, Rudy T, Sakane M, Kanamori A, Ma C & Woo S. (1999). Journal of biomechanics, 32(4), 395-400. Brazen D, Todd M, Ambegaonkar J, Wunderlich R & Peterson C. (2010). Clinical Journal of Sport Medicine, 20(4),286-292. Pollard C, Sigward S, & Powers C. (2010). Clinical Biomechanics, 25(2), 142-146.

### IMITATION IN ADULTS WITH AUTISM SPECTRUM CONDITIONS: THE EFFECTS OF SOCIAL MODULATION AND MOTOR ABILITY

Andrew, M., Bennett, S.J., Elliott, D., Gowen, E., Hayes, S.J.

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Introduction Individuals with autism spectrum conditions (ASC) struggle to engage in social interactions. One difficulty is voluntary imitation, which affects learning new motor behaviours and is related to copying how (kinematics) a movement is performed. This difficulty is hypothesised to be based on brain structures associated with social modulation and/or motor ability (Hamilton, 2013). To this end, in Experiment 1 we investigated the social modulation hypothesis by examining imitation of unnatural and natural movement kinematics by using a non-human agent that removes social context. In Experiment 2, we investigated the motor ability hypothesis by examining the acquisition of a related, but novel spatial-temporal movement sequence through motor training. Methods Nine adults with ASC and nine age and IQ matched typical adults volunteered for the study. All provided informed consent which was approved by host University ethics committee. In Experiment 1, all volunteers imitated a non-human agent (white dot) where the movement trajectory was manipulated to display novel kinematic profiles (unnatural; natural; constant velocity). Imitation accuracy was examined using separate ANOVAs. In Experiment 2, all volunteers practised a novel spatial-temporal sequence through motor training. Following practice all participants performed a retention test. Motor performance accuracy and variability were examined using separate repeated measures ANOVAs. Results The performance data in Experiment 1 indicated the ASC group were 262 ms more accurate ( $F(1, 16) = 4.387, P = 0.05$ ) at imitating the model's movement time than the typical control group. The kinematic data indicated that both groups ( $F(2, 32) = 22.929, P < 0.01$ ) imitated the natural and unnatural movement kinematic profiles. In Experiment 2 the performance data showed both groups became more accurate ( $F(6, 96) = 21.342, P < 0.01$ ) and less variable ( $F(6, 96) = 22.322, P < 0.01$ ) at executing the novel spatial-temporal sequence task across practice and retention. Discussion Individuals with ASC imitated unnatural movement kinematics to the same extent as a typical group, yet were more accurate at imitating movement time. Therefore, they showed adaptive and functional motor behaviour. These data suggest a previously well established broken mirror neuron hypothesis cannot account for imitation deficits observed in ASC. Having controlled for motor ability and modulating social contiguity with a non-human agent, the findings support suggestions that a deficit in imitation in those with ASC is associated with top-down control (Hamilton, 2013). References Hamilton, A. F. d. C. (2013). Dev. Cog. Neuro. 3(0), 91-105.

15:00 - 16:00

### Mini-Orals

#### PP-SH22 Sport Statistics and Analyses [SA] 1

##### ANALYSIS ON THE MATCH PHYSICAL DEMAND CHARACTERISTICS OF CHINESE ELITE MALE FIELD HOCKEY PLAYERS

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Introduction The motional patterns of field hockey matches are complicated, the intensity and property of players' physical load keep varying at different match time. Carrying experimental equipments by the players is forbidden by the rules, so it is impossible to track players' physiological indices during matches. What is more, various aerobic and anaerobic loads coming out at different intensities and time, accompanying with irregular body contacts and intermissions, make it much more difficult to assess the players' match physical load. In purpose to evaluate players' physical demand statistically; this paper analyzed the players' running distance, technique using, and intermissions in matches. Methods All matches played in the 11th Chinese National Games which was held in Shandong 2009 were filmed. The software of SIMI Scout was undertaken to analyze the recorded match films to draw out related statistics. Running distance, technique using and match intermissions of 38 players from different positions (defender, midfield and forward) were analyzed. ANOVA analysis was undertaken to compare the positional differences. Results (1) During the matches of the 11th Chinese National Games, the players' average running distance is  $7334 \pm 877$  (mean  $\pm$  s) meters,  $3693 \pm 441$  meters in the first half and  $3640 \pm 437$  meters in the second, both the total distance covered and running distance at various speed differ from players of distinct positions ( $P < 0.05$ ); (2) The undertaken techniques of ball passing and touching, marking and defense-assistance also differ from the players of different positions ( $P < 0.05$ ); (3)

The average intermittent time per match is  $1838.1 \pm 247.8$  seconds, the average number of intermissions is  $155.6 \pm 13.5$  times, the average intermittent time is  $11.8 \pm 7.4$  seconds. Discussion It has been verified that "performance in (field) games can be analyzed by notating players' actions" (Thomas Reilly, 2001) and it is "a consensus in sport science that the most effective training for preparing athletes for competition is that which most closely replicates competitive performance conditions" (V. Di Salvo et al., 2007). This study verified the differences of performance and demands of Chinese male field hockey players in different individual positions during match play; therefore it could provide some guidance on evaluating players and formulating training prescriptions. References Thomas Reilly (2001): Assessment of sports performance with particular reference to field games, *European Journal of Sport Science*, 1:3, 1-12 V. Di Salvo, R. Baron, H. Tschan, F. J. Calderon Montero, N. Bachl, F. Pigozzi (2007): Performance Characteristics According to Playing Position in Elite Soccer, *International Journal of Sports Medicine*, 28: 222-227

### EFFECTS OF LOW-VOLUME HIGH-INTENSITY INTERVAL TRAINING ON CARDIORESPIRATORY FITNESS IN ADULTS: A META-ANALYSIS OF CONTROLLED AND NON-CONTROLLED TRIALS.

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**Background** Low cardiorespiratory fitness is a risk factor for cardiovascular and total mortality. Improving fitness in the general population with efficient training programmes is therefore worthwhile. Here we present the first meta-analytical review of the effects of low-volume high-intensity interval training on fitness represented by peak oxygen uptake ( $VO_{2peak}$ ). **Methods** A search of five literature databases yielded 24 interval-training studies meeting the following eligibility criteria: adult subjects;  $VO_{2peak}$  assessed pre and post training; training period of at least 2 weeks; repetition duration 30-60 s; work/rest ratio <1; and exercise intensity maximal or near maximal. The total of 44 mean effects on  $VO_{2peak}$  in training and control groups were converted to percent changes for a novel mixed-model meta-analysis that included the usual between-study random effect and a within-study random effect to account for studies with control groups. The fixed effects in the model included type of study (controlled, uncontrolled), subject characteristics (sex, training status, pre  $VO_{2peak}$ ) and training parameters (number of training sessions, work/rest ratio). Effects were weighted using percent standard errors from exact p-values or from estimated errors of measurement. Probabilistic inferences were based on standardized thresholds for small, moderate and large changes (3.2, 9.6 and 19% for sedentary subjects; 1.2, 3.6, and 7.2% for active non-athletes) derived from between-subject SDs for pre  $VO_{2peak}$ . **Results** The meta-analysed effect on  $VO_{2peak}$  of an average interval-training protocol (13 sessions, 0.14 work/rest ratio) in a controlled study was a possibly large increase of 6.4% (90% confidence limits  $\pm 3.8\%$ ) in male non-athletes with a pre  $VO_{2peak}$  of 45 ml/min/kg and a possibly moderate increase of 11.5% ( $\pm 6.6\%$ ) in sedentary males with a pre  $VO_{2peak}$  of 30 ml/min/kg. Study and subject characteristics had the following modifying effects, ranging from moderate to trivial and unclear: -3.9% ( $\pm 3.5\%$ ) for subjects with  $VO_{2peak}$  higher by 10 ml/min/kg; 3.0% ( $\pm 3.1\%$ ) for each 3-fold increase in number of sessions; -1.5% ( $\pm 3.1\%$ ) for each 3-fold increase in work:rest ratio; and -1.7% ( $\pm 6.3\%$ ) for females. Unexplained variation in effects between research settings was typically  $\pm 3.0\%$ . **Discussion** Low-volume high-intensity interval training produces clear substantial improvements in cardiorespiratory fitness of sedentary and active males, with greater benefit for the less fit. More studies are needed to confirm the benefit of such time-efficient training in females.

### QUALITATIVE ANALYSIS ON FOOTBALLERS' BEHAVIOURS LEADING TO AN HANDLING THE BALL INFRINGEMENT

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**Introduction** Referees and assistant referees still have difficulties analysing and applying the rules when it comes to call an handling the ball foul because of the subjective feature called "deliberate act" (in Law XII, FIFA booklet Laws of the Game). The aim of this study is to identify the player's behaviours that lead to an infringement and to find performance indicators that help to produce new training programmes to a better refereeing. **Methods** Data was crossed through out: experts' opinions (to identify and classify the most problematic situations); motor behaviours' structure and functional analysis (to acquit infringements' indicators); bibliographic support of reference studies. Experts were experienced Portuguese top-standard referees (n=22, 1st and 2nd inquiry) and assistant referees (n=34, 1st inquiry; n=46, 2nd inquiry). Referees (n=7, 1st inquiry; n=10, 2nd inquiry) and assistant referees (n=6, 1st and 2nd inquiry) were on the FIFA list. Through percentages, a descriptive data analysis was done. Structural analysis was based on the Law 12 "Handling the ball". The distance between the opponent and the ball was calculated using the SIMI Motion Twin software. Both last analyses were videos analysis from Portuguese professional leagues. **Results** Experts mention that the difficulty to identify the infringement is related with lack of visibility (22%), deliberate act (21%) and the distance between the opponent and the ball (18%). 62.5% mentioned the crossover as one of the most difficult actions to identify and other 20% identified the rebound. 28.6% were when the distance between the opponent and the ball was 1- 2m and 21.4% when it was 2- 3m; these were identified when the action was done in the penalty area (28,6%) or near the touch line (19%). Due to shoulder structure (humerus, clavicle and scapula) and the ball size, when the arm is raised and there is a ball contact with the shoulder, there is always a contact with the arm and therefore it is an infringement. Having as a reference the running, the vertical jump and the arm rise to reach a ball motor patterns, present in other sports, we perceive that in football the over head action has the aim of reaching for the ball. Considering a 200ms visuo-motor delay, a 25m/s ball speed, after the kick, and a 100ms between the toe-off and the ball-contact, at least 2.5m of distance is necessary for the opponent to achieve movement reprogramming and intercept the ball deliberately. **Discussion** In order to improve refereeing it is important to know how to read body movements in the usual circumstances where handling the ball occurs. Training programs should provide drills to improve visibility and decision-making experiences required on apply the handling the ball law.

### LESSONS FROM THE LONDON OLYMPICS: ATHLETICS, SWIMMING AND HOME NATION MEDAL ADVANTAGE

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**Introduction** A mention of London 2012 brings to mind images of the charismatic Usain Bolt in athletics, Michael Phelps with his record haul of swimming medals and Jessica Ennis striking gold in the women's heptathlon, with all of Great Britain's weight on her shoulders. There is much more to learn about athletics, swimming and home nation medal advantage. **Athletics** The fraction of 1988 winners who would still win dropped from 68% in 2000 to 50% in 2008 only to rise to 57% in 2012. Athletics winners at London were worse than those in 1988, after which a crackdown began on performance enhancing drugs. By 2008, Olympic champions had caught up with their coun-

terparts from 1988, only to lose ground in 2012, coincident with post 2008 proactive anti-doping surveillance such as introduction of the chemical passport by WADA. Swim Suits Following the 2008 Olympics, when men's swimming times improved 1.69% over one Olympiad, FINA concluded that high tech suits were contributing to that improvement (even though times had improved 1.63% per Olympiad from 1956-1988). Effective January 1, 2010, lower tech suits had to be used. If FINA was correct, times should have especially deteriorated for men. That did not happen. There had been a 0.82% average four-year improvement for the last World Short Course, World Long Course and Olympic competition using the high tech suits. In fact, there was a higher average four-year improvement of 0.99% for those same three competitions when the lower tech suits were first worn. Home Nation Medal Advantage Over the last 13 fully attended Games, the home nation won an average of 13 more medals at home than it had won four years before and the home nation then won an average of seven fewer medals, four years after being host. For London, Great Britain was projected to win 47+13=60 medals (65 were won). China was projected to win 100-7=93 medals (88 were won). The average prediction error was zero. For Rio in 2016, Brazil is projected to win 17+13=30 medals while Great Britain should win 65-7=58 medals.

## ANALYSIS OF SET FOR UNDER-19, UNDER-21 AND ELITE MALE BEACH VOLLEYBALL ACCORDING TO PLAYER ROLE

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**Introduction** In beach volleyball, the set is the action that has the purpose to provide the best conditions for the attacker to finalize the rally [1]. In indoor volleyball, the set is executed primarily using the overhand. However in beach volleyball the rules only allow clean overhand pass. Therefore, players use the overhand pass and forearm pass to perform the set. In beach volleyball, there are two player role, according to their action in defense, defender and blocker, what affect their physical characteristics [2]. It has not found information in the literature review related to the way of execution the set in relation to role player and age group. Therefore, the purpose of this study was to determine the types of settings used in a game in the categories under-19, under-21 and elite, according to player role (blocker and defender). **Methods** A total of 810 side out setting's (30 sets) from Under-19, 713 side out setting's (24 sets) from Under-21, and 1271 side out setting's (42 sets) from Elite. Actions were collected from their respective World Championships (season 2010 and 2011). Sets analyzed were selected randomly according their level of the teams and their confrontation. Only two-set matches were observed. The variables studied were: overhand pass (OP), forearm pass (FP), player role (defenders = DF, & blockers = BO), and age groups (U-19, U-21 and Elite). Chi-square test was used to test differences between analyzed variables. Statistic significance was set at  $p < 0.05$ . **Results** Results show that in the U-19 category, there are no differences between the types of setting ( $p = 0.940$ ) according to player role, i.e. OP (DF = 20.5% vs. BO = 20.2%) and FP (DF = 79.5% vs. BO = 79.8%). Therefore, results showed that there are significant differences between the types of setting in the category U-21 ( $p = 0.001$ ) according to player role, i.e. OP (DF = 44.5% vs. BO = 24.5%) and FP (DF = 55.5% vs. BO = 75.5%) and elite ( $p = 0.001$ ) according to player role, i.e. OP (DF = 41.8% vs. BO = 32.5%) and FP (DF = 58.2% vs. BO = 67.5%). **Conclusions** The present study showed the forearm pass was the most type of set more used by blockers and defenders in the different age groups studied. In U-21 and elite, defenders used with more frequency the overhand pass that blockers. **Acknowledgments** This research was supported by grants from Capes Foundation, Brazilian Ministry of Education (068812-6/2012). **References** [1] Homberg, S., & Papageorgiou, A. (1995). Handbook for beach volleyball: Meyer & Meyer Verlag. [2] Palao, J. M., Gutiérrez, D., & Frideres, J. E. (2008). Height, weight, body mass index, and age in beach volleyball players in relation to level and position. *Journal of Sports Medicine & Physical Fitness*, 117, 1- 5.

## RELIABILITY AND VALIDITY OF JUDGING ARTISTRY ON BALANCE BEAM AT WORLD CHAMPIONSHIP IN TOKIO 2011

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**INTRODUCTION** The judging in artistic gymnastics crucially determines outcome. Currently, final score is a sum of difficulty score and execution (E) score by the panel of 6 judges. E score is calculated by subtracting deductions for various mistakes from 10 points, including the deductions for flaws in artistry. Evaluation of artistry could be associated with serious insufficiencies of reliability and validity. We have analyzed the reliability and validity of deductions in artistry at one of the top gymnastics competitions. **METHODS** The evaluated categories of artistry are: inappropriate gesture or mimic, insufficient variation in rhythm, sureness of performance and lack of creative choreography. We have used the data from judge evaluation sheets to examine the deductions for artistry for each individual contestant. We have calculated the correlation coefficients (Kendall's tau-b) for association between the total artistry deduction and final E score. Same method was used to calculate the correlations in separate categories of artistry between all possible judge-pairs. Finally, the special aspect of judging validity was examined by calculating the Kendall's W statistic - this method gives high and statistically significant values of W, when individual judges systematically give relatively high or low deductions (systematic bias). **RESULTS** The number of contestants penalized for other components of artistry was highly variable between the judges: no deduction for insufficient variation in rhythm was given to either 10 contestants (judge 5), 46-88 contestants (judges 1,3 and 4), but even up to 138 contestants (judge 2). High variability was found in the magnitude of deductions: for the sureness of performance judge 1 used the 0,3 deduction in 158 contestants and judge 3 in only 9 contestants. The range of mean total deductions for artistry was 0,18-0,39. The average Kendall's tau-b correlation coefficient between the total artistry deduction and final E score for the 5 judges was -0,61 (range -0,49 to -0,71,  $p$  for all  $< 0,001$ ). The average correlation between judge pairs in same artistry categories was 0,45 (range 0,01-0,83). When the total artistry deductions were examined for validity, the Kendall's W statistic was high: 0,53 ( $p < 0,001$ ). The highest problems in validity were found in sureness of performance: Kendall's W 0,53 ( $p < 0,001$ ). **DISCUSSION** Our results have shown that reliability of judging artistry is low: there was a high variability between the judges in the number of penalized contestants in separate categories of artistry and a very low average correlation between judge-pairs for the same categories of artistry. Of highest concern is our finding of significant systematic bias between judges implicating a lack of validity. It is clear that we have to monitor the judging of artistry in future and if such findings are repetitively found, the justification for including artistry deductions should be reassessed by the regulating body (FIG).

## ESTIMATION OF PHYSICAL ACTIVITY ENERGY EXPENDITURE IN CHILDREN DURING SIMULATED FREE-LIVING ACTIVITIES: PRECISION OF THE ACTIHEART SENSOR

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**Introduction** The validity of the Actiheart – a combined heart rate and movement sensor – for assessing physical activity energy expenditure has been demonstrated in older children during treadmill walking and running and in a limited range of ‘lifestyle’ physical activities (Corder et al., 2005, 2007). Our aim was to evaluate the precision of the Actiheart in younger children performing a wider range of child-relevant simulated free-living activities. **Methods** Thirty-two children (13 girls and 19 boys) aged 9–11 years volunteered to participate. Using regional data on the most commonly performed physical activities in this age group, we devised two routines of six activities ranging from sedentary (e.g. card playing) to vigorous intensity (e.g. soccer). Participants were randomly assigned to one routine, performing each activity for 5 min, with 5 min rest. Indirect calorimetry (Cosmed, K4 b2) was used to estimate resting energy expenditure (short protocol) and criterion physical activity energy expenditure above rest in J/min/kg (Weir, 1949). We derived Actiheart-based estimates from the built-in child ‘group’ equation, and from individual heart rate: energy expenditure relationships observed in a modified 8-min ramped step test. Valid data were available for 21 children (9 girls, 12 boys). Accounting for the hierarchical structure of the data (repeated measures within subjects) we applied a linear mixed model (random slopes and intercepts, unstructured covariance) to derive the within-subjects standard error of the estimate. This statistic provides the typical error in predicting criterion physical activity energy expenditure from either of the Actiheart estimates, at the level of the individual participant. **Results** There was no substantial difference between methods in the mean physical activity energy expenditure. The within-subjects standard error of the estimate from the Actiheart group equation was 53 J/kg/min (90% confidence interval 44 to 63 J/min/kg), versus 49 J/min/kg (42 to 58 J/kg/min) from the Actiheart individual calibration equation. **Discussion** The increase in precision afforded by the simple individual calibration was trivial. The typical within-subject prediction error from both Actiheart equations was around 15% of the mean across all activities (336 J/kg/min). We conclude that this level of precision is adequate for the assessment of free-living physical activity energy expenditure in children. **References** Corder, K., Brage, S., Wareham, N.J., et al (2005). *Med. Sci. Sports Exerc.*, 37 (10), 1761–1767. Corder, K., Brage, S., Mattocks, et al (2007). Comparison of Two Methods to Assess PAEE during Six Activities in Children. *Med. Sci. Sports Exerc.*, 39 (12), 2180–2188. Weir (1949). *J Physiol.*, 109 (1-2), 1-9.

## RELATIONSHIP BETWEEN REGIONAL AND WHOLE-BODY COMPOSITION TO ONE MAXIMAL WEIGHT-LIFT PERFORMANCE <1RM>

Pessôa Filho, D.1, Neiva, C.M.1, Verardi, C.E.L.1, Peinado, A.B.2, Benito, P.J.2

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**Introduction** The assessment of 1RM from modeling approaches had observed that lift repetition performance with submaximal weight is suitable to ensure a valid reference of 1RM (statistically confidence) and soft protocol (avoiding heavier loads) (Abadie; Wentworth, 2000). Although, the reliance of anthropometrics data to predict 1RM has not same goodness of the estimative, despite force ability has been related to parameters of body shape and size (Mayhew et al., 1993). However, the concerning that general anthropometric data input would constrain the power of the estimative equation of 1RM has not been appropriately investigated. This study aimed to compare the power of regional and whole-body composition to estimate 1RM in weight-lift systems. **Methods** Fifteen well-trained males (23.7 (5.3) years, 180.4 (5.6) cm, 83.6 (10.6) kg, and 18.9 (4.9)% body fat) were undergone to three standardized 1RM test protocol, repeated at the same time of the day with 24h of rest, in Bench-press (BP), Seated row (R), Arm-curl (AC), French triceps press (FTP), Leg-press 45° (LP45), Knee-extension (KE), and Leg-curl (LC). Anthropometric measurements were: girths (arm, shoulder, waist, and thigh), bone breadth (humerus, wrist, femur, and biacromial), and skinfolds thickness (biceps, triceps, chest, subscapular, suprailiac, and thigh). Whole and regional body compositions were evaluated from DXA (Hologic Discovery QDR, plus software APEX). Multiple linear regression analysis was applied to adjust the data from stepwise method. Significance level was set at 0.05. **Results** The mean values of force for the best score were: BP (96.8•21.9kg), AC (50.9 (10.1) kg), FTP (48.9 (8.9) kg), R (114.1 (22.0) kg), KE (147.1 (36.0) kg), LC (100.9 (21.5) kg), and e LP45 (366.8 (59.3) kg). The lean mass of upper limbs (9.1 (1.5) kg) was the best predictor of 1RM in BP (R<sup>2</sup> = 0.812, SEE = 9.7kg) and AC (R<sup>2</sup> = 0.747, SEE = 5.2kg), whereas arm girth (33.5 (3.4) cm) did influence FTP (R<sup>2</sup> = 0.630, SEE = 5.4kg), and lean body mass (66.3 (6.7) kg) predicted 1RM in R (R<sup>2</sup> = 0.837, SEE = 9.2kg), KE (R<sup>2</sup> = 0.720, SEE = 19.6kg), LC (R<sup>2</sup> = 0.645, SEE = 14.4kg), and LP45 (R<sup>2</sup> = 0.407, SEE = 44.3kg). **Discussion** Regression analysis did support the high reliance of maximal dynamics force on body composition parameters, rather than girth and breath data. Thus, regional composition has not better power than whole-body composition to predict 1RM weight-lift performance. Furthermore, despite the goodness of the adjustments between force and anthropometric data, the statistical indexes are not in the same order than those for submaximal force score (Mayhew et al., 1993). **References** Abadie BR, Wentworth MC. (2000). *J Exerc Physiol.* 3,1-7. Mayhew JL, Piper FC, Ware JS. (1993). *J Sports Med Phys Fitness.* 33, 159-65.

## THE RELATIONSHIP BETWEEN THE DIRECT AND INDIRECT MEASUREMENT OF VO<sub>2</sub>MAX IN THE 20-M SHUTTLE RUN TEST AMONG A GROUP OF ADOLESCENT BOYS LIVING IN THE NORTH WEST PROVINCE OF SOUTH AFRICA – PAHL STUDY

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**Introduction** The methods that have thus far been used to test the validity of the 20-m SRT have not been empirical sound (Chatterjee et al., 2009; Mahar et al., 2006). Therefore, the purpose, of this investigation was to determine the relationship between the indirect (predicted) and direct measurements of oxygen uptake (VO<sub>2</sub>max) in the 20-m SRT. **Methods** A total of 52 boys in grade 8 of high schools in the Tlokwe District (Potchefstroom area) of the North West Province of South Africa were randomly selected out of a total of 247 learners to be fitted with a portable gas analyser while they ran the 20-m SRT. The gas analyser was used to sample expired air continuously and the rate of oxygen consumption (VO<sub>2</sub>), carbon dioxide production (CO<sub>2</sub>), minute ventilation (VE), the respiratory exchanges ratio (RER) and record the heart rate for each 5 second period. The Bland and Altman plot method was used to compare the two measurement techniques (Bland and Altman, 1986). **Results** The results of the Bland and Altman plot showed that almost all of the participants’ VO<sub>2</sub>max-values were under predicted by the 20-m SRT. Also, all of the participants’ VO<sub>2</sub>max-differences, except for three participants, fell in between the 95% limits of agreement range that was set. **Discussion** To our knowledge, this is the first study to investigate the relationship between the indirect and direct VO<sub>2</sub>max values obtained from the 20-m SRT, among adolescent boys in the North West Province of South

Africa. Almost all of the participants' VO<sub>2</sub>max results were under predicted by the 20-m SRT indirect measurement when compared to the direct portable gas analysis obtained values. The underestimation of the 20-m SRT VO<sub>2</sub>max derived values are probably related to age, gender and racial differences between the population of our study and that of the European adults from which the original Légar and Lambert 20m-SRT VO<sub>2</sub>max prediction equation was developed (Légar and Lambert, 1982). In conclusion these results show that the 20-m SRT is not a valid test for the accurate prediction of VO<sub>2</sub> and VO<sub>2</sub>max in a group of adolescents and that new prediction equations need to be developed for practitioners who want to use the 20m-SRT to predict the VO<sub>2</sub>max values of especially children. References Bland, J.M. & Altman, D.G. (1986). *The Lancet*, 1, 307-310. Chatterjee, P., Banerjee, A.K., Das, P. & Debnath, P. (2009). *Int J Appl Sport Sci*, 21(2), 113-121. Légar, L.A. & Lambert, J. (1982). *Eur J Appl Physiol*, 49, 1-12. Mahar, M.T., Welk, G.J., Rowe, D.A., Crofts, D.J. & McIver, K.L. (2006). *J Phys Act Health*, 3(2), S34-S46.

### THE CIRCUS IN PHYSICAL EDUCATION: A PORTRAIT OF PRODUCTION AVAILABLE IN THE MAGAZINE PHYSIQUE ET ÉDUCATION SPORT / FRANCE

Duprat, R.1, Ontanon, T.1, Bortoleto, M.1, Mateu, M.2, Martinez, A.2

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**Introduction** The academic production about the circus and its relationship with physical education has significantly increased in recent decades (ONTAÑÓN, DUPRAT, BORTOLETO, 2012). Much of this production has been published by the French magazine 'Éducation Physique et Sport' (EP&S) placing it as an important vehicle for the dissemination of the progress made on the issue. Thus, the present study is an analysis of all EP&S's articles published between 1969 and 2012. **Methods** It was a literature review in all editions of the Journals EP&S and EP&S1 (available at the library of the 'Institut Nacional d'Educació Física de Catalunya' (INEFC Barcelona -Spain-). The articles selected were analyzed based on the content analysis method (BARDIN, 2002). **Results** A whole of 31 papers were analyzed, which 3 were published in the 1980s, 7 in 1990s, 13 between 2000 and 2010 and 8 articles between 2011 and 2012, showing a continued and regular growth. The content of articles focuses on three broad categories: - Pedagogy of circus techniques: 15 articles dedicated to juggling, balance ball, slack-line, stilts, rola-bola and cigarbox; - Professional circus schools or circus companies: 3 articles explaining experiences in the field of education / training. - Educational experiences reports in physical education classes: 13 articles that the circus stands out as physical education content. **Discussion** We analyzed only items directly related to the circus. However, many others were not considered, although there was possibility for transfer, like the acrosport or oscillating ropes. The first papers date from 80s, when the 'new circus' (WALLON, 2010) takes shape as a growing art and when the French government began to invest in training, production and research of aesthetics circus. Remarkably steady growth of the production, although after 2000 a significant growth is perceived, showing increased attention of physical education professionals with the pedagogical, historical and social circus aspects (FOUCHET, 2003). Most articles concern how to teach some of different circus modalities (juggling, for example), or the school experiences reports. We didn't identify comparative and longitudinal studies that show effectively the circus educational potential and what the most appropriate ways to teach. **References** BARDIN, L. (2002). *Análisis de contenido*. Madrid: Ediciones Akal. FOUCHET, A. (2006). *Las artes del circo: Una aventura pedagógica*. Buenos Aires: Stadium. ONTANÓN T, DUPRAT R, BORTOLETO M. (2012). *Educação Física e Atividades Circenses: 'O Estado da Arte'*. *Revista Movimento*, vol. 18, n. 2, p.149-168. WALLON, E. (org.). (2008). *O circo no risco da arte*. Belo Horizonte: Autêntica.

15:00 - 16:00

### Mini-Orals

#### PP-BN10 Coaching [CO] 1

### THE USE OF THE ADIDAS MICOACH TO QUANTIFY THE PHYSIOLOGICAL LOAD OF HIGH-LEVEL BASKETBALL GAMES

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**Introduction** The Adidas miCoach Speed\_CellTM is a triaxial accelerometer developed as a personal training system. However, its design and accuracy (Porta et al., 2012) suggested its further use to quantify the load imposed during professional sports practice. Regarding to basketball, some research has been done to determine the physiological demands (McInnes et al., 1995; Narazaki et al., 2009) and their differences according to playing positions (Ben Abdelkrim et al., 2007) but none of these studies used accelerometers in their methods. The present provides additional data to the field of study. **Methods** The study sample consisted of 24 matches played during the pre-season and first leg of the 2012-2013 regular season of the Spanish professional basketball league (Liga Endesa). We selected randomly two players from the same team, who wore a Speed\_CellTM sensor attached to the right shoelaces throughout the game. The Speed\_CellTM sensor registered the active time (AT), total load in meters covered (LOAD), maximum speed in meters per second (MS). We could obtain also the amount of high-intensity efforts ratio per minute (HIER, those which exceed de speed of 1.6 m/s), short duration high-intensity efforts to active time ratio (SDHIER, consisting in efforts lasting up to three seconds), and long duration high-intensity efforts to active time ratio (LDHIER, over three seconds) and the distance to active time ratio (DATR). **Results** The averages and standard deviations per player were: 67.28±13.63 min for AT, 6004±963 m for LOAD, 1.78±0.26 for HIER (divided between the value of 1.00±0.18 for SDHIER and the 0.78±0.23 for LDHIER), 90.1±8.3 m for DATR and 5.49±0.48 m/s for MS. Some differences have been found between groups. HIER is higher for forwards than for guards while centers showed lower MS. **Discussion** The Speed\_CellTM sensor is a useful tool to assess physiological demands in professional basketball. The device allows the assessment of high-intensity efforts that seem to be a better predictor of the playing level than other physiological indicators (Ben Abdelkrim et al., 2007). Our findings differ from previous studies in which guards were pointed out as the players with a greater game load and intensity. **References** Ben Abdelkrim N, El Fazaia S, El Ati J. (2007). *Br J Sports Med*, 41, 69-75. McInnes SE, Carlson JS, Jones CJ, McKenna MJ. (1995). *J Sports Sci*, 13(5), 387-97. Narazaki K, Berg K, Stergiou N, Chen B. (2009) *Med Sci Sports*, 19, 425-432. Porta JP, Acosta DJ, Lehker AN, Miller JT, King GA. (2012). *International Journal of Exercise Science: Conference Abstract Submissions*, 2(4), article 23.

## EFFECT OF APPLICATION OF PREPARATORY MOVEMENTS AND ACTIONS BEFORE SHOOTING ON THE ACCURACY OF FREE THROWS

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**Introduction** Many scientists claim that movement accuracy is much determined by the preparation to perform the movement – the preparation phase. Before a free throw basketball players perform preparatory movements and actions which are defined as a set of motor, affective and cognitive behaviors before the performance of the main action. It has been established that preparatory actions and movements of skilled basketball players influence beginners. **Methods** The research methods applied: experiment; testing free throws before the experiment and after experiment. Before the experiment the experimental group was provided with all information and preparatory movements were demonstrated as well as their sequence according to the methodology of Amberry (1996). The subjects (young aged 14-15 female basketball players) performed 30 free throws (10 sets of three free throws) according to new methods. The control group performed free throws under usual conditions, as they had learnt before. The teaching lasted for one month, and practice sessions took place four times a week. **Results** After a month of learning, when the experimental group learnt free shots applying a sequence of preparatory movements and actions before them, the second testing was carried out, and the results of it were as follows: for players in the experimental group 70.3% ( $21.1 \pm 3.1$  accurate free throws), for players in the control group 63.3% ( $19.0 \pm 2.1$ ). The indices of the second testing showed that the average number of successful free throws in the experimental group statistically significantly increased ( $p < 0.05$ ) compared to the results of the first testing. **Discussion** Preparatory movements as well as their sequence, efficiently affect the accuracy of free throws for young female basketball players (Czech et al., 2004). We found that the accuracy of free throws of young basketball players who had learnt the sequence of preparatory movements and actions according to the methodology of Amberry (1996) improved by 9%, when the accuracy of free throws in the control group remained unchanged. While using preparatory movements, athletes carry out their individual plans of actions before starting the performance of their task (Lidor, 2007). Our research revealed that one month of learning preparatory movements, actions and their sequence appeared to be efficient for the accuracy of free throws for young (aged 14-15) female basketball players. **References** Amberry T. (1996). *Free throw. Seven steps to success at the free-throw line*. New York: Harper Collins Publishers. Czech D. R., Ploszay A. J., Burke K. L. (2004). An examination of the maintenance of preshot routines in basketball free throw shooting. *Journal of Sport Behavior*, 27 (4), 323–329. Lidor R. (2007). Preparatory routines in self-paced events: Do they benefit the skilled athletes? Can they help the beginners? In G. Tenenbaum & R. C. Eklund (Eds.), *Handbook of sport psychology* (3rd ed.) (pp. 445–465). Hoboken, NJ: John Wiley & Sons, Inc.

## UNDERSTANDING THE FEINT IN FOOTBALL – QUANTIFYING FOR TRAINING

Lopes, H., Fernando, C., Vicente, A.

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**Introduction** The feint in football is, in a very simplified form, a situation where a stimulus that is given by one player and one time the opponent will react. This is a situation where players often try to deceive their opponents so that they can have an advantage over them and be successful (Vicente et al., 2010). The objective of this study is to characterize some of the times involved in the feint in football in order to improve efficiency in training, quantifying the execution times of possible trajectories of the foot over the ball by the attacking player. **Methods** We've filmed 30 subjects (sports science college students, being 15 of them football players) that had to move one foot (outer edge facing the ball) as fast as possible over the ball touching the ground on the other side and returning to the starting position. Each individual held the position three times (with three preliminary attempts) and decided when to start the movement. The footage was taken with a camera to capture speed of 50 frames per second, having been digitized and analyzed using Pinnacle Studio 12. **Results** The average times obtained by the students footballers was of 987 milliseconds and the average time obtained by the not footballers was 1003 milliseconds. There were no significant differences between the obtained times from footballers and not footballers. **Discussion** The obtained times (approximately 1000 milliseconds) allow the opponent to realize that, if we consider acceptable reaction times (400 to 500 milliseconds), it's possible to intercept the ball during this movement. If players don't do it's probably because they are looking to react to the movement as a way to counter a possible movement of the ball. However, this movement can lead to situations that may allow the players who perform it a chance of passing. The fact that the time it takes to move your foot over the ball is not significantly different between those who play football and those who do not play reinforces the idea that what is essential is not the feint technical execution speed but the dialogue established between the players what should be taken into account when training players in this situation. **References** Vicente, A., Fernando, C., Lopes, H. & Almada, F. (2010). 15th ECSS, Antalya.

## COMMUNICATION AND MOTIVATION IN THE COACH-ATHLETE RELATIONSHIP

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**Introduction** Several sports scientists share the common opinion that the coach is the one person who can influence an athlete motivation the most (Mageau, Vallerand, 2003; Amaro, Anderson-Butcher, 2007; Guzmán, Calpe-Gómez, 2011). For better or for worse, the coach can have an impact on how the athletes perform. Research within the framework of Self-Determination Theory (SDT), have reached the conclusion that it's easier to have motivated athletes if the coach adapts an autonomy-supportive coaching style (Mouratidis et al, 2010; Gillett et al. 2009). The aim of this study is to investigate the role of communication in the coach-athlete relationship, and how it affects athlete motivation. It's interesting to investigate **Methods** The method used to investigate this is topic was focusgroup interviews (Postholm, 2010). The sample in this study consisted of boys and girls (aged 16-19 years) from three different Norwegian basketball clubs. From each team it was conducted one interview with the boys team and one with the girls team, adding to a total of six interviews. Group sizes varied from 4 to 8 participants. The duration of the interviews varied from 45 to 55 minutes. **Results** The preliminary results of this study show that both the boys and girls would like to have a coach that cares for them, seems interested and have enough experience. They also highlight that autonomy-supportive communication from the coach has the biggest influence on their own motivation towards playing basketball. These findings are similar to what Mouratidis et al. (2010) and Gillett et al. (2009) found in their studies. However, the athletes also highlight the importance of having a coach that is disciplined towards them, and that the autonomy-supportive aspects isn't always necessary in order for the coach to motivate them. **References** Amaro, Anthony J., Anderson-Butcher, Dawn. (2007). *Psychology of Sport and Exercise*. Vol 8, No. 5:654-670 Deci, Edward L., Ryan, Richard M. (1985). *Personality and Social Psychology*. New York: Plenum. Guzmán, Jose Francisco., Calpe-Gómez, Vicente. (2011). *Journal of Human Sport & Exercise*. Vol. 7, No 2: 376-382. Mageau, Geneviève,

A., Vallerand, Robert, J. (2003). *Journal of Sports Sciences*. Vol. 21, No. 11: 883-904. Mouratidis, A., Lens, W., & Vansteenkiste, M. (2010). *Journal of Sport & Exercise Psychology*. Vol. 32, No 5: 619-637. Postholm, May Britt. (2010). Universitetsforlaget.

### ESTIMATING THE BASKETBALL WINNING FACTORS FROM PLAYERS RECORDS AND GAME STRATEGIES

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**Introduction** The purpose of this study was to figure it out the basketball winning factors through analyzing players game records and their position for scores via video records. **Methods** We have collected the data from 2012-2013 Korea Basketball League(KBL) which 10 games for each team. We have collected the six offence factors(2p%, 3p%, FT%, Offense Rebound, Assist, Turn Over) and four defense factors(Defense Rebound, Steal, Good Defence, Block Shoot). We also have recorded game which was analyzed the players score position and running time. The data were analyzed that which factors was most contribute for the winning the game using Pearson correlation and logistic multiple step regression. All significance levels were set at  $p < .05$ . **Results** We have estimate the determinants of winning and lost game and three offense factors(2p%, 3p%, FT%) were significantly affecting game winning. Also, Two defence factors(DB, ST) were significantly affecting game winning percent. In addition we calculated the players scoring position via watching video tape, and court elbow area and free throw area were most scoring position. **Discussion** This study is still on going study and we have not analyzed all data for video records and players scoring position. However, we have tried to estimate the game winning factors which is not shown in offence and defence data. We tried to estimated the data according players role and position that which position is more critical for scoring situation and winning the game. **Reference** Park D.,(2012). Analyzing of contribution point in pro-basketball score, winter season workshop. Korea Sport Measurement and Evaluation, Seoul Park J.,(2008). The analysis of the factor for winning a game in the 200-2001 season KBL. *Journal of Korean Society of Sports Science*, 17, 129-138. Wood T., & Shu W.,(2006). Measurement theory and practice in kinesiology. Human Kinetics. Champaign, IL.

### ATTACKING IN FOOTBALL: POSSIBLE STRATEGIES TO STOP WASTING OPPORTUNITIES

Vicente, A., Lopes, H., Fernando, C.

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**Introduction** In the FIFA World Cup 2010 there were 1810 shots on the 64 matches (an average of 28.28 shots per game) but only 683 on target. However, from these shots only 145 resulted in goal (8%) meaning that, in average, a team needed to shot more that 12 times (12,48) to score. It wasn't much different in the UEFA Euro 2012 where teams shot 822 times in 31 matches to get 76 goals (9,23% success), shooting more that 10 times (10,82) to score one goal. The top scorer (Fernando Torres) achieved 3 goals in a total of 189 minutes played (5 matches) from 10 shots (7 on target). There are few opportunities to shoot in a game. And when opportunities appear players tend to waste the vast majority of them. However, there are few studies on this situation (mainly empirical) and there is not enough knowledge to understand it functionally so that it can be improved and players can become more efficient. The aim of this study was to analyse a set of attacking situations from a major football competition (Euro2012) in order to understand them functionally in the continuation of previous studies (e.g. Vicente et al., 2012). **Methods** Using a team sports model (Almada et al., 2008) we've analyzed twenty attacking situations that resulted in finishing attempts from the Euro2012 Final (Spain vs. Italy), focusing specifically in the last attacking player actions and his relation with the opponent(s). We've defined an analysis grid to understand the player's actions and also to quantify their action times (t - strikers time, t' - defenders time) to determine other possible solutions for the play. **Results** From our analysis the attacking players mostly started their movement before the defenders and, in average, 200 milliseconds (ms) before the ball being passed by their team-mates. Attackers tended to had enough time (320 ms in average) to choose another action or to prepare better the chosen one. But in 68% of the situations strikers had opportunity shot lines to the goal but missed them and in the other 32% they had no opportunity shot line but still decided for shooting. **Discussion** Understanding the relations between attacking and defending players according to their actions times, and by knowing the inherent variables, it's possible to identify how to improve player's performance. Players do not need to be faster but they can look for other options to get advantage over the opponents to succeed taking advantage of most opportunities that the team creates to score. For this to happen, beyond training the skill players need to face situations in order to train decision-making. **References** Almada F., Fernando C., Lopes H., Vicente A., Vitoria M. (2008). V.M.L., Torres Novas. Vicente A., Fernando C., Lopes H., (2012). 17th ECSS, Bruges.

### RUNNING A TEAM IS LIKE LAYING A PUZZLE – COACHES' EXPERIENCES OF WOMEN'S ICE HOCKEY

Henriksson, T., Fjellman-Wiklund, A., Gilenstam, K.

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**Introduction:** Women's ice hockey (WIH) is dominated by two countries, Canada and the U.S.. The large difference in quality between North America and the other countries has been used as an argument for exclusion of the sport from the Winter Olympic program. The reason for the large differences in ice hockey performance has not been investigated. Thus, the aim of this study was to investigate socio-cultural influences and demands important to performance in elite WIH in North America and Sweden. **Methods:** Thematized interviews were conducted and analyzed according to Qualitative content analysis (1). Eight ice hockey coaches, two women and six men, from the top ten teams in Sweden and North America, were purposely sampled as informants. **Results:** The results show one theme, "Running a team is like laying a puzzle". It reveals the complex structure of running and organizing a top-level team while at the same time fighting for necessary resources, since WIH is a low priority in comparison to male professional sports. Further results reveal seven categories involving gendered approach on coaching, access and use of resources, perspectives of performance, view of WIH and its development. The coaches perceive that performance is context bound but also dependent on the individual's skills and resources, and development of individual skills requires resources. The North American teams are associated to universities, which provide resources for individual development through expertise and personnel available through sport-related courses. This ensures a high quality of coaching and knowledge in accordance with current research. In Sweden teams belong to general sports clubs, which do not have the same natural access to knowledge. Very few players in the countries concerned are professionals in the sense that they can live on their sport. However, the North American players' access to athletic scholarships enable them to play ice hockey full time even at senior level. In Sweden, there are sports schools for young girls, but after the age of 19 they are forced to work part-time to make a living, which affects time available to spend on ice hockey. **Conclusion:** Running a team requires access to money, time, knowledge and personnel. WIH needs greater support from their federations in terms of gender equity, economy and marketing, which coaches experience significant for

increasing the value of WIH and make it more competitive. Reference: Graneheim U, Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today*, 24(2), 105-112.

### **FACTORS INFLUENCING DECISION MAKING DURING THE FAST-BREAK IN BASKETBALL GAMES**

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**Purpose:** This study aimed to investigate factors influencing decision-making in the fast-break of basketball games while considering the team's athletic abilities. **Method:** Participants included 177 university basketball players (98 males and 79 females) who took a decision-making ability test in which they were asked to estimate or choose the next situation or optimal play just after stopping a projection of a videotaped basketball game scene. The test battery consisted of 81 test items based on 29 play scenes. Each test item measured 4 decision-making processes. We defined the "correct" play/situation as that which  $\geq 4$  of 8 basketball authorities chose as the correct answer. The total score for correct answers was analyzed using Quantification Theory Type 1, in which various factors such as athletic level evaluated by the coach, gender, and position were independent variables. **Results:** Results of deviance analysis indicated that this model was significantly fitted at the .1% level (chi-square=255.8, degree of freedom=5). Ranges of category weights in each item were 3.01, 1.18, and 0.57 for position, athletic level evaluated by the coach, and gender, respectively, indicating that the most influential factor was position, followed by athletic level evaluated by the coach, and gender. However, as the influence of gender was small and this analysis did not consider the athletic level of teams, we reanalyzed it using position, athletic level evaluated by the coach, and team as independent variables. Results of deviance analysis indicated that this model was also significantly fitted at the .1% level (chi-square=409.5, degree of freedom=11). Ranges of category weights in each item were 3.21, 2.97, and 1.57 for team, position, and athletic level evaluated by the coach, respectively. In short, the most influential factor on decision-making ability in fast-break was the team, followed by position played, and athletic level evaluated by the coach. Category weights were 1.24, -0.46, and -1.74 for guards, forwards, and centers, respectively, indicating that guards had excellent decision-making abilities but centers did not. The order of the category weights for teams was almost equivalent to that of their game performance. In terms of athletic level evaluated by the coach, the category weights were 0.851 in starting players, -0.168 in not-attending-games players, and -0.720 in second-string players. Starting players who had extensive game experience had the highest category weight, but players who did not play in games and could objectively watch the games had a higher weight than second-string players who were considered to be better in skills and tactics. **Conclusion:** Team factors, characterized by main tactics, coaching philosophy, training methods, and so on, have a greater influence on decision-making ability than athletic level evaluated by the coach, which characterizes the game-playing experience.

### **THE ASSOCIATION BETWEEN BASEBALL ATHLETES' PERFORMANCE EVALUATION AND PSYCHOLOGICAL ADAPTATION TO UNIVERSITY BASEBALL TEAMS**

Shimizu, Y., Miyazaki, M.

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**Introduction** Baseball is one of the most popular club sports from elementary school to university level in Japan. One of the prevalent problems in baseball clubs is athletes' maladjustment to teams and dropout from clubs. The purpose of this study was to develop Psychological Adaptation Scale for Baseball Club Activities (PASBCA) and Subjective Performance Evaluation Scale for Baseball Athletes (SPESBA) and to examine the relationship between the subscales of PASBCA and SPESBA. **Methods** The subjects of 264 baseball athletes (mean age=19.45, SD=0.89, mean baseball experience=11.30, SD=2.24) in high competitive four official university baseball teams were asked to answer a questionnaire composed of question items on socio-demographic background as well as 30 baseball athletes' psychological adaptation evaluation question items and 12 baseball athletes' subjective performance evaluation question items, both of which were developed from our preliminary survey in 2010. Exploratory factor analyses and reliability analyses were conducted to develop PASBCA and SPESBA. Multiple regression analysis with stepwise method was employed to examine the relationship between PASBCA and SPESBA. **Results** The results of exploratory factor analyses yielded for PASBCA a 4-factor model ("Avoidance," "Weariness," "Negative Human Relationships," "Satisfaction") with 24 items and for SPESBA a 1-factor model with 12 items. Reliability analyses confirmed that each scale had acceptable satisfactory Cronbach's alpha reliability from 0.916 to 0.964. The results of multiple regression analyses showed that the subscales of "Avoidance" and "Satisfaction" in PASBCA had significantly positive association with SPESBA. **Discussion** The findings above suggests that baseball athletes with high satisfaction of club activities tend to have high evaluation on their own performance, and this implies that psychological intervention programs which aim to enhance athletes' adaptation to their team can lead to improvement of their performance evaluation. However, contrary to our expectation, reluctant athletes also have high evaluation of their performance. This may be because they place little value on team practice as they think that their performance is good enough or better than their teammates. Future research with a larger sample size and longitudinal design will be needed in order to explore effective psychological coaching intervention methods. **References** Saki MURAIISHI, Yasuo SHIMIZU (2011) Development of Psychological Adaptation Scale for Junior High School Sport Club Activities. *Kyusyu Journal of Sport Psychology*. 23:50-51.

**15:00 - 16:00****Mini-Orals****PP-SH25 Misc. topics 2****THE EFFECT OF AERODYNAMIC DRAG IN THE SERVICE SPEED OF HIGH-LEVEL MEN'S VOLLEYBALL.**

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**Introduction** The serve speed is an important factor for the game performance in volleyball (Moras et al., 2008; Quiroga et al., 2010). However, even more relevant seems to be the ball speed at the reception contact. The aim of the present study was to analyse if due to drag effect, the speed at which the ball reaches the receiver has significant differences with the peak velocities registered during service execution and to determine if this parameter is relevant to assess the serve outcome in high-level men's volleyball. **Methods** The present study was carried out in January 2012. 774 services from the Spanish Volleyball Cup held in Teruel were analysed. Service velocities were recorded and assessed using a Stalker ATS II radar-gun and the Stalker ATS software (Stalker Pro, Radar Sales Inc., Minneapolis, USA). The services included in the sample were the jump topspin (JT) and the jump float (JF) serves because of their preferential use in high-level men's volleyball (Ageloniadis, 2004; Häyrynen et al., 2011). Two expert observers executed the recording and the encoding of the data in every game. The first observer started speed recording with the authorization of the service and stopped it when the ball contacted with the receiver. The second observer introduced additional data referred to the analysed serve in a worksheet (player, type and effect of the serve). An intraclass correlation analysis and descriptive statistical tests were performed to all records. **Results:** The average peak speed recorded for the JT was  $25.69 \pm 3.58$  m/s and for the JF was  $14.97 \pm 1.61$  m/s. The average speed at which the ball reached the receiver was  $20.79 \pm 3.46$  m/s and  $13.14 \pm 1.49$  m/s respectively; the average loss rate due to aerodynamic drag effect was  $4.89 \pm 1.39$  m/s for the JT and  $1.90 \pm 0.78$  m/s for the JF. An intraclass correlation coefficient of 0.964 indicates agreement between peak and reception velocities. **Discussion:** Significant differences can be found between the peak velocities and the speed at which the ball reaches the receiver in a volleyball service due to the effect of aerodynamic drag. Reception contact speed records provide a better value to assess the effect of the different services in game-like situations, with a higher adjustment to the conditions in which the reception is performed. **References:** Ageloniadis Y. (2004). *J Hum Movement Stud*, 47, 205-213. Häyrynen M, Mikkola T, Honkanen P, Lahtinen P, Paananen A, Blomqvist M. (2011). *J Sport Med*, 45, 543. Moras G, Buscà B, Peña J, Rodríguez S, Vallejo L, Tous-Fajardo J, Mújika, I. (2008). *J Sport Med Phys Fit*, 48(1), 31-36. Quiroga M, García-Manso JM, Rodríguez-Ruiz D, Sarmiento S, de Saa Y, Moreno MP. (2010). *J Strength Cond Res*, 29(4), 2316-2321.

**COMPUTER-BASED MUSCLE DYSMORPHIA ASSESSMENT**

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**Introduction** Muscle Dysmorphia (MD) is a mental disorder which a person who suffer it self-perceive lean and weak, but he/she is big and strong indeed. This disorder is more prevalent in weightlifters and bodybuilders. The first study on MD was in 1993 (Pope, Katz y Hudson, 1993), it is a relative new discovery. Actually this is the reason for there are not much instruments to detect it. The aim of this study is describe the process like a prospective to develop a program computer for assessment MD, based on data mining. **Methods** A total of 734 participants (562 male and 172 female) with an average of seven hour per week lifting weights took part in this study. We administered Escala de Satisfacción Muscular (ESM; González-Martí, Fernández, Contreras, & Mayville, 2012), Somatomorphic Matrix (Gruber, Pope, Borowiecki, & Cohane, 1998) to know MD symptoms, and we measured the weight, height, and skinfolds. In other hand we applied a Demographic and Physical Self-concept (Goni, Ruiz de Azúa, & Liberal, 2004) questionnaires too. **Results** After having revised a number of available data mining solutions, it was decided to use regression analysis, and decision trees and rule learners. Finally, regression models and decision tree and rule classifiers were calculated for the target variable, "Bodybuilding Dependence", an ESM factor. As a result, a set of indicators which describe a psychological profile of a person was obtained with good correlation coefficient ( $R = .77-.78$ ). Moreover, low, medium and high levels of the disease were analyzed, and the most influential factors for every degree were stated. **Discussion** Modelling and simulation have demonstrated that several models can be used for the diagnosis and prevention of the MD (Hildebrandt, Alfano & Laungenbucher, 2010). The models obtained with regression analysis enable evaluation of each explanatory variable in relation to the target variable "Bodybuilding Dependence". Application of decision tree models and rule learners permits to identify the most influential factors which can be used with diagnostic purpose. The results of this case study can facilitate important references during evaluation of bodybuilders and weightlifters in order to organize early prevention and treatment. **References** Hildebrandt T, Alfano L, Laungenbucher JW. (2010). Body image disturbance in 1000 male appearance and performance enhancing drug users. *J Psychi Research*, 44 (13), 841-846. González-Martí I, Fernández JG, Contreras OR, Mayville SB. (2012). Validation of a Spanish version of the Muscle Appearance Satisfaction Scale: Escala de Satisfacción Muscular. *Body Image* 9, 517-523. Goni A, Ruiz de Azúa S, Liberal A. (2004). El autoconcepto físico y su medida. Las propiedades psicométricas de un nuevo cuestionario. *R Psico Depor*, 13(2), 195-213. Gruber A, Pope HG, Borowiecki J, Cohane J. (1998). The Development of the Somatomorphic matrix: a bi-axial instrument for measuring body image in men and women. In Proceedings of Conference of the ISAK.

**PRACTICALITY OF A TENNIS SIMULATOR FOR PLAYER IMPROVEMENT**

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**Introduction** When a tennis match is in-play, the viewer has knowledge on in-play serving statistics such as first and second percentage of serves in and won. There has been various works involved in applying serving statistics to increase serving performance and to find the optimal serving strategy. Barnett et al. (2008) suggest separating serving statistics in relations to the surface of the court, Gale (1971) applied a simple mathematical model, whilst George (1973) applied a probabilistic model. Although various research has been performed, limited research has involved in applying in-play serving statistics to increase serving and player performance. The aim of this

study was to apply in-play serving statistics into a set simulator to determine whether this application is an effective coaching tool for player improvement. Methods The set simulator allows the inclusion of faults to increase the accuracy of the probability of winning a set in tennis. This simulator has the ability to adjust the server's probability of winning a point on first and second serve at any phase of the set in order to calculate the likelihood of each player winning the set. To test the effectiveness of the set simulated, it was compared against the Markov Chain model that was applied to a case study. The Markov Chain model is generally used in the tennis literature to calculate the probability of winning a game, set and match before and during a match. To increase the accuracy of the results, serving statistics are collected from the first set and applied to calculate the probability of winning the second set. Results Results showed that the simulator was superior in estimating the outcome of the set. In comparing the two methods, the Markov model gave an extra 0.13 probability to the underdog to win the set, where the favourite won the set 6-1. Thus the simulator was more effective in this case study. By increasing the underdog's serving statistics by two percent, resulted in increasing the simulated probability of winning the set by six percent. If the underdog decides to change serving strategy by increasing the percentage of first serves in by five percent, the simulated increased the likelihood of winning the set by three percent. Discussion The results suggest that the simulator that incorporates the faults and in-play match statistics is a more effective approach than using the Markov Chain model. From the results showed, this simulator can be an effective coaching tool to improve player's performance such as altering serving strategy to improve the outcome of the match. References Barnett T, Meyer D, Pollard G. (2008). *Med Sci Tennis*, 13(2), 24-27. Gale D (1971). *Mathematics Magazine*, 44, 197-99. George S (1973). *Appl Stat*, 22, 97-104.

### TACTICAL ANALYSIS IN FOOTBALL. T-PATTERNS RELATED TO COUNTER-ATTACK

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Introduction The detection and analysis of regular structures of behavior in Football has received increasing attention from researchers and trainers. The main purpose of this study was to detect temporal regular structures (t-pattern) of behavior in International Milan (IM 2009/2010) Real Madrid (RM 2010/2011) counter- attack. Methods 24 games (12 of each team) were analyzed. To collect data we used the observational instrument developed and validated by Sarmiento et al. (2010). Software THÈME 5.0, was used in order to detect the existence of t-patterns. This is a professional system for detecting and analyzing hidden patterns in behavior, by performing intensive structural analysis of behavioral data. The study of the reliability shows high levels (above 0.90 for all criteria) for the intra and observer agreement. For pattern detection, we only considered completed patterns, that were repeated 3 times, and the significance level was set at 0.005. Relatively to the results, there are not completed T-patterns related to IM counterattack, and only tree patterns related to RM counterattack . The t-pattern refers to the whole process, from recovering possession of the ball until completing the offensive process (OP) successfully. The analysis of the completed t-pattern allows us to understand that the recovery of possession is due to an interception of the ball in the left corridor of the offensive midfield. The second action happens in the central corridor of the offensive midfield, and it is a ball reception. The process ended when the ball entered the zone eleven (offensive third). Conclusion As noted in previous studies the results demonstrate the potential of THEME 5.0 software for detecting structures of regular behavior in football, but the unpredictability of the game is an obstacle in order to determine the existence of completed patterns. References (1) Sarmiento, H., Anguera, T.; Campaniço, J. & Leirão, J. (2010). Development and Validation of a Notational System to Study the Offensive Process in Football. *Medicina (Kaunas)*, 46(6), 401-407.

### THE SCORING SKILLS THAT DETERMINE THE FINAL OUTCOME OF VOLLEYBALL HIGH LEVEL IN SENIOR MEN'S WORLD LEAGUE 2011

João, P.V.1,2, Mota, M.P.1,2, Paulo, T.N.2

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Introduction The game analysis assumes a leading role so that coaches play a more fruitful part in the direction and conduct of training and competition (João, et al., 2010; Zetou et al., 2007). It is thus intended with this study to determine which of these actions, terminals or non terminals are more influential in the final outcome of the volleyball games in high level teams. Methods This study sample was drawn from two groups of the World League of 2011 Senior Men teams, Group C, Portugal, Finland, Argentina and Serbia and Group B, Russia, Bulgaria, Germany and Japan, composed by  $n = 24$  games. The recording and analysis of the data was performed by the software Data Volley. The discriminating function analysis was used in order to identify indicators that contribute most to establish the maximum difference between wins and losses. We considered as relevant to the interpretation of the linear composites  $|SC| \geq .30$  (Tabachnick & Fidell, 1996). The significance level was set at 5%. The results calculation was performed by the SPSS software version 17.0. Results Regarding the results, only the variable excellent reception differ significantly. The variables that contributed most to the discrimination between defeat and victory were: attack error (SC= -.66), the service error (SC= -.45), excellent service (SC= -.42), opponent error (SC= -.38) and also excellent reception (SC= .36). Discussion The excellent service, excellent reception and opponent's errors variables seem to be associated to victory. The variables, attack error and service error, may be associated with defeat. Since the high level Volleyball teams are very and balanced and with the results obtained in this study, it was concluded to be more important not to miss than to score. References João P V, Leite, N, Mesquita I, Sampaio J. (2010). *Perceptual and Motor Skills*, 111, 3, 893-900. Zetou E, Moustakidis A, Tsigilis N, & Komninakidou A. (2007). *Journal of Quantitative Analysis in Sports*, 3 (4), 1-9.

### A CASE STUDY OF A TOTAL SUPPORT SYSTEM FOR THE ACTIVATION OF YOUTH SPORTS IN MEDIUM-SIZED CITIES

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*Mokpo National University*

Introduction In South Korea today, school physical education policies have shifted the focus from school athletic clubs to school sports clubs for general students. Despite those policy efforts, however, youth sports activities still remain in a poor situation in small local cities. This study thus set out to propose a university-based support system case as a youth sports support system and explore its meanings for the activation of youth sports in small- and medium-sized cities. Methodology As a case study, the study collected cases of networking among university, community, and schooleducational agency) in M, a medium-sized city, and analyzed a series of implementation processes. Results M University held an 'open-Gym (oG)' and 'Youth Sports Festival' to help activate local youth sports. In September, 2012, the university set up the Youth Sports Education Center for the activation of youth sports in the community and took on a project leading the networking efforts between the community and school (educational agency) with initiative. The first step of such efforts was the 'oG'

program. The program was designed to open the gym to adolescents, who would usually devote the evening after school to going to a private educational institute and playing games on the Internet, for free and be run in an autonomous manner by emphasizing autonomy, initiative, and responsibility to adolescents, the participants. Today only the gym is open to them to play basketball and futsal. In addition, a basketball and futsal competition took place as part of 'Youth Sports Festival' in December last year. There was no participation fee in the competition, whose budget was supported by the Athletics Department of M University and a community sports club. The competition was run by the Basketball Team of M University and Youth Sports Education Center and promoted by the local educational agency. A good number of students have shown their interest in the 'oG' program and have started to visit the gym since the Youth Sports Festival. Discussion 'oG' and 'Youth Sports Festival' have become after-school play and exercise places for adolescents in M in the evening and examples of community youth sports education based on the network among university, community, and educational agency. School sports clubs and Sports Day on Saturdays, which are actively facilitated by the government these days, can be actively applied to students and schools in the heart of a city, but they can face many issues due to lack of human resources and facilities and no accessibility in local areas beyond the urban perimeter. A university-community-educational agency support system can be an alternative to solve the problem of policy alienation and promote the activation of youth sports. The case of M University is an important case of a university-based community-educational agency support system.

### THE RUGBY ATTACK ASSESSMENT INSTRUMENT : RESULTS IN A LEARNING SEQUENCE

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**Introduction** The assessment of game performance in team sports made a turn after the emergence of teaching models based on tactics such as TGfU (Bunker & Thorpe, 1982). The GPAI (Osolin et al., 1998) and the TSAP (Gréhaigne et al., 1997) are the most used tests to assess performance in this context (Arias & Castejón, 2012; Memmert & Harvey, 2008). The purpose of this paper is to present the results obtained applying the RAAI, an instrument used to assess the actions of the ball carrier in a learning sequence of rugby. **Methods** The RAAI is based on the video analysis of a 5 vs. 5 situation of simplified rugby. The units of analysis are the actions of the players with the ball. These actions are codified as favourable actions (F) or unfavourable actions (D) in relation to the principles of the game. Actions are also identified as simple actions (S) or combined actions (C). To obtain the Index of Performance (IP) all actions are weighted with magnitude and sign (positive/negative) according to its tactical relevance. Four trials were performed during a learning sequence of 11 sessions with 10 novice players. **Results** The IP values for the four trials were 58.4, 54.1, 51.0 and 55.4 for team A, and 55.6, 55.9, 50.8 and 58.6 for team B. Other specific data emerge from the use of RAAI, for example, the total number of weighted F actions of both teams: 159, 136, 120 and 176, or the total number of weighted D actions: 19, 29, 34, 30. **Discussion** With the present results, the RAAI can be a useful instrument to assess ball carrier's actions (Llobet et al., 2012). However, there are some issues that need revision: (a) the value of some partial actions weights on the IP, (b) some actions outside the IP, like the number of passes or the amount of defence breaks, and (c) the absolute number of observed actions. Further research should contemplate these considerations. **References** Arias, JL & Castejón, FJ (2012). Review of the Instruments Most Frequently Employed to Assess Tactics in Physical Education and Youth Sports. *J Teach PE*, 31, 381-391. Bunker, D & Thorpe, RD (1982). A model for the teaching of games in secondary school. *Bulletin PE*, 18 (1), 40-44. Gréhaigne, JF, Godbout, P & Bouthier, D (1997). Performance assessment in team sports. *J Teach PE*, 16, 500-516. Llobet, B, López-Ros, V, Barrera-Gómez, J & Comino, J (2012). The assessment of tactical performance in rugby union (RAAI). 5th Conference of TGfU. Loughborough U. Memmert, D & Harvey, S (2008) The GPAI: some concerns and solutions for further development. *J Teach PE*, 27, 220-240. Osolin, JL, Mitchell, SA & Griffin, LL (1998) The Game Performance Assessment Instrument (GPAI): development and preliminary validation. *J Teach PE*, 17, 231-243.

### EFFECT OF RESISTANCE TRAINING ON BDNF EXPRESSION AND MUSCLE QUALITY IN TYPE 2 DIABETIC SKELETAL MUSCLE

Song, W., Kim, H., Oh, S., Kim, Y.

*Seoul National University*

**Introduction** Recent evidence demonstrates that brain-derived neurotrophic factor (BDNF) plays a role not only in central metabolism, but also in regulating energy metabolism in peripheral organs. However, the changes of BDNF expression following resistance training in diabetic skeletal muscle with severe glucose tolerance have not fully established. The purpose of this study was to investigate the effect of progressive resistance training on BDNF expression and its relation to muscle quality in ZDF (Zucker diabetic fatty) rat skeletal muscle. **Methods** Six week-old male ZDF and ZLC (Zucker lean control) rats were randomly divided into 3 groups: sedentary ZLC (ZLC-Con), sedentary ZDF (ZDF-Con), and exercised ZDF (ZDF-Ex). ZDF-Ex rats were trained (once every 3 days for 8 weeks) to climb a 1.1-m vertical (80° incline) ladder with weight secured to their tail for progressive resistance exercise. Body weight, grip strength, and glucose tolerance were evaluated at every weekend. The volume of skeletal muscle was analyzed by PET-CT (positron emission tomography-computed tomography) and expression of BDNF was measured using ELISA in extracted skeletal muscles. **Results** After 8 weeks of resistance training, substantial reduction of body weight was observed in ZDF-Ex compared to ZDF-Con. Grip strength and muscle quality was significantly increased ( $p < 0.05$ ) in ZDF-Ex compared to ZDF-Con without change of the skeletal muscle volume (hypertrophy). The area under the curve (AUC) values of plasma glucose during glucose tolerance test in ZDF-Ex was significantly reduced ( $p < 0.05$ ) compared to ZDF-Con. In solves, expression of BDNF was increased in ZDF-Con, but significantly decreased ( $p < 0.05$ ) in ZDF-Ex showing training effect. Moreover, we found that there was a negative correlation ( $r = -0.657$ ;  $p = 0.004$ ) between grip strength and BDNF expression whereas there was a positive correlation ( $r = 0.612$ ;  $p = 0.008$ ) between plasma glucose level and BDNF expression in skeletal muscle. **Discussion** Progressive resistance training significantly improved grip strength and glucose tolerance in type 2 diabetic rats. Although the volume of total skeletal muscle was not changed following 8 weeks of resistance training, significant improvement of muscle quality (weight/volume) was found in ZDF-Ex compared to ZDF-Con suggesting substantial muscle function seems to be increased. Regarding BDNF expression in skeletal muscle, resistance training is likely to decrease BDNF levels in type 2 diabetic skeletal muscle including soleus, tibialis anterior and EDL muscles. Based upon our results, muscle-derived BDNF might be a potential mediator for the preventive effect of resistance training on progress of type 2 diabetes, however, further research is needed to elucidate the regulatory role of muscle-derived BDNF in type 2 diabetic skeletal muscle.

15:00 - 16:00

## Mini-Orals

## PP-SH08 Psychology [PS] 1

**WORKING MEMORY CAPACITY AS CONTROLLED ATTENTION IN SPORTS**

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**Introduction** The controlled attention theory (CAT, Engle, 2002) of working memory suggests that working memory capacity (WMC) represents a domain free limitation in the ability to control attention and is predictive of an individual's capability of staying focused, avoiding distraction, and impulsive errors. In two experiments (Furley & Memmert, 2012) we tested the predictive power of WMC in computer-based sport tasks. **Method** In our general methodological approach we sampled the WMC of athletes (69 basketball players; 55 ice-hockey players) using complex span measures (e.g. Engle, 2002) and subsequently invited the upper and lower quartiles of the distribution to take computer based sport tasks. In Experiment 1 basketball players had to perform a speeded forced-choice basketball decision making task under auditory distraction conditions (di- and monosyllabic nouns) using stereo head-phones. After a certain time the first name of the participant appeared (once) in the distracting auditory stream and participants were asked at the end of the task whether they had noticed their name. In Experiment 2 ice-hockey players performed a speeded forced-choice ice-hockey decision making task. Some decision making trials were preceded by a simulated team time-out in which participants received tactical information from a virtual coach. The experimental manipulation involved whether the tactical information received from the coach "fits" a subsequent game situation—valid information—or does not fit the game situation—invalid information. **Results** Experiment 1: In line with CAT we found that low WMC athletes performed worse on the decision making task ( $p = .0001$ ) and were more prone to distraction (noticed name more often;  $p = .002$ ) which was further supported by a significant correlation of WMC and a questionnaire measuring distractibility in everyday life ( $r = -.37$ ,  $p = .001$ ). Experiment 2: Again, in line with CAT low span ice-hockey players were more likely to follow the tactical information given in a time-out, if it did not fit the subsequent game situation (invalid trial,  $p = .004$ ) and failed to adapt their decision according to the game situation. **Discussion** Based on these findings WMC measures are promising in identifying people who have a superior ability to control their attention: i.e. staying focused on performance and blocking out irrelevant distraction and resolving response competition in interference situations. **References** Furley, P., & Memmert, D. (2012). Working Memory Capacity as controlled attention in tactical decision making. *Journal of Sport and Exercise Psychology*, 34, 322–344. Engle, R.W. (2002). Working Memory Capacity as Executive Attention. *Current Directions In Psychological Science*, 11, 19–23.

**THE PARADOX OF TRAUMA AND PSYCHOLOGICAL GROWTH: EXAMINING THE EXPERIENCES OF PARALYMPIC ATHLETES**

Day, M.C.

*University of Chichester*

**Introduction** It is clear that the occurrence of a traumatic and disabling injury can present the individual with a multitude of life changes. Yet while research has predominantly concentrated on the negative impacts of trauma, an emerging body of research has supported the notion of posttraumatic growth. This study aimed to examine the positive experiences of athletes with an acquired disability caused by physical trauma, prior to competing in the London 2012 Paralympic Games. **Methods** Participants were 7 Paralympic athletes representing a wide range of sports, including both team or partnered sports, and individual sports. Participants took part in either 2 or 3 life history interviews. These interviews lasted between 2.5 and 4 hours. A holistic content analysis was used to focus on the content presented in each participant's story. This method allows for the patterns and themes within the narratives to be revealed. **Results** A number of themes emerged which demonstrate how being a Paralympic athlete allowed participants to experience psychological growth following trauma. All participants outlined initial difficulties accepting and adjusting to disability, reported feeling socially isolated, and struggled to find purpose and meaning in their lives. Yet despite these experiences, participation in Paralympic sport allowed participants to reconstruct their self and identity, to gain social support and understanding through shared experiences, re-enforced coping ability, and enhanced determination. While latter themes were inherently positive, results highlight that psychological growth is gradual, often emerging alongside negative experiences of trauma. **Discussion** Results highlight the complexities associated with posttraumatic growth. While post-traumatic growth and posttraumatic stress have often been viewed as separate entities, this research supports the emerging perspective that these should be considered together in order to understand the experience of the individual. This study highlights the importance for research and practice to consider that growth can not only occur alongside trauma symptoms, but further, that the experience and acceptance of negative symptoms may even form part of the process of achieving positive growth. Consequently, the 'supercrip' stereotype, often associated with those who achieve after disability, may conceal the difficulties and complexities associated with achieving posttraumatic growth.

**COGNITIVE FUNCTION IN OBESITY: INTERVAL VERSUS CONTINUOUS EXERCISE INTERVENTION**

Weeks, A., Khalil, A., Harris, E., Dye, L., Birch, K.M., Lawton, C.L.

*University of Leeds*

**Introduction** Cognitive deficits in executive function, verbal memory and attention have been observed in obese subjects when compared to healthy weight controls (1), with cardiovascular risk factors suggested as mechanisms. The domains vulnerable to impairment in obesity are responsive to change via aerobic exercise in non-obese samples (2). However, aerobic exercise has not been investigated as a tool for improving cognitive function in obese subjects. The aim of the study was to investigate the effect of interval (INT) or continuous (CON) aerobic exercise training on cognitive function and cardiometabolic risk factors in middle-aged women. **Methods** 20 women (42±1 yrs, BMI 31.9±3.6 km/m<sup>2</sup>) completed tests of executive function, verbal memory and attention. Subjects were assessed for body composition and cardiovascular fitness and randomised to CON (n=10) or INT (n=10) cycle ergometer training groups. Groups exercised twice/week for 12 weeks in the heavy intensity domain, matched for work (KJ). The work/recovery ratio for INT was 40s:80s. Baseline tests

were repeated at week 6 and 13. Results Following CON, delayed verbal recall significantly increased (pre  $9.78 \pm 1.99$ , mid  $13.44 \pm 2.60$  words) whereas INT did not change (pre  $10.67 \pm 3.04$ , mid  $10.88 \pm 3.01$ ; gp x time interaction  $p < 0.05$ ). A trend for significance was observed following INT for a reduction in time to solve an executive function task (pre  $265.84 \pm 60.94$ s, post  $219.55 \pm 57.21$ s), whereas CON showed less improvement (pre  $242.53 \pm 60.94$ s, post  $235.32 \pm 76.48$ s; gp x time interaction  $p = 0.09$ ). Although not significant, absolute  $VO_2\max$  increased in INT (pre  $2081.36 \pm 430.45$ , post  $2131.14 \pm 367.04$  ml/min) and CON (pre  $2118.68 \pm 287.18$ , post  $2193.41 \pm 270.78$  ml/min  $p > 0.05$ ). Systolic blood pressure (SBP), although non-significant decreased following INT (pre  $124.3 \pm 11.37$ , post  $118.70 \pm 7.31$  mm/Hg) and did not change following CON (pre  $124.8 \pm 15.27$ , post  $124.1 \pm 14.75$  mm/Hg,  $p > 0.05$ ). Discussion Superior improvements were observed in delayed verbal memory for CON, whereas INT demonstrated greater improvements in executive function,  $VO_2\max$  and SBP. Verbal memory is supported by the hippocampus and linked with glucoregulation and insulin sensitivity (3), suggesting the work/recovery ratio for INT was not appropriate for such metabolic changes. The enhanced alteration in SBP and oxygen uptake in INT may serve to drive executive function in the dorsolateral and medial frontal cortices (2, 4). References 1. Selbom & Gunstad, (2012) Journal of Alzheimer's Disease 30, 1–7 2. Erickson et al., (2012), Aging Research 3(1), 34–47 3. Awad et al, (2002), Behavioral Neuroscience, 116, No. 4, 691–702 4. Bucur and Madden, (2010), Experimental Aging Research, 36: 153–168

### THE EFFECTS OF AN EXERCISE INTERVENTION ON SYMPTOMS OF PREMENSTRUAL SYNDROME AND QUALITY OF LIFE

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Introduction Premenstrual syndrome (PMS) is a diverse collection of symptoms affecting 75–85% of women of reproductive age during the luteal phase of the menstrual cycle. Previous observations have suggested that physically-active women report fewer PMS symptoms compared to sedentary individuals (Choi and Salmon, 1995). However, few studies have confirmed any effect of an exercise intervention in previously sedentary individuals, nor have they been able to identify potential mechanisms. The current study investigated whether a moderate intensity exercise intervention had any effect on PMS symptoms and Quality of Life (QoL) and whether any such effect is mediated by changes in plasma sex hormone concentrations. Methods Twenty-five sedentary women, identified as suffering moderate PMS symptoms, were recruited to a randomised control trial spanning four menstrual cycles, the first served as a baseline followed by three cycles of intervention. Participants were randomised into either an exercise (EX) group ( $n=13$ ), which involved three supervised 30-minute moderate-intensity (70–80% HR max) exercise sessions per week, or to a control (CON) group ( $n=12$ ) which included a 90-minute, one-to-one meeting once per week with the investigator. Venous blood samples were collected three times per week during cycle 1 and cycle 4 to determine plasma estradiol and progesterone concentrations. PMS symptoms were evaluated every other day by a prospective symptom questionnaire throughout the study (Moos, 1968). Results Participants assigned to the EX group showed a reduction in PMS symptoms between cycles 1 and 4 (pain, water retention, autonomic reaction & impaired concentration,  $P < 0.05$ ), whereas no difference was observed in the CON group. Neither group showed any differences in arousal, although the EX group demonstrated a marginal reduction in negative affect ( $P = 0.07$ ) and behaviour change ( $P = 0.08$ ) that was not observed in the CON group. A 15% decrease in total symptom scores was reported between cycle 1 and cycle 4 in the EX group. The EX group also reported a 13% reduction in the number of 'unhealthy' QoL days during cycle 4 compared with cycle 1 ( $P < 0.05$ ). There were no differences in QoL indices in the CON group. No differences were observed in peak plasma estradiol or progesterone concentrations between cycle 1 and cycle 4, in either the EX group or CON group. Discussion Moderate-intensity exercise over three months may reduce the symptoms of PMS and improve QoL; however this effect is not mediated by changes in plasma estradiol or progesterone concentrations References Choi PYL, Salmon P (1995). Br J Clin Psychol, 34, 447–460. Moos RH (1968). Psycho Med, 30(6), 853–867.

### PSYCHOLOGICAL STATE ASSOCIATED WITH MENSTRUAL CYCLE PHASES IN WELL TRAINED AND RECREATIONAL ATHLETES.

Tengah, R.1, Mohd Rasyid, N.1, Mokhtar, A.B.2, Yusof, A.2

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Introduction The aim of this study was to determine attitudes towards menstrual cycles in well trained and recreational athletes. Methods Attitudes toward menstruation were assessed by Menstrual Attitude Questionnaire (MAQ). Subjects were asked to fill the questionnaires before menses. Participants were 16 elite athletes and 17 recreational athletes, respectively 19 - 26 years old. Results Well trained athletes (WTA) gave the highest mean agreement on attitude towards menstrual cycle rating from subscale "menstruation is natural event" ( $5.11 \pm 0.55$ ), followed by "anticipation and prediction of onset of menstruation" ( $4.95 \pm 0.59$ ), "menstruation is a debilitating event" ( $4.42 \pm 0.46$ ), "menstruation is bothersome event" ( $4.33 \pm 0.55$ ) and "denial of any effect of menstruation" ( $3.96 \pm 0.62$ ). Recreational athletes (RA) attitude towards menstrual cycle ranked from "menstruation is natural event" ( $5.26 \pm 0.36$ ), followed by "anticipation and prediction of onset of menstruation" ( $5.26 \pm 0.65$ ), "menstruation is bothersome event" ( $4.63 \pm 0.69$ ), then "menstruation is a debilitating event" ( $4.52 \pm 0.62$ ), and finally "denial of any effect of menstruation" ( $3.32 \pm 0.83$ ). Even though attitude toward menstrual cycle in WTA and RA are about the same but there is significant different in subscale denial of any effect of menstruation. Independent samples t-test showed there was a significant difference on the subscale denial of any effect of menstruation between groups,  $t(31) = 2.517$ ,  $p < 0.05$ . Well trained athletes ( $3.96 \pm 0.62$ ) strongly denied that they were affected by the menstrual cycle compared to recreational athletes ( $3.32 \pm 0.83$ ). Discussion The findings of this study suggested that both well trained and recreational athletes believed menstrual cycle is a natural event and they can predict and anticipate of onset of menstruation very well. However they claimed that menstruation is a bothersome and debilitating event. One of the most significant findings of the attitude towards menstruation was on dimension of 'denial of any effect of menstruation'. This observation suggests that well trained athlete deny of any effect of menstruation in their daily life although they need to be involved in strenuous exercises or activities. Therefore a strong need for denial will help these athletes to accept changes in their body, and not turning their symptoms into uncontrolled behaviours. It is known that the need for denial is related to the desire or tendency to submit passively to external force, to admit inferiority, error or failure (Gaion, et al., 2011). Thus, as the way to reject failure in performance female athletes shall be provided with the menstruation knowledge campaign and coping strategies intervention. References Chang, Y.T., & Chen, Y.C., (2009). Study of Menstrual Attitudes and Distress Among Postmenarcheal Female Students in Hualien County. Journal of Nursing Research. 17 (1), 20–29. Gaion, P.A., & Vieira, L.F. (2011). Influence of Personality on Pre-menstrual Syndrome in Athletes. The Spanish Journal of Psychology, 14 (1), 336–343.

## DIABETES ASSOCIATED COGNITIVE DECLINE IN PATIENTS WITH TYPE 1 DIABETES, AN EPIDEMIOLOGICAL CROSS SECTIONAL STUDY.

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**Introduction** Type 1 Diabetes (T1D) can have a significant impact on brain function, better known as a Diabetes Associated Cognitive Decline (DACD) (1). In the last decennia there is a growing interest in the relationship between physical activity (PA) and cognitive function (CF) (2-4). In patients with T1D, surprisingly few studies have been conducted regarding the effects of PA on CF. Therefore, the purpose of this study is to evaluate possible predictors of a DACD, and to investigate the relation between the level of PA, diabetes associated factors and CF in T1D. **Methods** A cross-sectional study was performed using 2 questionnaires (Barriers of Physical Activity in Type 1 Diabetes, International Physical Activity Questionnaire) and 5 cognitive tests (TMTA & B, the STROOP test, the OSPAN test and the SMT) in T1D adults. Blood samples were collected to determine markers of neuroplasticity (e.g. IGF-1), and glycaeted haemoglobin (HbA1c), an indicator of chronic glycaemic control. Statistical analysis was performed using single and multiple regression analysis. Differences were considered significant when  $p < 0.05$  was achieved. **Results** A total of 98 T1D subjects (51 males, 47 females; mean age 36.87 ( $\pm 14.39$ ) yrs) participated in this study. Episodes of severe hypoglycaemia ( $p = 0.027$ ), poor chronic glycaemic control ( $p = 0.027$ ), poor performance in the memory ( $p = 0.44$ ) and executive function ( $p = 0.021$ ) domain predict a negative influence on attention ( $R^2 = 0.99$ ). The strongest predictors of a DACD in the executive function were a combination of age ( $p = 0.00$ ), poor memory performance ( $p = 0.00$ ) and having a long diabetes duration ( $R^2 = 0.996$ ). In men, level of PA was also a predictor of a DACD ( $R^2 = 0.22$ ;  $p = 0.020$ ). Education ( $p = 0.005$ ), poor performance on the executive function ( $p = 0.00$ ,  $R^2 = 0.98$ ). Diabetes duration ( $p = 0.029$ ,  $R^2 = 0.97$ ) significantly predicted a DACD in the spatial memory function in female T1D patients. Preliminary data of IGF-1 did not show significant results. **Discussion** A combination of personal (e.g. age, level of PA, education, level of PA) and diabetes associated factors (e.g. episodes of severe hypoglycaemia, diabetes duration and poor glycaemic control) can induce a DACD. This suggests that aggressive glucose management (e.g. glycaemic control, preventing hypoglycaemic episodes and the prevention of other diabetes associated complications) with the combination of PA could be a preventive tool for the control of a DACD. **References** (1) Mijnhout GS, et al. *Diabetologia*. 2006 Jun;49(6):1447-8 (2) Hillman CH, et al. *Nat Rev Neurosci*. 2008;9(1):58-65 (3) Erickson KI, et al. *Proc Natl Acad Sci USA*. 2011;108(7):3017-22. (4) Kramer AF, et al. *J Appl Physiol*. 2006;101(4):1237-42

## THE USE OF MINDFULNESS IN SPORT PSYCHOLOGY: A SYSTEMATIC REVIEW

Sole, S., Palmi, J.

INEFC Lleida

**Introduction** A psycho-social approach in the different aspects of Sport Psychology is very important to face the challenges that the sportists find in their careers. To look for a higher performance with a minimum injuries' risk will allow them a sustainable practice, maintaining the sportist's quality of life and well-being. The objective of this study is to make a systematic review about the use of mindfulness concept in the world of Sport Psychology. Mindfulness is an ancient concept that comes from "sattī", a Sanskrit word and has not a clear translation. It is a way of paying attention that originated in Eastern meditation practices. It has been described as "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (Kabat-Zinn, 1990). Mindfulness is situated in the called third generation in Behavioural Therapy model, (Hayes, 2002). **Methods** A literature research was taken using Medline, Psychinfo, Web of Science, Cochrane, Ebscohost, Isi Web of Knowledge databases and references of retrieved articles. The search included original articles, books and dissertation published since 1985 to 2012. For the final selection the books and dissertations were excluded. The main search terms were mindfulness, sports and sport psychology. All articles were coded for their design, type of control, study population and outcome measures. Nine studies were considered eligible for the present review and are presented in a table. **Results** In this present review we can observe that there are a few number of studies, with little samples and methodological limitations, such as nonrandomization. Despite of this, the preliminary results indicate that the use of mindfulness-based interventions can increase the sport performance (Bernier et al, 2009, Gardner & Moore, 2004, Lutkenhouse, 2007, Shwanhausser, 2009, Shaji John et al, 2011, Thompson et al, 2011). In addition to this, mindfulness levels increased significantly (Aherne et al, 2011, Kauffman et al, 2009, Schwanhausser, 2009, Thompson et al, 2011) and a significant reduction of pre-competition stress and anxiety was found (Gardner & Moore, 2004, Schwanhausser, 2009, Shaji John et al, 2011, Thompson et al, 2011). **Discussion and Conclusions** Although the use of mindfulness in sport psychology is very new, it seems that it can be a promising research line. Two mindfulness-based interventions are already being used: the Mindfulness-Acceptance-Commitment Approach (MAC) and Mindfulness Sport Performance Enhancement (MSPE). To confirm their efficacy, it would be also necessary to understand better the physio-neurological mechanisms, to adapt it to different sports or evaluate physiological variables as well. New mindfulness-based interventions with a better research methodology are suggested and will be the objective of future studies.

## OPINIONS AND PERCEPTIONS OF POLICY MAKERS TOWARDS PROMOTION OF PHYSICAL ACTIVITY

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Because most adults in industrialized countries do not meet physical activity guidelines, population-wide interventions are needed. Environmental and policy interventions are based on ecological models of behavior and have the potential to influence entire populations. Policy refers to legislative, regulatory, or policy-making actions that have the potential to affect physical activity. Policies are organizational statements or rules that are meant to influence behavior. They may be explicit or implicit and their effects can be intentional or unintentional. Policies are considered sociocultural influences because people often make policies to respond to the perceived needs or desires of their constituents. On this regard, it is important to take into consideration policymakers' opinions and perceptions. An e-mail survey of 175 mayors of the Emilia Romagna and Piemonte regions (Italy) was conducted. This survey investigated mayors' attitudes toward physical activity promotion and their perceptions. Most of the participants rated as very important the promotion of physical activity. However, they think it is not so easy to motivate citizens. Among the most feasible ways to promote physical activity, participants reported promotion of walking groups and low-threshold interventions. Most of the participants reported that lack of resources is one of the most important barriers to promote physical activity.

## THE PHENOMENON OF DOPING FROM THE PERSPECTIVE OF THE SPANISH OLYMPIC CYCLING NATIONAL TEAMS

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THE PHENOMENON OF DOPING FROM THE PERSPECTIVE OF THE SPANISH OLYMPIC CYCLING NATIONAL TEAMS Morente-Sánchez, J.I, Freire, C.I, & Zabala, M.I. 1 Faculty of Sport Sciences, University of Granada (Spain) 2 Spanish Cycling Federation, Madrid (Spain) Introduction Recent events such as "Operation Puerto" in 2006 or the dispossessions of the 7 Tours of France to Lance Armstrong in 2012 have made cycling lose much of its credibility from a social point of view [1]. The aim of this study was to know and compare the opinion of the Spanish cyclists about doping discriminating according to Olympic disciplines. Methods A sample of 72 Spanish national team cyclists, (19.7±4.7 years, 51 males, 21 females) was divided into four groups according to the 4 different Olympic cycling disciplines: Mountain bike -MTB- (n = 18), Bicycle Moto Cross -BMX- (n = 12), Track -TRA- (n=9) and Road -ROA-(n=33). A descriptive design was carried out using a bespoke questionnaire consisting in 7 free-response questions whose answers were analyzed and categorized. Results Data were expressed in terms of percentage of participants who mentioned some (one, two or three) of the three most mentioned statements (% n), and were shown in the following order: "Total sample"; MTB, BMX, Track and Road. 1- Words associated with doping: Cheating ("44.6"; 50.0%, 33.3%, 66.7%, 42.4%), Lie ("28.4"; 55.6%, 0, 22.2%, 27.3%). 2- Responsible agents of Doping: Doctor ("51.3"; 50.0%, 8.3%, 11.1%, 84.8%), Cyclists ("48.6"; 55.6%, 41.7%, 33.3%, 45.5%), and Coach/Manager ("40.5"; 22.2%, 16.7%, 11.1%, 63.6%). 3- Differences Cycling vs Other sports: Different treatment ("47.3"; 27.7%, 16.7%, 55.6%, 66.7%), Numbers of controls ("20.3"; 27.8%, 8.3%, 22.2%, 30.3%). 4- Reasons for initiation in doping: Sport achievements ("44.6"; 44.4%, 25.0%, 88.9%, 100%), External pressures ("28.4"; 38.9%, 8.3%, 11.1%, 39.4%), Contract/money ("25.7"; 22.2%, 25.0%, 55.6%, 27.3%) 5 - Have you ever been suggested to dope? "Yes" ("5/72"; 1/33, 0, 1/12, 3/9) 6 - Have you ever seen another person inciting/being incited? "Yes" ("7/72"; 2/33, 0, 1/12, 4/9). 7- Proposed solutions: the three most mentioned suggestion to eradicate doping in sport were "More controls" ("41.9"; 72.2, 41.7, 44.4, 36.3), Prevention early ages ("21.62"; 27.8%, 8.3%, 22.2%, 24.2%), No solution ("20.3%; 0, 33.3%, 22.2%, 27.3%). Discussion Low percentage of cyclists saw a was suggested to dope (<10%). "Doctor" was the main responsible agent o doping only for ROA, others groups focused on "cyclists". "Sport achievement" was the main reason while "More controls" the main proposed solution. It is claimed prevention in early ages as it was suggested in previous studies [1, 2]. It would be interesting to propose similar studies in other type of sports to make comparisons. References 1. Morente-Sánchez J, Zabala M. Sports Medicine 2013 May; 43(2): ahead of print. 2. Alaranta A, et al. Int J Sports Med 2006; 27: 842-846.

## PSYCHOLOGICAL FACTORS TOWARD TO DOPING AND SUBSTANCE ABUSE IN IRANIAN ELITE ATHLETES

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Introduction: Doping is regularly studied in sports, but we have found no such data for elite athletes. We have studied doping in athletes at 2011-2012. The researcher-made questionnaire for studying doping and psychological factors was used. This study aimed to determine the relations between cognitive variables (self-efficacy, locus of Control, and dysfunctional attitudes) and psychological factors with using doping agents in elite athletes. Methods: We conducted a case-control study in Iran among elite athletes using 100 athletic drug users with reported use as a case group and 100 athletic nonusers and 100 nonathletic nonusers as controls that were matched on salient demographics (aged 18 years or older). Controls selected by a simple random sampling. They were then studied by self-efficacy questionnaire, locus of control scale, dysfunctional attitude scale, and general health questionnaire. Hypotheses tested by variance analysis and Tukey's test. In addition, outcome measures included sport orientation (win and goal orientation and competitiveness), doping attitude, beliefs and self-reported past or current use of doping. A structural equation model was developed based on the strength of relationships between these outcome measures. Results: Our findings showed that athletic drug users had a lower self-efficacy, more dysfunctional attitudes, and exhibited external locus of control rather than control groups. They were also more sensitive to psychological morbidity. Most of relations were statistically significant. Discussion: In general, the possible reasons toward doping including: 1) the athlete is given the chance of becoming a member of a famous team, of financial gain, social recognition, and national fame. 2) The coach and the medical team may play an important role in strengthening the pressure to train and assisting in the attempts to fulfill the training schedule irrespective of any signs and indications of fatigue or over training. 3) The athlete who is most at risk of taking forbidden substances is the one who tries to conform to the picture of a 'super person' that the sport system wants him or her to represent, and this may mean that he/she feels the need to cheat. 4) The athlete may develop a psychological imbalance and a loss of self-confidence to cope with the pressure to excel by his or her own means. In this situation, doping may offer to the athlete a quick solution for coping with the extant pressure. Our findings were in accordance with the theoretical basis of cognitive psychology. More than 85% of all the athletes included in our study do rely on coaches. In other words, the pressure for the first by coach, Join and stable in national team, fear of failure in competition and winning at any cost are important factors for players that they are toward doping and substance abuse. In conclusion, we strongly suggest permanent educational anti-doping programs and sport psychology for elite athletes as well as for their coaches and physicians.

## SEARCHING FOR THE PERFECT EXPERIENCE: THROUGH THE COMPARATIVE EXAMINATION OF THE HIP – HOP DANCE AND HANDBALL

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Introduction In hip-hop dance it's evident that Flow-experience evolves in hip-hop dancers really soon, because it allows freer motions and happens to music which can cause stream experience if we seriously pay attention for it. On the other hand, in playing handball the number of collisions, violence and aggression is too much which can block that feeling. Csikszentmihályi in 1991 defined Flow first. Susan A. and Csikszentmihályi studied the contact of the sport and Flow in 2001. Karageorghis (1999) made more previous researches about Flow and the music. Looking through the pre-Flow researches I didn't find an answer for in the dance what kind of level is Flow? In playing handball is Flow present or not, what kind of level on and do the two values show significance? My hypothesis 'that in hip-hop dancing the value of Flow is much higher. Methods The method of the research happened with the distribution of a three-page questionnaire which in I used Oláh's questionnaire (Oláh, 2005, page 141-143) and 26 attributes for the expression of Flow-state (Jackson and Csikszentmihályi, 2001, page 22). The experimental group consists of 18 and 23-years old handball players (70 people), the control group consists of 18 and 23-years old competition hip-hop dancers (70 people). Results The results supported my hypothesis that at hip-hop

dancers the value of Flow is much higher than at handball players, but this isn't excluded to be fulfilled. It's shocking I got high Flow value in the handball. The feeling of weariness and discomfort is higher in the handball. All results were significant maximally, so the results don't due to accidental. Discussion We have already known that the dance is very strong in the feeling of FLOW. But that was the very first examination that show us the FLOW level of team handball: You play hard and tough however you enjoy it and be in the Zone! References Jackson, S., Csíkszentmihályi, M. (2001): Sport és Flow. Vince Kiadó, Budapest. Karageorghis (1999): Entering „The Zone”: A Guide for Coaches, In.: The Sport Journal, vol 2. num 3. 2012. október 10. <http://www.thesportjournal.org/article/entering-zone-guide-coaches> Szabó, Balogh et al (2009): The Effects of fast- and slow-tempo music on recreational basketball training, In.: International Quarterly of Sport Science, vol 2. 2010. október 11. [http://www.iqss.eu/issue/20092/1\\_szabo\\_et\\_al\\_IQSS\\_2009\\_2.pdf](http://www.iqss.eu/issue/20092/1_szabo_et_al_IQSS_2009_2.pdf)

### PSYCHOLOGICAL DEVELOPMENT ACROSS AN INTENSIVE WRESTLING CAMP: A MIXED METHOD CASE STUDY

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*Michigan State University*

**Introduction** There has been an increased interest in studying how sport can influence psychological growth and development in recent years (Gould et al., 2012; Larson et al., 2006). Despite this interest, little attention has been paid to the process of development, especially at the individual level. An intensive wrestling camp in the United States, following an Army Ranger approach to training, promised improvements in psychological development. The purpose of this study was to provide an idiographic examination of psychological development across the camp and evaluate the effectiveness on development of one of the athletes enrolled. **Methods** An in-depth case study was conducted on one male wrestler, age 16, who attended an intensive 14 day wrestling camp. He was selected because he reported psychological gains that allowed the researchers to understand the specifics of development. In-depth interviews were conducted prior to and immediately after the camp and 8 months later after a full season of competition. A parent and a coach will be interviewed at follow-up to triangulate information from athlete interviews. Two researchers were embedded at the camp, making observations and field notes. The athlete completed a pre, post and follow-up camp questionnaire, which employed psychometrically valid instruments. An idiographic profile was created for the athlete using questionnaire data, hierarchical content-analysis, field notes and observations. The resulting profile provided a narrative of psychological development from the beginning to the end of camp (8 month follow-up underway). **Results** The athlete made gains in psychological and life-skills across camp, including imagery, goal-setting, responsibility, and accountability, as well as wrestling skills. Additionally, the athlete consciously identified the significance of psychological skills, such as personal responsibility, to help him deal life events off the mat. Presence of a reflective style and good work ethic entering camp, and readiness to reflect on and learn from camp experiences were important contributors to development. Additionally, interactions with camp counselors, other wrestlers, and the camp structure influenced development. Results from 8-month follow up will also be presented. **Discussion** Camp participation enhanced psychological and life skills development. Results are consistent with research in non-sport settings that suggests youth learn from the surrounding culture and environment to enhance understanding of emotional episodes (Larson & Brown, 2007). The intense Army Ranger nature of the camp will be discussed as it differs from typical youth sport programs and links to achievement goal theory will be made. The 8 month follow-up will be used to examine lasting influence of the camp. **References** Gould, D., Flett, M.R., & Lauer, L. (2012). *Psych of Sport & Exer*, 13(1), 80-87 Larson, R., & Brown, J.R. (2007). *Child Dev*, 78, 1083-1099 Larson, R., Hansen, D., & Moneta, G. (2006). *Dev Psychol*, 42(5), 849-863

### THE INFLUENCE OF ACUTE BOUT OF MODERATE-INTENSITY WALKING ON EXECUTIVE FUNCTION IN ADOLESCENTS

Soga, K.1, Shishido, T.2, Nagatomi, R.1

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**Introduction** During moderate-intensity aerobic exercise, it was reported that executive function (EF) transiently declines in young adults aged 18-24 yr (Pontifex & Hillman., 2007). In preadolescents aged 9-11 yr, however, EF was demonstrated to be maintained during and after moderate-intensity walking (Drollette et al., 2012). It was, therefore suggested that exercise influence on EF may change depending on the age group probably due to the development or maturation of the brain and its function. The purpose of this study was to demonstrate the effect of moderate intensity exercise on EF in adolescence when brain tissue becomes structurally stable. **Methods** EF was assessed using a modified flanker task and a modified spatial n (0, 1, 2) - back task to assess inhibitory control and working memory (WM), respectively. In a randomized within-subjects counterbalance design, twenty eight Japanese adolescents aged 15-16 yr (mean age = 15.7 ± 0.5 yr) completed cognitive tasks under following conditions: 1) walking on treadmill at 60 to 70 % of estimated maximum heart rate for approximately 15 minutes, and 2) seated on a chair for approximately 15 minutes. Tasks were performed in a randomized order with an interval of at least one day. **Results** Response accuracy in Flanker task did not change during-exercise as compared to baseline before the exercise (95.0% ± 4.4% vs. 96.0% ± 3.6%,  $p > 0.05$ ), but increased after-exercise as compared to during-exercise (96.9% ± 3.0% vs. 95.0% ± 4.4%,  $p < 0.01$ ). Reaction time (RT) in n-back task was shortened after-exercise compared to during-exercise (418.2ms ± 87.6ms vs. 449.1ms ± 62.6ms,  $p < 0.01$ ), and elongated during-exercise compared to resting state (449.1 ms ± 72.2 ms vs. 406.8 ms ± 62.6 ms,  $p < 0.01$ ). **Discussion** There was a discrepancy in the effect of moderate exercise on 2 EF tasks in adolescents. There was substantially no effect of exercise on inhibition control, whereas a transient decline in WM function was observed during moderate intensity exercise. These findings may represent a transitional stage of maturation of brain function in the adolescence. **References** Pontifex M. B. Hillman C. H. (2007). *Clinl Neurophysiol*, 118(3), 570-80. Drollette E. S, Shishido T, Pontifex M. B, Hillman C. H. (2012). *Med Sci Sports Exerc*, (23), 2017-2024

15:00 - 16:00

## Mini-Orals

### PP-SH18 Sociology [SO] 2

#### MUSLIM MAGHRIBIAN WOMEN WAYS OF PARTICIPATION IN SPORT AND PHYSICAL ACTIVITY IN CATALONIA: ATTITUDES AND EXPERIENCES

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Muslim Maghribian Women (MMW) are characterized for a low participation in the Catalan society (Nash, 2001). In relation with sport participation, several experiences include MMW doing activities as football, gymnastics or aerobic in Immigrant Associations or Immigrants Support Organizations (IAISO) (Soler, Gaztelu, & Serra, 2010; Balibrea, 2005). Nevertheless, this practise is still "invisible" and the way in which they do sport is still unknown. According to various studies, this situation is due to a combination of social, economic, political and also cultural and religious factors (Nasri & Soler, 2012; Nasri, 2011; Jawad, 2011). Giving this "invisibility" and influencing factors, we have analysed how MMW participate (or not) in sports and why. By 30 interviews, we have found MMW that did not practice sport and now they practice in Catalonia reaching several forms to combine religion and sport. Most of them try to pass unnoticed even some don't venture to do outdoor activities for modesty. The IAISO have an important role to promote MMW sport practice, but sometimes it can reinforce their "invisibility". Finally, some women say that they don't do sport because of the lack of female spaces or because they don't know them. In conclusion, we have observed that MMW have diverse attitudes towards sport and they practise it in different ways or not, depending on the personal and social circumstances.

#### GENDER DIFFERENCES IN SPANISH ONLINE SPORTS NEWSPAPERS

Schiefer, M.1,2, Gómez Ruano, M.A.1, Fernandez Aguila, J.1, García-Quismondo, J.1, Marín Marín, G.1, Liu, H.1, Frangeul, G.1, Grams, L.1,3

*1: Technical University of Madrid, 2: German Sport University Cologne, 3: Hannover Medical School*

Introduction The available research over the last decades showed tremendous differences in sports media coverage between male and female athletes (Pratt et al., 2008; Stone & Horne, 2008). This includes the number of articles, words per article, pictures in print media, but especially differences in attributes and characteristics (Kane & Maxwell 2011). Since "Marca" and "AS" are the most important online sports newspapers in Spain, the aim of this study was to evaluate both of them concerning their coverage of female athletes. The hypothesis predicted that these online Spanish newspapers publish more news about male than female athletes. Methods All articles were gathered from the open access web domains (www.marca.es and www.as.com) during one week, randomly selected in the year 2010 and searched for gender specific variables, photos and words per article. They were distinguished between male, female and neutral (both genders). To evaluate the hypothesis, descriptive statistics (means and frequencies), Pearson's chi-square test, and one-way ANOVA with post hoc test (DMS) using the statistical software program SPSS 20.0 were applied. Significance level was set to  $p < 0.05$ . Results There was no significant difference between both online newspapers, "AS" and "Marca" concerning number of articles and pictures ( $\chi^2 = 0.61$ ;  $p = 0.74$ ;  $\chi^2 = 5.39$ ;  $p = 0.05$ ). The newspaper "AS" contained 86.7% male, 5.6% women and 7.7% neutral articles. In the other reviewed newspaper ("Marca") 84.2% male, 1.8% female and 14.0 % neutral items were detected. Regarding pictures, "AS" published 89.2% male, 5.4% female specific and 5.4% neutral. Likewise "Marca" printed more male than female athletes' pictures (94.7% vs. 1.1%; 4.3% neutral). The one-way ANOVA test was significant ( $p < 0.001$ ) in words per article between groups, and post hoc test of DMS displayed greater values in men compared to women and neutral ( $p < 0.01$ ). Discussion Results support the hypothesis that male athletes are more frequently represented in the two examined Spanish online newspapers than female athletes. Frideres et al. (2008) recommend campaigns against female athletes' discrimination in order to equalize them to male athletes. Furthermore there is still an essential need to change the way of how women are displayed in several sport media coverage to promote women's sport in society (Kane & Maxwell, 2011). References Frideres, JE, Palao, JM, Mottinger, SG. (2008). WSPAJ, 17(2), 62-67. Kane, MJ, Maxwell, HD. (2011). JSM, 25, 202-216. Pratt, J, Grappendier, K, Grundovig, A, LeBlanc, G. (2008). WSPAJ, 17(2), 34-41. Stone, J, Horne, J. (2008). JSS, 32(1), 94-112.

#### MEDIATED GENDER RELATIONS IN A GENDER MIXED SPORT – REPRESENTATIONS OF GENDER IN EQUESTRIAN SPORTS DURING THE OLYMPIC GAMES IN 2012

Hellborg, A., Hedenborg, S.

*Malmö University*

Introduction In contemporary Sweden equestrian sport is one of the most popular sports and horse riding is number two when it comes to girls' sport activities. On a "sports for all" level horse riding is associated with women and femininity but on elite level, however, the number of men is higher than on the "sports for all" level (Hedenborg, 2012). Method In this study articles from two different Swedish morning papers have been analysed. The study is based on articles, notifications and columns published between 27th of July and 13th of August 2012. Butler's framework is used together with insights from Connell and Ridgway in order to understand mediated gender constructions in a gender mixed sport. Results Four mediated gender stories appear as the most dominant stories in the papers. One is focused on a Swedish female competitor who won a silver medal in eventing. Her performance is in different ways devalued in the mediated story. Another depict two male riders, where a dressage rider is associated with rock music and a jumping rider is described as gentlemanlike when he withdraws from competition due to his horse's injury. A third story deals with a female rider who crashed badly in the first round of the jumping competition and then continued to compete the day after. There is more pity than admiration in the mediated story about her. Several stories concern the excuses for failures. In the media narrative it seems like the failures of the male riders were caused by external factors while the female riders seem to cause their own failures. Discussion The gender mixing evoked questions in this article on whether equestrian sports could be an arena where gender constructions are less visible or different in comparison to other sports and in what way women and men were described in media. But it seems as the media narratives are confirming the binary gender system Butler states is the basis of our understanding of society (Butler, 2006). Many of the stories about the male and

female riders refer to gender appropriate attributes and behaviours. Ridgeway (1997) means that there are expectations that men are more competent than women, and this study shows how this becomes a complicating factor in the equestrian event. At the same time there are many contradictions that are found when narratives on femininity and masculinity are to be analysed. Yet, the mediated stories are consistent when it comes to gender separation. In this analysis of the morning papers it is clearly a gender difference evident in the depiction of the riders. References Butler, J. (2006) *Gender trouble* Routledge Hedenborg, S. & Hedenborg White, M. (2012) *Sport in society* Vol. 13, no.3, p.302 Ridgeway, C. (1997) *American sociological review* Vol. 62, No. 2, p. 218

### **GENDER INEQUALITY AND DEMAND FOR WOMEN'S SPORT: UNIFIED GERMANY AS A NATURAL EXPERIMENT**

Meier, H.E., Konjer, M., Leinwather, M.

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Sport is a highly gendered social sphere. Accordingly, gender inequality within societies is correlated with women's opportunities to participate in high-performance sport and national performance levels. Since sex-discriminatory socialisation appears to play a decisive role for sport consumption, the main question addressed here is whether socialisation by more gender equal policies serves to increase demand for women's high performance sport. In order to test this idea TV ratings for the German women's national football team are analysed because re-unification has created a unique natural experiment on socialisation effects of gender policies. Results provide no support for the idea that a stronger social acceptance for non-familiar roles of women increases audience demand for women's sport. Rather, it seems that gender divisions specific to sport matter, which has important implications for future research and policies aimed at popularising women's sport.

### **EQUALITY AT STAKE: THE PRESENCE OF WOMEN AND GENDER PERSPECTIVE IN STUDIES OF PHYSICAL ACTIVITY AND SPORT**

Serra Payeras, P., Vilanova Soler, A., Soler Prat, S.

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Introduction For more than a decade, the number of female students in Spanish universities has been slightly higher than male students. However, percentages of both sexes in some areas of knowledge differ considerably. As in engineering, Physical Activity Sciences and Sport also have a low percentage of female students (CEIFCAFyD, 2011). The aim of this presentation is to describe the research design and preliminary results of this research, financed by the Ministerio de Economía y Competitividad with "ayudas para la realización de proyectos de investigación fundamental no orientada (DEP2012-31275, de la Convocatoria I+D 2012) whose main objectives are the following: 1)To diagnose women interest and final presence in PAS studies: Professional education, "CAFE" degree, MEF degree, Master, PhD, and as university lecturers. 2)To analyze perception and attitudes of students in the last year of compulsory secondary education (ESO, 16 years) and in the 2ndof Preuniversity course (18 years) related to PAS and possible causes of the lack of interest of young girls. 3)To describe how gender perspective is included in the curricula of degrees and masters of PAS Education. 4)To develop some proposals for promotion and recruitment of women students and teachers at different levels of PAS Education, as models of good practice adding gender perspective in these studies. Methods For each objective, different methods will be used. We are combining quantitative and qualitative approaches depending on the objective. For the first one, a secondary analysis based on the enrollment data in different kind of studies related to sports. These data is available in the education institutions. For the second aim two tools are use: a survey on PAS Education perception to 16 years girls and a focus group to discuss different perceptions on PAS. For the third objective a content analysis of public "syllabus" is done together with in-depth interviews to secondary education teachers. Finally, for the last objective, a content analysis of other good practice proposals to increase women presence in university studies is done in order to relate it to our own findings. Results The preliminary results of this research, based on INEF Catalonia, shows that the number of girls who have interest for this kind of studies are decreasing vertiginously. In 2006 a decrease process starts in the number of PASS enrollment, and thus in the interests' girls too. The percentage of female enrollment had been of 32 % until 2006; nowadays, percentage is of 21%, and it keeps going down. Discussion Through this research we want to create an intervention program to increase the number of women in these studies and improve the image of PAS studies to make them more attractive and most appealing to girls.

### **SOCIETAL EFFECTS OF PHYSICAL ACTIVITY INTERVENTIONS, A SYSTEMATIC REVIEW**

Barte, J., Mikolajczak, J., Hermens, N., Wendel-Vos, G.

*National Institute for Public Health and the Environment*

Introduction: Physical activity has many positive health, personal, and economical effects. Besides these consequences, physical activity also has a potential societal effect. Physical activity policy is often (partly) based on this conviction that physical activity has positive social consequences. However, conclusive evidence for such a statement is lacking. Therefore, the aim of our study is to systematically review the societal effects of physical activity interventions in order to give insight in the available evidence for such an effect. Methods: A systematic search in the databases Medline, Embase, SciSearch, Social SciSearch, and PsycInfo was performed. Articles were selected when describing interventions including physical activity or aiming for an increase in physical activity and measuring the social effects on the society. These societal effects were divided into five categories: 'social capital and social cohesion', 'social participation and integration', 'anti-social behavior', and 'other possible effects on social behavior or relations between (groups of) people'. Results: 1260 potentially eligible records were identified and after the selection procedures 5 studies were included in the review, of which two were randomized controlled trials. The included studies show a great variety in type of physical activity, study population, and social outcome. Intervention programs consisted of sport training, fitness, water exercise, walking, and playing Wii. Study populations include inactive women, children with autism or Asperger syndrome, youth with intellectual disability, and elderly. Social outcomes embrace social capital, children's social behaviour, social participation and loneliness. In general, the studies indicate a positive societal effect of the interventions. Conclusion: Notwithstanding a possible positive effect of physical activity on social outcomes, the scarcity of and diversity in studies addressing this relationship prohibits a conclusive statement. Therefore, more research is needed to investigate this causal relationship and to establish the magnitude of this possible effect. For policy decisions the other effects of physical activity, which are not discussed in this review, should also be taken into account. Therefore, despite the lack of convincing evidence for the societal effects of physical activity promotion enhancing physical activity levels will remain an important focus for policy makers.

## TIME EFFECT ON MOTIVATIONAL ACHIEVEMENT AND SPORT ATTITUDES IN CONTRASTING FOOTBALL CLUBS

Domingues, M., Gonçalves, C.E.

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**Aim:** The study's purpose is to understand how contrasting contexts of practice influence the athletes' perceptions of motivational climate and attitudes towards sport, acting the perceived climate as a predictor of moral attitudes. **Design:** To analyze the effect of context on bivariate statistics the researchers employed one way ANOVA. Factor analysis was conducted considering four sub-scales for SAQ (cheating, gamesmanship, convention and commitment) and three factors for PMCSQ-2 (Important role, Effort/Improvement, Punishment for Mistakes and Unequal Recognition). Correlation matrix was also used to determine possible statistical relationships between variables. **Method:** Participants were young male football players (n= 74) from two contrasting football clubs in the north and center region of Portugal. A professional oriented club (POC, n=53 Mage=14.43 yrs, age range: 13-17 years, SD=1.076) and a social oriented club (SOC, n=21 Mage=14.26yrs, 13-17 years, SD=1.129). **Results:** Furthermore, correlation matrix revealed moderate statistically significant relations between perceived motivational climate sub scales and attitudes toward sport. There is a context effect that determines the way young athletes perceive sport. Findings from the cross sectional analysis contradicts the initial assumption regarding SOC, results show no difference in terms of performance oriented climate between the two clubs with significant differences in mastery involving climate. These higher values from the POC demonstrate a better internal organization and sport motivational climate. **Conclusion:** The findings highlight the importance of distinguishing between competitive contexts when examining ecological variables. It is also important to study the impact motivational climate has on moral functioning in youth football.

## ABLED RIDERS AND EQUESTRIAN SPORTS

Larneby, M., Hedenborg, S.

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In Sweden, equestrianism is the most popular disability sport, and horse riding for disabled people is integrated in the Swedish Equestrian Federation (SEF 2012). The SEF provides and organizes horse riding as sport and recreation, not as therapy. This study focus on perceptions of the body as expressed in contemporary discourses on ability and disability in equestrian sports, on an organisational level in Sweden. **Method** Empirical data for the analysis consists of semi-structured interviews with persons linked to organised riding for the disabled, and various texts from the SEF. A discursive approach and a theoretical framework based on insights from crip theory is used to uncover ideas about able and disabled bodies. McRuer (2006) presents the theory of compulsory able-bodiedness, arguing that the able-bodied norm in a sense produces disability. **Results** Three major recurring themes have been identified in the organisational discourses on horse riding for disabled people. First, equality and inclusion is an important issue for the SEF, to give everybody unregarding ability the opportunity to ride horses. Second, concealed exclusion and segregation is challenging the rhetoric of inclusion. All riding schools don't offer riding for disabled, which is explained partly due to negative attitudes of disability. When offered, it is often in segregated groups with ability as a determinant. Third, acceptance and differentiation through focus on impairment is visible in various texts. Disabled riders are generally portrayed as objects of therapy rather than athletic subjects, implying that impairment differentiates riders but simultaneously accepts ability differences among equestrian riders. **Discussion** Contemporary discourses on horse riding for disabled people in Sweden poses questions whether equestrian sports, as a sporting institutional site, is an arena for the production, securement and containment of disability. A solid inclusivity discourse surrounds horse riding for disabled people and the idea that equestrian sports are empowering rather than rehabilitating can be seen as a way of including all horse riders in the same sport. However, this discourse is contradicted by attitudes to disability that can be interpreted as ideas of segregation, which in practice may actually lead to exclusion of organised riding for disabled people. The riders want to focus on the ability, yet disability is focused because it contrasts the able-bodied riders. Compulsory able-bodiedness (McRuer 2006) is prevalent in the discourses examined, producing both a flexible body in the inclusivity discourse and a disabled body in the exclusion discourse. As this study shows, a true permissiveness and inclusivity could be based on an understanding of how compulsory able-bodiedness is imposed through discourses that produce and reproduce wider societal attitudes. **References** McRuer, R. (2006) *CripTheory* New York University Press SEF (2012) Swedish Equestrian Federation Official Website

## THE IMPACT OF OLD-AGE RETIREMENT ON LEISURE-TIME PHYSICAL ACTIVITY

Lahti, J., Laaksonen, M., Lahelma, E., Rahkonen, O.

*University of Helsinki*

The impact of old-age retirement on leisure-time physical activity Lahti Jouni, Laaksonen Mikko, Lahelma Eero, Rahkonen Ossi Department of Public Health, University of Helsinki, Helsinki, Finland **Introduction** Physical activity is an important part of healthy ageing (1). Physical inactivity is associated with increased risk of chronic diseases and loss of functioning (2). However, many older adults do not engage in physical activity as recommended for maintaining good health (3). Retirement is a major life change with possible consequences for lifestyles. Thus the aim of this study was to examine whether transition to old-age retirement impacts moderate and vigorous intensity leisure-time physical activity and whether the proportion of those physically inactive changes. **Methods** The baseline data were collected in 2000, 2001 and 2002 among 40–60-year-old employees of the City of Helsinki. A follow-up survey data were collected among the baseline respondents in 2007 (n=7332, response rate 83%). Employment status, type of retirement pension and date of retirement was asked at the follow-up. Respondents with missing information in any of the study variables (n=432) and respondents who were on disability retirement (n=231) or non-employed (n=194) were excluded. This study included 5453 female and 1253 male employees of which 1057 retired due to old-age during the follow-up. Leisure-time physical activity was asked with similar questions in both surveys. **Results** Old-age retirees increased significantly their time used in moderately intensive leisure-time physical activity: mean increase among women was 31 (95% CI=18–44) minutes per week and among men 42 (95% CI=18–67) minutes per week. Such changes were not found among those remaining employed. There were no changes in vigorous activity. Physical inactivity at follow-up was lower among old-age retirees compared with employees of nearly the same age (OR 0.78, 95% CI 0.63–0.95) when gender and baseline inactivity were adjusted for. Adjusting for potential baseline confounders had no effects on these findings. **Discussion** The mean increase found among the old-age retirees was relatively small considering that about 40 hours per week can be used in leisure pursuits after retirement. From a public health perspective it is encouraging that those inactive employees increased their physical activity after transition to retirement. Nonetheless, physical activity among those about to retire should be encouraged. **References** 1. Peel NM, McClure RJ, Bartlett HP. Behavioral determinants of healthy aging. *Am J Prev Med* 2005, 28(3): 298-304. 2. Physical Activity Guidelines Advisory Committee. Physical Activity Guidelines Advisory Committee report, 2008. Washington DC: US. Department of Health and Human Services, 2008. 3. Martinez-

Gonzalez MA, Varo JJ, Santos JL, De Irala J, Gibney M, Kearney J, Martínez JA. Prevalence of physical activity during leisure-time in the European Union. *Med Sci Sports Exerc* 2001, 33(7): 1142-1146.

### **NORWEGIAN POLICE STUDENTS TRAINING AND PHYSICAL PERFORMANCE DURING THE THREE-YEARS OF POLICE EDUCATION.**

Lagestad, P.

*Norwegian Police University College*

**INTRODUCTION** Physical skills is important in police work (Lagestad, 2012; Shephard & Bonneau, 2003), and police students had to conduct and pass four physical tests (bench press, pull in the boom, standing long jump and a 3000-metre run) at the Norwegian Police University College. This study will compare male and female police students training forms at the start and the end of their three-year of police studies. Furthermore, the study will examine the physical performances in the four physical tests among male and female police students in the same period. **METHODS** 235 police students answered a survey upon training forms (maximal strength, body building, strength endurance, endurance, power and sprint) at the start and the end of their three-years of police studies, while 85 police students participated in the four physical tests at the same period. **RESULTS** The results showed that maximal strength training became significantly more important for both men and women during the police studies, while strength endurance, endurance and sprint training significantly decreased for both gender. No significant differences were found in training body building and power training. The change in training forms was also shown in the results in the performance tests, where the bench press and pull-up performance increased considerably for both gender. **DISCUSSION** The results was surprising since exactly the same selection of police students reported that endurance was the most required physical skill in relation to police work, while maximum strength was the second least important physical skill (Lagestad, 2011). This is also suggested by other studies (Birzer & Craig, 1996; Lönn, Lönn & Hansen, 2006; Waddington, 1999). According to this finding, the police student don't exercise in relation to their own beliefs. It is argued that maximum strength seems to be a highly valued training form among the police students, probably because maximum strength is important if they have to use physical force. **REFERENCES** Birzer, M.L., & Craig, D.E. (1996). Gender differences in police physical ability test performance. *American Journal of Police*, 15(2), 93-108. Lagestad, P. (2011). «Fysisk styrke eller bare prat». Om kjønn, fysisk trening og ordenstjeneste i politiet. PhD. Oslo: The Norwegian University of Sport and Physical Education. Lagestad, P. (2012). Physical skills and work performance in policing. *International Journal of Police Science and Management*, 14(1), 58-70. Lönn, I., Lönn, P., & Hansen A.R. (2006). Vi tar pulsen på politen. *Svensk idrottsforskning*, 4, 29-32. Shephard, R.J., & Bonneau, J. (2003). Assuring Gender Equity in Recruitment Standards for Police Officers. *Canadian Journal Applied Physiology*, 27(3), 263-295. Waddington, P.A.J. (1999). *Police citizens: Authority and rights*. London: UCL Press

**15:00 - 16:00**

### **Mini-Orals**

#### **PP-SH20 Sport Management [SP] 1**

### **SEGMENTING THE SPECTATORS OF THE 23RD MEN'S HANDBALL WORLD CHAMPIONSHIP SPAIN 2013**

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*Universitat de Girona*

**Introduction** The 23rd Men's Handball World Championship was held in Spain from which some preliminary matches and the final were carried out in Barcelona. Spectators from different countries with different backgrounds came to the city searching different experiences at the same sport contest. Therefore, the aim of this study was to analyse the public's characteristics of this event in order to classify them into segments. **Methods** Based on the existent literature, we conducted a survey analysing the demographic characteristics, the cultural and economic level, the sport habits and the motivations and experiences (Hunt, Bristol, and Barshaw, 1999, Funk, Mahony, Nakazawa and Hirakawa, 2001, Huang, Lee, and Hou 2011). We also used the Sporting Event Experience Search (SEES) scale developed by Bouchet, Bodet, Bernache-Assollant and Kada (2011) in order to categorize the fans into four dimensions corresponding to their consumptions patterns. The data were in the Palau Sant Jordi on game day 5 in the Group D and during the final match. **Results** The total number of spectators was 23.060 (9.760 Day 5, 13.300 final). Our sample consisted of 204 spectators from which approximately 70% were male and their average age was 32 years (SD = 10.60). Half of them were Spanish (51%), followed by French (19%) and German (14%). A 47% practiced sport between 1h and 5h per week, being handball (36%) the most common sport. Following the SESS scale the 54% were identified as aesthete, 8% as interactive, 19% as supporters and 8% as opportunist. The analysis of the qualitative data reinforces the description given by Bouchet et al. (2011) for these four dimensions. **Discussion** The results revealed different motivations that made the spectators attend to the championship. The most frequent dimension was the aesthetic one, which is mainly related to the beauty of the game. Our research was limited to a concrete sport event and it would be recommendable to compare these results in other contexts. The information obtained in this study can be useful for future organizers of similar tournaments, for the cities that are balancing the possibility of hosting this event as well as for the managers of the general sport events sector. **References** Bouchet P, Bodet G, Bernache-Assollant I, Kada F. (2011) *Sport Management Rev*, 14, 42-53. Funk D, Mahony F, Nakazawa M, Hirakawa S. (2001). *International J of Sports Marketing & Sponsorship*, 3, (3), 291-316 Huang C, Lee C, Hou C, (2011). *International Conference on Innovation, Management and Service*, 14, 79-84. Hunt, K. A., Bristol, T., & Bashaw, R. E. (1999). *J of Services Marketing*, 13, 439-452

### **THE COVERAGE OF HANDBALL NEWS IN TURKISH PRINT MEDIA: A CASE STUDY IN ESKISEHIR**

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**Introduction** Local papers are not only part of the cities but also they are integrated. The succes in any sport branch has been anticipated as the succes of the city itself (Kaya, 2001). Especially coverage of handball in local print media was quite popular during the year of 1980-1995. For this reason, the frequency of print media coverage of handball started to decrease after 1995. Some factors such as media,

institutionalization, advertisements, and organizations are very important. For this reason the study advises that several projects should be carried out immediately. There might be some ways to enlarge print media coverage of handball (Çeliksoy et al., 2008). The aim of the research is to analyze contents of 2011 coverage of handball news in Eskişehir print media such as Sakarya, İstikbal, Milli İrade, İki Eylül, Son Haber. Methods A content analyze form, which has 20 subjects, has been used in the analyze and evaluation process. Before the content analyzes process, the newspapers have been scrutinized, subjects have been identified. SPSS 21 program has been used. Frequency and percentage analyzes have been used in evaluation process. Results These newspapers are outstanding in respect to their selling and editions. The range of the coverage of handball in the newspapers is as follows: İstikbal %44.3. On weekdays it is 61.5% but at weekends it is 38.5%. The most coverage is on the back cover of the newspapers, 73.2%. Middle page has taken the first place with a percentage of 41.1%. In the topics distribution, "The most emphasized topics" are team % 40.0, score %21.2. The majority size of the coverage was 10.1-20.0 cm<sup>2</sup> with %31.5, 21.0-30.0 cm<sup>2</sup> with %23.4. Constructive critics of the coverage is 47.8%, neutral is 43.3%, negative is 8.9%. Discussion The most coverage of handball is in İstikbal (%44.3). 61.5 % of the coverage of handball is on weekdays. Football has more coverage than other sports at weekends. The percentage of the back coverage of the newspapers, is 73.2%. Because teams weren't successful enough in 2008 championships, so coverage of handball didn't appear on other pages. The majority size of the coverage is 0-30.0 cm<sup>2</sup> with 69 %, generally team and score (%61.2) were reported in the news and they were objective and constructive critics (%91.1). References Çeliksoy, M.A. and Çeliksoy, S. (2008). S. Physical Education Teachers, Athletes And Spectators' Opinions On Development Of Turkish Handball: A Case Study In Eskişehir, 3- 4. Estoril/Portugal. Duncan and Brummet, (1998). Media Sport, 7-8. Routledge 11 New Fetter Lane, London. Gamst, G.; Sutherland, Y.N. and Evans, B.A. (1993). A Profile of Newspaper Sports Section Readers and Nonreaders, Journal of Sport Behavior, 8-9. Vol.16. Lever, J. and Wheeler, S. (1993). Communication Research, 3-4. Vol. 20, No. 1. Kaya, Y.A. (2001). Sports Press in Turkey , Anadolu University Institute of Social Sciences Eskişehir.

## GALES OF LAUGHTER FROM SCHOOL SPORTS MANAGEMENT PERSPECTIVE

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The government, public, schools and Physical Education (PE) Teachers of Hong Kong aware the importance of health and physical activity level in students' development. Not only physical fitness, wellness is also highly concerned as a whole-person development. The prime goal of PE is to cultivate students to be active generation for developing active lifestyle and life-long exercise habits. // In this action research, a co-educational secondary school in Hong Kong is examined to see the circumstance of students' participation in physical activity during lunch time. This school promotes sporting experiences, habits and culture, and provides wide range of physical activity for students during and out of PE lessons. For lunch time, the school opens sports venues for students taking part in physical activity. Those activities are not structured and organized one, and the participants are regular. Therefore, this research aims to study how the change on managerial roles and skills of teachers affects students' participation in physical activity during lunch time and how the GALES framework established. // In normal practice, PE teachers of this school act as observers at different school sports venues during lunch time to ensure students' safety. To effectively manage and organize physical activity during lunch time, the roles of PE Teachers are changed from being observers to trainers and managers. As a trainer, PE panel head organizes sports leadership training workshop to a group of Students Sports Ambassadors, named "Lunch Sports Buddies". These sports ambassadors execute their duties during lunch time to organize sports programs/activities, do exercises with other students and monitor students' safety. At the venues, PE teachers also act as managers to mainly provide instant advices on safety measures or emergency cases to sports ambassadors. // Two cycles of interventions are implemented in this action research. In Cycle 1, PE teachers/panel head arrange a sports leadership workshop to sports ambassadors. Sports ambassadors carry out a three-day sports program/activity during lunch time. PE Teachers record the numbers of participants per session and jot down the points on a reflection sheet for evaluation with the researcher and then with sports ambassadors. Based on the evaluations made in Cycle 1, Cycle 2 begins and the second leadership training workshop is held for modifications and improvements on managing and organizing the three-day sports programs/activities. Similar to Cycle 1, sports ambassadors carry out a three-day sports program/activity during lunch time. Number of participants will be reported. The researcher records the changes of managerial roles and skills of PE Teachers and sports ambassadors and other related aspects and outcomes. Interviews with PE Teachers, sports ambassadors and participants of the sports programs are arranged to evaluate the effectiveness of the managerial roles and skills of PE teachers on organizing sports programs/activities for cultivating active generation.

## COMPETENCIES DEVELOPMENT IMPLICATIONS TOWARDS THE PREPARATION OF SPORT MANAGERS

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Introduction In the process of the development of persons career it is very important to help student to make the decision and to choose the right education, professional training and work so that the needs of person and work world would be satisfied (Jarvis, 2003). The competence of the employees is one of the main features, which could influence the competitiveness of organizations and their activity efficiency. In the practice of sport management in most of the European countries there are no requirements for the sports managers for the professional qualification and in this context there are no general competencies as the main, settling of comprehensive person development, professional flexibility and mobility. Scientific research shows the growing significance of general competencies, the importance of their development in the organization (Boyatzis, 2002). Less research are made in which competencies of sports managers and their development are discussed. The activity of sport organizations, the competencies of their managers are more emphasized in them (Chelladurai, 2006). Methods One (accidental) questionnaire was aimed to evaluate future sports managers attitude to the development of general competencies and their personal features and values. Other one was constructed to evaluate the opinion of sports managers specialists on the general competencies. Results Sports managers mostly lack main knowledge skills and their use in practice, such as, activity organization and control, the implementation of organizations consumers demand research, conflicts solving at work, to determine and analyze problems of sport organization activity, to analyze, generalize the results of organizations activity, to use holistic attitude to the organizations activity and to the influencing environment, by using innovations in technologies and organizations internal and external environment valuation, by paying attention to the countries economy and conditions of European economical and social stability. In the analysis of theoretical knowledge, mostly lack basic knowledge: finance and calculation; marketing research organization and implementation; advertising and promotion, human resource management, strategic planning, orientated to the consumer marketing. By generalizing such competencies, which working sports management specialists think to be very important in the work of sports manager, can be excluded: main professional knowledge, ability to plan and organize, to make decisions, to work in command and independently. References Jarvis, P. S. (2003). Career Management Paradigm Shift: Prosperity for Citizens, Windfalls for Governments.

Canada. Boyatzis, R. E. (2002). Core Competencies in Coaching Others to Overcome Dysfunctional Behavior. Case Western Reserve University. Chelladurai, P. (2006). Human resource management in sport and recreation. *Human Kinetics*, 368.

### **BRAZILIAN SPORT CLUBS: MANAGEMENT PERSPECTIVES FROM A CASE STUDY IN A SPANISH BASKETBALL CLUB**

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*CDS-UFSC; UDC; GEPESP-FEF-UNICAMP; EEFERP-USP*

**Introduction** As in the eighteenth century in England, nowadays the sport clubs are one of the leading organizations promoting sport, especially in the western world, like Brazil. However, in recent decades sport changed and is adapting to the globalized world, to the consumer society and to the speed of the media, manifesting itself in multiple ways and contributing to different segments of society. The sport clubs, in contrast, are divided between traditional aspects of its management and operation and the current demands of diversification and professionalization (GALATTI, 2010). From this perspective, the study addresses the interface between sport and sport clubs in order to understand the current moment in the Brazilian context, intending to signal new opportunities of development. **Methods** The investigation started with a literature review about sport and club in Brazil and in Spain; then, the study advances to a case study in a Spanish Basketball club. It was made with document research at club documents and from semi-structured interviews with directors of the club in order to identify management actions that have made possible the sportive and institutional club growth. **Results** The management actions has shown success in providing basketball, with an increase of 374.5% federated athletes linked to the club in the last five years and also results for their basketball adult team that led them to ascend in three professional leagues in Spain. The specific actions founded in this club were: strengthening interdependence between base teams and professional team; athletes of the base teams as fans and consumers of the products of the club; diversification of the club products and people involved; professionalization of services - internal and external audiences; Respect with the social group that motivates and keeps the club (fans and consumers). **Discussion** Brazilians sport clubs, with representative teams at sport leagues, are not enough professional as the contemporary sport. As seen in the Spanish models of sport clubs management, it's necessary to improve sport as a cultural heritage, with more practices. From that, it's necessary to professionalize managers, with the perception of sport as a possibility of promoting the club in the contemporary, as much as the club like a place of improving sport in Brazil, especially with the big sport events coming to the country. **References** GALATTI, L.R. (2010) *Esporte e clube sócio-esportivo: percurso, contextos e perspectivas a partir de estudo de caso em clube esportivo espanhol*. Tese (Doutorado em Educação Física)-Faculdade de Educação Física. Universidade Estadual de Campinas.

### **STATISTICAL DATA ANALYSIS OF ANTI-DOPING AGENCY OF SERBIA IN LAST 7 YEARS**

Dikic, N., Vukasinovic, V.M., Andjelkovic, M., Antic, T., Vajagic, B.

*Anti-doping Agency of Serbia*

**Introduction** Anti-doping Agency of Serbia (ADAS) was founded in 2005. After ratification of the UNESCO International convention against doping in sport, complete anti-doping regulations in Republic of Serbia are in line with World Anti-Doping Code and ADAS is "Code Compliant" with 2009 World Anti-Doping Code. The results of ADAS work showed importance of continuing the fight against doping in sport. **Methods** In this cross sectional study, we analyzed official statistical data from ADAS for last 7 years, from 2006 to 2012. We evaluated the number of conducted doping controls (in and out of competition), total number of adverse analytical findings (AAF), prohibited substances used as doping and, in the end, in which sports doping was present the most. **Results** Basic statistic showed that for the last 7 years, from 2006 to 2012, we performed in total 3,982 doping controls. Total number of AAFs in this period was 48, while in the same period there had been 3 other Anti-doping rule violations. During this period there was 4.03% of AAFs which is two times more compared to world statistics for the same period of time. In 2011 and 2012 that percentage was 1.75% which is in line with world statistics for these years. We tested athletes in 50 different sports and there were AAFs in 21 of them. First 5 sports by AAF are: wrestling (13%), body building (13%), boxing (11%), handball (11%) and athletics (6%). For the last 7 years 67 different prohibited substances were used as doping by athletes and in 13 cases athletes used more than 1 of prohibited substances. In addition, six different groups of prohibited substances were used: S1.anabolic agents (50%), S8. cannabinoids (16.67%), S5. diuretics and other masking agents (16.67%), S6. stimulants (13.64%), S3. beta 2 agonists (1.52%) and P2. beta blockers (1.52%). **Conclusion** Despite increase in number of doping controls, Serbia still performs two times less doping controls comparing with countries with similar number of inhabitants, economic and sports potential. In 2006 most of sport workers in Serbia thought of doping as something which is not significant problem in this country. During this period ADAS showed that doping is significant problem in Serbian sport which has been presented by number of AAFs. Thanks to systematic approach to this problem and continues education we finished 2012 with 7 times less numbers of AAFs. The challenge of developing a rigorous global Anti-doping program, as well as Athlete Outreach program, requires acceptance of doping as a problem by sport organizations, athletes, and public authorities. Individual stakeholders must be prepared to preserve the values of sport, which means free from doping. This will require vigilance by all interested parties for the benefit of elite athletes and society overall. **References** 1. Fraser AD. Doping control from a global and national perspective, *The Drug Monit.* 2004 Apr.

### **SUPPORTING THE STUDENT ATHLETES IN THE UK: THE CASE OF THE TALENTED ATHLETE SCHOLARSHIP SCHEME**

Lee, P., Jiang, R.

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**Introduction** It is increasingly recognized that helping talented elite athletes to cope with their academic studies and sport is one of the most commonly encountered issues in different countries. In the UK, the Talented Athlete Scholarship Scheme (TASS), which is a government backed partnership between talented young athletes, educational institutes and national governing bodies of sport, was launched in 2004. **Objectives** This discussion is about elite, or high performance, sport and primarily about how the UK provides life support for talented [student] elite athletes. The concern is of the major contributions of implementing the TASS since 2004. **Materials & Methods** The documentary-based element takes the form of qualitative content analysis, which applied to the form of analysis of a number of British sport official reports, academic articles, and media commentaries and so on. In total, 65 references were reviewed and 33 commentaries were identified to conduct this research. The data was subject to analysis and coding employing the NVivo 9 software package. **Results & Discussion** In 2004, the Department for Culture, Media and Sport (DCMS) administered a TASS programme which serves athletes below the World Class Performance Programme (WCPP) as an initiative to reduce the drop-out rate from athletes unable to maintain the balance between sports and education and other life pressures (Henry, Amara, Aquilina, & PMP Consultants, 2004). Two major services were provided through the TASS program, namely, "Core Services" (strength and conditioning, physiotherapy and medical sup-

port, lifestyle support/mentoring and education and career support) and "Sport Specific Services" (coaching, competition and training expenses, equipment and sport science) (DCMS, 2011). The TASS service has made a significant contribution to supporting the UK's elite sport performance, with 66% TASS athletes and alumni in the last Olympic and Paralympic cycle. At the recent London Olympic Games, over 200 current or former TASS athletes competed for the UK and 44 of these athletes won the medals (57), 10 of whom won multiple medals (TASS, 2012). Conclusions To some extent, delivery of the TASS has met those 'needs' of government, educational institutes, NGBs, and student athletes in some elements. This implies that such a scheme is able to assist student athletes balance other aspects of their academic life with their sport training and competing. And, the major contributions of the TASS are concluded as the followings: contributions to medals, athlete welfare, and athlete focus. References DCMS. (2011). Talented Athlete Scholarship Scheme 2009-2010: Athlete, sport and institution policies. London: Author. Henry, I., Amara, M., Aquilina, D., & PMP Consultants. (2004). Education of elite young sportspersons in Europe. Brussels: European Commission: DG Education and Culture. TASS. (2012). TASS athletes help Team GB and Paralympics GB achieve best ever results. Retrieved from TASS Website: <https://www.tass.gov.uk/news/2012/9/best-british.html> 2012/09/17

### **THE PUBLIC-PRIVATE PARTNERSHIPS OF CONSTRUCTING SPORTS FACILITY IN THE UNITED STATES: A CASE STUDY OF DALLAS COWBOYS STADIUM**

Lee, K.W., Lee, P.C., Yang, C.W., Lin, C.R., Huang, J.H.

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**Introduction** Over the past four decades, state and city governments in the United States have invested billions of public dollars in professional sports facilities (Long, 2012). However, taxpayers were not always called upon to pay for the venues where privately-owned sports franchises played (Siegfried & Zimbalist, 2000). Therefore, the aim of this research seeks to understand the interactions between the U.S. government and private cooperation on the construction of sports facilities. **Methods** The research analyzed the success case of Dallas Cowboys Stadium using the view point of public-private partnership. The document analysis and in-depth interviews were used to collect research data from public and private sectors involved in the construction of the Dallas Cowboys Stadium. **Results** The construction cost of Cowboys Stadium was \$1.15 billion. The City of Arlington provided over \$325 million in bonds as funding. Also, the NFL provided the Cowboys with an additional \$150 million loan, as per their policy for facilitating financing for the construction of new stadiums. And Cowboys owner covered the other construction costs of the stadium. Participants in the Cowboys Stadium deal included city government, team and other private entities. The findings show that the project was benefited by sustained advocacy from public officials together with numerous government incentives and other forms of economic assistance. The land acquisition costs for this sports facility were almost entirely borne by taxpayers. In addition to Cowboys owner, the projects received other private-sector financial support, provided as a business investment. **Discussion** The results found in the present study coincides with previous findings that cities provide the owners of professional sports franchises with hundreds of millions of dollars of subsidies for the construction of new stadiums and arenas and expect these facilities to generate economic benefits exceeding these subsidies (Coates & Humphreys, 2003). Also, the public-private partnerships for major league sports facilities have become complex. The public cost and public share of deal could be broke down into two categories of development costs (building, land, and infrastructure) and ongoing annual costs (lease expenses net of lease revenues, foregone property taxes). The financing packages for sports facilities required years to negotiate, and involve varying combinations of public and private partners, debt and equity financing, and facility and non-facility revenues. These findings reiterated information found in the literature on this subject (Long, 2012). **References** Coates, D., & Humphreys, B. R. (2003). Professional Sports Facilities, Franchises and Urban Economic Development. *Public Finance & Management*, 3(3), 335-357. Long, J. (2012). Public/private partnerships for major league sports facilities. London: Routledge. Siegfried, J., & Zimbalist, A. (2000). The Economics of Sports Facilities and Their Communities. *Journal Of Economic Perspectives*, 14(3), 95-114.

### **SWIMMING POOLS AND CHEMICAL TREATMENTS OF WATER: A QUALITATIVE VISION FOR MAINTENANCE MANAGERS**

Fernández-Luna, A.1, Burillo, P.2, Felipe, J.L.1, Sánchez-Sánchez, J.3, García-Unanue, J.3, Plaza-Carmona, M.3, Ubago, E.3, Hernández, E.3, Gallardo, L.3

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**Introduction** Attendance at indoor swimming pools involves exposure to chlorine gas and disinfection byproducts (DBPs) generated through chlorine and bromine. The exposure to these products is associated to numerous health problems. There are alternative water treatments such as ozone, UV lamps and salt chlorination that could reduce the presence of DBPs in pool water and environment, and they can also improve the management of the facility. Thus, the aim of this research was to evaluate the characteristics of the chemical treatments used in indoor swimming pools **Methods** A semi-structured interview was designed. The sample consists of pool maintenance managers who use different chemical treatments (n = 15). **Results** Most of the maintenance managers have specific training for their workstation and have received training during their working life. Although they ask for most useful content for daily routine in the installation in seminars. Chlorine is considered the cheaper chemical treatment and UV lamps and ozone are considered the greenest. The most popular chemical treatments are ozone and salt chlorination because of the safety of users, the viability of the facility, saving water and disinfectant power. Working with chemical treatments has adversely effects to the health of maintenance managers that use chlorine or bromine, while managers who use other treatments feel more comfortable in their jobs. **Discussion** An adequate training in the maintenance of indoor swimming pools is needed in Spain because there is not a specific qualification, as shown in a qualitative study where maintenance managers have identified the need for a better training (Mapfre. Prevention Service, 2007). Ozone and UV treatments generate fewer DBPs (Cassan et al., 2006, Lee et al., 2009), resulting in lower water consumption and a lower risk to the health of users and swimming pool workers. Moreover, both treatments are better disinfectants than chlorine or bromine. Working with a combined chemical treatment reduces direct contact with corrosive substances by maintenance workers, thereby decreasing the risk of health problems and increasing their satisfaction. **References** Cassan D., Mercier B., Castex F., Rambaud A. (2006). Effects of medium-pressure UV lamps radiation on water quality in a chlorinated indoor swimming pool. *Chemosphere*, 62(9), 1507-1513. Lee, J., Ha, K. T., y Zoh, K. D. (2009). Characteristics of trihalomethane (THM) production and associated health risk assessment in swimming pool waters treated with different disinfection methods. *Sci Total Environ*, 407(6), 1990-1997. Mapfre. Prevention Service (2007). Working without risk in the swimming pool. Mapfre, Madrid

## WHAT IS THE ROLE OF THE STAKEHOLDERS IN DECISION MAKING? EVIDENCE FROM A FOOTBALL CLUB

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**Introduction** We know little about the relationships between sport management organizations and stakeholders (Russo & Vito, 2011). For that reason, organizations must identify and prioritize stakeholders in order to improve the efficiency and outcomes of their decision-making processes (Anagnostopoulos, 2011). This study aims to identify and prioritize the perceptions of internal and external decision-makers as regards sports organization stakeholders, based on Mitchell, Agle and Wood (1997) approach. **Methods** The study focuses on a Portuguese football club. A questionnaire was applied to the internal and external decision-makers (Agle, Mitchell, & Sonnenfeld, 1999). A multiple linear regression analysis was done to assess the influence of the attributes of power, legitimacy and urgency to the stakeholder's respective salience. To identify and prioritize the perceptions of internal and external decision-makers a correlations analysis between the three attributes was done. **Results** In validating the hypotheses corresponding to external decision-makers the attribute of power has a positive relationship only with salience of operational management ( $\beta = .58$ ); regulatory bodies ( $\beta = .55$ ); and suppliers ( $\beta = .65$ ) presenting adjusted  $R^2$  coefficient values of .25; .3 and .37, respectively. To internal decision-makers the power attribute correlates only with the salience of the local community ( $\beta = .64$ ;  $R^2$  adjusted = .79), with power being the factor best explaining the salience of this stakeholder group. The results show convergence between external and internal decision-maker perceptions regarding the three main stakeholder groups: top management, sponsors, and association members. Furthermore, four types of stakeholders were identified: definitive, dangerous, demanding and non-stakeholders. **Discussion** The study suggests that organizational success will depend on both identifying and assessing the relevance of stakeholders, and highlighting just who should get priority in strategic decision-making and why. We suggest there should be a pro-active approach to organizational management able to anticipate and coordinate the responses and requests of the various stakeholders. This attitude ensures the maximization and maintenance of a favourable position in relation to all organizational interests in strategic decision-making. **References** Agle, B., Mitchell, R., & Sonnenfeld, J. (1999). *Academy of Management Journal*, 42(5), 507-525. Anagnostopoulos, C. (2011). *Soccer & Society*, 12(2), 249-264. Mitchell, R., Agle, B., & Wood, D. (1997). *Academy of management review*, 22(4), 853-886. Russo, A., & Vito, G. (2011). *European Sport Management Quarterly*, 11(4), 327-335.

## EVALUATION OF INTERNATIONAL YOUTH VOLLEYBALL PERFORMANCE CENTRES

Rath, G., Tilp, M.

*Karl-Franzens University Graz*

**Introduction** For the majority of European volleyball federations, youth high performance centres are an essential part of athlete development. These centres should primarily prepare its athletes for a future professional career (Rodríguez-Ruiz et al., 2010; Emrich et al., 2009). The aim of the present study is to evaluate European high performance centres for volleyball and identify structural characteristics which are responsible for the development of top athletes. **Methods** Fourteen high performance volleyball centres situated in eight countries participated in this study. Data of the centres' structural characteristics were obtained through interviews and questionnaires during research stays. Basis for the assessment of the centres' outcome was the percentage of athletes participating in the highest national league and/or senior national team, normalized to CEV (European volleyball federation) and FIVB (world volleyball federation) rankings. Based on this procedure all surveyed centres were ranked and subsequently correlations (Spearman,  $\alpha=0.05$ ) were performed to relate data of the questionnaire with the ranking. **Results** Significant correlations to high performance outcome were inter alia found regarding the existing years of the centre ( $r_s -0.928/\alpha -0.00$ ), the existing years of the talent development program ( $r_s -0.761/\alpha -0.03$ ), the annual average budget ( $r_s -0.787/\alpha -0.02$ ), the percentage of membership fee ( $r_s 0.854/\alpha -0.01$ ), the percentage of athletes living in boarding schools ( $r_s -0.749/\alpha -0.03$ ), and the number of sport medical tests/year ( $r_s -0.831/\alpha -0.01$ ). A negative Spearman's rho is based on a correlation between a low (=better) ranking number and a high value of the respective questionnaire item. **Discussion** Data revealed that successful centres are equipped with an appropriate financial funding and their athletes are subjected to medical sports tests on a regular basis. Regarding the obligatory membership fees at high ranked centres, the results show that these centres and development programs should be open to everybody and financially affordable. Furthermore, it appears to be favourable to provide a boarding school to combine training and education. The results might provide valuable information of how to organise a high performance centre, for reassessing and restructuring already established centres, and for a design of young athletes' development programs. **References** Rodríguez-Ruiz, D., García-Manso, J.M., Muchaga, F.L.F., Fernández, D.C., & Dantas E. (2010). Recruitment, training and specialisation of volleyball players for high-performance sports using the Permanent Concentration system (1989-2008). *Physical Education and Sport*, 54, (3), 151-155. Emrich, E., Fröhlich, M., Klein, M., & Pitsch, W. (2009). Evaluation of Elite Schools of Sport. *International Review for the Sociology of Sport*, 44, (2-3), 151-171.

## HOW SPAIN IS ADAPTING THE SPORTS TRAINING TECHNICIAN EUROPEAN MODEL

Seguí, J., Nebot, R., Camps, A., Papous, S.

*INEFC-Lleida*

**Introduction** Spanish Sports Act (10/1990) introduced the need to adapt the Spanish sports training technician model to the characteristics of the education system, to the needs of the market and the European standards. Spanish sports federations were reluctant due to loss of their monopoly (management and income). Accounted for the strong Spanish sports federations opposition have taken more than 20 years to reach a standardized process in accordance with the European Union demands of training and access to work model. We present in this communication how the Spanish technical sports training model has been adapted to those European standards and which instruments were used. How the model was implemented? The Law 5/2002 of professional qualifications and vocational training laid the foundation for defining, by INCUAL, professional qualifications in the sports sector and more specifically to the "physical and sporting activities" family. The National Catalogue of Professional Qualifications recognizes 25 different qualifications into 3 levels. It is from the professional qualifications and its skills which are defined what academic training is necessary and what titles can be derived by them. The system allows people, without academic qualification or formal training, to enter into the market or into qualifications programs by accrediting competences to the public bodies. This accreditation is based on professional experience and knowledge acquired throughout life. How the formation is structured? The technical sport training has two different models: a- Training included in the special regime of vocational training. Managed by the education system. - Adapted to Bologna Titles: Caving, Diving, Horse Riding, Sailing, judo / self-defence and Lifesaving and rescue. - Titles not adapted to Bologna: Mountaineering, Skiing, Soccer, Basketball, Athletics and Handball. b- Formation in the transitional period. Managed by the sports system. The strong reluctance of sports federations has made a

significant number of disciplines and modalities have not been integrated into the education system. From 2007 these configurations must necessarily conform to the qualifications and skills of the European model. In that way the training structures and the appropriations for each subject have been unified. When these trainings will be integrated into the education system, diplomas will be recognized as Bologna effects. In either of the two models is fixed an intermediate qualification, with two levels of training (Level I and Level II), and an advanced qualification (Level III). References Law 10/1990. Law 5/2002. Organic Law 2/2006. RD 1128/2003. RD 1538/2006. RD 1224/2009. RD 1363/2007. Order EDU/3186/2010. Mobility Action Plan, EC 2000. Recommendation 2001/613/EC. Education and training programme, 2002. Resolution on learning, EC 2002.

### WHAT MAKES THE EXCELLENCE OF SPAIN'S TEAM SPORTS?

Hongyou, L., Javier, S.M.

*Faculty of Physical Activity and Sport Science (INEF), Polytechnic University of Madrid (UPM)*

With the latest success in the Men's Handball World Championship, Spain's sport teams, including football, basketball, volleyball, field hockey, handball, baseball, water polo, roller hockey and futsal, have won 173 medals in the Olympic Games, World Championships and European Championships, 65 gold, 66 silver and 42 bronze. Most of the trophies were obtained in the recent 25 years, especially the women's who won their first medal in 1992. A question comes that: what makes the current excellence of the Spain's team sports? In order to answer it, a comprehensive analysis was conducted to the sport policies, coach and technician teams, tactic and technique systems and competition systems of the team sports in Spain. Results show that: (1) the founding of "Association of Olympic Sports" (ADO) after 1988 Korea Olympic Games is the initiation of a series of reforms in sport policies who set up lots of centers, councils, laws and regulations which created a favorable atmosphere for the development of the team sports; (2) the well-trained and experienced head coaches, officially certificated assistant and technique coaches, physiotherapists, IT and video specialized technicians, directors and managers consist a cooperative multidisciplinary technical team; (3) the insistence of its own style, the emphasis on match process instead of results and the stress on team spirits lead to a perfect tactic and technique system in all kinds of team sports in Spain; (4) all the 9 kinds of team sports are professionalized in Spain and various league and cup games are running throughout all the years.

**16:20 - 17:50**

## Oral presentations

### OP-PM43 Sports Medicine [SM] 4

#### CAFFEINE AND PERFORMANCE OVER TWO DAYS OF SIMULATED CROSS-COUNTRY SKIING COMPETITION

Stadheim, H.K., Spencer, M., Jensen, J.

*Norwegian School of Sport Sciences*

Introduction Performance improvements on exercise tasks lasting 10-90 min after caffeine (CAF) ingestion is well documented (1-2). In most competitions e.g.: Tour de France, Tour de Ski, or World Championships athletes compete several days in a row. Indeed, it is possible an improved performance after CAF ingestion may cause augmented fatigue and impair performance the following day. However to the author's knowledge studies testing effects of CAF so far have used a one day protocol. The aim of the study was therefore to test effects of placebo (PLA) and two different CAF dosages (3 and 4.5 mg•kg<sup>-1</sup> bodyweight) on performance in a cross-country double poling ergometer test (C-PT) two days in a row. Methods 8 highly trained male cross-country skiers (VO<sub>2</sub>max-run 78.5±1.6 ml•kg<sup>-1</sup>•min<sup>-1</sup>) participated in the study which had a randomized double-blinded, placebo-controlled, cross-over-design. Performance was assessed as mean speed during a 10 min all out C-PT. Prior to the all out C-PT two standardized workloads equivalent of 75% (10 min) and 80% (5 min) of VO<sub>2</sub>max-poling was performed. A standardized warm-up protocol consisting of four workloads from 50-65% of VO<sub>2</sub>max-poling was performed on each testing day before the 15 min+10 min all out C-PT. Oral ingestion of CAF or PLA was done 75 min before the all-out C-PT. Similar treatment was done both days in a row. Results Increased poling speed after CAF ingestions compared to PLA was observed both days. The improvement was 4.2% for both CAF dosages (P<0.05), on day one while improvements on day two were 5.0 and 5.1% for CAF3 and CAF4.5 respectively compared to PLA. Mean speed on the 10 min C-PT were 15.5 ±0.2 and 15.4±0.4 km • h<sup>-1</sup> for PLA day one and two, while it increased day one to 16.2 ±0.4 km • h<sup>-1</sup> for both CAF3 and CAF4.5. Day two, same mean speed was observed for CAF4.5, while a small decrease was observed to 16.1±0.4 km • h<sup>-1</sup> for CAF3 compared to PLA (n.s). Of all subjects participating 87.5% improved performance on both days after CAF ingestions. Discussion The novel heading in this study is that CAF ingestion improved performance both competing days. Higher speed was associated with increased heart rate (HR), blood lactate (LA-) and VO<sub>2</sub> consumption after CAF ingestions. No difference in HR, LA- or VO<sub>2</sub> was observed during the warm-up or during the first 15 min of the C-PT were workloads were similar between treatments. In conclusion ingestion of both CAF dosages increases subjects physiological capacity, also when competing two days in a row. The higher physiological stress on day one did not impair performance the following day when CAF was ingested. Referencelist 1.McNaughton LR (2008) Int.J.Sports Physiol Perform Jun; 3(2):157-63 2.Ivy JL (2009) Int.J.Sport Nutr.Exerc.Metab (Feb;19(1):61-78)

#### EFFICACY OF FLYWHEEL RESISTANCE EXERCISE TO MAINTAIN MYOSTATIN AND OXIDATIVE AND GLYCOLYTIC POTENTIAL OF MUSCLE DURING 90 D BED REST

Rodriguez-Miguel, P.1, Fernandez-Gonzalo, R.2, Tesch, P.A.2,3

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EFFICACY OF FLYWHEEL RESISTANCE EXERCISE TO MAINTAIN MYOSTATIN AND OXIDATIVE AND GLYCOLYTIC POTENTIAL OF MUSCLE DURING 90 D BED REST Introduction Skeletal muscle atrophy and metabolic perturbations may jeopardize health and fitness of astronauts during long-term spaceflight. Although alterations in muscle function and morphology after spaceflight simulation have been well described, there is lack of knowledge in regards to related skeletal muscle metabolic adaptations. While resistance exercise (RE) training is shown to

maintain muscle size and function during 90 d bed rest (Alkner & Tesch 2004), this study determined muscle oxidative and glycolytic potential along with myostatin before and after 90 d bed rest with or without RE. Methods Twenty-one healthy males (26-41 yrs) were randomly assigned to either 6° head-down tilt bed rest with (BRE; n=9) or without (BR; n=12) concurrent resistance exercise (RE) for 90 d. RE was performed every third d using iso-inertial flywheel technology (4 x 7 maximal concentric-eccentric supine squats). Before (PRE) and after (POST) the intervention, muscle biopsies were obtained from m. vastus lateralis, and mRNA expression of regulators of muscle mass (myostatin), oxidative capacity (peroxisome proliferator-activated receptor gamma coactivator-1alpha; PGC-1alpha, and vascular endothelial growth factor; VEGF) and glycolytic potential (phosphofructokinase; PFK), were subsequently analyzed. Results PGC-1alpha and VEGF mRNA expression decreased ( $P < 0.002$ ) in both BR (PGC-1alpha; 1.3-fold, VEGF; 1.3-fold) and BRE (PGC-1alpha; 1.5-fold, VEGF; 1.8-fold). PFK mRNA content increased from PRE to POST in BR ( $P < 0.001$ ; 1.5-fold) but not in BRE. Thus, PFK expression was greater in BR than BRE at POST ( $P < 0.03$ ; 1.4-fold). Myostatin mRNA levels increased from PRE to POST in BR only ( $P < 0.001$ ; 2.4-fold). BR showed greater myostatin expression than BRE at POST ( $P < 0.001$ ; 3.7-fold). Discussion A single bout of the RE paradigm employed here increased PGC-1alpha and VEGF in ambulatory subjects (Fernandez-Gonzalo et al 2013). However, this stimulus, when offered every third day, was insufficient to counteract unloading-induced alterations in these markers of oxidative capacity. Nevertheless, the RE carried out by BRE ameliorated the increase in PFK and myostatin induced by spaceflight simulation. This suggests both muscle glycolytic potential and muscle size are maintained with use of the current RE regimen. Hence, additional exercise countermeasures are needed to preserve muscle oxidative potential during long-haul space missions. References Alkner BA, Tesch PA (2004). *Eur J Appl Physiol* 93: 294-305. Fernandez-Gonzalo R, Lundberg TR, Tesch PA (2013). *J Appl Physiol* (in review).

### CREATINE SUPPLEMENTATION ASSOCIATED OR NOT WITH STRENGTH TRAINING UPON DEPRESSION AND COGNITION IN OLDER WOMEN

Gualano, B., Alves, C.R.R., Merege Filho, C.A.A., Benatti, F.B., Brucki, S., Pereira, R.M.R., de Sá Pinto, A.L., Lima, F.R., Roschel, H.

*University of Sao Paulo*

**Introduction** In spite of the potential therapeutic role of isolated strength training or creatine supplementation on cognition and depression in older individuals, no studies have investigated the possible additive effects of these strategies combined. Therefore, the aim of this study was to assess the effects of creatine supplementation, associated or not with strength training, upon depression and cognition in old individuals. **Methods** This is a 24-week, parallel-group, double-blind, randomized, placebo-controlled trial. The individuals were randomly allocated into one of the following groups (n=14 each): 1) placebo, 2) creatine supplementation, 3) placebo associated with strength training or 4) creatine supplementation associated with strength training. According to their allocation, the participants were given creatine (4 x 5 g/d for 5 days followed by 5 g/d) or placebo (dextrose at the same dosage) and were strength trained or not. Cognitive function, assessed by a comprehensive battery of tests involving memory, selective attention, and inhibitory control, and depressive symptoms, assessed by the Geriatric Depression Scale, were evaluated at baseline, after 12 and 24 weeks of the intervention. Muscle strength and food intake were evaluated at baseline and after 24 weeks. **Results** After the 24-week intervention, both training groups (ingesting creatine supplementation and placebo) had significant reductions on the Geriatric Depression Scale scores when compared with the non-trained placebo group ( $p=0.004$  and  $p=0.029$ , respectively) and the non-trained creatine group ( $p<0.001$  and  $p=0.002$ , respectively). However, no significant differences were observed between the non-trained placebo and creatine ( $p=0.77$ ) groups, or between the trained placebo and creatine groups ( $p=0.83$ ). Both trained groups, irrespective of creatine supplementation, had better muscle strength performance than the non-trained groups. Neither strength training nor creatine supplementation altered any parameter of cognitive performance. Food intake remained unchanged. **Conclusion** Creatine supplementation did not promote any significant change in cognitive function and depression parameters in apparently healthy older individuals. In addition, strength training per se improved depression and muscle strength, but not cognition, with no additive effects of creatine supplementation. Registered at Clinicaltrials.gov as NCT01164020.

### VITAMIN D DEFICIENCY AND EVALUATION OF APPLIED SUPPLEMENTATION IN POLISH ATHLETES

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*1 National Centre of Sports Medicine, Warsaw, Poland. 2 Mossakowski Medical Research Centre, PAS, Warsaw, Poland.*

**Introduction** Recently Vitamin D is considered as an important factor not only in calcium homeostasis but in muscle metabolism involved in sports activity as well. Poland has a moderate climate, thus sun dependent activation of provitamin D is limited resulting in increased risk of hypovitaminosis (below 30 ng/ml) in general population and in athletes (desired at least 40 ng/ml). The aim of this study was to evaluate the concentration of vitamin D in Polish athletes and effectiveness of recommended supplementation. **Methods** Professional athletes of track and field, fencing, handball and volleyball were monitored regularly for three years for blood total vitamin 25(OH)D concentration (number of samples: 2010 – 190; 2011 – 209; 2012 – 250). In 2011 according to blood monitoring results supplementation program was introduced with dose of 1000 units daily. In subjects who showed no improvement doses of 2000-4000 units daily were applied in 2012. Influence of training camp abroad with high sunshine exposure during winter was evaluated in 2012. **Results** Annual average vitamin 25(OH)D concentration in 2010 was  $27.6 \pm 0.6$  ng/ml, with clear seasonal rhythm (winter Dec-Feb  $25.0 \pm 1.3$  ng/ml; summer Jun-Aug  $29.1 \pm 0.7$  ng/ml,  $p<0.01$ ). Athletes who had trained during winter abroad with high sunshine exposure showed significantly enhanced vitamin 25(OH)D concentrations of  $53.1 \pm 1.8$  ng/ml, compared to  $34.0 \pm 1.3$  ng/ml,  $p<0.001$  in subjects who stayed in Poland. Supplementation with 1000 units daily showed significant improvement in 2011 ( $37.5 \pm 1.0$  ng/ml,  $p<0.001$ ), higher doses of 2000-4000 units daily produced further improvement in 2012 ( $40.9 \pm 1.3$  ng/ml,  $p<0.05$ ). **Discussion** Vitamin D deficiency was confirmed in population of Polish athletes, especially in winter. Monitoring of vitamin D is necessary, as primary recommendations for supplementation of 1000 units daily have proved to be effective, but in some athletes higher doses of max 4000 units daily are required in order to produce desired results. The other, natural but more difficult, way to prevent hypovitaminosis is to spend some part of winter in warm and sunny climate.

### MITOCHONDRIAL BIOGENESIS AND ENDURANCE PERFORMANCE IN RESPONSE TO HIGH INTENSITY INTERVAL TRAINING AND ENDURANCE TRAINING IN GAELIC FOOTBALL PLAYERS

Tobin, C.1, Kelly, D.1, O'Connor, P.L.1, McCaffrey, N.1, Gerling, C.2, Palmer, M.2, Daly, P.3, Spriet, L.L.2, Moyna, N.M.1  
*Dublin City University*

**Introduction** Brief repeated sessions of high intensity interval cycling induce changes in skeletal muscle energy metabolism that resemble endurance type training. PGC-1 $\alpha$  is a transcriptional co-activator which through the activation of both nuclear and mitochondrial transcription factors up-regulates mitochondrial biogenesis. At present, there are no studies which have examined the effect of brief repeated sessions of high intensity interval running (HIIR) on mitochondrial biogenesis and endurance performance in players involved in team sports. Therefore the aim of this study was to compare the changes in mitochondrial biogenesis and endurance performance in response to HIIR and endurance running (ER) in Gaelic football players. **Methods** Fourteen club level Gaelic football players (mean  $\pm$  SD; age 21.7  $\pm$  2.3 yr; BMI 24.2  $\pm$  1.2 kg.m<sup>2</sup>; VO<sub>2</sub>max 55.1  $\pm$  4.9 ml.kg<sup>-1</sup>•min<sup>-1</sup>) were randomly assigned to an ER or HIIR group. Both groups undertook 6 training sessions over a 2 week period. ER involved 50 min of continuous running at 75% VO<sub>2</sub>max. The HIIR group performed 3 sets of 3 x 110 m shuttle sprints with a 20 s recovery period between each sprint, and a 5 min recovery period between sets. Muscle biopsies were taken before and after training. Western blot analysis was used to measure the protein content of p38 MAPK, AMPK, PGC-1 $\alpha$ , Tfam and OXPHOS subunits. Maximal activities of CS and  $\beta$ -HAD were determined spectrophotometrically. Endurance performance was evaluated by measuring the time to exhaustion at 110% vVO<sub>2</sub> max before and after the 6 exercise session. **Discussion** Training resulted in a significant increase in protein content of AMPK (p<0.05) and COX I-IV (p<0.05) subunits in the HIIR group, whereas PGC-1 $\alpha$  (p<0.05) and COX V subunit (p<0.05) increased in both groups. There was no increase in Tfam protein content in either group post training. Compared to baseline glycogen, ATP and PCR concentration increased (p<0.05) in the HIIR group only. The activity of CS and  $\beta$ -HAD were significant higher (p<0.05) than baseline in both groups following the 6 training sessions. Endurance performance increased in both the HIIR (p<0.05) and ER (p<0.01) group in response to training. Compared to 6 sessions of ER, HIIR induced a similar improvement in endurance performance and a more pronounced increase in mitochondrial biogenesis. **References** Little J.P, Safdar A., Wilkin G.P., Tarnopolsky M.A., Gibala M.J. (2012), *J Physiol*, 588.6, 1011–1022 Gibala M.J., Little J.P, Van Essen M., Wilkin G.P, Burgomaster K.A., Safdar A, Tarnopolsky M.A, (2006), *J.Physiol*, 575.3, 901–911 Hood D.A., (2001) *J Appl Physiol* 90:1137-1157

### ORAL L-ARGININE MODULATES BLOOD LACTATE AND INTERLEUKIN-6 AFTER EXERCISE IN HIV-INFECTED MEN

Alves, G.N.1, Tavares, A.M.V.1, Vieira, P.J.C.1, Sprinz, E.2

*1:Exercise Pathophysiology Research Laboratory and Cardiovascular Division 2: Division of Internal Medicine, Clinical Hospital of Porto Alegre - Porto Alegre, Brazil*

**Introduction** The acute administration of L-arginine (L-arg), a nitric oxide (NO) precursor, reduces lactate (LAC) concentration after exercise in healthy individuals. Lower concentration of L-arg may enhance the action of some inflammatory cytokines in HIV-1 infected patients. We tested the hypothesis that acute L-arg administration may reduce post-exercise blood LAC and inflammatory cytokines levels in HIV-infected patients. **Methods** Ten HIV-infected men performed 2 maximal incremental cardiopulmonary exercise tests, separated by one week. Thirty minutes before each test, patients received oral placebo (Plcb) or 20g of L-arg. Blood LAC, tumor necrosis factor alpha (TNF-alpha), interleukin-6 (IL-6), and interleukin-10 (IL-10) were measured before and up to 60 min after exercise. **Results** L-arg administration had no significant effect on peak heart rate, peak oxygen uptake, and peak respiratory exchange ratio. Compared to Plcb, L-arg administration reduced maximal post-exercise blood LAC from 8.7 $\pm$ 0.6 to 6.9 $\pm$ 0.4 mmol/L (p < 0.05). L-arg administration had no significant effect on TNF-alpha or IL-10 concentrations, but increased post-exercise IL-6 (Plcb = 19  $\pm$  3 pg/ml; L-arg = 63  $\pm$  8 pg/m; p < 0.05). **Discussion** There is solid evidence indicating that the elevation of IL-6 in response to exercise may exert anti-inflammatory effects, by blocking TNF-alpha (Pedersen, 2011; Pedersen and Febbraio, 2005; Stevens et al., 2000). Our data suggest that, in HIV-1 positive individuals, L-arg supplementation is needed for the manifestation of the anti-inflammatory effects of acute exercise. Further studies should be conducted to test the hypothesis that chronic L-arg supplementation may improve the anti-inflammatory effects of exercise training. **In conclusion**, in HIV-1 infected men, acute administration of L-arg reduces post-exercise blood LAC and increases IL-6 levels, suggesting the activation of the L-arg-NO pathway, with possible anti-inflammatory consequences. **References** Pedersen BK. (2011). *J Exp Biol* 214, 337–346 Pedersen BK, Febbraio M. (2005) *Brain Behav Immun* 19, 371-376 Stevens BR, Godfrey MD, Kaminski TW, Braith RW. (2000) *Med Sci Sports Exerc* 32, 2102–2108

**16:20 - 17:50**

## Invited symposia

### IS-PM03 Oxygenation and fatigue in humans: unravelling the mechanisms \*

#### NUCLEOTIDES, THE KEY TO HEALTH AND PERFORMANCE?

Hellsten, Y.

*University of Copenhagen*

ATP is a nucleotide of exceptional importance in the body, both for basal cellular functions and for exercise performance. It is the only directly usable energy source for muscle contraction and many other energy demanding functions, but it is also a very important signaling molecule. During short-term, high intensity exercise the rate of ATP utilization within the skeletal muscle cells may exceed the rate of regeneration from ADP, with a consequent acute reduction in intracellular ATP levels. Moreover, a small fraction of the acutely degraded ATP is lost from the muscle as inosine and, if intense exercise is repeated frequently over a period of time, an accumulated loss can occur leading to lowered resting ATP stores. Such reduced ATP levels could, in theory, affect performance, although existing data do not directly support this. Extracellular ATP levels have been proposed to affect muscle contractility and the activity of Na<sup>+</sup>/K<sup>+</sup> pumps that are essential for removal of extracellular K<sup>+</sup>, and thus for development of fatigue. In the muscle interstitium extracellular ATP may primarily originate from secretion from the skeletal muscle cells, but factors controlling such release remain to be identified. In plasma, ATP is a potent

vasodilator and sympatholytic compound and is believed to be important for the control of proper oxygen delivery to skeletal muscle. Plasma ATP originates primarily from secretion from erythrocytes and endothelial cells and if this secretion is impaired, oxygen supply may be inadequate and limit performance. This is believed to occur in lifestyle diseases such as Type II diabetes.

### **BRAIN OXYGENATION AND FATIGUE: ROLE OF PAO<sub>2</sub> AND CAO<sub>2</sub>?**

Calbet, J.

*University of Las Palmas de Gran Canaria*

A rapid increase of oxygenation relieves fatigue during maximal exercise in severe acute and chronic hypoxia. Since this effect is almost instantaneous and it is observed only during exercise with a large muscle mass it has been postulated that this phenomenon indicates that during whole body exercise in severe acute hypoxia fatigue is predominantly caused by a central mechanism linked to insufficient brain oxygenation. The fatigue relieving effect of oxygenation has been observed when the level of hypoxia during the exercise was high (P<sub>IO<sub>2</sub></sub><86 mmHg) but not in moderate hypoxia (P<sub>IO<sub>2</sub></sub>=104 mmHg). At high levels of hypoxia, when the PaO<sub>2</sub> lies in the rectilinear region of the oxygen dissociation curve of the hemoglobin (ODC), an increase of PaO<sub>2</sub> causes a proportional elevation of SaO<sub>2</sub> improving both the pressure driving the diffusion of O<sub>2</sub> from the capillaries to the mitochondria and the delivery of oxygen. However, during exercise in the flat upper region of ODC an increase of PaO<sub>2</sub> elicits a smaller improvement in SaO<sub>2</sub>. If the ergogenic effect of oxygenation is more dependent on PaO<sub>2</sub> than SaO<sub>2</sub> then it should be present regardless of the change elicited in SaO<sub>2</sub>. Using near-infrared spectroscopy, transcranial Doppler, assessment of blood gases, and novel experimental approaches to manipulate swiftly brain blood flow and PaO<sub>2</sub> we will show that at moderate to high levels of hypoxia PaO<sub>2</sub> appears to play a dominant role.

### **OXYGENATION AND TRAINING**

Lundby, C.

*University of Zürich*

Altitude training in the form of Live High – Train Low was first demonstrated effective in increasing athletic performance in the late 1990s and since then numerous studies have either confirmed this or reported no effects. A meta analysis on the topic suggest an approximately 1% increase in performance following LH<sub>TL</sub>, which is obviously not to be neglected when it comes to exercise performance in elite athletes. However the scientific gold-standard design of a double blind, placebo controlled, cross-over trial has never been conducted on LH<sub>TL</sub> and most studies have not made use of truly elite athletes. Thus previous studies should be met with some skepticism. Although the underlying mechanisms for performance gains have been debated since LH<sub>TL</sub> was first launched, it now seems safe to say that a hypoxia induced increase in hemoglobin mass is a prerequisite for LH<sub>TL</sub> also to increase performance. A recent analysis suggests that the erythropoietic response to LH<sub>TL</sub> may depend on the initial nHb value, i.e. a person with an already high nHb will not respond to the hypoxic stimulus as much (or at all) as a person with an initial low nHb. This questions the added value of LH<sub>TL</sub> for truly elite endurance athletes. Furthermore the analysis demonstrated that much more time is required to increase nHb with continuous altitude acclimatization than what is currently recommended for LH<sub>TL</sub>. Thus the rationale to recommend LH<sub>TL</sub> to elite athletes may not be as clear as previously expected.

**16:20 - 17:50**

## **Invited symposia**

### **IS-PM08 Limits to performance during short-term and prolonged exercise in the heat sponsored by Aspetar**

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#### **CARDIOVASCULAR LIMITS DURING EXERCISE IN A HOT ENVIRONMENT**

González-Alonso, J.

*Brunel University*

Understanding what factors limit human performance is one of the most fascinating and complex scientific challenges in Sport Science. Multiple experimental approaches have been and continue to be employed to address this fundamental question depending on the paradigm used. In physiology, a classic approach is to investigate whether a single or several key physiological variables correlate closely with functional processes leading to fatigue. The heart, the brain and the muscles all generate and process numerous regulatory signals to adjust the supply of oxygen, substrates and blood flow to the local demand in the locomotor muscles. A myriad of research endeavours have tried to establish the relative contribution of these organs to fatigue and examine whether regulatory failure in one or all of these organs underpins fatigue. A major focus of this presentation lies on the circulatory limitations to exercise performance in hot environments, particularly the involvement of the heart, brain and muscles. Blood flow can limit the intensity and duration of exercise via its effect on the supply of oxygen and substrates and thus tissue metabolism. Over the years, it has become increasingly evident that blood flow to the active skeletal and respiratory muscles and the brain does not increase linearly with elevations in local metabolic demand produced by increases in exercise intensity or are maintained stable during strenuous constant load exercise. Cardiac output and blood flow to the active muscle and brain either decline during constant load high intensity exercise to exhaustion (which simulates the circulatory and energy requirements of middle distance events) or level off at submaximal intensities during incremental exercise to exhaustion (e.g., Mortensen et al. 2008; González-Alonso et al. 2008; Vogiatzis et al. 2009). At the heart level, coronary blood flow might also be compromised when cardiac output is impaired owing to diminished stroke volume. Thus, findings over the last decade shed new light on the physiological mechanisms of fatigue during short intense and prolonged exercise typical of many sports by indicating that exhaustion during exercise in hot environments is preceded by restrictions in the provision of essential oxygen and substrates to the active muscles and brain, thereby impacting upon local metabolism in the organs with limited functional oxygen reserve. Although addressing the precise contribution of each organ system warrant further investigation, the significant global circulatory strain prior to fatigue during both prolonged exercise and intense exercise in hot environments support the hypothesis that events in active muscles,

the heart and the brain are all contributing to some extent to the physiological processes leading to fatigue. References González-Alonso J et al. (2008). *J Physiol* 586, 45-53. Mortensen SP et al. (2008). *J Physiol* 586, 2621-2635. Vogiatzis I et al. (2009). *J Physiol* 587, 3665-3677.

### **METABOLIC LIMITATIONS DURING PROLONGED EXERCISE IN A HOT ENVIRONMENT**

Mora-Rodríguez, R.

*University Castilla-La Mancha*

In this talk I will discuss how exercise in the heat alters substrate utilization during prolonged submaximal exercise in comparison to similar exercise in a thermoneutral environment. Also, if heat acclimation, external cooling, or rehydration corrects the shift towards increased reliance on carbohydrate metabolism and what are the implications for performance in a hot environment. Exercise in the heat often results in increased intramuscular glycogen utilization rates (1) a concomitant reduction in fat oxidation and increased blood and muscle lactate accumulation. Lowering of intramuscular glycogen stores is one important cause of fatigue during prolonged exercise. However, glycogen depletion has not been deemed as an important cause of fatigue during prolonged exercise in the heat. At the point of fatigue, during time to exhaustion testing, glycogen concentration remains above 300 mmol/kg dry wt (2). Furthermore, carbohydrate supplementation during exercise in the heat does not delay fatigue (3). Unlike muscle glycogen, blood glucose utilization does not seem to be altered by exercising in a hot environment (4). The possible mechanisms by which exercise in the heat stimulates glycogen phosphorylase activity will be briefly presented. Among those; a) stimulation of anaerobic glycolysis due to a decreased O<sub>2</sub> delivery secondary to reduction in muscle blood flow with severe dehydration, b) hormonal stimulation due to the increased circulating epinephrine concentrations, c) a direct effect of elevated muscle temperature (Q10) on the enzymes. Heat acclimation reduces muscle glycogen use and epinephrine concentration but the decrease is not completely explained by a shift towards fat oxidation or increased blood flow. In addition, external cooling and prevention of dehydration help to reduce glycogenolysis rate during prolonged exercise in the heat. 1. Febbraio, M. A., R. J. Snow, C. G. Stathis, M. Hargreaves, and M. F. Carey. Effect of heat stress on muscle energy metabolism during exercise. *J. Appl. Physiol.* 77(6): 2827-2831, 1994. 2. Parkin, J. M., M. F. Carey, S. Zhao, and M. A. Febbraio. Effect of ambient temperature on human skeletal muscle metabolism during fatiguing submaximal exercise. *J. Appl. Physiol.* 86(3): 902-908, 1999. 3. Febbraio, M. A., P. Murton, S. E. Selig, S. A. Clarke, D. L. Lambert, D. J. Angus, and M. F. Carey. Effects of carbohydrate ingestion on exercise metabolism and performance in different ambient temperatures. *Med. Sci. Sports Exerc.* 28: 1380-1387, 1996. 4. Hargreaves, Mark, Damien Angus, Kirsten Howlett, Nelly Marmy Conus, and Mark Febbraio. Effect of heat stress on glucose kinetics during exercise. *J. Appl. Physiol.* 81(4): 1594-1597, 1996.

**16:20 - 17:50**

### **Invited symposia**

#### **IS-PM11 Muscle mass regulation in humans: relative importance of protein synthesis and protein breakdown \***

##### **PROTEIN IN PROMOTING ADAPTION WITH EXERCISE TRAINING**

Phillips, S.

*McMaster University*

Muscle hypertrophy requires the balance of muscle protein turnover to favour net protein accrual. The stimulus of resistance exercise is a potent stimulator of the process of muscle protein synthesis (MPS); however, muscle protein breakdown (MPB) is also stimulated and net muscle protein balance does not become positive and protein accretion promoted until protein is consumed. Protein consumption after resistance exercise has been unequivocally shown to result in MPS being greater than MPB for a prolonged period of time, whereas protein consumption during and prior to resistance exercise appears of equivocal benefit. Different types of protein can also impact the MPS response and the collective evidence shows that proteins rich in leucine that are rapidly digested provide the most robust stimulus to MPS. Sustaining the MPS response after resistance exercise does not appear to require sustained aminoacidemia, although further work remains to be done in this area. How different types of exercise affect which proteins are being made following exercise is an area of ongoing investigation, however, evidence suggests that myofibrillar protein synthesis is strongly driven by resistance exercise and is nutritionally responsive. In other words protein augments the MPS response. It is far less clear if the same is true of aerobic exercise, which with training begins to stimulate MPS but confined more to the mitochondrial fraction; however, such stimulation does not appear to require or be stimulated by protein provision. Recent evidence surrounding how protein ingestion can influence adaptation, through practical protein consumption strategies will be discussed.

##### **CATABOLISM: IMMOBILISATION AND INFLAMMATION**

Murton, A.J.

*University of Nottingham*

The unintended loss of muscle mass can have significant consequences on an individual's quality of life, incidence of fall-related fractures, and their chance of survival following subsequent disease or illness. Reports of increased expression of the ubiquitin ligases MAFbx/atrogen-1 and MuRF1 mRNA in animal models of cachexia, along with the ability of proteasome inhibitors to block the muscle atrophy that typically develops in these models, has led to the idea that muscle protein breakdown (MPB) via action of the ubiquitin-proteasome system (UPS) represents the predominant mechanism by which muscle atrophy occurs in many cases (Lecker et al., 2004). However, recent work in humans has questioned the idea of a common muscle atrophy "programme" that centres on the idea of enhanced MPB. Following leg-immobilisation, where a 5% loss of quadriceps muscle mass is typically observed after just 14 days of immobilisation (Jones et al., 2004), consistent increases in ubiquitinated proteins and UPS components are only observed in the first few days (<3 days). More prolonged periods of disuse have resulted in inconsistent observations with regards to expression of UPS components

(Murton et al., 2008). In contrast, the suppression of muscle protein synthesis (MPS) is consistently observed in humans during limb-immobilisation and moreover, appears of a magnitude that can fully account for the atrophy observed, suggesting it is the principle mechanism responsible for the loss of muscle mass. The role of MPB in the aetiology of inflammatory-based cachexia is equally unclear. Expression of the cytokines TNF-alpha and IL6 is enhanced in the majority of inflammatory-based diseases, and are known to individually elicit muscle atrophy when administered in vivo; mechanistic evidence suggests that both TNF-alpha and IL6 can suppress MPS and activate UPS-mediated MPB. However, studies in humans demonstrate clearly that chronic expression of either cytokine does not necessitate an enhancing effect on the UPS. Indeed, we have found that systemic increases in IL6 and TNF-alpha in conjunction with increased intramuscular IL6 mRNA expression, are observed in cachectic non-small cell lung cancer patients, and yet muscle 26S proteasome activity and MAFbx/atrogen-1 and MuRF1 mRNA levels remain unchanged compared to healthy age-matched controls (A. Murton et al, unpublished observations). Collectively, these observations serve to illustrate our rudimentary understand of the molecular mechanisms that elicit muscle catabolism during disuse or disease in humans, but it is clear that a "one size fits all" mechanism for the loss of muscle mass is an inappropriate over simplification. Jones et al., (2004) FASEB J. 18: 1025-7. Lecker et al., (2004) FASEB J. 18: 39-51. Murton et al., (2008) Biochim Biophys Acta. 1782: 730-43.

## AGEING SARCOPAENIA: EXERCISE AND NUTRITIONAL INTERVENTION

Atherton, P.

*University of Nottingham*

Exercise and dietary protein intake, independently, and synergistically stimulate muscle anabolism. Mechanistically, nutrient-mediated increases in muscle protein synthesis (MPS) are initiated after amino acid (AA)-transport into muscle cells, whereupon leucine activates the mechanistic target of rapamycin complex-1 (mTORC1), independently of proximal insulin signalling. Exercise also activates mTORC1 independently of proximal insulin signalling via mechano/chemo-transduction processes. Subsequent downstream signalling enhances translational initiation via activation of mTORC1 cognate substrates (e.g. p70S6K1) culminating in polyribosome formation and increased MPS. In terms of kinetics, muscle is only briefly receptive to the anabolic effects of essential AA (EAA) (~2 h), thereafter displaying tachyphylaxis. This has been termed "muscle-full" as muscles can intrinsically sense excess AA, and divert them toward oxidation. Nutrient intake also provides a second route for anabolism, via insulin-mediated suppression of muscle protein breakdown (though this occurs via poorly defined mechanisms). Superimposing exercise onto nutrition markedly delays the "muscle-full" state to facilitate physiological adaptation in accordance to the demands imposed e.g. resistance vs. endurance exercise. In terms of ageing, it has been shown that these anabolic effects of exercise and nutrition are blunted- a phenomena termed 'anabolic resistance'. Discovering the physiological level(s) at which this blunting is mediated and determining the contribution of age-related inactivity are important foci in managing the impact of sarcopaenia. In addition, the discovery of novel strategies to enhance the anabolic effects of exercise and nutrition (e.g. regimens, nutra-ceuticals) remains a hotly pursued avenue. Finally, the application of systems biology approaches has produced new insight into the effects of exercise on molecular networks associated with ageing. These analyses have revealed that exercise is not simply the 'reverse' of ageing. Moreover, the application of unbiased genome-wide approaches have led to discoveries that provide novel information on, and challenge accepted paradigms of exercise adaptation yielded through reductionist approaches.

**16:20 - 17:50**

## Oral presentations

### OP-PM28 Physiology [PH] 5

#### EFFECT OF ACUTE ISOMETRIC BILATERAL LEG EXTENSION EXERCISE ON BRACHIAL AND COMMON FEMORAL ARTERY FLOW-MEDIATED DILATATION

Howland, L.J.1, Wiles, J.D.1, Coleman, D.A.1, Swaine, I.L.1

*1: Canterbury Christ Church University*

Introduction Flow-mediated dilatation (FMD) is an endothelium-dependant and nitric oxide specific index of endothelial function. The chronic effects of exercise on endothelial function and improvements in FMD have been well established (Tinken et al., 2010). The impact of acute exercise on FMD remains inconclusive. The aim of this study was to investigate the effect of acute isometric bilateral leg extension exercise performed at two different intensities on brachial (BA) and common femoral artery (CFA) FMD. Method 11 healthy male participants visited the laboratory for six visits. High intensity, low intensity exercise and control conditions were performed twice at random. High and low exercise intensity were calculated from an Incremental Isometric Exercise Test (Devereux et al., 2011). BA and CFA FMD were measured pre and 5 minutes post exercise for each of the conditions. The absolute change in BA and CFA FMD was expressed as a percentage (%) and raw (mm). Doppler Ultrasound was used to measure FMD. Edge-detection, wall tracking software was used for analysis. During each exercise bout Doppler Ultrasound was used to measure CFA blood flow and artery diameter. Results There was a significant difference in absolute change BA FMD% between high (mean change -4.23%) and low (2.77%) exercise intensities ( $p=0.033$ ). There was a significant difference in absolute change BA FMD (mm) between high (-0.02mm) and (0.01mm) low intensities ( $p=0.035$ ). No significant differences existed in absolute change CFA FMD% or FMD (mm) between high and low intensities ( $p=0.856$  and  $p=0.741$ ) respectively. Blood flow and shear rate were analysed during exercise contractions and upon release. A significant time by intensity interaction was evident ( $p=0.02$  and  $p=0.014$ ) with significantly higher antegrade blood flow and antegrade shear rate upon release in the high condition. There was no significant main effect or time by intensity interaction evident ( $p>0.05$ ) with retrograde blood flow and retrograde shear rate. Normalisation of FMD to the shear rate stimulus is ongoing. Discussion Results demonstrate that absolute BA FMD% and FMD (mm) are significantly reduced after a high intensity bout of exercise is performed, which coincides with research utilising alternative modes of acute exercise (Llewellyn et al., 2012). The increases in blood flow and shear rate were greater throughout exercise, when compared to more widely researched exercise modes (Gonzales et al., 2011). This research may provide further insight into how the specific exercise stimulus may cause different acute responses in endothelial function, perhaps promoting isometric exercise training as an efficient alternative to improve resting blood pressure. This research could potentially inform future exercise prescrip-

tion for training studies which ultimately aim to improve cardiovascular health. Devereux et al (2011). Journal of Sports Sciences. 29(7). Gonzales et al (2011). Appl Physiol Nutr Metab. 36. Llewellyn et al (2012). Acta Physiol, 205. Tinken et al (2010). J Physiol, 5003-5012.

### EFFECTS OF DAWN SIMULATION ON MARKERS OF SLEEP INERTIA AND POST-WAKING PERFORMANCE IN HUMANS

Thompson, A.I, Jones, H.I, Gregson, W.I, Atkinson, G.2

*1.Liverpool John Moores University 2. Teesside University*

Introduction "Sleep inertia" is a transient state between sleep and feeling fully awake. Individuals typically report symptoms of grogginess, disorientation, decreased motor control and lower cognitive and physical performance. Artificial dawn simulation, mediated by a device which gradually increases the light intensity prior to waking, has been proposed as a method to reduce these symptoms. Therefore, the effects of a simulated dawn during the last 30 minutes of sleep on the subsequent dissipation of sleep inertia, and, for the first time, improvements in simulated work and physical performance were examined. Methods Eight participants, who reported particular difficulty with morning waking (Munich chronotype questionnaire) were recruited. Participants completed, in a random order, a control (C) and a dawn simulation (DS) trial. The DS trial involved a sigmoidal increase in light intensity from 0.1 to 300 lux (Body Clock Active 250, Lumie, UK), which started 30 minutes prior to waking from 8 hours of nocturnal sleep. Subjective ratings of sleep quality (10 cm VAS) and sleepiness (KSS) were measured alongside mathematical and reaction time tasks (Vienna Test System, A2340, Vienna, Austria) at 5, 30 and 75 min after waking at habitual workday times. Physical performance was measured 35 min post waking using a self-paced 4-km cycling time-trial. Data were analysed using two-factor within-subjects (trial x time) generalized estimation equations, with trial-order as a covariate in the model. Time-trial and sleep quality data were analysed using paired t-tests. Data are described as mean±SD. Results After waking in the DS condition, perceived sleep quality was 1.2±0.9 (P = 0.01) points higher compared with C. Ratings of sleepiness were significantly lower in DS compared with C (3.5±1.2 vs. 4.1±1.1, P = 0.04) throughout the testing period. Cognitive performance (mathematical and reaction time) improved in both trials as time-awake increased (P < 0.0005). On average, participants completed a greater number of additions in DS compared with C (70±15 vs. 67±17, P = 0.03). Reaction times were also faster in DS compared with C (0.81±0.07 vs. 0.86±0.06 s, P < 0.0005). The self-paced cycling time-trial was completed, on average, 21.4 s (4.7%) quicker in DS than C (95% CI of the difference: -1 to 43 s, P = 0.07). Conclusion These data provide novel insight into the interactions between phototherapy and performance. For the first time we have demonstrated that gradually increasing light exposure during the last 30 minutes of habitual sleep can decrease subjective sleepiness and improve both cognitive and physical performance soon after waking. These outcomes have implications for both athletic and general populations.

### POST-EXERCISE ELECTROCORTICAL ALTERATIONS INDUCED BY DIFFERENT RECOVERY INTERVENTIONS

De Pauw, K., Roelands, B., Tellez, H.F., Knaepen, K., Meeusen, R.

*Vrije Universiteit Brussel*

Introduction Comprehensive data are available on the effect of different recovery interventions on cycling performance and physiological parameters (Barnett, 2006). However the interplay between recovery and brain functioning might add supplementary information on the effectiveness of a specific recovery intervention. Therefore, we investigated the impact of three different recovery interventions on subsequent cycling performance in the heat and their effect on electrocortical activity. Recovery specific changes will be associated with electrocortical alterations reflecting regional brain processing. A higher activation of frequency band beta (12-30Hz) after exercise has been linked to a greater cortical activation (Moraes, 2007; Nielsen 2003). Methods After a max test and familiarization trial, 9 trained male subjects (22.7±3.4yrs) performed 3 experimental trials in the heat (30°C; RH 43.7±5.6%). Each trial consisted of two exercise tasks separated by 1h. The first one was a 60min constant load trial (55% of Wmax), followed by a 30min simulated time trial (TT1). The second one comprised a 12min simulated time trial (TT2). After TT1 active recovery (AR; cycling at 80W), passive rest (PR; sitting on a comfortable chair) or cold water immersion (CWI; until sternum, water temperature: 15°C) was applied for 15min. We obtained 3min EEG datasets pre and post an exercise task. EEGlab was used to process the datasets (1-45Hz, Notch, ICA). Discrete Fourier transform calculated the absolute power spectrum ( $\mu V^2$ ) for each 4s segments. A normality test, Friedman tests and Wilcoxon Signed-rank tests were conducted (p<0.05). Results CWI resulted in faster TT2 performance when compared to PR (4.2%) and AR (4.7%). The absolute power spectrum pre TT2 did not significantly differ between the recovery interventions. After CWI,  $\beta_2$  power significantly increased at FP1 (p=0.028) [FP2: (p=0.051)] and AR significantly increased  $\beta_2$  power at F3, Fz, F4 and Cz (p<0.039) post compared to pre TT2. PR showed no significant differences post compared to pre TT2. Discussion CWI induced increased prefrontal activation after TT2, which influences information processing and psychological variables like attention and arousal. AR increased  $\beta_2$  power activation at aforementioned electrode sites after TT2 indicating increased information processing at frontal and somatosensory brain areas. We postulate that there exists a link between the absolute  $\beta_2$  power at specific brain areas and the effectiveness of a recovery intervention. References Barnett. Sports Med 2006;36(9) Moraes et al. Arq Neuropsiquiatr 2007;65(3-A) Nielsen, Nybo. Sports Med 2003;33(1)

### MODEST FOOD RESTRICTION STIMULATES INCREASES IN APPETITE THAT DO NOT OCCUR IN RESPONSE TO AN EQUIVALENT EXERCISE-INDUCED ENERGY DEFICIT.

Deighton, K., Douglas, J., Pryke, H., Stensel, D.J.

*Loughborough University*

Introduction Weight loss is the result of a sustained negative energy balance, which is typically achieved by decreasing food intake and/or increasing physical activity. Research suggests that appetite, energy intake and plasma acylated ghrelin concentrations increase in response to a daily energy deficit of ~4820 kJ when induced via food restriction but not when achieved via exercise (King et al., 2011). The present study investigated whether such contrasting responses occur with smaller, more practical energy deficits induced by exercise and food restriction. Methods Twelve healthy male volunteers (mean (SD); age 24 (5) years, body mass index 23.8 (2.7) kg.m<sup>-2</sup>, maximum oxygen uptake (VO<sub>2</sub> max) 55.4 (9.1) mL.kg<sup>-1</sup>.min<sup>-1</sup>) completed three 8 h trials separated by one week in a counterbalanced Latin Square design. Participants arrived at the laboratory at 8 am after an overnight fast. Standardised test meals were provided at 1 h and 4 h. Appetite ratings and plasma acylated ghrelin concentrations were measured throughout each trial. Food intake was monitored from an ad libitum meal at 7 h. Thirty min of continuous cycling exercise at 64.5 (3.2) % of VO<sub>2</sub> max was performed from 0-0.5 h during the exercise trial (Ex-Def), which induced an energy deficit of 1469 (256) kJ. An energy deficit of 1478 (275) kJ was induced in the food restriction trial (Food-Def) by deducting the net energy cost of exercise from the energy provided at the standardised test meals. No energy deficits were induced during the control trial (Con). Results The appetite delta AUC was significantly higher in Food-Def than Ex-Def from 0-1 h (P =

0.012), 4-7 h ( $P = 0.018$ ) and for the entire 8 h trial (0-8 h;  $P = 0.009$ ). However, energy intake at the ad libitum meal did not differ between trials ( $P = 0.634$ ; Con 4376 (1634); Food-Def 4481 (1846); Ex-Def 4217 (1850) kJ). Acylated ghrelin delta AUC was elevated in Con relative to Ex-Def and Food-Def from 0-1 h ( $P = 0.049$ ) but did not differ between trials during any other time periods. Closer inspection of the data revealed large individual differences in plasma acylated ghrelin profiles. Discussion An acute energy deficit of ~1478 kJ stimulated increases in appetite when achieved via food restriction but not when induced via exercise. Appetite appeared to be unrelated to changes in plasma acylated ghrelin concentrations, which adds to the current debate regarding the importance of ghrelin in the physiological regulation of appetite (Lippl et al., 2012). Ad libitum energy intake did not differ between trials and may need to be monitored in a free-living environment. References King JA, Wasse LK, Ewens J et al. (2011). *J Clin Endocrinol Metab*, 96, 1114-21. Lippl F, Erdmann J, Steiger A et al. (2012). *Regul Pept*, 174, 26-31.

### CARDIAC FUNCTION AND LEFT VENTRICULAR MECHANICS IN MEN AND WOMEN AT REST AND DURING EXERCISE

Nio, A.Q.X., Stöhr, E.J., Meah, V., Stembridge, M., Shave, R.

*Cardiff Metropolitan University*

**Introduction** During incremental exercise, cardiac output (Q) increases similarly in men and women. However, women have been suggested to depend on a larger end-diastolic volume (EDV) and men on a smaller end-systolic volume (ESV) during peak supine exercise. Furthermore, sex differences in the underpinning left ventricular strain and twist ('LV mechanics') have not been examined. The aim of this study was to compare LV function and the underlying mechanics in men and women at rest and during exercise. We hypothesised that a similar Q will be attained via different LV mechanics in men and women during exercise. **Methods** 12 healthy men (mean±SD; age 23±3 y; body fat 17±5%; VO<sub>2</sub>peak 43±7 mL/min/kg) and 13 healthy women (age 23±4 y, body fat 30±4%; VO<sub>2</sub>peak 35±6 mL/min/kg) completed four consecutive 4-min stages of exercise at 10, 30, 50 and 70% supine cycling peak power (Wpeak). Heart rate (HR), Q, stroke volume (SV), EDV, ESV, isovolumic relaxation time (IVRT) and LV mechanics were assessed using echocardiography. Q, SV, EDV and ESV were allometrically scaled to fat free mass for statistical analysis. Data were analysed using mixed ANOVA and post-hoc t-tests with Bonferroni correction ( $\alpha=0.05$ ). Relationships were assessed using Pearson's product-moment correlation. **Results** With exercise, HR, Q, SV and EDV increased, and ESV decreased. EDV tended to differ between men and women across exercise ( $p=0.06$ ). Peak basal radial strain remained unchanged but the peaks of all other parameters of LV mechanics (basal and apical radial and circumferential strain and strain rates, rotation and rotational velocities, and LV twist and untwisting velocity) increased with exercise. IVRT was shorter in women at 50 (men 61±10; women 52±12 ms) and 70% Wpeak (men 57±12; women 46±10 ms;  $p<0.05$ ). A shorter IVRT during exercise was related ( $r^2=0.68$ ;  $p<0.01$ ) to a greater uncoupling of peak diastolic rotation velocities (i.e. longer time interval between peak basal and apical rotational velocity). At 70% Wpeak only, this uncoupling of peak regional rotational velocities was more pronounced in women than men (21±15 vs. 6±10% of diastole;  $p<0.05$ ). **Discussion** This is the first study to examine sex differences in LV mechanics during exercise. Whilst the results of the present study suggest that Q in men and women at moderate intensity exercise (70% Wpeak) may be generated by different underlying mechanics, they clearly demonstrate that cardiac function and mechanics are similar in men and women at rest and during low intensity exercise. Whether the uncoupling of peak diastolic basal and apical rotational velocity in women at 70% Wpeak hastens development of the intra-ventricular pressure gradient for mitral valve opening, shortens IVRT and enables maintenance of EDV requires further investigation.

### PACING AND TECHNIQUE OF TALENTED SPEED SKATERS: PERSIST TO THE END.

Stoter, I.K., Hettinga, F.J., Otten, E., Stam, A., Elferink-Gemser, M.T., Visscher, C.

*University Medical Center of the University of Groningen*

**Introduction:** Speed skating is an intriguing time trial sport in which maintenance of technique is of great importance to retain velocity. It is therefore important to incorporate technique in choosing an adequate pacing strategy. The present study investigates technical variables, underlying push-off effectiveness and aerodynamics, and pacing in relation to the performance of talented speed skaters. It is hypothesized that talented speed skaters who out-perform other talented speed skaters are better able to maintain low body angles for an effective push-off and aerodynamics at the end of the race, when they have to cope with fatigue. Furthermore, the results might reveal a performance determining factor defining talents in speed skating. **Methods:** Lap-times, knee, hip, trunk and push-off angles per lap (0-300m, 300-700m, 700-1100m and 1100-1500m) were measured during an official 1500m time trial in 45 (international speed skating talents. Based on end-times (ET), the talents were divided in a fast talent group (FTG), including eight male ( $ET < 115.5s$ ) and eleven female ( $ET < 129s$ ) talents, and a slower talent group (STG), including thirteen male ( $ET > 116.5$ ) and thirteen female ( $ET > 130s$ ) talents. A repeated measures ANOVA was used to find differences in lap-times and body angles between the FTG and STG. A multiple regression analysis was used to find the determining technical factors of speed skate performance. **Results:** Lap-times, knee, hip and push-off angles increased over the race, whereas trunk angles decreased. A between subject effect was found for lap-times, knee, hip and push-off angles. Post-hoc tests showed that FTG had lower lap-times in lap 4 (mean±SD: 33.0±2.1° vs 34.7±2.2°) and lower knee, hip and push-off angles during lap 3 (mean±SD: 108.7±5.0° vs 113.0±5.2°, 62.6±5.1° vs 67.6±6.3° and 57.2±2.8° vs 60.1±2.5° resp.) and lap 4 (mean±SD: 109.4±4.5° vs 114.9±5.6°, 63.6±4.1° vs 69.0±7.7° and 58.0±2.6° vs 60.6±3.5° resp.) than STG. Trunk angle profiles were similar for FTG and STG. Multiple regression analyses showed that knee and hip angles in lap 3 were determining for performance. **Conclusion:** The present study showed that technique (in particular knee and hip angles) is most important for performance at the end of the race for talented speed skaters. The faster talents seem to be better able to pace themselves, limiting increase of knee, hip and push-off angles at the end of the race and simultaneously perform a faster final lap with respect to the slower talents. The results emphasize the importance of maintaining technique when fatigued for the performance of talented speed skaters and could be useful for talent development.

16:20 - 17:50

## Invited symposia

**IS-BN01 What the dynamics of team sports tell us about collective behaviours****INTER-TEAM DYNAMICS IN SOCCER: EVIDENCE FROM SMALL-SIDED GAMES AND FULL-SIZED MATCHES**

Frencken, W.

*Hanze University of Applied Sciences*

Positional data is available in team sports like soccer. Each player's positional data can be used to calculate geometrical configurations that quantify the inter-team dynamics during competition. The main aims of this presentation are to introduce these performance measures that quantify the inter-team dynamics, discuss evaluations thereof in small-sided training games and full-sized matches, and to demonstrate that pitch size manipulations constrain interactive team behaviour. I will discuss a series of experimental and observational studies involving youth, adult and (non) elite-standard soccer players (Frencken et al., 2011; 2012; 2013). In the first experiment, the surface areas and centroid positions of two teams are discussed as geometrical measures that could provide a basis for descriptions of interaction processes between two teams. It will be demonstrated that approximately half of all goal-scoring opportunities and goals display changes in the relative longitudinal position of the centroids of both teams, often characterized by crossings thereof. Based on these observations, a follow-up experiment involved calculations of the absolute differences between the longitudinal or lateral centroid positions of the teams (inter-team distances). Critical match periods were extracted from periods of high variability in longitudinal and lateral inter-team distances in one elite-standard soccer match and subjected to further video analysis. Most critical match periods were associated with events in which the ball was passed longitudinally or laterally and players of one of the teams collectively changed running direction. In order to demonstrate that teams adapt their interactive behaviour to specific task constraints and that previously observed findings need to be interpreted carefully, the effect of task modifications on pattern development of longitudinal and lateral inter-team distances and the surface area difference were evaluated in four small-sided soccer games with different pitch dimensions. It was demonstrated that pitch size manipulations of length and width indeed affect teams' spatio-temporal interaction patterns. Additionally, a crossover effect was observed, meaning that changes in pitch length or width also initiate a response in teams' interactive behaviour in lateral and longitudinal directions. The presentation will conclude with suggestions for future research and clear practical implications for coaches and sports scientists. Frencken, WGP, Lemmink, KAPM, Delleman, NJ & Visscher, C (2011). Oscillations of centroid position and surface area of soccer teams in small-sided games. *Eur J Sport Sci*, 4, 215-223. Frencken, WGP, De Poel, HJ, Visscher, C & Lemmink, KAPM (2012). Variability of inter-team distances associated with match events in elite-standard soccer. *J Sport Sci*, 30(12), 1207-1213. Frencken, WGP, Van der Plaats, J, Visscher, C & Lemmink, KAPM (2013). Size matters; pitch dimensions constrain inter-team distances and surface area difference in small-sided soccer games. *J Syst Sci Complex*, 26(1), 85-93.

**PAIRED BEHAVIORS IN RUGBY UNION: THE COMPLEMENTARITY BETWEEN STABILITY AND VARIABILITY**

Passos, P.

*Technical University of Lisbon*

**Introduction** The aim of this study was to describe the attackers' behavior in a 2 vs. 1 situation in rugby union (i.e., two attackers vs one defender). To succeed the attackers must create an interpersonal synergy i.e., the support player must maintain an adjustable angular position with regard to the ball carrier position. This synergy will drive the attackers to a coordination pattern that enables them to avoid the defender and keep running with the ball to the try line. The behavior of one player regulates the behavior of the other in a type of reciprocal compensation (Riley et al., 2011). However decreasing interpersonal distance to the defender may disturb this interaction and attackers must adjust their behaviors to keep decreasing the distance to the score line (Passos et al., 2011). **Methods** Twenty-four under-16 rugby union players with national level experience performed 65 trials on a field with 5 m width and 22 m depth. The trials were videotaped at 25 Hz. TACTO 8.0 software was used to digitize players' positions on the playing field (Fernandes & Malta, 2007). To describe the attackers' behavior we analyzed the following variables over time: i) players distance to the try line; ii) angle between support player and ball carrier; iii) attackers running line velocity. **Results** The data reveal that the position of the ball carrier and support player were strongly correlated ( $0.8 < r < 1$ ) regarding the distance to the try line. As a coordinative variable we used the angle between support player and the ball carrier. Values close to 0 degrees signify that ball carrier and support player are almost side by side, which is a desirable relative position to receive a pass from the ball carrier. This angle initially tends to increase, and close to the moment of the pass, tends to stabilize or decrease. This pattern was stable across trials. During each trial attackers running line velocity was continuously changing. **Discussion** To manage the relative position with the ball carrier the support player needs to manage his own running line velocity which results in continuous fluctuations of both players running line velocity. Therefore the synergy can be described with the angle between support player and ball carrier as a performance variable, which remains within a suitable range to succeed due to variability of attackers running line velocity. **References** Fernandes O, Malta P. (2007). Techno-tactics and running distance analysis using one camera. *J Sports Sci Med*, 6(Suppl. 10), 204-205. Passos P, Milho J, Fonseca S, Borges J, Araújo D, Davids K. (2011). Interpersonal Distance Regulates Functional Grouping Tendencies of Agents in Team Sports. *J Mot Behav*, 43: 2, 155 — 163. Riley M, Richardson M, Schockley K, Ramezoni C. (2011). Interpersonal synergies. *Front Psychology* 2:38. DOI: 10.3389/fpsyg.2011.00038

**TEAM COORDINATION IN BASKETBALL: WHAT CAN VARIOUS LEVELS OF ANALYSIS REVEAL ABOUT INTERPERSONAL DYNAMICS?**

Bourbousson, J.

*Nantes University*

**Introduction** In team sports, the understanding of the cognitive processes that underlie actions of players has been historically focused on the characterization of the information processing and perceptual skills of performers. Besides of the valuable results obtained, recent research has proposed that the cognitive processes underlying actions of players in team sports should be investigated using alternative approaches, especially those allowing more substantial emphasis on the interpersonal relations between players and teams over time in

which actions and decisions are embedded. Actually, new directions are explored by researchers, notably focusing on team coordination and trying to reveal the processes by which teammates and opponents interact and give rise to the team game dynamics. In this context, amongst the main approaches that emerge (i.e., eco-dynamics approach, course-of-action approach) we will argue that some "multi-level" investigations could deepen our understanding of how does collective intelligence emerge. Especially, we will illustrate two lines of empirical investigation. A multi-level approach of decision making in team sports First, one can observe in eco-dynamics approach a focus (a) on the dyadic level of analysis (attacker/defender relationship), and (b) on the inter-team level of analysis (Team A/Team B relationship). These levels of analysis sign a willingness to embed the decision making processes in local interactions on the one hand, and to consider the inter-team relationship as a dynamic state emerging from local interaction and that may be investigated in itself. However, an investigation of the links between these various levels of description may deepen our understanding of the informational constraints that support actions and their dynamics. A study conducted within basketball will serve to illustrate a multi-level approach of decision making in team sports. A Social Network Analysis of intra-team connectedness Second, recent years have seen some attempts to use social networks approaches in various team coordination investigations. We will argue for the specific use of Social Network Analysis (SNA) to account for various level of description (individual, dyadic, triadic, collective), particularly the use of heuristic variables like centrality, reciprocity, transitivity, and density. A simultaneous description and comparison of the respective dynamics of each variable could point out some bottom-up and top-down phenomena, thus offering a way to discuss about circular causality and slaving principles in teams (i.e., emergence and downward causation). A study that adopted the course-of-action framework within basketball will serve to illustrate a multi-level description (i.e., SNA) of the dynamics of intra-team cognitive connectedness. We assume that methodological concerns and directions could be extended to various empirical data. Together, these two lines of research will serve us to conclude about the need for a more multi-level view of collective intelligence in sport's teams.

**16:20 - 17:50**

## Invited symposia

### IS-BN04 Cyclic sports: energetics, evaluation and constraints \*

#### INTER-LIMB COORDINATION IN SWIMMING: EFFECT OF EXPERTISE

Seifert, L.

*University of Rouen*

In this talk the inter-limb coordination of elite and sub-elite swimmers are discussed with a view to informing coaches of the similarities and differences between these groups. In the past it has been reported that the inter-limb coordination should show an opposition mode, i.e. a propulsive continuity between the propulsion of one limb and those of the other limb, in order to minimize the intra-cyclic velocity variations. However, the research of our centre of research highlighted the fact that the inter-limb coordination mode adopted by the swimmers corresponds to three types of constraint defined by Newell (1986): organismic, task and environmental constraint. The skill level of the swimmers, the specialty, the gender, the handedness and the breathing laterality act as organismic constraints; the imposed race pace, the stroke frequency, the number of strokes, the breathing frequency and pattern could be consider as task constraints while the active drag and his correspondent velocity relate to the environmental constraints. Inter-limb coordination was found to vary from catch or glide coordination mode to superposition mode, showing that the opposition mode is only the best "theoretical" mode and the glide mode is not a technical mistake. Therefore it is advised for coaches to don't consider an ideal coordination mode in the absolute but to teach the swimmers in different ways when developing coordination. This talk presents new information based on recent scientific research conducted at the CETAPS. The variables of interest were: average swim speed, stroke length, stroke frequency, intra-cyclic velocity variations, breathing laterality, relative duration of arm and leg stroke phases, time gap between propulsive actions assessed by total time gap (TTG) in the simultaneous strokes and by index of coordination (IdC) in the alternate strokes. Interesting findings emerged that have implications for the both elite and sub-elite swimmers should be coached.

#### A LASER SYSTEM AS A TOOL FOR ASSESS PERFORMANCE IN REAL-TIME IN SPORTS

Ferro, A.

*Faculty of Physical Education and Sports Science. Polytechnic University of Madrid, Spain.*

The biomechanical analysis of the sports technique remains an essential tool to achieve performance improvements. After twenty years of experience offering biomechanical support to high-level athletes, using photogrammetric technique, findings seem to point to immediacy and reliability as key to obtaining valuable biomechanical information. Based on this, we developed a kinematic analysis system of real-time movement applying laser technology, Biolasersport (Ferro & Floria, 2010; Ferro, 2012). The system could be used both in competition and in training conditions in all those sporting events in which straight movements are essential. The system is to feature a two-axes motorized device that will allow to track athletes' movements. In addition, kinematic analysis software has been developed to allow the coach to evaluate the performance of the athlete in real-time. On top of all the above, a video camera capture the images that will be annexed aiming to facilitate the data interpretation provided by the laser system. We expect that the set of modules could be a novel and useful technological tool. There are some works where the system laser was used to obtain data, however, there are few studies that demonstrate the validity and reliability of the system to determine the velocity in sprint (Bezodis, Salo, & Trewartha, 2012; Dickwatch et al. 1994; Harrison et al., 2005). The validity and reliability of the system was assessed. The laser sensor type 1 (LDM301, Jenoptik, Germany) was used to record positions of the subjects to 2000 Hz. The data were analyzed using DSL-30 routine created with DasyLab v.10.0. A Photogrammetry-2D system with a high-speed camera (Exilim High Speed EX-F1, Casio) and a double photocell (Polifemo Light, Microgate, Italy) with an electronic stopwatch (Microgate, Italy) Racetime2 were used. The correlation coefficients obtained were higher than 0.86 regarding to photogrammetry and higher than 0.92 regarding to photo-cells. The laser system showed excellent test-retest reliability for average and maximum velocities with a coefficient of correlation intraclass (ICC) between 0.7-0.9 (Ferro et al., 2012). The system has been used in different sports and environments conditions, indoor and outdoor. All in all, it is our aim to introduce a brand new technological tool for biomechanical analysis to support both coach and athlete improving their achievements. References Bezodis, N. E., Salo, A. I. T. & Trewartha, G. (2012). *International Journal of Sports Medicine*, 33(6), 439-444. Dickwatch, H., Hildebrand, F. & Perl, B.

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## ECONOMY AND EFFICIENCY IN CYCLIC SPORTS

Zamparo, P.

*University of Verona*

For cyclic sport activities (on land and in water) energy expenditure can be accurately measured when the energy cost (C) of that form of locomotion is known. C depends on the speed (v) and the mode of locomotion and is calculated by the ratio:  $E'/v$  where E' is metabolic power (derived from aerobic and anaerobic energy sources). For a given form of locomotion, and at a given speed, C depends also on the factors that affect mechanical work (W<sub>tot</sub>) and locomotion efficiency (e<sub>L</sub>). In cyclic sports e<sub>L</sub> defines the ability to transform net muscle force into the "minimum" external work necessary to move (Cavagna, 1988) and can be considered as the product of two main components: muscle efficiency (e<sub>m</sub>) and transmission efficiency (e<sub>T</sub>):  $e_L = e_m \cdot e_T$ . Transmission efficiency (in aquatic locomotion it is known as propelling efficiency: e<sub>P</sub>) is the ratio between the "minimum" external work and total mechanical work (W<sub>tot</sub>) and accounts for all the energy dissipation 'outside' the involved muscles. When the whole mechanical energy flux is known, and when the metabolism is aerobic, muscular efficiency (e<sub>m</sub>) cannot exceed a value of 0.25-0.30; this efficiency depends on the fibre's type composition, on contraction length and speed and on the type of contraction (concentric or eccentric) (e.g. Minetti 2004). Transmission efficiency could range from 0 (no "external work" production such as in isometric contractions) to 1 (when all the work generated by the muscles is utilized to produce "external work"). Thus, e<sub>L</sub> will range from 0 to about 0.3. In cycling e<sub>L</sub> is close to 0.25 and this indicates that in this form of locomotion e<sub>m</sub> is nearly maximal and e<sub>T</sub> is close to 1. In elite swimmers e<sub>P</sub> could be as high as 0.35-0.40 but this value is reduced in children, masters and unskilled swimmers (e.g. as low as 0.10-0.20) (Zamparo et al. 2011). In rowing and kayaking e<sub>P</sub> is larger: it could be as high as 0.65-0.75, depending on the speed and on the level of skill (e.g. Pendergast et al. 2003). Since  $e_L = e_m \cdot e_P$ , in swimming it is possible to estimate e<sub>m</sub> based on measured e<sub>L</sub> and e<sub>P</sub>. As shown by Zamparo and Swaine (2012) the so calculated efficiency turns out to be of about 0.20-0.25 and corresponds to the efficiency (sometimes indicated as gross, overall or mechanical efficiency) that can be calculated by measuring energy expenditure (metabolic input) and mechanical power (mechanical output) by means of a land based swimming ergometer (Zamparo and Swaine 2012). References Cavagna GA (1988). *Muscolo e Locomozione*. Ed. Cortina, Milano. Minetti AE (2004). *J Exp Biol*, 207, 1265-1272. Pendergast DR et al. (2003). *Eur J Appl Physiol*, 90, 377-386. Zamparo P, Capelli C, Pendergast DR (2011). *Eur J Appl Physiol*, 111, 367-378. Zamparo P, Swaine IL (2012). *J Appl Physiol*, 113, 584-594.

**16:20 - 17:50**

## Invited symposia

### IS-SH04 The impact of sport for all policies on elite sporting success

#### DOES MORE MONEY IN EQUAL MORE MEDALS OUT? AN INTERNATIONAL COMPARISON IN 15 COUNTRIES, RESULTS OF THE SPLISS 2.0 STUDY

De Bosscher, V., Van Bottenburg, M., Shibli, S., Westerbeek, H.

*Free University Brussels/ Utrecht University*

**INTRODUCTION** International competition in elite sport has increased in such way that more nations invest strategically in the development and planning of elite sporting success. In the beginning of the 21st century Hogan and Norton (2000) found a linear relationship between public money spent and total medals won by Australia since the 1980s. The past decade however is characterized by an escalating global sporting arms race, with increased public funding and diminishing return of investment (ROI) in terms of medals won at the Olympics (De Bosscher et al., 2008). **AIM** The aim of this study is to analyze the relationship between (public) funding and international success in summer and winter sports. **METHODS** Using the SPLISS (Sports Policy factors Leading to International Sporting Success) framework, researchers in 15 countries, who took part in a large-scale study named SPLISS 2.0, collected data on the national public funding for sport and elite sport, overall (since 2000) and sport by sport (2010). Data were analysed using descriptive statistics and Pearson correlations. **RESULTS** The results revealed that funding is highly correlated ( $r > 0.9$ ) with success (Olympic Games, World championships – top three and top eight places) both in winter and summer sports. Three countries in summer sports (Australia, the Netherlands and France) and in winter sports (Switzerland, Canada, Flanders) performed above the average: they won relatively more medals (2009-2012) than what they invested, compared to the other sample countries. However, despite increasing expenditures in all nations except from Spain and Switzerland, success in the sample nations did not increase to the same extent: it even decreased for summer sports in Australia, Portugal, Belgium and for winter sports in France, Australia, Belgium and Estonia. Increased success (along with increasing investments) was noticed especially in Japan, the Netherlands and Brazil. **DISCUSSION** While the best predictor of output appears to be the absolute amount of funding allocated to elite sport, the results show evidence of an escalating global sporting arms race. Nations have to invest more, simply to keep ahead of the competition and standing still means going backwards. In elite sport the rules of the game are dictated by what rival nations are doing, not on the basis of what an individual nation is doing now compared with what it did in the past. However, although a minimum amount of funding seems necessary for success, elite sport success is the result of the way the resources are invested in a blend of factors. **REFERENCES** De Bosscher, V., Bingham, J., Shibli, S., van Bottenburg, M., & De Knop, P. (2008). A global sporting arms race: An international comparative study on sports policy factors leading to international sporting success. Aachen, Germany: Meyer & Meyer. Hogan, K & Norton, K 2000, 'The 'price' of Olympic gold', *Journal of Science and Medicine in Sport*, vol. 3, pp. 203-218.

**THE IMPACT OF SPORT FOR ALL POLICIES ON ELITE SPORTING SUCCESS**

Dijk, B., van Bottenburg, M., de Bosscher, V., Westerbeek, H., Shibli, S., Kärmeniemi, M.

*Utrecht University*

Although it is often assumed that the scale of sport participation is a condition for elite sporting success, the literature on this subject is inconclusive (Green, 2005; Green & Houlihan 2005; Sotiriadou, Shilbury & Quick 2008; De Bosscher & Van Bottenburg 2011). The relationship between sport for all and elite sport is not that straightforward. Many people practice a sport without any desire to attain a higher level, and increasingly on an informal, non-competitive basis. It also appears to be possible to build high performance programs without relying on a broad participation base, making use of highly developed system-related talent identification and development processes (Green 2005). Unfortunately, there is a dearth of empirical analyses of this relationship, primarily due to a lack of internationally comparable data (De Bosscher et al. 2008; De Bosscher & Van Bottenburg 2011). This paper contributes to filling this gap in the literature, based on the SPLISS 2.0 study, to what extent national sport policies directed towards sport participation determine their elite sporting success, and which policy aspects are most crucial in that respect. The SPLISS 2.0 study elaborates on earlier studies in which a nine-pillar model was developed which identified key sports policy factors that influence the international success of nations (De Bosscher et al. 2008). From January 2011 onwards, researchers from 15 nations collected data following this pillar model and measured 126 critical success factors. Pillar 3 (sport participation) consists of 16 questions, measuring 12 critical success factors. Six levels of analysis were distinguished: 1) the organization of sport at schools; 2) the level of non-organized sport participation; 3) the level of sport participation in clubs; 4) the level of sport participation in competitions; 5) the national policy to improve total quality management in sports clubs; 6) the national policy to improve the quality of talent development in sports clubs. At the time of this abstract submission, the final results could not be calculated yet. However, preliminary findings revealed interesting results. First, in general, the relationship between national policies directed towards sport participation and national sporting success appeared to be rather weak. Second, the relationship was found the weakest with respect to national policies towards total quality management in sport clubs, the level of unorganized sport participation, and the organization of sport at schools, and the strongest with respect to the level of organized sport participation and sport participation in competitions. These findings suggest that sport policies directed towards broadening the participation base are only of secondary importance in explaining differences in elite sporting success between nations, and that such policies are most effective from an elite sport perspective if they lead to more organized sport participation.

**NEW INSIGHTS TO MEASURING THE PERFORMANCE OF NATIONS IN THE OLYMPIC GAMES**

Shibli, S.

*Sheffield Hallam University*

In the London 2012 Olympic Games 204 nations took part and the majority (115) left empty handed. It would be inappropriate to label the majority of participating nations as 'failures' which raises the question 'are there any non-medal based measures of performance that enable nations to demonstrate the effectiveness of their elite sport development systems?' If sporting talent was distributed evenly across the globe, one Olympian would be produced for around every 700,000 people. This statistic legislates against small nations even attending the Olympic Games let alone having a chance of medal success. In order to deliver Jacques Rogge's 'real universality' the reality is that many nations are offered 'wild card' places to enable them to take part. By contrast large and dominant nations have limits on how many medal winning opportunities they can contest. For these reasons, there needs to be a degree of expectation management concerning what it is reasonable to expect a nation to achieve. This paper is concerned with conceptualising non-medal based measure of performance as a first step in helping to set performance and expectation parameters. The research is primarily desk research involving the secondary analysis of existing data and where necessary the construction of data tables from different sources. A significant breakthrough in the capability to analyse performance in the Olympic Games is provided by the Infostrada Podium Performance database. The results reveal that athletic talent is not distributed evenly across the globe and that some nations are more efficient at producing Olympians than others. For example, the Cook Islands with a population of 20,000 was able to send 8 athletes to London 2012, a ratio of 1 Olympian per 2,500 people. By contrast, Bangladesh with a population of 147 million sent five athletes to London 2012, a ratio of one Olympian per 29.4 million people. If we extend the measurement of success from medals to finalists (top eight) we find that in London 2012 the majority of nations (115) register at least one top eight place. Furthermore this is a trend that has been on an upward trajectory since the low of 72 nations in the post-boycott era. Finalists who do not win medals are awarded 'diplomas' for their achievements and thus a new measure of performance that would be relevant to most participating nations would be number of diplomas won. For the 89 nations that do not achieve a diploma there are other contextual measures of performance that may be of value. These include measures such as the number of athletes posting: season's best performances; lifetime best performances and national records. These are all positive outcomes that indicate that athletes were prepared to peak performance for the most important event of their year. Overall the results point to the need for a framework whereby nations can be realistic about their performance expectations and can draw positives from lower levels of achievement than medal winning success.

**16:20 - 17:50****Invited symposia****IS-SH09 Towards a theory of sports coaching****TOWARDS A THEORY OF COACHING: THE LEARNING ORDER**

Jones, R.L.

*Cardiff Metropolitan University*

The principal facet or helix within the coaching 'course of action' is that to do with learning. This reflects interpretations of athlete learning, and takes into account that the 'core business' of coaching is athlete understanding, improvement and performance. Within this dimension, it is recognised that coaches (generally although not always) decide what needs to be learned, how, by whom and by when. This learning needs to be reached (and evidenced) before further learning, or learning something new, can be engaged with. Coaches have

their own cues for 'reading the learning of athletes', and make decisions on the basis of them. However, athletes may have their own learning 'cues' too, which they use to assess their own progress. Naturally such processes sometimes collide. The negotiation (inclusive of inevitable contextual power relations) evident here comprises the 'learning work' of coaching.

### **'TOWARDS A THEORY OF COACHING: THE TEMPORAL ORDER'**

Mesquita, I.

*Faculty of Sport -University of Porto*

The temporal order relates to how time impacts on events and situations within the coaching trajectory. The temporal order in this respect is both predictable and unpredictable. Events in terms of the temporal order are also experienced differently by participants. For example, for the busy coach with a hectic schedule, meeting athletes and listening to their concerns, the time may pass slowly. On the other hand, the opportunity to talk is likely to have been eagerly awaited by the athletes for whom the time passes quickly. An aspect to consider under this facet then, is how the social actors involved in coaching experience time-passing, in addition to how they cooperate or fight against given or alternative schedules to fill such time.

### **TOWARDS A THEORY OF COACHING. PART 1: THE SECURITY ORDER**

Ronglan, L.T.

*Norwegian School of Sport Sciences*

The purpose of this symposium is to present a conceptualisation of coaching as a number of inter-related helices encased in a general progressive 'course of action'. The significance of the project lies in the need to organise coaching around new, largely phenomenologically derived concepts in what remains a largely unexplored terrain. As a basis for future theoretical development, this presentation proposes a conceptual trajectory as an analytical device to bring together the disparate perspectives of those involved in coaching. The three principal facets which comprise the trajectory (and which will form the basis of the symposium) include, 'the insecurity order', 'the learning order' and 'the temporal order'. The context and the interactions of coaching are inherently ambiguous (Jones & Wallace, 2005, 2006). It is a context which induces anxiety, excitement and nervous expectation; conditions which are sometimes generated although more-than-often tempered or alleviated by coaches (intentionally or unintentionally). When the tasks associated with providing security are neglected or badly done, the security order is badly affected. Such work associated with developing or providing such security can be sub-divided into (1) interaction work, (2) trust work, (3) awareness context work, (4) rectification work (which also comprises 'face'work), and (5) identity work.

## **16:20 - 17:50**

### **Oral presentations**

#### **OP-SH15 Sport Statistics and Analyses [SA] 1**

##### **TRACKING CAREER PERFORMANCE OF SUCCESSFUL TRIATHLETES**

Malcata, R.M., Pearson, S., Hopkins, W.G.

*Auckland University of Technology*

Introduction: Tracking the progression of an athlete's performance is important in elite sport. For sports with simple, objective outcome measures and stable performance environments, determining progression is reasonably simple; however tracking of performance is more problematic for sports with large environmental effects. The purpose of this study was therefore to develop career performance trajectories for elite triathletes, investigating separately the progression of swim, cycle, run and overall performance times while accounting for confounding factors. Methods: Performance times of 337 female and 427 male triathletes competing in 419 races of the World Championships (including Junior and Under-23), World Series, World Cup, European Championship and Olympic Games between 2000 and 2012 were obtained from triathlon.org. Athletes were categorized Top if they finished in the top 16 at a World Championships or Olympic Games between 2008 and 2012. A mixed linear model accounting for race distance (Sprint, Olympic), type of competition, calendar-year trend, athlete's category and clustering of times within athletes and races, was used to derive athletes' individual quadratic performance trajectories. These trajectories provided estimates of age of peak performance and predicted outcomes at the 2012 London Olympic Games. Results: By markedly reducing the scatter of individual race times, the model produced well-fitting quadratic trajectories that were suitable for comparison of athletes' performance progressions. The trajectories for top-16 athletes showed different patterns depending on phase. Trajectories also differed more among women than among men. Ages of peak overall performance were  $28.4 \pm 2.3$  years and  $28.2 \pm 3.4$  years for men and women, respectively, while ages of peak performance for individual phases differed by up to two years. High correlations between observed and predicted placing at the Olympics for men (0.78; 90% confidence interval 0.67-0.85) and women (0.61; 0.4-0.76), represent slightly better prediction than typical race placing in the year of the Olympics. Conclusions: Differences between athletes' trajectories will help to identify athletes' strengths and weaknesses. The wider range of trajectories among women should be taken into account when trajectories are used to select athletes or to set performance targets. Trajectories offer a small advantage over usual race placing for predicting Olympic performance, with potential refinements of the model identified to further improve these predictions.

##### **BODY MASS MANAGEMENT OF FEMALE CYCLISTS: TRENDS IN THE PELOTON**

Haakonssen, E.1,2, Martin, D.1, Burke, L.1, Jenkins, D.2

*1: AIS (Canberra, Australia), 2: UQ (Queensland, Australia)*

Introduction A number of Australian and International female cyclists have resorted to unsafe practices in order to manipulate body mass. No known studies have reported the perceptions of female cyclists towards their body mass as it relates to performance. Methods

Entrants in the Australian National Championship Women's Road Race (n=31) completed a short questionnaire that sought to identify their current body mass; seasonal fluctuations in body mass; perceived optimal body mass; their level of consciousness towards body mass manipulation; techniques used to manipulate body mass and the regularity of their menstrual cycle. Results All but one respondent believed that female cyclists are a 'weight conscious population'. On a 0-10 scale (0 = 'never'; 10 = 'more than once every hour') female cyclists reported being conscious about wanting to change their body mass on average 'once a week' (mean  $\pm$  stdev,  $5\pm 3$ ) and 19% reported being conscious 'more than once a day'. 58% reported that their body mass was not optimal for current competition. Perceived ideal body mass for competition was  $1.3\pm 1.4$  kg less than their actual present mass ( $57.1\pm 5.0$  kg) and 71% reported their lowest body mass was 'beneficial' or 'extremely beneficial' for performance. There was a  $5.4\pm 3.1$  kg difference between the highest and lowest reported body mass for the previous 12 mths. 71% reported reducing body mass in the previous 12 mths ( $-2.3\pm 1.1$  kg). 35% reported that their coach or director had been dissatisfied with their body mass. 16% had previously been diagnosed with eating disorder. The most common weight loss techniques selected were '1 reduced food intake throughout the day' (n=24); '1 avoided foods high in fat' (n=20); and '1 avoided foods high in sugar' (n=19). Five athletes reported skipping meals; 6 performed long rides (>2hrs) without eating; 3 avoided post training meals and 7 increased total training duration. Ten cyclists reported having an irregular menstrual cycle in the previous 12 months and nine reported that their menstrual cycle had ceased for >3 months. Discussion The results suggest that elite Australian female cyclists are indeed a weight conscious population and in many cases are dissatisfied with their body mass coming into major competition. Self reported body mass fluctuated significantly (~5 kg). It appears weight loss was brought about by a range of techniques – most commonly by reducing energy intake and avoiding foods high in fat and sugar. Some athletes resorted to more extreme measures such as skipping meals (n=5), purging (n=2) and wearing excessive clothes or plastic wraps while training (n=1). Almost a third of cyclists reported menstrual dysfunction which may be a symptom of low energy availability (Loucks et al., 2011). References Loucks A, Kiens B, Wright H. (2011). *J Sports Sci*, 29(S1), S7-15.

### ANALYSIS OF OFFENSIVE GAME SITUATIONS IN TEAM HANDBALL BY MEANS OF ARTIFICIAL NEURONAL NETWORKS

Schrapf, N., Tilp, M.

*Institute of Sports Science*

Introduction Analysis of game situations are important for the development of successful game tactics and the planning and controlling of training. Since focus on single action analysis only gives restricted insight into tactical behavior, Carling (2008) suggested analyzing action sequences. Therefore, the aim of the present study is to classify sequences of game actions in team handball to identify offensive behaviors. Methods For this study 6 games from the EHF EURO Men 18 in Hard (Austria) were analyzed. Each game was captured by 8 cameras. Subsequently, all shots and up to 5 passes prior the shot were annotated with custom-made software. Every annotation includes the ground position of the ball carrier and the position of the receiving player for every pass-action. In total 3212 actions were recorded. These single actions generated 612 action sequences which were then analyzed by an artificial neuronal network software (Perl, 2002). In order to obtain suitable entropy, data was enlarged by duplicating to a quantity of 3060 datasets with a noise of 15%. To minimize unwanted learning effects due to the duplication, datasets were also permuted. Subsequently, action sequences were used to train the neuronal network with a dimension of 400 neurons. Each neuron represents a pattern in action sequence. Hereafter, similar neurons are grouped to clusters which represent similar offence play behavior. Results With a similarity resolution, which defines selectivity between similar and dissimilar neurons, of 70% the network recognized 32 clusters. Ten network neurons, containing 34 action sequences (5,6%), could not be classified to a cluster. Summarizing, the net identified 42 different offensive strategies (32 clusters and 10 single neurons) of the different teams. Discussion The analysis revealed the potential to identify offensive patterns in team handball by means of artificial neuronal networks. Expert review of the recognized patterns shows a promising accordance with the original data of the action sequences. However, results have to be taken with care due to the data preprocessing including the enlargement of the original datasets. The next step will be the detection of preferred offensive tactics of single teams. Moreover, with the integration of data about goal success, successful offensive tactics can be identified. Another future goal is to integrate defensive behavior in order to determine effective offensive tactics in relation to the opponent's defense tactic. References Carling, C., Bloomfield, J., Nelsen, L., & Reilly, T. (2008). The role of motion analysis in elite soccer: contemporary performance measurement techniques and work rate data. *Sports Medicine*, 38(10), 839-62. Perl, J. (2002). Game analysis and control by means of continuously learning networks. *International Journal of Performance Analysis of Sport*, 2, 21-35.

### EFFECTS OF LOW-VOLUME HIGH-INTENSITY INTERVAL TRAINING ON POWER OUTPUT IN ADULTS: A META-ANALYSIS

Weston, M.1, Batterham, A.M.1, Taylor, K.1, Hopkins, W.G.2

*Teesside University (Middlesbrough, UK). 2AUT University (Auckland, New Zealand)*

Background Many basic activities of daily living are dependent on muscle power. Power training can improve mobility-related outcomes. Here, we present a meta-analysis on the effect of low-volume high-intensity interval training on lower extremity power output. Methods A search of five literature databases yielded 14 utilisable interval-training studies meeting the eligibility criteria: adults; 30-s Wingate assessed pre and post intervention; intervention period of at least 2 weeks; repetition duration 30 s; work/rest ratio <1; and exercise intensity maximal or near maximal. The total of 19 mean effect estimates on peak power in training and control groups were converted to percent changes for a novel mixed-model meta-analysis that included the usual between-study random effect and a within-study random effect to account for studies with control groups. The fixed effects in the model included type of study (controlled, uncontrolled), subject characteristics (sex, pre peak power) and training parameters (number of exercise sessions, work/rest ratio). With only 15 available effect estimates, mean power was analysed with a standard meta-analysis. Effects were weighted using percent standard errors from exact p-values or from estimated errors of measurement. Probabilistic inferences were based on standardized thresholds for small, moderate and large changes (1.4, 4.6 and 9.2% for peak power; 1.4, 4.3, and 8.5% for mean power) derived from between-subject SDs for pre peak and mean power. Results The meta-analysed effect on peak power of an average interval-training protocol (12 sessions, 0.12 work/rest ratio) in a controlled study was an unclear but possibly small increase in peak power of 2.9% (90% confidence limits  $\pm 6.2\%$ ) in active, non-athletic subjects with a pre peak power of 11.6 W/kg. There was a likely moderate increase in peak power of 7.2% ( $\pm 4.0\%$ ) in uncontrolled studies. Study and subject characteristics had the following possibly small effects: 2.2% ( $\pm 6.6\%$ ) for subjects with peak power lower by 6 W/kg; 0.6% ( $\pm 6.1\%$ ) for each 3-fold increase in number of sessions; 1.5% ( $\pm 4.0\%$ ) for each 4-fold increase in work/rest ratio; and 3.0% ( $\pm 16.1\%$ ) for females. Unexplained variation in peak power effects between studies was typically  $\pm 4.2\%$ . There was a possibly moderate enhancement in mean power of 5.2% ( $\pm 4.2\%$ ) compared with controls. Conclusions Low volume high-intensity interval training produces small to moderate improvements in the peak and mean power output of active, non-athletic subjects, with

greater benefit for the less fit. More studies are needed to clarify the effects of changing the parameters of this efficient form of training, to clarify the effects in women, and to examine the effects in older populations.

### EARLY IMPROPER MOTION DETECTION IN GOLF SWING

Stancin, S., Djordjevic, S., Tomazic, S.

*University of Ljubljana*

**Introduction** Performing the golf swing is a demanding process involving the whole psychophysical system (Nesbit and Serrano, 2005; Hayne, 2009; Leadbetter, 2000; Jacobs and Bowden, 1998; McLaughlin and Best, 1994). Ideally, led with the desire to achieve the same shot outcome, a particular golfer would in multiple trials perform his or hers golf swing completely identically. Due to swing motion comprehensiveness, realistically, some deviations from the desired motion are always present. Not all of these swing motion deviations are detrimental to performance and as such unacceptable. **Methods** Measurements were performed on a professional golfer using his hybrid club. Swing data were collected using a wearable 3D motion sensor comprising gyroscopes and accelerometers produced by TMG-BMC Ltd. The sensor was positioned on the golfers leading arm, i.e., the left arm for a right handed player. All swing observations were labelled according to performance. Performing the Principal Component Analysis (PCA) on the reference observations of properly performed swings, the basis of acceptable motion deviations was established. Using this basis, motion deviations in observations of other swings were examined. **Results** The results obtained for the considered example show improper swing motion in the early phase of the swing, i.e., the first part of the backswing. Similar behaviour of unacceptable deviations in the time domain indicates typical improper motion in the associated swings. **Discussion** The analysis is made under the assumption that the reference set of properly performed swings encompass all acceptable deviations of proper golf swing motion. Swing performance evaluation is achieved individually and the presence of improper motion is explored with reference to that player's properly performed swings. The potential benefit of such early detection of improper swing motion conducted on an individual basis is in providing valuable assistance for the performance improvement process. **References** Nesbit, S.M.; Serrano, M. Work and Power Analysis of the Golf Swing. *J Sports Sci Med.* 2005, 4, 320-333. Hayne, H. Hank Haynes Essentials of the Swing: A 7-point Plan for Building a Better Swing and Shaping Your Shots, 1st ed.; John Wiley & Sons Inc.: NJ, USA, 2009. Leadbetter, D. The Fundamentals of Hogan, 1st ed.; Sleeping Bear Press/Doubleday, Chelsea, MI, USA, 2000. Jacobs, J.; Bowden, K.; Practical golf, 1st ed.; The Lyons Press: Guilford, CT, USA, 1998. McLaughlin, P. A.; Best, R. J. Three dimensional kinematic analysis of the golf swing. In *Science and Golf II, Proceedings of the World Scientific Congress of Golf*, St. Andrews, Scotland, 1994.

**16:20 - 17:50**

## Oral presentations

### OP-BN01 Biomechanics [BM] 1

#### PRELIMINARY STUDY: ELECTROMYOGRAPHICAL CHANGES IN BAREFOOT AND SHOD RUNNING, BEFORE AND AFTER A FATIGUING 10KM RUNNING TRIAL

Tam, N., van Pletzen, L., Albertus-Kajee, Y., Astephen Wilson, J.L., Noakes, T.D., Tucker, R.

*University of Cape Town*

**Introduction:** Barefoot running has been proposed as the most natural, efficient and safest way to run. Biomechanical differences have been explored between barefoot and shod running. The neuromuscular responses of the lower limb musculature during running in the barefoot and shod conditions have not been fully explored and may reveal certain subtleties in control and adaptation. Further, an aim was describe if difference existed between conditions as a result of fatigue. The aim of this study is to provide insight into the differences in muscle activity of the lower limb between barefoot and shod running both before and after a 10km fatiguing trial. **Methods:** Fifteen recreational runners who were had a 10km race time below 50 minutes participated. First participants performed a 10km familiarization time trial on a treadmill. During the second visit participants ran down a 40m runway and over a floor embedded force plate at 4.3min/km. This was performed seven times in both the shod and barefoot condition. These were conducted prior to and post a run at 10km race pace for 10km. EMG activity was recorded using a telemetric EMG system. The following lower limb muscles were recorded: Vastus lateralis (VL), Biceps femoris (BF), Tibialis anterior (TB) and lateral gastrocnemius (LG). The raw EMG signal was filtered using a 50Hz notch filter. The signal was then filtered a second time using a 15-500Hz band pass filter. The data were smoothed using route mean squared analysis (RMS), calculated as a 50ms-moving window. Thereafter, data were segmented into pre-activation, defines as 100ms prior to initial ground contact, and ground contact, defined between initial ground contact and toe off as determined by a force plate. **Results:** During pre-activation conditional differences were found in TA and LG activity. Lower TA activity and higher LG activity was observed in the barefoot when compared to the shod condition. Further, lower LG activity was found in the barefoot condition when compared to shod. Lastly, increased activity at the end of the fatiguing trial was seen in TA activity and lower activity in BF and VLO during ground contact. **Discussion :** Increased TA activity and decreased LG activity during pre-activation prior to ground contact in the shod condition is indicative of an adjusted running style. These differences in activity may be reflective of the muscular preparation prior to initial ground contact as shod runners tend to land in greater dorsiflexion. With greater dorsiflexion in the shod condition a reduced LG activity was expected. Decreases in VLO and BF activity during ground contact appear to be a result of fatigue and maybe due to muscle rotation, decreased muscle firing rate and recruitment. Conversely, increased TA activity was found during ground contact over time. These difference as a result of fatigue maybe due to muscle size and function. Lower LG activity in the barefoot condition during ground contact maybe indicative of the different biomechanics employed to propel the body during running in the two-different conditions.

## GENDER DIFFERENCES IN FORCE APPLICATION DURING OFFENSIVE AND DEFENSIVE AGILITY MOVEMENTS

Spiteri, T., Wilkie, J.L., Nimphius, S.

*Edith Cowan University*

**Introduction** It is well-established gender differences exist as a result of physical and anthropometrical characteristics (McLean et al., 2004) that have been shown to influence change of direction (COD) performance. COD ability is a physical attribute excluding the cognitive requirements more relevant to sport performance termed agility. Thus athletes often change direction in response to a stimulus with the intent to rapidly exit the COD, termed post-stride velocity. The combination of cognitive and physical abilities required for a faster agility performance may result in an altered force profile produced by each gender that is representative of differences within gender. **Methods** Twenty-four male and female athletes performed six unilateral isometric back squats on a force plate, followed by twenty-four agility trials. COD movements were performed at a 45° angle in response to movements of a human stimulus in offensive (opposite direction) and defensive (same direction) as the stimulus. The COD step was performed on an in ground force plate (Kistler, Type9290AD, Australia), with peak braking and propulsive force and relative braking, propulsive and total impulse measured across stance phase for the dominant leg. Reaction time (RT) during the COD was assessed using a high-speed video camera. Post COD stride velocity of the athlete after the COD was measured using a 12 camera, 250Hz Vicon motion analysis system (Oxford Metrics Ltd., Oxford, UK). **Results** Males demonstrated significantly greater lower body strength, greater braking and propulsive force, impulse and a faster RT to the stimulus, enabling a faster post-stride velocity to be achieved compared to female subjects, during offensive and defensive trials. **Discussion** Increased braking force as observed for males has been identified to contribute to the storage and utilization of elastic energy (Hunter et al., 2005) enabling an increased propulsive force output, improving propulsive ability. Faster running speeds have been attributed to increased lower body strength (Brughelli et al., 2008), to rapidly apply greater amounts of force throughout the movement. Additionally, increasing the time to prepare the body for upcoming movements by reducing RT, can also enable increased force and impulse to be produced (McBride et al., 2008). In conclusion, the greater strength, RT and subsequent increased force application during the plant phase was present in males that also had significantly faster post COD stride velocities. **References** Brughelli M, Cronin J, Levin G, Chaouachi A. (2008). *Sports Med*, 38(12), 1045-1063. Hunter JP, Marshall RN, McNair PJ. (2005). *J Appl Biomech*, 21, 31-43. McBride JM, McCaulley GO, Cormie P. (2008). *J Strength Cond Res*, 22(3), 750-757. McLean SG, Lipfert SW, van den Bogert AJ. (2004). *Med Sci Sports Exerc*, 36(6), 1008-1016.

## UNWEIGHTING STATE AS A PREPARATORY MOVEMENT SHORTEN THE SIDESTEP INITIATION FOR BASKETBALL PLAYERS IN 1-ON-1 BASKETBALL SITUATION

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*1. Kyoto University (Kyoto, Japan), 2. Japan Society for the Promotion of Science (Japan), 3. Ritsumeikan University, (Shiga, Japan).*

**Introduction** In basketball, the preparatory motion of a defensive motion should be small and involve landing on both feet for strict time and motion constraints. We thus proposed the movement creating an unweighting state, where the body weight of a player is instantaneously decreased during standing before sidestepping. First, we examined the effect of creating unweighting state the experiment where defenders react to the LED stimulus by sidestepping (experiment-1). Second, we investigated the effect on real basketball 1-on-1 defending (experiment-2). In the two experiments, we hypothesized that the defender's preparatory motion creating the unweighting state improves basketball 1-on-1 defending, i.e., sidestepping. **Methods** In experiment-1, ten basketball players performed a two sidestep and reach task reacting to the LED stimulus with and without the voluntary, continuous vertical fluctuation movement. In experiment-2, the same ten players performed dribble 1-on-1 game with basketball. In both experiments, the motions of the players were captured and their ground reaction forces (GRFs) were measured. Movement initiation time and lateral peak velocity were calculated based on trunk lateral velocity, according to the rule of basketball. **Results & Discussion** The results in experiment-1 indicated that the preparatory movement shortened the time of defenders' sidestep initiation (301 vs. 314 ms) and reaching performance (883 vs. 910 ms) but did not increase their peak vertical GRF or movement velocity. The mechanism of the improvement was estimated to be the following: in the preparation phase, the voluntary vertical body fluctuation created the force fluctuation; around the direction signal, the unweighting state can shorten the time required to initiate the sidestepping; around the initiation phase, the dropping down of the body and weighting state can contribute to the reaching performance. In experiment-2, the results demonstrated that the unweighting state shortened the defender's movement initiation relative to the dribbler's and made defended in 70.2 % probability, whereas the weighting state did in 17.5 %. Additionally, the results showed that the hopping, in which the players were in the air more than 100 ms, provided stably high peak velocity but variably change vertical GRFs. The hopping would be undesirable for preparatory motion of defending in basketball 1-on-1 situation. Consequently, it suggests that creating unweighting state but not hopping in attacker's movement initiation would be effective to defend the dribbler in basketball 1-on-1.

## ENERGETIC COST OF LOCOMOTION AND BIOMECHANICAL ASPECTS OF THE DOUBLE POLING TECHNIQUE

Zoppirolli, C.

*University of Verona*

**Introduction** Double poling technique (DP) is extensively used during cross-country skiing races. During DP, the propulsion is generated by synchronized actions of upper limbs and trunk, and transmitted to the ground through the poles. The aim of this study was to analyze the relationship between the energetic cost (EC) and the biomechanics of DP. It has not been widely studied so far, despite the importance of DP in skiing performance (Stöggl et al., 2006). It's knowledge should be important in improving skiing efficiency. **Methods** Eight high level (HL) and eight recreational (R) skiers performed a DP trial on a treadmill, using roller skies and poles. EC was measured at steady state and synchronized biomechanical measurements were acquired, for at least 20 consecutive cycles, during the last minute. Inclination of the poles respect to horizontal plane ( $\alpha$ ), vertical position of centre of mass (COMz) and body inclination respect to the vertical ( $\theta$ ) were monitored at the start of poling phase (on), instant of peak force (p), end of poling phase (off). Integral of poling force, peak poling force, cycle time and poling time were also considered. ANOVA test for repeated measurements was performed to assess the group effect on families of variables. When  $P < 0.05$ , Holm-Bonferroni post-hoc was applied. Biomechanical variables were entered in a stepwise multiple regression analysis to determine the more predictive variables of EC. **Results** HL showed lower EC ( $P = 0.000$ ), higher  $\alpha$ -on and  $\alpha$ -p ( $P < 0.05$  in all cases), higher COMz-on, COMz-p and COMz-off ( $P < 0.05$  in all cases), more pronounced  $\theta$ -p ( $P < 0.05$ ) and higher force integrals ( $P < 0.05$  in all cases).  $\theta$ -p for HL and  $\theta$ -on for R were the only variables able to predict EC ( $R = 0.78$ ,  $P = 0.23$  and  $R = 0.73$ ,  $P = 0.38$ , respectively). In HL,  $\theta$ -p was positively related to force integrals, peak of propulsive force and cycle time ( $P < 0.05$  in all cases), while  $\theta$ -on in R was

not further related to any biomechanical parameter. Discussion DP is an arm-based locomotion, far from the typical legged human locomotion. HL showed lower EC, higher force integrals, a different use of poles and centre of mass.  $\theta$  during the first part of the poling phase was the best predictor of EC. It probably allows to partially load the poles with body weight, permitting an energy-saving mechanism for the muscles involved in the poling movements. HL athletes can maintain a pronounced  $\theta$  for long time during the poling phase, influencing force exertion and cycle timing. R athletes cannot manage  $\theta$  for long time, losing a full benefit of an advantageous use of centre of mass. Our study demonstrated that biomechanical strategies are important to economize DP skiing. References Stöggl T, Lindinger S, Müller E. (2006). *Med Sci Sports Exerc*, 38: 586-91.

### **LOCOMOTION ADAPTATION WITH AGE - CHANGES IN JOINT MOMENTS AND POWERS DURING WALKING, RUNNING AND SPRINTING**

Kulmala, J.P., Korhonen, M., Kuitunen, S., Suominen, H., Heinonen, A., Avela, J.

*University of Jyväskylä*

**Introduction** In old age, muscular force declines. This has been linked to altered joint kinetics during gait where elderly people are known to have reduced joint moments and powers of the ankle but increased effort from the hip joint (1). However, the age-related changes in joint kinetics during more demanding activities like running and sprinting are not well documented. Therefore, the aim of this study was to examine age-related changes in lower extremity kinetics during walking, running and sprinting. **Methods** Young (Y, n=13, age 26±6 years), middle-aged (M, n=13, 61±5 years) and old (O, n=13, 78±4) men with power trained background participated in this study. Inverse dynamics was used to compute joint moments and powers during the stance phase of walking (1.6 m/s), running (4 m/s) and sprinting (maximal speed). **Results** During walking, O had 21% lower concentric ankle power compared to Y (P<0.05). During running O demonstrated 36% lower ankle moment (P<0.001), and 32% less eccentric and 38% less concentric ankle power compared to Y (P<0.05, P<0.001). However, hip power during early stance phase of running was 42% higher in O compared to Y (P<0.05). During sprinting, O showed 27% and 16% lower ankle moment compared to Y and M (P<0.001, P<0.05), respectively. Ankle eccentric power showed 53% and 31% lower values (P<0.001, P<0.01) and ankle concentric power 55% and 23% lower values for O compared to Y and M (P<0.001, P<0.01), respectively. In addition, Y showed 36% and 33% higher hip power during early contact compared to O and M (P<0.05, P<0.05), respectively. No between groups differences observed at the knee joint level. **Discussion** To the best of our knowledge, this is the first study to examine age-related changes in joint kinetics across the whole range of locomotion from walking to sprinting. The main findings shows that during walking and running the deficit of the ankle moment and power generation became larger with age but can be compensated by increasing muscular output of the hip joint. However, during sprinting, young individuals are able to generate significantly greater hip moment and power compared to middle-aged and elderly people. Interestingly, knee kinetics showed only minor changes between age groups. These findings suggest that age-related declines in human locomotion are mainly a result of reduced muscular output of the ankle rather than hip or knee. **References** 1) DeVita et al. 2000. *J Appl Physiol* 88: 1804-1811.

### **RUNNING PERFORMANCE ON DIFFERENT SURFACES IN ELITE AND AMATEUR ORIENTEER ATHLETES**

Hébert-Losier, K., Holmberg, H.C.

*Mid Sweden University*

**Introduction** Training for and competing in orienteering involves a wide variety of differing terrains and the ability to run fast on different surfaces may therefore be a key determinant of performance. This study was designed to test the hypothesis that the elite orienteer athletes run faster in the forest than amateur orienteer athletes, at both short and long distances. **Methods** Eight elite male and eight amateur male orienteer athletes ran on a road, on a path and in a forest twice on two separate days. The first day, each athlete ran 2 km as fast as possible on each surface (in a random order) with 15-min recovery between surfaces. A global positioning system with a heart rate (HR) monitor was used to track each athlete. On the second day, every athlete sprinted 20 m through timing gates on each surface (in a random order) with 2-min rest between sprints. The 2 km and 20 m mean velocity was compared between groups and surfaces. **Results** At both short and long distances, the elite athletes were faster than the amateurs on all surfaces (P ≤ 0.01). Despite similar % HR max across orienteer groups and running surfaces (P ≥ 0.527), the between-group differences in 2 km velocity was greatest in the forest (75s•km<sup>-1</sup>), less on the path (54s•km<sup>-1</sup>), and least on the road (43s•km<sup>-1</sup>), due to the change in surface having a greater influence on amateurs (P < 0.001). A similar pattern in the between-group differences was observed for the 20 m sprint velocity (forest: 0.72 m•s<sup>-1</sup>, path: 0.64 m•s<sup>-1</sup>, road: 0.47 m•s<sup>-1</sup>). The difference in sprint velocity from road to path was greater in the amateur than the elite group (P = 0.05), but the change in sprint velocity from path to forest and road to forest was similar in both groups (P ≥ 0.141). **Discussion** Not only did the elite orienteer athletes, as expected, run faster than the amateurs on all three surfaces; the elites also maintained a faster 2 km velocity on the path and in the forest. Furthermore, the elite athletes kept a faster sprinting velocity than the amateurs on the path vs. the road, but both groups demonstrated similar changes in velocities when sprinting in the forest vs. path or road. The probable explanation for this latter finding is that the maximal sprint velocity in the forest is limited by the risk of fall or injury. Further, short sprints in a forest are rare in orienteer competitions given that winning times range from 12 to 105 min and that the athletes run while consulting maps or compasses. Nonetheless, the elite athletes demonstrate a distinct ability to run fast on various surfaces, thus highlighting the value of integrating regular off-road sessions in training for orienteering. Further, at the elite level, monitoring running performance on various surfaces as described here might prove beneficial for assessment and adjustment of training.

18:00 - 19:30

## Oral presentations

### OP-PM21 Nutrition [NU] 2

#### **BETROOT JUICE AND EXERCISE: THE PHARMACOKINETIC-PHARMACODYNAMIC AND DOSE-RESPONSE RELATIONSHIPS**

Wylie, L.J.1, Kelly, J.1, Bailey, S.J.1, Blackwell, J.R.1, Skiba, P.F.1, Winyard, P.G.2, Jeukendrup, A.E.3, Vanhatalo, A.1, Jones, A.M.1

1: SSHS (Exeter, United Kingdom), 2: PCMD (Exeter, United Kingdom), 3: GSSI (Barrington IL, USA)

**Introduction** Dietary supplementation with beetroot juice (BR) containing ~ 5-8 mmol of inorganic nitrate (NO<sub>3</sub><sup>-</sup>) has been shown to increase plasma nitrite concentration ([NO<sub>2</sub><sup>-</sup>]), to lower blood pressure and the O<sub>2</sub> cost of submaximal exercise, and to improve exercise tolerance (Bailey et al., 2009). However, the dose-response relationship between ingested BR and physiological effect has not been investigated. The purpose of the present study was to investigate the NO<sub>3</sub><sup>-</sup> dose-response effect on the aforementioned variables when NO<sub>3</sub><sup>-</sup> was administered as NO<sub>3</sub><sup>-</sup>-rich BR. **Methods** In a balanced crossover design, ten healthy males ingested 70, 140 or 280 ml of concentrated BR (containing 4.2, 8.4 and 16.8 mmol NO<sub>3</sub><sup>-</sup>, respectively) or no supplement. Blood pressure was measured and venous blood samples were obtained at rest, and 1, 2, 4, 8, 12 and 24 h post-ingestion. Subsequently, on six separate occasions, subjects completed moderate-intensity and severe-intensity cycle exercise tests 2.5 h post-ingestion of 70, 140 and 280 ml BR, or NO<sub>3</sub><sup>-</sup>-depleted BR as placebo (PL; containing <0.12 mmol NO<sub>3</sub><sup>-</sup>). Pulmonary O<sub>2</sub> uptake (VO<sub>2</sub>) was measured during all exercise tests and the severe-intensity exercise bouts were continued until the limit of tolerance. **Results** Following acute BR ingestion, plasma [NO<sub>2</sub><sup>-</sup>] increased in a dose-dependent manner (~220-654 nM) whilst systolic blood pressure (SBP) and mean arterial pressure (MAP) declined dose-dependently (SBP; ~5-10 mmHg and MAP; ~2-5 mmHg) up to a dose of 140 ml, with the peak changes occurring at ~2-4 h. Compared to PL, 70 ml BR ingestion did not alter the physiological responses to exercise. However, ingestion of 140 and 280 ml BR reduced the steady-state VO<sub>2</sub> during moderate-intensity exercise by 1.7% (P=0.06) and 3.0% (P<0.05), respectively, whilst time-to-exhaustion was extended by 14% and 12% (both P<0.05), respectively, compared to PL. **Discussion** The results of this study indicate that, while plasma [NO<sub>2</sub><sup>-</sup>] and the O<sub>2</sub> cost of moderate-intensity exercise are improved dose-dependently with NO<sub>3</sub><sup>-</sup>-rich BR, there is no further reduction in SBP or MAP or improvement of exercise tolerance after ingesting BR containing 16.8 compared to 8.4 mmol NO<sub>3</sub><sup>-</sup>. These results provide important practical information which may underpin the potential use of NO<sub>3</sub><sup>-</sup> supplementation for improving cardiovascular health in the wider population, and for enhancing exercise performance in athletes. **References** Bailey SJ, Winyard P, Vanhatalo A, Blackwell JR, DiMenna FJ, Wilkerson DP, Tarr J, Benjamin N, Jones AM. (2009). *J Appl Physiol*, 107, 1144-1155.

#### **EFFECT OF TWO BUFFERING AGENTS ON REPEATED SPRINTS DURING INTERMITTENT EXERCISE PERFORMED UNDER HYPOXIC CONDITIONS**

Saunders, B.1,2, Sale, C.2, Harris, R.C.3, Sunderland, C.2

1: USP (São Paulo, Brazil), 2: NTU (Nottingham, UK), 3: Junipa Ltd (Newmarket, UK)

**Introduction** Repeated sprint ability (RSA) is considered an important aspect of team sport performance and increased RSA has been associated with increased H<sup>+</sup> buffering capacity (Rampinini et al., 2009). When exercise is performed at altitude, there is an earlier reliance on anaerobic glycolysis due to the higher relative intensity for an absolute level of work (Levine et al., 2008), which leads to an increase in both muscle and blood lactate accumulation (Wolfel et al., 1991), resulting in a concomitant rise in H<sup>+</sup>, which would place an increased reliance on the buffering systems of the body to maintain performance. Therefore, the aim of this study was to investigate the separate and combined effects of sodium bicarbonate and β-alanine supplementation on repeated sprint performance during simulated match play performed under hypoxic conditions. **Methods** Study A: 20 recreationally participants performed two main trials following acute supplementation with either sodium bicarbonate (0.3 g/kg B/M) or placebo (maltodextrin). Study B: 16 recreationally active participants were assigned to either a placebo or β-alanine (6.4 g/day for 4 weeks, 3.2 g/day for 1 week) for 5 weeks, and performed one main trial prior to supplementation (with maltodextrin) and two following supplementation (with sodium bicarbonate and with maltodextrin). Main trials consisted of 3 sets of 5 x 6 s repeated sprints performed during a football specific intermittent treadmill protocol under hypoxic conditions equivalent to 2500 m altitude (15.5% O<sub>2</sub>). Mean power output (MPO) and peak power output (PPO) were recorded as the performance measures. Data are presented as mean ± 1SD. **Results** Study A: Overall MPO was lower with sodium bicarbonate than placebo (P = 0.02, 539.4 ± 84.5 vs. 554.0 ± 84.6 W), although there was no effect of sodium bicarbonate on MPO or PPO across the 90 minutes (all P > 0.05). Study B: There was no clear effect of β-alanine supplementation, or co-supplementation with sodium bicarbonate, on MPO or PPO, although there was a trend towards higher MPO with sodium bicarbonate when combining both supplementation groups (P = 0.07, post hoc P = 0.03). **Discussion** Despite previous research suggesting an association between increased buffering capacity and improved RSA, the current investigation showed that sodium bicarbonate and β-alanine supplementation, separately and combined, did not improve 5 x 6 s repeated sprint performance throughout simulated games play under hypoxic conditions. **References** Levine et al. (2008). *Scand J Med Sci Sport*, 18(1), 76-84. Rampinini et al. (2009). *Appl Physiol Nutr Metab*, 34, 1048-1054. Wolfel et al. (1991). *J Appl Physiol*, 70, 1129-1136.

#### **EFFECTS OF COMBINED SUPPLEMENTATION OF DIETARY NITRATE AND L-ARGININE ON PHYSIOLOGICAL RESPONSES, SPRINT AND ENDURANCE PERFORMANCE**

Bucher Sandbakk, S.1, Sandbakk, Ø.1, Peacock, O.2, James, P.3, Wisløff, U.1, Böhle, N.4, Tjønnå, A.E.1

*Department of Circulation and Medical Imaging*

**INTRODUCTION:** Nitric oxide is produced by nitric oxide synthases (NOS) during the catalysis of L-arginine to L-citrulline (NOS dependent) and due to ingestion of nitrate-rich foods via the reduction of nitrate to nitrite (NOS independent). Increased NO bioavailability may enhance oxygen and nutrient delivery to active muscles, thus improving tolerance to physical exercise and recovery mechanisms. However, studies on highly trained populations are sparse and show several discrepancies. The current study examined the effects of acute inges-

tion of dietary nitrates and combined supplementation of nitrates and L-arginine on sprint and endurance running performance, as well as on exercise economy, lung function and blood pressure. METHODS: A randomized cross-over, double-blinded design tested the effects of placebo, 614 mg potassium nitrate and 614 mg potassium nitrate + 6 g L-arginine supplementations in nine elite cross country skiers (69 ml/min/kg VO<sub>2</sub>max). After standardization of nutrition and exercise the subjects were tested for blood responses, blood pressure, lung function, submaximal running at 10 km/h and 14 km/h at 1 % incline, and 200 m and 5 000 m running performance. RESULTS: Plasma nitrite concentrations were higher after nitrate (328 ± 107 nmol/L) and nitrate + L-arginine (319 ± 54 nmol/L) supplementations compared with placebo (149 ± 64 nmol/L, p<0.001). There were no differences in 200 m or 5000 m time-trial performances, lung function or physiological responses during submaximal running between placebo and treatment. CONCLUSIONS: The significantly increased plasma nitrate and nitrite concentrations in the treatment conditions relative to placebo are consistent with previous studies. However, acute ingestions of dietary nitrate or combined nitrate + L-arginine did not enhance 200 m or 5000 m running time-trial performances, exercise economy or lung function in endurance trained cross-country skiers compared to placebo treatment. These findings contrasts studies on untrained subjects, but is supported by studies on elite endurance athletes. Thus training status seems to be an important factor linked to the ergogenic effect of increased NO.

### PROTEIN-LEUCINE INGESTION FOLLOWING INTENSE ENDURANCE EXERCISE STIMULATES A REGENERATIVE INFLAMMATORY TRANSCRIPTOME IN SKELETAL MUSCLE

Rowlands, D., Nelson, A., Raymond, F., Metairon, S., Mansourian, R., Leikis, M., Hayes, M., Faulkner, J., Clarke, J., Moore, D., Stellingwerff, T.

*Massey University*

Introduction Dietary protein and leucine intake following exercise modulates skeletal muscle gene expression, increases protein synthesis, and in some circumstances can lead to enhanced subsequent endurance performance, relative to low protein ingestion. The effect of protein-leucine dose on the transcriptome-directed molecular programme guiding acute-phase skeletal muscle regeneration and recovery after endurance exercise, however, is unknown. Methods In a crossover, twelve trained men completed 100 min of high-intensity cycling prior to ingesting a total of 70/15/180/30 g protein/leucine/carbohydrate/fat (15LEU), 23/5/180/30 g (5LEU) or 0/0/274/30 g (CON) beverages across 4 servings during the first 90 min of a 240-min monitored recovery period. Biopsies from the vastus lateralis were taken 30 and 240 min into recovery and messenger RNA was analysed by Illumina microarray. Gene selection contrasts were interrogated using Ingenuity Pathway Analysis software. Results The top functional modular network in the 15LEU-5LEU dose contrast at 30 min was proinflammatory, centred on interleukin (IL)-1-Beta programming increased leukocyte migration and differentiation, and extracellular-matrix protein gene expression. Furthermore, the 5LEU and 15LEU vs CON feedings promoted cytoskeleton and increased cell viability with a myogenic signature at 30 min. By 240 min, however, in both 5LEU and 15LEU vs CON, and with dose response, an IL6 centred anti-inflammatory and promyogenic transcriptome dominated, with inhibition of NF-Kappa-Beta and SMAD pathway activity guiding expression indicative of decreased leukocyte migration, increased immune and muscle cell apoptosis, and cell metabolism. The transcriptome suggests protein-leucine feeding upregulated an early-phase regenerative programme reflecting wound-healing biology. Conclusions Ingesting a supplement containing 23 g of protein and 5 g of leucine following exercise simulated an early inflammatory transcriptome common to skeletal muscle regeneration biology that was more evident with the 3-fold higher protein-leucine dose. These findings suggest the higher quantity of protein-leucine ingested over the 90-min period post-exercise may better stimulate an inflammatory promyogenic molecular response influencing skeletal muscle recovery processes following strenuous training. Funding from Nestec Ltd.

### DOES SODIUM BICARBONATE LOADING IMPROVE FIRE FIGHTER PERFORMANCE

Williford, H., Smoak, L., Esco, M., Reilly, E., Pugh, S., Walker, A.

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Introduction Fire fighter performance is often evaluated by a simulated job performance task (FFJPT). The purpose of the FFJPT is to quantify fire fighter physical fitness in order to meet criterion job standards. Highly fit fire fighters can perform the FFJPT in less than 2 min. Because of the anaerobic nature of the task, it was hypothesized that sodium bicarbonate loading may improve FFJPT performance times. Methods Nine male fire fighters who were part of a FFJPT competition team participated in the study. Their characteristics were: height (183.73 cm, weight 79.98 kg, age 25.1 yrs., and years' fire fighting experience 2.8 yrs.). Each fire fighter performed the FFJPT as fast as possible. The FFJPT consisted of a stair climb, hoist, forcible entry, hose drag, and dummy drag. Times were recorded for experimental and placebo trials with and without sodium bicarbonate ingestion. The experimental trial consisted of a 20 oz. drink mixed with 0.3 g/kg of sodium bicarbonate. The drink was taken one hour before starting the trial. Performance times were recorded and blood lactate (BL) was measured immediately post exercise, and 2.5, 5.0, and 10.0 min. post exercise. A paired T-test was used to evaluate differences in dependent variables (p < 0.05). Results The mean time to complete the task during the placebo trial was 2.8 min compared to 2.6 min for the experimental trial. There was a mean 17 sec improvement in performance (p = 0.007) for the experimental trial. The blood lactate values were respectively significantly higher for all post exercise trials p < 0.05. Other investigations with athletes have also shown increased BL values with sodium bicarbonate loading with improved performance times. Table 1. Blood Lactate (mean±SD) Placebo (mmol) Experimental Trial (mmol) Pre Test 1.5 ± 0.5 1.3 ± 0.5 Immediate Post 9.9 ± 4.1 12.9 ± 3.4 2.5 min post 11.5 ± 1.7 15.1 ± 2.1 5.0 min post 11.0 ± 3.1 14.8 ± 1.5 10.0 min post 11.3 ± 1.5 14.6 ± 1.8 Conclusion Results of the investigation indicate that sodium bicarbonate loading may improve fire fighter job performance. The negative effects of the trial were gastrointestinal discomfort. Further study is needed related to appropriate sodium bicarbonate dosages related to performance times.

18:00 - 19:30

## Oral presentations

## OP-PM27 Physiology [PH] 4

**DOES PHYSICAL TRAINING INFLUENCE THE INCRETIN EFFECT?**

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*University of Copenhagen*

## Introduction

It is well-known that insulin secretion in response to an oral or intravenous stimuli is lower in endurance trained athletes (T) compared to sedentary people (UT). The mechanism behind, however, is not fully described and might differ between ways of administration. Incretin hormones (glucagon like peptide-1 (GLP-1) and glucose-dependent insulinotropic peptide (GIP)) are stimulated by nutrients in the small intestine and increase the glucose induced insulin release. We have shown that GLP-1 (higher fasting value) and GIP (lower postprandial release) adapts to physical training (Lund et al. unpublished data). Whether this is followed by a change in  $\beta$ -cell sensitivity to the incretins is unknown. Our aim was to measure and compare the incretin effect, defined as the difference in insulin release during an oral and intravenous glucose test with matched plasma glucose levels, in T and UT. Methods Ten T and ten UT (VO<sub>2</sub>max: 67±2 and 46±2 ml/min/kg; age: 25±1 and 25±1 yrs; BMI: 22±1 and 23±1 kg/m<sup>2</sup>, respectively) healthy men were included. Subjects reported to the lab twice, separated by at least 48 h, after an overnight fast. Day 1 subjects ingested 75 g of glucose dissolved in 300 ml water (OGTT) and plasma glucose was measured every fifth minute for 3½ h. Day 2 glucose was infused intravenously (IIGI) to match the plasma glucose levels during the OGTT at any given time. Blood for insulin measurements, were drawn twice at baseline and at 15, 30, 45, 60, 90, 150 and 210 minutes both test days. Results Glucose concentration (4.9 vs. 4.9 mM, p=0.74) was similar, but insulin concentration (27 vs. 42 pM, p=0.048) lower at baseline in T compared to UT, respectively. There was no difference in glucose AUC between test days in UT (OGTT: 1255±32 vs. IIGI: 1266±24 mM • 210 min, p=0.36) or T (OGTT: 1184±16 vs. IIGI: 1192±15 mM • 210 min, p=0.18), but glucose AUC was lower in T vs. UT both test days (OGTT: p=0.03 and IIGI: p=0.007). Also insulin concentration during the OGTT (T: 21387±1104 vs. UT: 35735±4597 pM • 210 min, p=0.007) and IIGI (T: 9894±714 vs. UT: 16795±2119 pM • 210 min, p=0.006) was lower in T vs. UT. The incretin effect calculated as: (AUCOGTT - AUCIIGI)/AUCOGTT) • 100% for incremental insulin values (70±4 and 67±3%) was similar in T vs. UT, respectively. Discussion With a lower insulin release during both tests in T compared to UT, our data confirms the well-known relationship between insulin secretion and physical training. The incretin effect was similar in both groups. This is a novel finding and in contrast to what could be expected given the markedly different insulin release in T compared to UT. Moreover with a similar incretin effect and an expected lower GIP release in T compared to UT it follows that in endurance trained athletes the GIP sensitivity of the  $\beta$ -cell must be increased.

**SMALL-SIDED GAMES TRAINING ARE AS EFFECTIVE AS TRADITIONAL CYCLE ERGOMETRY AT REDUCING CLINICAL RISK FACTORS ASSOCIATED WITH THE DEVELOPMENT OF DIABETES AND CARDIOVASCULAR DISEASE**

Mendham, A.E., Duffield, R., Coutts, A.J., Marino, F., Bishop, D.J.

*Charles Sturt University*

Introduction The majority of research investigating the potential for exercise to reduce clinical risk factors associated with diabetes and cardiovascular disease has used continuous exercise (Hays et al., 2006; Hutchison et al., 2012). The present study sought to examine whether small-sided games (SSG) could be an effective alternative to traditional continuous exercise training. Methods Thirty middle-aged, sedentary, men (48.6±6.6 y) were randomly assigned to a cycle ergometry (n=11), SSG (n=10), or control group (n=9). Participants in both exercise groups trained 3 d/wk for 8 wk, while control participants maintained normal activity and dietary patterns. All participants completed pre- and post-intervention testing: dual-energy x-ray absorptiometry scan, incremental exercise test, resting oral glucose tolerance test (OGTT) and a resting muscle biopsy. Plasma glucose and insulin concentrations were measured in a fasted state and throughout the 2 h OGTT. Total content of proteins associated with mitochondrial biogenesis, and glucose and insulin signaling were analysed via western blotting. Results In response to the OGTT, the control group exhibited no changes, yet both cycling and SSG groups showed a decline in the area under the curve (AUC) for glucose, whilst only SSG showed a decline in the AUC for insulin (P<0.05). There were no significant changes in proteins associated with mitochondrial biogenesis, glucose or insulin signaling (P>0.05). However, there was a trend for an increase in PGC-1 $\alpha$  (effect size (ES) ± confidence interval: 0.49±0.62), P53 (ES 0.47±0.55) and GLUT4 (ES 0.57±0.65) within the SSG group and for mitochondrial complex I (P<0.05; ES 1.0±0.67) and IV (P<0.05; ES 1.1±0.77) within the cycling group. Participants in both exercise groups decreased total body fat mass (%) and intra-abdominal fat mass (kg; P<0.05). Additionally, peak oxygen consumption improved by 19% in both exercise groups (P<0.05). Discussion This study showed that both cycling and SSG improved aerobic capacity, body composition, and blood biochemistry in relation to glucose regulation. However, such changes were not reflected within the skeletal muscle proteins associated with mitochondrial biogenesis, or glucose and insulin signaling. While the underlying mechanisms need to be further investigated, SSG training in sedentary middle-aged populations was as effective as traditional cycle ergometry by reducing clinical risk factors normally associated with the development of chronic diseases. References Hays NP, Starling RD et al. (2006) *J Gerontol A Biol Sci Med*, 61, 299-304. Hutchison SK, Teede HJ et al. (2012) *Diabetologia*, 55, 1424-34.

**TWO WEEKS OF PHYSICAL INACTIVITY REDUCES THE MITOCHONDRIAL RESPIRATORY CAPACITY IN YOUNG AND ELDERLY HEALTHY MEN**

Gram, M., Vigelsoe, A., Yokota, T., Nørregaard, J., Wiuff, C., Kuhlman, A.B., Helge, J.W., Hey-Mogensen, M., Dela, F.

*Xlab*

Introduction The effect of physical inactivity on mitochondrial respiratory capacity in human skeletal muscle is largely unknown. The purpose of this study was to investigate the effect of physical inactivity and subsequent aerobic training on mitochondrial respiratory capacity in young and elderly healthy men. Methods 17 young (Y) (23±1 yr (mean±SEM); 48±1 ml O<sub>2</sub>/min/kg) and 15 elderly (E) (68±1 yr; 33±2 ml O<sub>2</sub>/min/kg) male subjects had one leg immobilised for two weeks using a DonJoy cast. This was followed by six weeks (20 sessions) of

supervised cycle ergometer training (86±1% of maximal heart rate). The daily physical activity level was monitored with a three-axis accelerometer before, during and after immobilisation. Muscle biopsies (v. lateralis) were obtained after immobilisation in the immobilised leg (IMMO), in the non-immobilised control leg (CON) and after training in the immobilised leg (TR). Mitochondrial respiratory rate was determined in permeabilised fibers during state 2 using glutamate and malate as complex I linked substrates (GM2), state 3 after addition of ADP (GM3) which was followed by addition of succinate for dual electron input into complex I and II (GMS3) and finally state 4 after addition of oligomycin to inhibit the ATP synthase (4o). Statistical differences were tested using a two-way ANOVA with repeated measures. Results During immobilization the physical activity level decreased ( $P < 0.001$ ) similarly in both Y (31±9%) and E (37±9%) after which it returned to baseline during the training period. After immobilisation, mitochondrial respiration in CON vs. IMMO decreased ( $P < 0.05$ ) similarly both in Y (GM3: 40±5 vs. 33±3; GMS3: 72±7 vs. 59±5 and 4o: 25±3 vs. 20±2 pmol/sec/mg) and in E (GM3: 37±2 vs. 30±2; GMS3: 75±5 vs. 60±3 and 4o: 23±2 vs. 19±1 pmol/sec/mg), respectively. After training, mitochondrial respiration in IMMO vs. TR increased ( $P < 0.05$ ) in Y (GMS3: 60±5 vs. 92±5 and 4o: 20±2 vs. 38±3 pmol/sec/mg) and in E (GMS3: 61±3 vs. 79±5 and 4o: 19±1 vs. 30±2 pmol/sec/mg), but interestingly there was no effect of training on GM3 in either group (Y: 32±3 vs. 35±4 and E: 31±2 vs. 29±2 pmol/sec/mg). After training, there was no difference in mitochondrial respiration between TR vs. CON in E, while TR was significantly higher than CON in Y ( $P < 0.05$ ). Conclusions We conclude that 1) immobilisation decreases mitochondrial respiration to an equal extent in young and elderly subjects. 2) Retraining after immobilisation have an augmented effect on mitochondrial respiration in young compared to elderly subjects. 3) In contrast to all other respiratory measures, state 3 respiration using glutamate + malate, did not increase with training in either young or elderly subjects.

### ACTN3 GENE POLYMORPHISM: ASSOCIATION WITH AEROBIC FITNESS

Pasqua, L.A.1, Artioli, G.G.1, Bueno, S.1, Damasceno, M.V.1, Lancha Jr, A.H.1, Lima-Silva, A.E.2, Bertuzzi, R.1

1: USP (São Paulo, Brazil), 2: UFAL (Maceió, Brazil)

**Introduction** Genetic polymorphisms have been highlighted as important determinants of physical performance traits. Among them, the R577X polymorphism of the ACTN3 gene, which results in a complete absence of  $\alpha$ -actinin-3 in subjects with XX genotype, has been extensively investigated in relation to sports performance. Association studies observed a higher frequency of the XX genotype among endurance athletes. Additionally, findings in animal models showed a more efficient oxidative metabolism in ACTN3 knockout mice. However, the relationship between the XX genotype and aerobic fitness in humans remains unknown. Thus, the aim of the present study was to verify the association between the XX genotype of the ACTN3 gene and physiological parameters related to aerobic fitness. **Methods** One hundred and fifty male healthy subjects performed a maximal incremental running test to determine maximal oxygen uptake (VO<sub>2</sub>max) and the speeds in which ventilatory threshold (VT) and respiratory compensation point (RCP) were attained. DNA samples were obtained from mouthwashes and subsequently analyzed by PCR reaction. The subjects were divided in terciles based on the analyzed variables. The genotype frequencies were compared through chi-squared test between the first (T1) and third terciles (T3), which represent the two "end-points" for each variable (the lowest and highest values, respectively). Results In relation to VT, T1 (8.8 ± 0.9 km.h<sup>-1</sup>) was significantly lower than T3 (11.3 ± 0.5 km.h<sup>-1</sup>;  $p < 0.05$ ). The XX genotype showed a lower frequency for VT in T1 (16.7%) and a higher frequency in T3 (41.7%,  $p < 0.05$ ), accounting for 32.4% of the observed difference. Similarly, when the individuals were divided by the RCP values, T1 was significantly lower than T3 (12.0 ± 0.8 km.h<sup>-1</sup> vs 15 ± 1.1 km.h<sup>-1</sup>;  $p < 0.05$ ). It was found a higher frequency of the XX genotype for RCP in T3 (52.8%,  $p < 0.05$ ), accounting for 16% of the difference. No differences were observed for the VO<sub>2</sub>max terciles. **Discussion** Our results show that XX subjects have a greater probability to attain the VT and RCP at higher speeds, suggesting that these subjects may sustain higher running speeds in lower exercise intensity domains. It could result in higher oxidation of lipid acids, saving muscle glycogen and delaying the onset of fatigue during prolonged exercises. Therefore, this could be one of the mechanisms that may explain the advantage of the XX genotype to endurance performance suggested in previous studies of association.

### INVESTIGATION OF COL3A1, COL6A1 AND COL12A1 POLYMORPHISMS WITH ANTERIOR CRUCIATE LIGAMENT RUPTURE IN TWO INDEPENDENT POPULATIONS

O'Connell, K.1, Ficek, K.2, Leonska-Duniec, A.3, Maciejewska-Karlowska, A.2, Sawczuk, M.2, Stepien-Slodkowska, M.2, O'Cuinneagain, D.4, Merwe, W.4, Posthumus, M.1, Cieszczyk, P.3, Collins, M.1,5

1: UCT (Cape Town, South Africa), 2: US (Szczecin, Poland), 3: Academy of Physical Education and Sport (Gdansk, Poland), 4: SSOC (Cape Town, South Africa), 5: MRC (Cape Town, South Africa)

**Introduction** The exact aetiology of ACL ruptures remains unknown however, a number of extrinsic and intrinsic risk factors, including a genetic component, have been identified (Griffin et al., 2006). The primary aim of this study is determine if an independent association exists between COL3A1 rs1800255 and COL6A1 rs35796750 and risk of ACL ruptures. The secondary aim of the study was to determine if any gene-gene interactions, between these variants and other previously associated variants (Ficek et al., 2012; Posthumus et al., 2009; Khoschnau et al., 2008; Posthumus et al., 2010) are associated with risk of ACL rupture. **Methods** 334 Caucasian participants were recruited for the South African cohort for this study. 122 participants with ACL ruptures and 212 participants with no history of ACL injury were recruited as controls. 234 male Polish participants were recruited for the Polish cohort of this study. 91 participants with ACL ruptures and 143 participants with no history of ACL injury were recruited as controls. Participants were genotyped for COL3A1 rs1800255, COL6A1 rs35796750 and COL12A1 rs970547. Results Significant, but opposite, associations were identified between COL3A1 rs1800255 and ACL injury risk in the male South African and Polish participants. No significant associations were identified for COL6A1 rs35796750 and COL12A1 rs970547. The major COL1A1 rs1800012, COL3A1 rs1800255 and COL12A1 rs970547 inferred haplotype, G+G+A, was significantly ( $p=0.016$ ) over-represented in the combined ACL group when compared to the combined CON group. **Discussion** The novel main finding of this study was a significant interaction between the COL1A1 rs1800012 G/T, COL3A1 rs1800255 G/A and COL12A1 rs970547 A/G variants and risk of ACL injury. References Griffin LY, Albohm MJ, Arendt EA et al. Am J Sports Med. 2006;34:1512-1532. Ficek K, Cieszczyk P, Kaczmarczyk M et al. J Sci Med Sport. 2012;S1440-2440(12)00205-8 Posthumus M, September AV, Keegan M et al. Br J Sports Med. 2009;43:352-356. Khoschnau S, Melhus H, Jacobson A et al. Am J Sports Med. 2008;36:2432-2436. Posthumus M, September AV, O'Cuinneagain D et al. Br J Sports Med. 2010;44:1160-1165.

**PLASMA ADIPOKINE CONCENTRATIONS IN PREPUBERTAL CHILDREN WITH DIFFERENT LEVELS OF CARDIORESPIRATORY FITNESS AND PHYSICAL ACTIVITY**

Llorente-Cantarero, F.J.1,2, Gil-Campos, M.2, Olza, J.3, Muñoz-Villanueva, M.C.4, Aguilera, C.M.3, Pérez-Navero, J.L.2

1: UCO (Cordoba); 2: URSH (Cordoba); 3: UGR (Granada); 4: IMIBIC (Cordoba).

**Introduction** Physical activity (PA) and cardiorespiratory fitness (CRF) could be protective against low-grade inflammation. Therefore, the aim of this study was to assess some adipokines and inflammation biomarkers in prepubertal healthy children with different levels of fitness and physical activity. **Methods** 132 healthy prepubertal children (78 boys/54 girls) aged between 7-12 years were recruited from local schools. Children were divided into two groups (equal or high fitness (HF) group, and low fitness group (LF) according to the 20-meter shuttle run test. Moreover, to estimate practice of exercise, participants were observed while engaged in an after-school program and answered a questionnaire. So, children were assigned either to the regular physical activity group (PAG) or to the sedentary group (SG). Anthropometric parameters and the following plasma adipokines were measured: leptin, resistin, adiponectin, tumor necrosis factor alpha, hepatic growth factor, interleukin 6 (IL-6), IL-8, macrophage chemoattractant type-1 (MCP1), nerve growth factor, and plasminogen activator inhibitor-1. **Results** After adjustment for BMI, age and sex, the LF group showed higher leptin levels and lower IL-6 levels as compared to the HF group. In relation to PA, adiponectin and MCP1 levels were higher in the SG as compared to the PAG but after adjustments, only MCP1 remained significant. When boys and girls were compared, no differences were found. **Discussion** CRF and PA may influence plasma adipokine levels regardless of BMI, age and sex, already in prepubertal healthy children. Sedentary and low fitness groups of prepubertal children show some changes in inflammatory cytokines comparing to the group of physically active children. At present, the potential anti-inflammatory role of CRF and PA in children is not yet clear. However, the role of risk factors during childhood on the development of cardiovascular diseases later in adulthood should be further analyzed. Whereas genetic and early programming features have been associated with low-grade inflammation in young people 1, an active lifestyle and a desirable CRF may attenuate its effects 2. It has been indicated that PA may have an indirect role through CRF and body fat, which are health determinants. The present study contributes to establish the groups with health risk in childhood that may be re-evaluated in later ages and that could benefit from scheduled physical activity programs. 1: Labayen I, Ortega FB, Sjöström M, Ruiz JR. *J Pediatr* 2009;155:673-7. 2: Martinez-Gomez D, Eisenmann JC, Wärnberg J, Gomez-Martinez S, Veses A, Veiga OL, Marcos A. *IJO* 2010;34:1501-7.

**18:00 - 19:30****Oral presentations****OP-PM05 Health and Fitness [HF] 1****STRENGTH, AEROBIC AND COGNITIVE EXERCISE TO IMPROVE EXECUTIVE FUNCTION**

Eggenberger, P.1, Schumacher, V.2, Angst, M.1, Holenstein, S.1, Theill, N.2, de Bruin, E.D.1

1: ETH Zurich, 2: University of Zurich

**Introduction** Different studies have demonstrated that cognitive functions improve to a greater extent in participants following combined strength and aerobic training than aerobic training alone (Colcombe and Kramer, 2003). Furthermore, neglecting the training of cognitive functions might be one reason for the absence of effects in fall prevention programs (de Bruin et al., 2011). Since executive functions (EF) are important in relation to falls in elderly (Mirelman et al., 2012), we hypothesized that cognitive function improves more when strength-aerobic training is combined with cognitive training and that training attention affects EF more than training working memory. **Methods** 69 elderly (79+-5.6 years) were randomly assigned to one of three groups; AEROBIC (strength-aerobic training only) DANCE (strength-aerobic and attention training) MEMORY (strength-aerobic and working memory training). They performed two one-hour training sessions per week for three months. To identify differences in EF between groups the Trail Making Test (TMT parts A & B; Arbuthnott and Frank, 2000; Sanchez-Cubillo et al., 2009) was assessed pre- and post-intervention and analysed with planned contrasts. Results Planned contrasts revealed that cognitive performance of the groups with combined training (DANCE and MEMORY) improved significantly more compared to the control group (AEROBIC): TMT B-A  $t(66) = 1.78$ ,  $p < .05$  & TMT B/A  $t(66) = 1.93$ ,  $p < .05$ , training type (attention vs. memory) was not different, TMT B-A  $t(66) = -.43$ ,  $p = .34$  (one-tailed) & TMT B/A  $t(66) = -.28$ ,  $p = .39$  (one-tailed). **Discussion** This study indicates an advantage of the combination of strength-aerobic with cognitive training over strength-aerobic training alone. Both combined training groups demonstrated similar performance developments over three months and similar transfer effects to performance in the TMT. These findings encourage further examination of the effect of exercise type and intensity on cognition and clinically relevant outcomes. **References** Colcombe S, Kramer AF (2003). *Psychological Science*, 14(2), 125-130. de Bruin ED, Reith A, Doerflinger M, Murer K (2011) *J Nov Physiother*, 1(104). Mirelman A, Herman T, Brozgol M, Dorfman M, Sprecher E, Schweiger A, Giladi N, Hausdorff JM (2012) *PLoS One*, 7(6), e40297. Arbuthnott K, Frank J (2000). *J Clin Exp Neuropsych*, 22(4), 518-528. Sanchez-Cubillo I, Perianez JA, Adrover-Roig D, Rodriguez-Sanchez JM, Riso-Lago M, Tirapu J, Barcelo F. (2009) *J Int Neuropsych Soc*, 15, 438-450.

**SPONTANEOUS PHYSICAL ACTIVITY, AEROBIC PHYSICAL EXERCISE AND CORTISOL TO DEHYDROEPIANDROSTERONE SULFATE RATIO IN POST-MENOPAUSE**

Di Blasio, A., Izzicupo, P., D'Angelo, E., Bucci, I., Ripari, P., Napolitano, G.

Chieti-Pescara University

**Introduction** Both aging and menopause are influencing factors of the increase of cortisol (C) and the decrease of dehydroepiandrosterone sulfate (D-S) plasma values. As the combination of these hormonal modifications has negative cardio-metabolic effects on health, the aim of our study was to investigate the effects of both spontaneous physical activity (SPA) and aerobic physical exercise on C to D-S ratio (C/D-S) in order to prevent and/or to treat the related cardio-metabolic diseases. **Methods** Fifty post-menopausal women (57.22±4.78 yrs), not involved in a physical exercise program, have been recruited and investigated for plasma values of C, D-S, insulin and glucose, together with body composition, blood pressure and aerobic fitness. Daily physical activity (DPA) of participants has been objectively recorded (SenseWear Pro3 Armband, BodyMedia) for seven consecutive days. After basal

measurements, participants walked at moderate intensity 4 days/wk, for 13 weeks, under controlled supervision. At the end of the training period, all measurements were repeated. To detect the presence of any SPA modification (i.e. increase or decrease) during the training period, DPA was recorded 10 days prior to the end of the training, and included both training days and non-training days. Results C/D-S has been shown positively correlated with age, years of menopause, insulin resistance and blood pressure. Also when controlled for the effect of the age, C/D-S did not show relationships with body composition and DPA. C/D-S variation has been shown correlated only with the total volume of the physical exercise (VPE) that participants reached ( $r=-0.435$ ,  $p=0.02$ ). Indeed, when participants were gathered according to tertiles of VPE, the first tertile ( $VPE < 123.13$  min/wk) did not modify C/D-S, the second tertile ( $123.13 < VPE < 159.34$  min/wk) had a quite significant reduction of C/D-S ( $p=0.08$ ) while the third tertile ( $VPE > 159.34$  min/wk) significantly reduced it ( $p=0.02$ ). No effects of SPA modification have been detected on C/D-S variation. Discussion In the absence of aerobic physical exercise, SPA of post-menopausal women does not seem able to influence C/D-S, probably because its characteristics did not adequately stimulate the body. Indeed, C/D-S variation has been shown correlated only with the VPE, independently from the modifications of both SPA and others investigated variables. Our results underline the importance of the practice of moderate intensity aerobic physical exercise and also confirm the importance to totalize at least 150 min/wk of exercise because only participants in the third tertile significantly reduced C/D-S. This result also suggests that C/D-S variation is volume-dependent.

### **TWITCH AND M-WAVE POTENTIATION INDUCED BY MAXIMAL VOLUNTARY CONTRACTIONS OF THE QUADRICEPS: DIFFERENCES BETWEEN OVER-THE-MUSCLE AND FEMORAL NERVE STIMULATION**

Rodriguez-Falces, J., Maffioletti, N., Place, N.

*Public University of Navarra*

**TWITCH AND M-WAVE POTENTIATION INDUCED BY MAXIMAL VOLUNTARY CONTRACTIONS OF THE QUADRICEPS: DIFFERENCES BETWEEN OVER-THE-MUSCLE AND FEMORAL NERVE STIMULATION** Rodriguez-Falces J (1), Maffioletti NA (2), Place N (3) (1) PUN, (Pamplona, Spain), (2) SC, (Zurich, Switzerland), (3) UG, (Geneva, Switzerland). Introduction It is well known that twitch force, as evoked by a single electrical stimulus, increases after a brief muscle contraction. This phenomenon is normally referred to as "potentiation" (Brown and von Euler, 1938). Potentiation is also the name given to the enlargement of the maximal M-wave observed following a conditioning contraction. Single electrical stimulation can be applied transcutaneously by using large electrodes placed over the muscle belly (over-the-quadriceps stimulation), while smaller stimulating electrodes could also be positioned over a major peripheral nerve (femoral nerve stimulation). The aim of this study is to investigate differences in twitch and M-wave potentiation in the quadriceps femoris when electrical stimulation is applied over the quadriceps muscle belly versus the femoral nerve trunk. Methods M-waves and mechanical twitches were evoked using over-the-quadriceps stimulation and femoral nerve stimulation between 48 successive isometric maximal voluntary contractions (MVC) from 10 young, healthy subjects. Potentiation was investigated by analyzing the changes in M-wave amplitude recorded from the vastus medialis (VM) and vastus lateralis (VL) muscles and in quadriceps peak twitch force. Results Potentiation of twitch, VM M-wave, and VL M-wave was greater for femoral nerve than for over-the-quadriceps stimulation ( $P<0.05$ ). M-wave potentiation tended to be greater for VL than for VM ( $P=0.087$ ). Despite a 50% decrease in voluntary force, M-waves during the 48 intermittent MVCs were greater than the M-wave at rest. Twitch potentiation was maximal at 15-20 s from the onset of the fatiguing protocol, after which the twitch underwent a steady decrease. Discussion With the assumption that full MU recruitment was achieved with both stimulation geometries, differences in the type of MU activated or number of MUs by femoral nerve vs. over-the-quadriceps stimulation can hardly account for the above differences in twitch potentiation. Although the enhanced electrogenic  $Na^+-K^+$  pumping is traditionally suggested as the main mechanism underlying M-wave potentiation, other factors (such as synchronization in the activation of muscle fibres and muscle architectural properties) might significantly influence the magnitude of M-wave enlargement. References 1. Brown GL, von Euler US. The after effects of a tetanus on mammalian muscle. *J Physiol* 1938;93: 39-60. 2. Sale DG. Postactivation potentiation: role in human performance. *Exerc Sport Sci Rev* 2002;30:138-143.

### **DIFFERENCES IN THE MITOCHONDRIAL CONTENT OF DIFFERENT FIBRE TYPES IN THE LEG AND ARM MUSCLES OF ELITE CROSS-COUNTRY SKIERS**

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Introduction Although it is generally believed that the MHC isoforms determine the metabolic profile of a muscle fibre, the relationship between these isoforms and the mitochondrial volume may vary (Handschin 2010), and arm and leg muscle differences has been proposed (Plomgaard et al. 2006). The aim here was to characterize this relationship between mitochondrial volume and MHC isoform in the limbs of elite cross-country skiers exceptionally training in both limbs. Methods Ten male elite cross-country skiers participated in the study, mean ( $\pm$ SD) age  $22 \pm 1$  yrs and  $\dot{V}O_2\max$   $72 \pm 2$  ml  $kg^{-1}$   $min^{-1}$ . Muscle biopsies were taken from arm (m. triceps brachii) and leg (m. vastus lateralis) muscles. Muscle segments were prepared for transmission electron microscopy (TEM) and the volume content of mitochondria were estimated by point-counting. Fibres were classified as type I or II based on a combination of z-line width and mitochondria content. Whole muscle MHC was determined by electrophoresis by with the average of 3 biopsies. Results The mitochondrial volume was higher in type I than in type II fibres. Although there were no clear significant difference between the fibre types of arms and legs (type I:  $0.126 \pm 0.01$  (leg) and  $0.128 \pm 0.01$  (arm) and type II:  $0.058 \pm 0.01$  (leg) and  $0.072 \pm 0.01$  (arm)  $\mu m^3$  per  $\mu m^3$  fibre volume), there was a strong tendency ( $P=0.05$ ) towards a higher mitochondrial volume in type II fibres in the arms vs. legs. The leg muscles contained predominantly MHCI ( $57 \pm 3\%$ ), whereas MHCIa dominated in the arms ( $63 \pm 2\%$ ). Despite this difference, there was no difference in the mitochondrial volumes of the leg and arm muscles, when weighing the mitochondrial content by the MHC distribution ( $0.0950 \pm 0.006$  (leg) vs  $0.0950 \pm 0.008$  (arm)  $\mu m^3$  per  $\mu m^3$  fibre volume). This conclusion was supported by the observation that the activity of citrate synthase, a definitive biomarker for mitochondria, was the same in both the arm and legs ( $118 \pm 6$  (leg) vs  $111 \pm 10$  (arm)  $\mu mol/g$   $dw/min$ ) in the muscles. Discussion Despite an overweight of MHC II fibres in the arms compared with the legs the two muscles have similar total mitochondria content and CS activity. Discrimination between fibre types indicates that the MHC II fibres of the arm muscles are more oxidative than found in the legs. Thus, the MHC phenotypes are clearly different between arm and leg muscles in these highly trained athletes, who have endurance-trained arm and leg muscles. References Handschin C (2010). *J Recept Signal Transduct Res.* 30, 376-84 Plomgaard et al. (2006). *J Appl Physiol.* 101, 817-25.

### MAXIMAL HEART RATE AND PERFORMANCE INCREASE WITH INTERMITTENT OXYGEN SUPPLEMENTATION DURING EXHAUSTIVE WORK IN ELITE ATHLETES

Gullstrand, L.1,3, Boberg, O.1, Fränberg, O.2, Larsson, Å.1, Lindberg, T.3, Lindholm, P.1

*Swedish Sports Confederation*

**Introduction** Inspiration of oxygen (O<sub>2</sub>) during exercise is known to increase peak work load (Bannister, 1954, Perry et al., 2005). Recent studies on pulmonary shunting during exercise suggest that O<sub>2</sub> per se could close these shunts and thus increase arterial PO<sub>2</sub> (Lovering et al., 2008). We hypothesized that a small increase in intrapulmonary PO<sub>2</sub> (5-10kPa) would suffice to get the performance enhancing effect of oxygen. We also hypothesized that intermittent supplementation of 10-20 L/min of O<sub>2</sub> to inspired air could yield this increase without using premixed gas in athletes ventilating 150-300 L/min. **Methods** 19 endurance trained, competitive male athletes were tested on an ergometer cycle in a blinded cross-over design on two separate occasions. Tests were done on two sub-maximal workloads (160 and 240W) and thereafter during a VO<sub>2</sub>max test with increasing workload by 22.5W/min until exhaustion. Measurements included VO<sub>2</sub>max (air), heart rate, SpO<sub>2</sub> etc. O<sub>2</sub> or air was added intermittently to the inspired air in one exercise protocol ending with air and the other with oxygen. O<sub>2</sub> was added at 10-20 L/min by an apparatus developed by Oxelate™, Stockholm, Sweden. **Results** Max workloads were 438.8 (50.6) W (Mean, SD) with air and 453.4 (49.7) W with O<sub>2</sub>,  $p = 2.8 \times 10^{-6}$ . Maximal heart rate were 188 (9.1) beats/min with air and 190.9 (9.7) with O<sub>2</sub>,  $n=17$ ,  $P = 9.7 \times 10^{-5}$ . VO<sub>2</sub>max (air) was 5.09 (0.66) L/min. End-tidal FO<sub>2</sub> was 21.38 (0.72) % at maximal workload with O<sub>2</sub> addition. **Discussion** These data suggest that intermittent supplementation of O<sub>2</sub> is enough to increase work performance and maximal heart rate in highly trained athletes. It also shows that maximal heart rate may be increased by a small increase in inspired PO<sub>2</sub> during maximal exercise. Using this kind of equipment may enable athletes to reach training intensities unattainable in normoxia in their regular training. The developed apparatus offers an easy to handle device for regular hyperoxia training. As this study measured acute responses, long term training effects of various forms (such as training frequency) of intermittent hyperoxia remains to be investigated. **References** Bannister R, Cunningham D. *J Physiol (London)* 1954; 125:118-137. Perry CG, Reid J, Perry W, Wilson BA. *Med Sci Sports Exerc.*, 2005; 37:1175-1179. Lovering AT, Stickland MK, Amann M, et al. *J Physiol* 586.18, 2008: 4559-65.

### HEAVY HIP EXTENSION STRENGTH TRAINING AND VOLUNTARY MOVEMENT RHYTHM IN CYCLING

Sardroodan, M., Madeleine, P., Voigt, M., Hansen, E.A.

*Aalborg University*

**Introduction** Freely chosen cadence (FCC) during submaximal cycling has been suggested to represent an innate voluntary movement rhythm, under primary influence of central pattern generators (Hansen & Ohnstad, 2008). Thus, FCC may be a good reflection of central pattern generator movement rhythm output. A period of heavy leg strength training, involving both hip flexion and extension exercise, has been reported to cause recreationally active subjects to reduce their FCC during submaximal cycling (Rønnestad et al., 2012). The changed rhythmic movement behaviour was observed after 4 weeks of training, where it was first measured. But, perhaps the change occurs even earlier, in response to neural adaptations. In this on-going study, we specifically investigate the early effect of hip extension strength training on voluntary leg movement rhythm represented by FCC. **Methods** At present, 7 recreationally active individuals have completed the entire study protocol. Four have performed strength training intervention consisting of standing hip extension in 2 sessions/week for 4 weeks. In each session, three 5RM-10RM-sets were performed with each leg. Three have acted as controls. Cycling was performed as 5 min bouts at 100 W, on an SRM ergometer. **Results** The preliminary data indicated, as expected, that strength (one repetition maximum, 1RM) in the training group increased. Thus, 1RM in the applied training exercise in the training group was  $40.1 \pm 10.3$  kg at pre-intervention and  $56.8 \pm 12.8$  kg at post-intervention, as average values for the two legs. For comparison, 1RM for the control group was  $48.3 \pm 2.5$  kg at pre-intervention and  $53.6 \pm 5.9$  kg at post-intervention. An indication of a reduction of FCC was seen in the training group that pedaled at  $85 \pm 9$  rpm at pre-intervention and  $71 \pm 4$  rpm at post-intervention. The change in FCC appeared to occur already after 1 week of training where it tended to decrease to  $72 \pm 9$  rpm. For comparison, FCC in the control group appeared to be unchanged from  $75 \pm 5$  rpm at pre-intervention to  $82 \pm 9$  rpm at post-intervention. **Discussion** The preliminary analysis indicated that FCC decreased as a result of heavy hip extension strength training already after 1 week of training. This indicates that neural adaptations rather than e.g. morphological changes can explain the changed movement rhythm. The training may have increased the efficacy of the neuromuscular activation resulting in reduced requirement of common descending supraspinal drive during the submaximal cycling at a constant preset power output. Such an adaptation could cause a reduced voluntary movement rhythm output reflected in a lower FCC. **References** Hansen EA, Ohnstad AE (2008) *Exp Brain Res*, 186, 365-73. Rønnestad BR, Hansen EA, Raastad T (2012) *J Strength Cond Res*, 26, 158-66.

**18:00 - 19:30**

## Oral presentations

### OP-PM56 Training and Testing [TT] 10

#### OPTIMAL JAMAR DYNAMOMETER HANDLE POSITION TO ASSESS MAXIMAL ISOMETRIC HAND GRIP STRENGTH IN EPIDEMIOLOGICAL STUDIES

Trampisch, U., Franke, J., Hinrichs, T., Platen, P.

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**Introduction** Hand grip strength measured by a hand dynamometer is an indicator of general muscle strength and is an easily accessible parameter of physical fitness in epidemiological studies. In some studies, a subject's grip strength has been defined to be the maximal grip strength achieved from measurements taken at several different dynamometer handle positions. However, little is known about the influence of these different positions on the measured grip strength. The aim of the study was to identify the best of all handle positions in order to determine one standard handle position that could be used to assess the maximal grip strength of subjects with only one single measurement. **Methods** Grip strength was assessed with a hand dynamometer (Jamar Plus; Sammons Preston, Rolyon, Bolingbrook, IL). 50 participants were included. Each participant's grip strength was measured 3 times in each of 5 different handle positions with each

hand. The single positions differed by means of the width of the grip between 3.5 cm to 8.7 cm. The best position for each participant was defined as the position at which they achieved their individual maximal grip strength. Results The mean ( $\pm$  standard deviation) age of the 50 participants (21 [42%] men, 29 [58%] women) was 41 ( $\pm$  13, range 23-68) years. Mean maximal grip strength was 43.7 ( $\pm$  12.4) kg for all participants; 55.0 ( $\pm$  10.2) kg for men and 35.4 ( $\pm$  5.2) kg for women. Handle position 2 (width 4.8 cm) was the best position for 70% of participants. The mean difference between the grip strength achieved by each participant at handle position 2 and that achieved at each participant's best position was 0.80 ( $\pm$  1.78) kg. Discussion The assessment of grip strength with the Jamar Plus dynamometer is easier and faster if a single, standard handle position is used rather than multiple different positions. Our results show that measurements taken at a single medium-wide standard handle position are sufficiently accurate to assess grip strengths for different subjects. Furthermore, only one measurement in a single, standard handle position also reduces fatigue and increases the comparability of results between subjects. We therefore recommend handle position 2 of the Jamar Plus dynamometer as the standard position for measuring grip strength with this instrument.

### EFFECT OF STRENGTH AND HIGH-INTENSITY TRAINING ON JUMPING, SPRINTING AND INTERMITTENT ENDURANCE PERFORMANCE IN PREPUBERTAL SOCCER PLAYERS

Ferrete, C., Requena, B., Suarez Moreno-Arrones, L., Saez de Villarreal, E.

UNIVERSITY OF PABLO DE OLAVIDE

Introduction Soccer is a sport with participants spanning from childhood to old age. High-intensity movements (i.e., sprinting, jumping or cutting) and low-intensity movements (jogging or standing) occur in varying lengths depending upon an array of factors (i.e., playing position, skill level, style of play, tactical strategies) (Implellizzeri et al 2006). High-intensity actions such as sprinting or vertical jumping are integral elements for success in soccer and therefore need to be trained as part of a periodized youth training program (Hoff et al 2004). No study has analyzed effects occur (<10 yr) and long-term training intervention (>24 wks) in prepubertal. The aim of this study was to examine the effects of an in-season, low-impact (low-volume) strength and high-intensity training program on physical performance among prepubertal soccer players. Methods We examine the effects of a 26-week on-field combined strength and high-intensity training on physical performance in the competitive phase. Twenty-four players between 8-9 years were randomly assigned to 2 groups: control (C) (n=13) (only trained soccer), and experimental group (S) (n=11). Both groups performed the identical soccer training program, while the S group also performed combined strength and high-intensity training before soccer training. The 15-m sprint time (sec), countermovement vertical jump (CMJ) displacement (cm), Yo-Yo intermittent endurance test (Yo-YoE) (m), and Sit & Reach flexibility (cm) were measured before (baseline) and after 9 (T2), 18 (T3) and 26 weeks (post-test) of training. Results There were no significant differences between the groups in any of the variables tested at baseline. After 26 weeks significant improvements were found in CMJ (6.72%; ES = 0.37), Yo-YoE (49.57%; ES = 1.39), and Flexibility (7.26%; ES = 0.37) variables for the S group. Conversely, significant decreases were found in CMJ (-10.82%; ES = 0.61) and Flexibility (-13.09%; ES = 0.94) variables in C group. A significant negative correlation was found between 15m sprint time and CMJ ( $r=-0.77$ ) and Yo-YoE ( $r=-0.77$ ) in S group. Discussion Training intervention used (2 days per week, squats, different type of jumps, sprints exercises) improves jumping performance. Furthermore, the intermittent endurance and hip-flexibility performance were significantly enhanced. These results tend to agree with most of previous studies performed in young soccer players (Chelly et al 2009, Stone et al 2006). Specific combined strength and high-intensity training in prepubertal soccer players for 26 weeks produced a positive effect on performance qualities highly specific to soccer. Therefore, we propose modifications to current training methodology for prepubertal to include strength and high-intensity training for athlete preparation in this sport. References Implellizzeri FM, Marcora SM (2006). *Int J Sports Med* 27: 483-492 Hoff, J. Helgerud, J. (2004) *Sports Med* 34 (3): 165-180 Chelly MS Fathloun, M (2009) *J Strength Cond Res* 23:2241-2249 Stone MH, Sands WA (2006) *Strength Cond J* 28(3): 44-53

### EFFECT OF A TYPICAL IN-SEASON WEEK ON STRENGTH JUMP AND SPRINT PERFORMANCES IN NATIONAL-LEVEL FEMALE BASKETBALL PLAYERS.

Calleja-González, J., Delextrat, A., Trochym, E.

FACULTY OF SPORTS SCIENCES. UNIVERSITY OF THE BASQUE COUNTRY. LONDON METROPOLITAN UNIVERSITY. LONDON. UNITED KINGDOM.

AIM: The aim of this study was to investigate the effect of a typical in-season week including four practice sessions and one competitive game on strength, jump and sprint performances in national-level female basketball players. METHODS: Nine female basketball players (24.3 $\pm$ 4.1 years old, 173.0 $\pm$ 7.9 cm, 65.1 $\pm$ 10.9 kg, 21.1 $\pm$ 3.8% body fat) participated in ten testing sessions, before and immediately after practices and game (five pre- and five post-tests). Each session involved isokinetic peak torque measurements of the quadriceps and hamstrings of the dominant leg at 60°·s<sup>-1</sup>, countermovement jump (CMJ) and 20-m sprint. Fluid loss and subjective training load were measured during each practice session, while the frequencies of the main movements performed during the game were recorded. A two-way ANOVA was used to assess the effect of each practice/game and the effect of the day of the week on performances, and the relationship between performance variations and variables recorded during practices/game were analyzed by a Pearson correlation coefficient. RESULTS: Individual sessions induced significant decreases in lower limb strength (from 4.6 to 10.9%,  $P<0.05$ ), CMJ (12.6% to 19.6%,  $P<0.05$ ) and 20-m sprint (1.3% to 7.3%,  $P<0.05$ ). Performances returned to baseline before the subsequent pre-test session, except on day 3. CONCLUSION: These impairments in performance highlight that coaches should plan conditioning programmes based on repeated sprint and repeated jump ability, and monitor the recovery of their players' strength, sprint and jump capacities following specific sessions. REFERENCES: 1. Ostojic SM, Mazic S, Dikic N. Profiling in basketball: physical and physiological characteristics of elite players. *J Strength Cond Res* 2006; 20: 740-4. 2. Delextrat A, Cohen D. Physiological testing of basketball players: toward a standard evaluation of anaerobic fitness. *J Strength Cond Res* 2008; 22: 1066-72.

### COMPARISON OF DYNAMIC AND STATIC STRETCHING WARM-UP ON JUMPING, SPRINT AND AGILITY RUN PERFORMANCE

Atan, T., Unver, S., Kose, B.

Ondokuz Mayıs University

Introduction Warm-up is one of the most important elements for an exercise program. The purpose of this study was to compare the dynamic and static stretching within a pre-exercise warm-up on jumping, sprint and agility run performance. Methods Thirty male subjects (age 22.00 $\pm$ 1.98 years) attending Physical Education and Sports Department participated the study. Subjects were required to visit the laboratory on 3 occasions, each separated by 48 hours. In the first visit, participants were taken to the laboratory in order to perform

static jump test, 20m sprint test and Illinois Agility Run test to become familiar with the procedure. After 48 hours, these performance test were applied either after dynamic or static stretching warm-up. The order of the 2 conditions was selected randomly to prevent an order effect. Paired t test was used for the statistical analysis. Results Jump power values were found  $3912.80 \pm 770.44W$  after dynamic warm-up and  $3898.26 \pm 1039.49W$  after static warm-up. There was no significant difference among warm-ups for the static jump performance ( $p > 0.05$ ). 20 m sprint speed values were  $6.31 \pm 0.32m/sec$  and  $6.30 \pm 0.36m/sec$  for the dynamic and static stretching warm-up respectively. No significant differences were found between two warm-up stretching for the sprint performance ( $p > 0.05$ ). Illinois Agility Running times were found significantly different between dynamic ( $24184.33 \pm 1172.57ms$ ) and static ( $24792.13 \pm 1504.73ms$ ) stretching warm-up ( $p < 0.01$ ). Discussion Little and Williams's (2006) study supported our finding that they found no significant difference among warm-ups for the jumping performance too. But in the study of Gelen (2008) results showed that, static stretching performed after aerobic exercises of mild intensity was found to hinder vertical jump performance, while dynamic warm-up was found to have a positive effect. No significant difference was found between dynamic and static stretching for sprint performance. Conversely, our results are different to the results of Fletcher and Jones's study (2004). Their main finding was a significantly faster sprint time when active dynamic stretching was incorporated into a warm-up, with significantly slower sprint times observed for subjects employing either static active or passive stretching regimes (Fletcher and Jones 2004). In our study the agility running performance was better after dynamic warm-up than static warm-up. This finding coincides with the results of a previous study. Data from the study by Little and Williams (2006) indicate that the dynamic-stretch protocol produced significantly faster agility performance than did the static stretch protocol. References Fletcher IM, Jones B. (2004). *Journal of Strength and Conditioning Research*, 18(4), 885–888. Gelen E. (2008). *SPORMETRE Beden Eğitimi ve Spor Bilimleri Dergisi*, 2008, VI (4) 207-212. Little T, Williams AG. (2006). *Journal of Strength and Conditioning Research*, 20(1), 203–207.

### CHANGES IN MUSCLE SIZE AND STRENGTH IN RESPONSE TO RESISTANCE TRAINING WITH MODERATE AND HIGH INTENSITIES IN YOUNG WOMEN

Alegre, L.M.1, Aguado, X.1, Rojas-Martín, D.1, Csapo, R.2

*University of Castilla-La Mancha*

1 University of Castilla-La Mancha, Biomechanics Laboratory, Toledo, Spain 2 University of California San Diego, Department of Radiology, San Diego, USA Introduction: Heavy-load resistance training is generally recommended as an important tool to develop and maintain muscle mass and strength, thereby promoting physical fitness and quality of life in healthy adults (1). As compared to heavy resistance training, few studies have investigated the effects of training with moderate loading intensities. The aim of this study was to analyse the changes in knee extensor strength and muscle size in response to resistance training at two different intensities, but similar overall training load. Methods: Fifteen women (age,  $21.7 \pm 2.7$  yrs; mass,  $58.5 \pm 6.8$  kg; height,  $164.6 \pm 5.4$  cm) participated in a 10-week knee extensor strengthening program. One leg (intensity leg, IL) was trained at increasing training intensity [50-80% of one repetition maximum (1RM)], with constant volume throughout the intervention period. The contralateral leg (volume leg, VL) was trained at constant intensity (50% of 1RM), but the number of repetitions was adjusted during the programme to match the mechanical work performed by the IL. At baseline and after training, isokinetic dynamometry was utilised to assess dynamic and isometric strength of the knee extensor muscles. In addition, vastus lateralis and rectus femoris muscle thicknesses were assessed at several locations by ultrasonography. Results: Both measures of isometric and dynamic strength (IL: 10.2-16.2%,  $P < 0.05$ ; VL: 10.1-14.4%,  $P < 0.05$ ) as well as muscle thicknesses (IL: 7.3-12.0%,  $P < 0.05$ ; VL: 7.9-11.0%,  $P < 0.05$ ) increased significantly during the training programme. However, no between leg differences in the training responses were found, although the gains in muscle thickness were larger in the IL by trend. Discussion: The present study shows that, when matched for overall training load, different resistance training protocols provoke comparable gains in muscle strength and size in a group of untrained, healthy young women. The lack of significant differences between training legs in spite of the different intensities may be attributed to a number of factors: 1) The hormonal and genetic environment was the same for the IL and VL. 2) Crossover training effects could have affected the strength gains of both legs (2). 3) A greater overall training load and longer training period could have brought about significant between leg differences. In conclusion, when a 10-wk resistance training programme is matched for training load in healthy young women, different protocols may lead to similar gains in muscle strength and size. References: 1. ACSM. (2009). *Med Sci Sports Exerc*; 41, 687-708. 2. HENDY AM et al. (2012). *J Sci Med Sport*; 15:94-101.

### STRENGTH TRAINING MAY ENTAIL A LOWER OVERLOAD RISK TO KNEE AND ANKLE. AN INFRARED THERMOGRAPHY STUDY

Fernández-Cuevas, I.1, Gómez Ruano, M.1, Kück, M.2, Marins, J.3, Gómez Carmona, P.1, Sillero-Quintana, M.1

*Technical University of Madrid (Universidad Politécnica de Madrid)*

Introduction Skin temperature (T<sub>sk</sub>) has been measured by Infrared Thermography (IRT) during and immediately after exercise (Merla et al., 2010). Depending on the type of exercise and intensity, T<sub>sk</sub> over muscle and joint areas changes, indicating the activation of these areas and the assimilation of workload (Čoh & Širok, 2007). The aim of this study was to analyse differences on the T<sub>sk</sub> response after strength and endurance training. Methods 14 physically active males (age:  $21.44 \pm 2.64$  yrs; height:  $1.78 \pm 0.04$  m; weight:  $73.23 \pm 7.63$  Kg) performed both an endurance [45' treadmill running at moderate intensity (60-75% MHR)] and a strength training [4 sets of 10 repetitions (70% of 1RM) for four exercises involving leg and pectoral]. T<sub>sk</sub> was recorded before the exercise, immediately after, and once every hour during the 8-hour post-exercise period, using an infrared camera (FLIR T335) under controlled conditions. T<sub>sk</sub> from Abdominal, Thigh, Knee and Ankle Region of Interest (ROI) were obtained by TernoTracker® software and for tympanic temperature a ThermoScan® PRO-4000 was used. ANOVA multivariate analyses of repeated measures with training as inter-subject factor were carried out to find significant differences between both trainings. Results: ANOVA multivariate analyses revealed significant differences between strength and endurance training depending on the considered area. Tympanic, and muscle ROI results were not significant ( $p > 0.05$ ). However, the results for Knee and Ankle T<sub>sk</sub> showed significant differences ( $p < 0.001$ ) between both trainings. Knee and Ankle T<sub>sk</sub> in endurance training increased immediately after exercise, before dropping continuously in the following hours. Nevertheless, T<sub>sk</sub> results of Knee and Ankle ROI in strength training underwent the opposite evolution. Discussion: Our results support the influences of exercise on T<sub>sk</sub>, which could be an indicator of the workload assimilation (Čoh & Širok, 2007). We found similar T<sub>sk</sub> evolution in muscle areas, but a significant difference in knee and ankle responses to the endurance and strength training. IRT has been used as injury prevention tool by detecting asymmetries and significant warmer T<sub>sk</sub> values (Hildebrandt et al., 2012). T<sub>sk</sub> reached higher values after endurance training for these ROI. Thus, strength training could entail a lower overload risk for Knee and Ankle areas. References •Čoh, M., & Širok, B. (2007). *Physical Education and Sport*, 5(1), 85-94. •Hildebrandt, C., Zeilberger, K., Ring, E. F. J., & Raschner, C. (2012). *An International Perspective on*

Topics in Sports Medicine and Sports Injury (pp. 534): InTech. •Merla, A., Mattei, P. A., Di Donato, L., & Romani, G. L. (2010) Ann Biomed Eng, 38(1), 158-163.

18:00 - 19:30

## Oral presentations

### OP-BN03 Biomechanics [BM] 3

#### PHYSIOLOGICAL AND BIOMECHANICAL ANALYSIS OF THE ARM SWING IN ROLLER SKI SKATING

Hegge, A., Ettema, G., De Koning, J., Sandbakk, O.

*VU University Amsterdam*

PHYSIOLOGICAL AND BIOMECHANICAL ANALYSIS OF THE ARM SWING IN ROLLER SKI SKATING Hegge, AM.1, Ettema, G.2, De Koning, J.1, Sandbakk, O.2 1: VU (Amsterdam, the Netherlands), 2: NTNU (Trondheim, Norway) Introduction In sports such as jumping and running, it has been demonstrated that the arm movement contributes to enhanced performance. These improvements are mainly explained by higher ground reaction forces resulting in an increased take-off velocity of the body's center of mass. Although the upper body movement is regarded highly important for cross-country skiing, with poling demonstrated to enhance skiing performance, the influence of the arm swing has not yet been investigated. In order to understand the contribution of the arm swing in cross-country skiing with the skating technique, the present study compared the G4 leg-skating technique using a pronounced arm swing (SWING) with leg-skating using locked arms (LOCKED) when roller ski skating on a treadmill. It was hypothesized that the arm swing supports the leg work which would enhance the propulsive forces, lead to longer cycle lengths and reduce the metabolic costs. Methods Sixteen male elite cross-country skiers (age 24±4 years, body mass 74.4±7.6 kg, VO<sub>2</sub>max 71.5±3.8 ml•min<sup>-1</sup>•kg<sup>-1</sup>) completed six 4-minute sub-maximal exercise tests in SWING and LOCKED at low, moderate and high speeds. Ventilatory variables were assessed by open-circuit indirect calorimetry and three-dimensional kinematics analyzed using the Qualisys Pro Reflex system. Kinetic variables were measured using roller skis instrumented with full bridge strain gauges. Results SWING generally demonstrated a higher total force impulse and higher peak force at all speeds, with a significant effect of speed on these differences (all P<0.05). Cycle length was longer for SWING at the highest speed (P<0.05). The flexion-extension movement of the legs was more pronounced for SWING with differences between the strong side and weak side legs here. For LOCKED the flexion-extension movement did not differ between the legs. The oxygen consumption was higher for SWING at low and moderate speeds (both P<0.05), while the blood lactate concentration was similar. At the high speed, blood lactate concentration was lower for SWING (P<0.01), while the oxygen consumption was independent of technique. Conclusions Taken together, the arm swing provides the possibility to use a greater flexion-extension movement of the legs and increases the total force production in roller ski skating. Although skiing at a deeper position with LOCKED compensated the reduced ski forces by improved force effectiveness and similar cycle lengths at the two lowest speeds, SWING led to longer cycle lengths and reduced the metabolic stress when skiing at the highest speed.

#### BIOMECHANICALLY RELEVANT EVENTS IN FIGURE SKATING SINGLE JUMPS CAN BE DETERMINED BY UNIAxIAL ACCELERATION DATA

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Introduction To optimize technique in sports, precise capture of biomechanical relevant events by performance diagnostics procedures is essential. In figure skating, it is challenging to identify events like toe-pick, release of glide leg, take-off and landing in single jumps. Video-based procedures are used for this intention as state of the art (Albert & Miller, 1996; King et. al., 2004). However, accuracy and usability of these procedures is limited. Therefore the purpose of this study is to validate a new method to determine biomechanically relevant events in single jumps by uniaxial acceleration data. Methods Uniaxial accelerometers (Analog Device ADXL78, 37g) were mounted at both skates heels parallel to the leg axis. 13 competitive figure skaters executed 6 proper trials of each single jump. Acceleration data were sampled (3kHz) and jumps were simultaneously recorded by high speed digital camera (Casio Exilim EX-F1, 300Hz). Raw and low pass filtered acceleration data (50Hz) were used to identify events by means of local signal characteristics. Acceleration event time data were correlated (Pearson) with reference data of the high speed video analysis for parallel test validation. Results Events toe-pick and landing are clearly identifiable in raw acceleration data for all jumps (r=0.996-0.999, p=0.000). Take-off event can already be identified by raw data analysis (r=0.990-0.998, p=0.000). Using low pass filtered data provides higher capability for exact take-off identification (r=0.994-0.998, p=0.000). Event release of glide leg event can also be identified by raw data analysis (r=0.972-0.991, p=0.000), using low pass filtered data leads again to higher reliability (r=0.973-0.994, p=0.000). Discussion Acceleration data provide high capability for valid and reliable identification of biomechanical relevant events in figure skating jumps. Using information from raw and filtered data enhances assessing comfort. Further development of this method for real time event detection is possible and offers new opportunities for technique training. References Albert, W. J., & Miller, D. I. (1996). Takeoff characteristics of single and double axel figure skating jumps. Journal Of Applied Biomechanics, 12(1), 72-87. King, D. L., Smith, S., Higginson, B., Muncasy, B., & Scheirman, G. (2004). Characteristics of Triple and Quadruple Toe-Loops Performed during The Salt Lake City 2002 Winter Olympics. Sports Biomechanics, 3(1), 109-123.

#### AERODYNAMIC DRAG COEFFICIENT OF MODERN SOCCER BALLS

Asai, T., Kazuya, S.

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Introduction We conducted a steady-state analysis (Asai and Kamemoto, 2011) of the newest soccer ball—the Adidas Tango 12 (32 panels)—and conventional soccer balls—the Adidas Roteiro (32 panels), Adidas Teamgeist II (14 panels), and Adidas Jabulani (8 panels)—through a wind tunnel experiment, and we clarified the drag coefficient (Cd) and critical Reynolds number. A simple 2D flight trajectory simulation was conducted based on the drag coefficient, and the effects of the drag characteristics on the flight distance and flight trajec-

tory were examined. Methods We measured the aerodynamic forces acting on different types of balls in a low-speed wind tunnel having a  $0.7 \text{ m} \times 0.7 \text{ m}$  rectangular cross section (turbulence level:  $\leq 1\%$ ). Four full-sized official FIFA soccer balls were tested: the conventional balls—the Adidas Roteiro (smooth surface with 32 pentagonal and hexagonal panels, used at UEFA Euro 2004), the Adidas Teamgeist II (small protuberances with 14 panels, used at the 2008 Beijing Olympic Games), and the Adidas Jabulani (small ridges or protrusions with 8 panels, used at the South Africa 2010 FIFA World Cup)—and the newly designed ball—the Adidas Tango 12 (small grip texture with 32 panels, used at UEFA Euro 2012 and the 2012 London Olympic Games). Results The critical Reynolds number of the Roteiro, Teamgeist II, Jabulani, and Tango was  $\sim 2.2 \times 10^5$  ( $C_d = \sim 0.12$ ),  $\sim 2.8 \times 10^5$  ( $C_d = \sim 0.13$ ),  $\sim 3.3 \times 10^5$  ( $C_d = \sim 0.13$ ), and  $\sim 2.4 \times 10^5$  ( $C_d = \sim 0.15$ ). The critical Reynolds number obtained for the Roteiro was the same as that reported by Asai et al. (2007). The standard  $C_d$  values for the Tango 12 and the Jabulani in the supercritical regime were  $\sim 0.18$  and  $\sim 0.15$ , respectively. The average  $C_d$  in the subcritical regime was  $\sim 0.47$ , which was slightly larger than that of the Jabulani ( $\sim 0.44$ ). Discussion Because the Tango 12 has a smaller critical Reynolds number than the Jabulani, it is inferred that the former has lesser aerodynamic resistance than the latter in the medium-speed region ( $11 < U < 19 \text{ m/s}$ ), the near-critical region for the former. The former has greater aerodynamic resistance than the latter in the high-speed supercritical region ( $20 < U < 29 \text{ m/s}$ ). The flight trajectory simulation (Goff and Carré, 2009) suggested that the Tango 12, one of the newest soccer balls, has less air resistance in the medium-speed region than the Jabulani and can thus easily acquire large initial velocity in this region. It is considered that the critical Reynolds number of a soccer ball, as considered within the scope of this experiment, depends on the extended total distance of the panel bonds rather than the small designs on the panel surfaces. References Asai T, Kamemoto K (2011). *J. Fluid. Struct.* 27, 727-733. Asai T, Seo K, Kobayashi O, Sakashita R (2007). *Sports Eng.* 10, 101-109. Goff JE, Carré MJ (2009). *Am. J. Phys.* 77, 1020-1027.

### LANDING TECHNIQUE DOES NOT EXPLAIN THE INJURY DISCREPANCY BETWEEN ELITE AND SUB-ELITE VOLLEYBALL PLAYERS

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1: BRL University of Wollongong (Wollongong, Australia), 2: AIS Movement Sciences (Canberra, Australia), 3: NOC\*NSF (Papendal, Netherlands)

Introduction Patellar tendinopathy is the most common overuse knee injury incurred in volleyball (Ferretti et al., 1990) with prevalence in elites athletes more than three times that of their sub-elite counterparts (Lian et al., 2005). It remains unknown, however, whether this discrepancy is a result of between-skill level differences in jump landing technique. Therefore, the purpose of this study was to investigate whether landing technique was moderated by skill level when landing from a lateral block jump. Methods Eight elite male and eight sub-elite male volleyball players, anthropometrically matched, performed a volleyball-specific lateral stop-jump movement. Three-dimensional landing kinematics (250 Hz), kinetics (1,500 Hz), and neuromuscular activation patterns of the gluteus maximus, biceps femoris, semitendinosus, rectus femoris, vastus medialis, and medial gastrocnemius (1,500 Hz) were collected during each trial. Peak patellar tendon force and the patellar tendon force loading rate were also calculated. Independent t-tests ( $p \leq 0.05$ ) with a Bonferroni correction identified whether any between-skill level differences in landing technique were evident. Results Elite volleyball players generated similar patellar tendon loading as the sub-elite players during landing. There were no significant between-skill level differences found in any of the landing kinematic variables. Furthermore, no significant differences in the onset or peak activation of the lower limb muscles relative to the time of the peak patellar tendon force were observed. Discussion This study revealed that the landing technique of elite and sub-elite volleyball players did not significantly differ, and thus technique differences do not explain the discrepancy in patellar tendinopathy prevalence. As patellar tendinopathy is an overuse injury (Richards et al., 1996), it is probable that high jumping and landing volume is the critical factor in developing the injury. Elite volleyball programs are recommended to reconsider performing a high volume of jumping at each training session, particularly for players who perform a high number of lateral stop-jumps, such as middle blockers. Interventions designed to modify the frequency of landings rather than trying to alter landing technique per se are recommended as a possible strategy to reduce patellar tendinopathy prevalence in volleyball players. References Ferretti A, Papandrea P, Conteduca F. (1990). *Sports Med*, 10, 132-138. Lian O, Engebretsen, L, Bahr R. (2005). *Am J Sports Med*, 33, 561-567. Richards DP, Ajemian SV, Wiley JP, Zernicke RF. (1996) *Am J Sports Med*, 24, 676-683.

### MOVEMENT PATTERNS OF RUGBY UNION PLAYERS PERFORMING SCRUMMAGING AGAINST A SCRUM MACHINE: THE EFFECT OF PLAYING LEVEL AND ENGAGEMENT CONDITION

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University of Bath

Introduction The scrum is an important element of rugby union from a performance perspective but has also attracted attention from an injury potential perspective. Little is known about the characteristics of expert technique or the effect of modifying the method of scrum engagement on players' technique. Therefore, our aim was to analyse the movement patterns of rugby union forwards performing scrums against a scrum training machine, taking into account playing level and engagement condition. Methods Thirty-four forward packs ( $n=272$  participants), ranging in playing level from Under 18 age group to Senior International teams, performed repeated scrum trials against an instrumented scrum machine (contact forces measured in three directions at 500 Hz) under five different engagement conditions, designed in part to modify the biomechanical loading experienced by players. Player's whole-body (CM motion), segment (trunk alignment) and joint (ankle-knee-hip) motions were reconstructed in the transverse and sagittal planes via video analysis (Vicon Motus v9.0) at 50 Hz. Results Engagement speeds ranged from 2.3 m/s (U18) to 3.0 m/s (Elite Club) between playing levels in the 'Base' engagement condition, and from 1.8 m/s ('FoldIn') to 2.9 m/s ('Base') between engagement conditions for the International level. 'FoldIn' engagement significantly reduced the maximum value of a combined kinetic/kinematic measure (trunk angle deviation multiplied by peak force) by approximately 50% compared with all other engagement conditions. Assessing player's joint actions in the sagittal plane uncovered few significant differences between playing levels due to within-group variability, but moderate effects were observed for professional players to have more flexed knee and hip joints at movement onset and to more closely maintain a horizontal trunk position throughout all phases of the scrum. Discussion Previous research has not found strong associations between player technique (joint angles) and performance (force production) during the sustained phase of scrummaging (Quarrie & Wilson, 2000; Wu et al., 2007). Our study confirmed that there were not obvious differences between playing levels in sagittal plane motions through all stages of the scrum including the engagement phase, although this was partly due to within-group variability. Modifying the engagement condition to introduce a 'FoldIn' engagement meant the same kinematics (body alignment) were executed in the presence of reduced forces, and there-

for the injury potential was considered to be reduced. References Quarrie K, Wilson B. (2000). *J Sports Sci*, 18, 237-246. Wu, W, Chang, J, Wu, J, Guo, L (2007). *J Strength Cond Res*, 21, 251-258. Acknowledgement Funded by the International Rugby Board

### DIALECTICAL COMPLEXITY APPROACH TO A CONTESTING ATHLETE IN TEAM SPORTS

Lebed, F.1,3, Bar-Eli, M.2,3

1: Kaya Academic College of Education in Beer-Sheva, 2: Ben Gurion University of the Negev, 3: Zinman College of Physical Education and Sport Sciences at the Wingate Institute in Netanya

**Introduction** In the sport sciences, many studies have addressed questions of complexity, for the most part in two often overlapping fields: (a) motor control and learning and (b) behavioural studies focusing on performance analysis in games. Both fields use a dynamical systems perspective for the interpretation of lab and field research data. While it may be relatively easy to accept this approach in the case of motor control and movement coordination studies (Glazier and Davids, 2009), the dynamical systems approach framework appears too narrow for the performance analysis of human behaviour in all the personal, mental, and social contexts that accompany skill performance (Lebed, 2013). **Methodology** The focus of our study is the phenomenon of 'complexity' in human systems acting in extreme conditions of sport contest in team sports. This aspect of a wider study (Lebed and Bar-Eli, 2013) is presented as an interdisciplinary review which (a) develops a complexity perspective on individual and team performance; (b) is methodologically based on the idea of dialectics as a framework for complexity studies. **Discussion** According to the dialectical view, a person engaged in a physical contest constitutes a unique instance of two correlated and coordinated complex systems. The first is the dynamical system that perceives, moves, and flexibly adapts to changing internal and external conditions of motor action. The second is the specific person's mental system, endowed with free will and therefore relatively independent of and unpredictable in terms of environment. We consider the transactional coordination of these two systems to be the 'dialectical complexity' of physically contesting humans. The suggested view makes it possible: (1) to explain both athletes' reactive actions in acute situations of time limit and their planned proactive activity permanently perturbing an opposing complex system; (2) to construct a complete complex framework for individual performance. Such a framework includes: a model of reactive individual performance, a model of proactive construction of mental action, their dialectical complementarity, and a view of individual performance in the context of environment. References Glazier, P. and Davids, K. (2009) 'Constraints on the complete optimization of human motion'. *Sports Medicine* 39, (1): 15-29 Lebed, F. (2013) 'Complex systems in team sports'. In T. McGarry, P. O'Donoghue, and J. Sampaio (eds.) *Routledge Handbook of Sport Performance Analysis*, Chapter 7, (pp. 74-86). London, UK: Routledge. Lebed, F. and Bar-Eli, M. (2013) *Complexity and Control in Team Sports. Dialectics in Contesting Human Systems*. London-New York: Routledge.

18:00 - 19:30

## Oral presentations

### OP-BN12 Motor Learning [ML] 3

#### AN ANALYSIS OF HERDING BEHAVIOURS IN BASKETBALL AS A FUNCTION OF SKILL LEVEL

Chow, J.Y.1, Tay, C.S.H.1, Chaturvedi, I.2, Lee, M.C.Y.1, Kee, A.Y.H.1

*Nanyang Technological University*

**Introduction** It is common to observe how beginners demonstrate herding behaviours in such a territorial game (Button et al., 2011). Variation in stretch indices, geometric centers of teams and analysis of randomness of players' behaviours using dynamic Bayesian networks (DBN) during basketball game play can be potentially useful variables to quantify herding behaviours. The aim of this study is to examine the extent of herding behaviours in basketball as a function of skill level and also confirm the suitability of the analytical variables used for this investigation. **Methods** Two games (beginners and skilled) of basketball were captured with a CCTV and players' trajectories determined with an A-Eye software (Barris, 2008). A total of 48 plays for both games (20 for beginner and 28 for skilled) were further analysed to ascertain level of randomness of players' interactions from their trajectories using the DBN with Markov chain Monte Carlo (MCMC) approach. Geometric centres and stretch indices of teams were also established from the identified plays to examine the extent of herding behaviour indicators. Results The correlation probability for interaction between players was significantly lower in skilled games (-7636.4±1229.9) than in beginner games (-6839.9±1519.9), indicating greater randomness in the skilled games. Difference in randomness of winning team from the losing team was found to be much larger in skilled games (-346.03±7947.53) than in beginners (-146.87±3528.64). Speed behaviour of teams prior to a shot was less correlated for the skilled games (83.07±20.01 for beginners and 71.5±17.04 for skilled). Average stretch index was lower in beginners (3.75±0.74) compared to skilled players (5.68±3.5). **Discussion** There is greater randomness for the skilled games and the game dynamics is more complex. The lower stretch indices for the beginners' teams in their games also suggest that the beginners tend to herd near to each other. Findings from this study shows that herding behaviour is more predominant in the beginners' game and the variables used to capture this herding behavior would be relevant to determine the extent of such behaviour, which has useful implications for determining changes in game play behaviours of players as a function of effective practice. References Barris, S. (2008). Automatic tracking and the analysis of human movement. *International Journal of Performance Analysis in Sport*, 8(2), 102-113. Button, C., Chow, J. Y., & Dutt Mazumder, A. (2011). Exploring the swarming effect in children's football. 7th World Congress on Science & Football, Nagoya, Japan, p. 59.

#### FAMILIAL, SOCIAL, AND ENVIRONMENTAL FACTORS IN THE DEVELOPMENT OF ELITE AUSTRALIAN CRICKETERS

MacMahon, C., Weissensteiner, J.

*Swinburne University of Technology; \*Australian Institute of Sport*

Previous research characterises elite athletes by a favourable socio-developmental background (Bruce et al., 2012; Hopwood et al., 2012), with effective support structures (Weissensteiner, 2009). Little work has investigated support beyond parents and siblings, including extended family, mentors and peers, or the types of support provided, such as emotional, technical, financial, and informational. A large-

scale online survey collected information on player development in Australian cricketers. This analysis presents the data for the elite male cohort, between the ages of 17 and 35 (N = 81). Just under 50% of the sample indicated that their father was a significant source of all types of support and commonly played competitive cricket (32% at community level, 10% at elite level). Twenty six per cent of fathers had also coached cricket, whether from community up to elite levels. Although a significant source of financial and emotional support, only two players indicated that their mother played competitive cricket. Thirty per cent of the sample indicated that supportive extended family members played cricket, with 14% at community, and 11% at elite level. Supportive mentors who played at elite levels were relatively frequent (38%) and commonly provided emotional, informational and technical support. Similarly, over 50% of the sample identified supportive peers who commonly acted as fellow participants in developmental play and practice, with 46% of these having competed at elite levels. Siblings also provided support as fellow participants and played cricket at community level, with three reported to have played at an elite level. Notably, 41% of the sample indicated they deliberately changed community level clubs to improve their chances of playing at higher levels. None of the participants cited that their parents were the main decision makers in the move, showing autonomous decision making. Those who changed clubs cited opportunity specific to higher levels of competition (64%), better coaching (58%), better playing opportunities (49%), and better training facilities (46%). Only 24% indicated having friends in the new team was a catalyst for changing clubs. The findings from this study demonstrate the breadth of support (sources and type) required to complement the development of elite athletes. While receiving strong support from multiple sources, these elite performers took ownership, sought better developmental opportunities and were relatively autonomous in their decision making specific to their career planning/strategy. These findings support current results in the literature which characterise elite athletes as highly self-regulated (Mathews et al., 2012). Discussion will focus on potential links between support and self-regulation.

### DIFFERENT LEVEL OF TASK VARIATION IN LEARNING A GOLF PUTTING SKILL

Schmidt, M., Hennig, M., Jaitner, T.

*TU Dortmund University*

**Introduction** Many theories such as Schema theory, Contextual Interference or Differential learning propose that varying the task during skill acquisition provokes superior performance in motor learning. However, empirical evidence is mostly based on a comparison of task variation to either blocked or null training. Only few analyze the effects of different amounts of variability on sports skill learning (e.g. Beckmann et al., 2010). The aim of this study was to investigate motor learning of golf putting by systematically increased contextual interference (CI) in comparison to two different protocols following the Differential Learning (DL) approach (Frank et al., 2008). **Methods** 33 students (12 female/21 male) with no prior experience in golf completed eight training sessions within four weeks and performed an overall of 288 puts. Subjects were randomly assigned to three groups: Group CI (n=12) trained with increasing CI, group DL (n=11) and DL+ (n=10) practiced according to the DL approach with high variability including random variations of initial position, amplitudes, movement dynamics and balls. The DL+ group also varied clubs. All subjects passed pretest, posttest and two retention tests (one week, respectively three weeks after posttest). Each test consisted of 10 trials of defined putting length and three transfer tests with different floor material. Average hit ratios were determined for each subject and analyzed group wise by ANOVA. **Results** For the hit ratios over all tests, ANOVA revealed a significant main effect for time only ( $p < .05$ ;  $\eta^2 = .381$ ). Hit ratios improved significantly between pre and posttest, but did not differ for the CI, DL and DL+ group. From post to retention tests performance remained at the same level, with no difference between groups. For the transfer task, no overall effect was found, but post hoc analyses showed that independent of group performance improved significantly between the first and the second test ( $p < .05$ ). **Discussion** Practicing the golf put with contextual interference as well as by differential learning leads to better performance after a 4-week-training period but motor learning seems not be effected by the amount of task variation. Concordant to Beckmann et al (2010) long term learning effects are supported by stable performance in the retention tests of this study whereas for drill learning decreases in performance after the acquisition phase were reported. Performance in the transfer task was comparable low at posttest but the follow up improvements might indicate a high adaptability to differing conditions due to variable training. Further studies are needed to provide deeper insight on these aspects. **References** Beckmann H, Winkel C, Schöllhorn WI (2010). *Int J Sports Psychol*, 41: 5-10. Frank TD, Michelbrink M, Beckmann H, Schöllhorn WI (2008). *Biological Cybernetics*, 98 (1), 19-31

### COACHES PERSPECTIVES UPON MOTOR DEVELOPMENT WHEN SELECTING TALENTED YOUNG SOCCER PLAYERS

Roas, T., Dalen, T., Aune, T.K., Ingvaldsen, R.P.

*Nord-Trøndelag University College*

**Introduction** The hunt for future top soccer players involves attempts of early selection of the talented children and exclusion of the less talented children (Unnithan et al., 2012). Here we ask, what are the criteria and thinking behind this? Our hypotheses and hope is that there should be a kind of theoretical foundation for this selection process i.e., that some kind of academic perspectives on motor development should underlie the argumentation for the proper selection. Perspectives on motor development can be divided in predeterminedistic and probabilistic epigenesis (Gottlieb, 2000). The purpose of this study was to explore whether this is reflected in top-level coaches' perspectives on motor development when selecting soccer players at a young age. **Method** Four top-level coaches from Norwegian elite soccer teams participated in a semi structured interview, containing both a set of questions and an open conversation concerning motor development and selection. **Results** The coaches were convinced that they could select the right players at an early age (7-12 years). There was, however, no consensus for the criteria for such an early selection. The coaches' were in general leaning to a predeterminedistic understanding of children's development with a clear understanding of some kind of talent as a constant factor in the process over time. One coach saw some problems in this approach, and had a more dynamic view of development, similar to the probabilistic epigenetic perspective. **Discussion** Selection of young soccer players is influenced by coaches understanding of motor development. The results showed that the coaches' understanding is dominated by a predeterminedistic epigenetic perspective. This can lead to early selection of players, with a great risk of choosing wrong (false-positives), or overlooking future elite players (false-negatives). From a probabilistic epigenetic perspective this early selection might be a problem, as a later selection, would increase the probability of choosing the right talent. The results indicate that coaches' perspectives on development influence their will to select players at an early age. Selecting wrong players at an early age can weaken the pool of potential elite players in the future (Reilly & Williams, 2003). **References** Gottlieb G (2000). *Environmental and Behavioral Influences on Gene Activity*. American Psychological Press, 2000, Vol 9, No. 3, p 93-97 Reilly, T. & Williams, A.M. (2003). *Science and soccer – Second edition*. Eastbourne: Routledge Taylor & Francis Group Unnithan, V., White, J., Georgiou, A., Iga, J., Drust, B. (2012). Talent identification in youth soccer. *Journal of Sports Sciences*, 2012, Vol. 30 Issue 15, p 1719-1727

**ON THE STRIDE RATE CHOICE IN RUNNING**

Hansen, E.A., Sardoodian, M., Madeleine, P., Voigt, M.

*Aalborg University*

Introduction Despite considerable amounts of research, key aspects of movement control in running remains to be clarified. It is e.g. unknown what factor(s) that influence an individual's freely chosen stride rate (FCSR). It has been suggested that humans choose stride rates to minimize their energy turnover (Alexander, 2002). However, this may be questioned (Dean, 2013). Further, the literature only provides a single, fair ( $r=0.68$ ), correlation between the energetically optimal and the FCSR during running, for a group of recreational runners (Cavanagh and Williams, 1982). An alternative explanatory approach is to consider the FCSR as a resultant rhythmic movement output from the nervous system including the key element of central pattern generators (Zehr, 2005). The aim of the present study was to test the hypothesis that FCSR during running is highly correlated with FCSR during another form of locomotion namely walking. Methods Recreationally active individuals (11 males and 4 females, age:  $25\pm 8$  years, body mass:  $73.2\pm 11.1$  kg, and height:  $181\pm 8$  cm) walked and ran on a motorised treadmill at 4.0 and 8.4 km per hour, respectively. For each participant and locomotion form, FCSR, as well as contact phase and swing phase durations (in s), were averaged across the two legs from data obtained by contact sensors mounted on the participants' feet. Results The individual FCSR ranged from 53-62 and 72-89 strides per min during walking and running, respectively. In accordance with the hypothesis, there was a high correlation ( $y=1.7x-20.5$ ,  $r=0.89$ ,  $p<.0001$ ) between FCSR during walking (x) and running (y). There was no significant correlation ( $y=-34.4x+88.7$ ,  $r=0.23$ ,  $p=.41$ ) between contact phase duration (x) and FCSR during running (y). The correlation ( $y=-75.6x+117.4$ ,  $r=0.77$ ,  $p=.0008$ ) between swing phase duration (x) and FCSR during running (y) was high. Discussion Although walking and running are distinct in terms of e.g. musculoskeletal loading and energy transfer, these are still related forms of locomotion e.g. with respect to the primary muscles recruited by the nervous system to execute the movements. We found that the FCSR during walking and running were highly correlated. An interpretation of the present results can be that walking and running share some common frequency generating elements in the nervous system. That may support a hypothesis of stride rate during running to being predominantly based on a central motor pattern in contrast to being predominantly based on feedback-dependent optimisation of e.g. energy turnover as previously suggested. References Alexander R (2002) *Am J Hum Biol* 14, 641-648 Cavanagh PR, Williams KR (1982) *Med Sci Sports Exerc* 14, 30-35 Dean JC (2013) *Exerc Sport Sci Rev* 41, 36-43 Zehr EP (2005) *Exerc Sport Sci Rev* 33, 54-60

**18:00 - 19:30****Oral presentations****OP-BN04 Biomechanics [BM] 4****THE INFLUENCE OF 6 WEEKS OF MAXIMAL ECCENTRIC PLANTARFLEXOR TRAINING ON MUSCLE-TENDON MECHANICS.**

Kay, A.D.1, Richmond, D.1, Talbot, C.1, Mina, M.A.2, Blazevich, A.J.3

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Introduction Resistance training can influence muscle-tendon properties including strength, flexibility, stretch tolerance and muscle-tendon stiffness; however the specific influence of eccentric-only training is unknown. Therefore, the aims of the present study were to examine the effects of a 6-week maximal eccentric resistance training programme on isometric plantarflexor moment (MVC), dorsiflexion range of motion (ROM), stretch tolerance (peak passive moment), muscle and tendon stiffness and running economy. Methods Thirteen recreationally active men (age =  $20.0 \pm 0.9$  yr, mass =  $75.9 \pm 8.5$  kg, height =  $1.8 \pm 0.1$  m) volunteered for the study after giving written informed consent; ethical approval was granted from the University of Northampton. Training was performed twice weekly for six weeks and consisted of 5 sets of 12 repetitions of 3-s maximal eccentric contractions at  $10^\circ \cdot s^{-1}$  from  $20^\circ$  plantarflexion to  $10^\circ$  dorsiflexion. Maximal isometric plantarflexor moment, dorsiflexion ROM, stretch tolerance, and muscle, tendon and muscle-tendon unit (MTU) stiffness were measured using isokinetic dynamometry, real-time ultrasound and 3D motion analyses before and after the training. Running economy (VO<sub>2</sub>) was determined at a running speed equating to 70%VO<sub>2</sub>max using online gas analysis. Repeated measures t-tests were used to determine significant differences between pre- and post-training data, significance accepted at  $p<0.05$ . Results A significant increase in plantarflexor MVC (47.1%;  $p<0.01$ ), dorsiflexion ROM (41%;  $p<0.01$ ) and stretch tolerance (108%;  $p<0.01$ ) was found after training, while no change was found in MTU stiffness (passive moment at the same joint angle) using dynamometry (2.5%;  $p>0.05$ ). Analysis of ultrasound data revealed a significant decrease in muscle stiffness (20.6%;  $p<0.05$ ) and increase in tendon stiffness (27.7%;  $p<0.01$ ). These mechanical changes were not sufficient to influence running economy (0.5%;  $p>0.05$ ). Discussion While the training-induced increase in plantarflexor strength was expected, the substantial increases in ROM, stretch tolerance and tendon stiffness, and the reduction in passive muscle stiffness, were important and novel findings. Interestingly, when measured during passive stretch, MTU stiffness remained unchanged while tendon stiffness increased and muscle stiffness decreased. These disparate findings have clear implications for testing methodologies, and indicate that imaging techniques must be utilised in order to examine the effects of interventions on specific tissues. As the training clearly enhanced the capacity of the muscle to tolerate both tissue loading and deformation, which are commonly associated with muscle strain injury, these data have clear implications for both muscular performance and injury risk.

**DOES MUSCLE ACTIVATION ALTER SYNERGISTIC MUSCLE BEHAVIOR?**

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Few human studies have reported on the possible intermuscular force transmission by observing the relative movements between muscles. Bojsen-Moller et al. (2010) showed that force may be transmitted between the triceps surae muscles in vivo. Tian et al. (2012) further estimated that the magnitude of force that is transmitted between the passive soleus and gastrocnemius muscles is in the order of few Newtons (<5N). This small force probably has very little functional relevance. However, when muscles are activated, intermuscular force transmission may also be greater. Lieber et al. (2000) suggested that activation of a muscle changes the stiffness of the collagen network

surrounding the muscle, which could then influence shear at the interface with other muscles. This study tested the hypothesis that selective activation of a muscle changes the behavior of adjacent muscles, reflecting intermuscular force transmission. 11 volunteers were positioned in an isokinetic dynamometer (Biodex) with the knee joint aligned to the ergometer's rotational axis. The ankle was kept in a constant neutral position by a stirrup attached to the dynamometer lever. A force transducer attached to the stirrup measured plantarflexion torque. Lateral gastrocnemius (LG) and soleus (SOL) muscle fascicles were imaged using ultrasonography at proximal and distal locations. Using transcutaneous electrical stimulations to the LG, we first identified the maximal intensity that produced an M-wave in LG but not SOL. 20 degree knee extension stretches (20deg/s) were elicited from knee angles of 30, 50, 70 and 90 deg. At each angle the stretches were first applied passively and then during LG stimulation. Two consecutive recordings were done in each condition. Brief contractions of the plantarflexors preceded each stretch protocol to minimise thixotropic effects. Differences in muscle fascicle length changes during the passive and active stretches were compared with a three factor ANOVA (muscle\*joint angle\*condition) with Bonferroni –corrected pairwise comparisons. SOL and LG fascicles responded differently to the stretch ( $p < 0.001$ ). An interaction between muscle, joint angle and condition was found and differences were localized to LG at 70 and 90 deg angles reflecting less stretch in the active vs. passive condition ( $p < 0.05$ ). This difference is likely due to excessive slack in the muscle-tendon unit at small knee joint angles. Activation of LG did not change SOL fascicle behavior leaving the hypothesis unsupported. References Bojsen-Møller et al 2010 J Appl Physiol 109(6):1608-18 Lieber et al 2000 Cells Tissues Organs 166(1):48-54 Tian et al 2012 J Appl Physiol 113(4):517-23

### STANCE LIMB KINETICS OF OLDER MALE ENDURANCE RUNNING PERFORMANCE

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**Introduction** Clear health benefits are evident for older adults who maintain participation in exercise and physical activity (Tarpennig et al., 2004). The isolated effects of disuse and ageing on athletic performance have however been difficult to differentiate. Biomechanical studies examining ageing in athletic activities have typically recruited untrained older adults (Wang, 2004), and have focused on extending insight into injury aetiology (Fukuchi et al., 2008). Exposure to regular athletic training may contribute to a reduced rate of decline in distance running performance. Therefore the aim of this study was to develop an understanding of the age-based, lower limb kinetics of running performances of male endurance athletes for the purpose of assisting in the development of customised coaching and training strategies for master athletes. **Methods** Six running trials were performed by each of 24 male endurance athletes, who were distinguished by three distinct age groupings (S32: aged 26 to 32 years, M50 aged 50 to 54 years, M60+: aged 60 to 68 years). Lower limb coordinate and ground reaction force data were collected using a nine camera infra-red system (Vicon 612, 120 Hz) synchronized with a force plate (Kistler, 1080 Hz). Lower limb kinetics including joint stiffness measures and step characteristics were determined and compared for each age grouping. Results A slower horizontal (mean±SD S32 =  $4.13 \pm 0.54$  m·s<sup>-1</sup>; M60+ =  $3.34 \pm 0.40$  m·s<sup>-1</sup>,  $p < 0.05$ ) running velocity was associated with significant ( $p < 0.05$ ) decreases in step length and vertical ground contact force at amortization between the M60+ and S32 athletes. The M60+ athletes simultaneously generated a 32 % and 42 % reduced ( $p < 0.05$ ) normalised ankle joint moment at amortization when compared to the M50 and S32 athletes. While a similar ankle and hip joint stiffness during pre-amortization was evident between groups, the M60+ athletes exhibited a substantially reduced (72%,  $p < 0.05$ ) knee joint stiffness during the respective phase when compared to the S32 athletes. **Discussion** The age-based reduction in the ankle moment was partially attributed to decreased lower leg muscular force generation which has previously been associated with age (Wang, 2008). As a function of ageing the knee joint demonstrated a decline in the ability to tolerate applied stretching during the stance phase of running. Therefore, joint-specific (particularly for the ankle and knee) coaching strategies customised to athlete age are warranted to maintain or enhance dynamic performance in master athletes. References Fukuchi R, Duarte M. (2008). J Sp Sci, 26(13), 1447-1454. Tarpennig K, Hamilton-Wessler M, Wiswell R, Hawkins S. (2004). Med Sci Sp Exer, 36(1), 74-78. Wang L. (2008). J Sp Sci Med, 7, 379-86.

### AGE-RELATED FASCICLE-TENDON INTERACTION IN REPETITIVE HOPPING

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1: Department of Biology of Physical Activity, University of Jyväskylä, Finland. 2: Osaka University of Health and Sport Sciences, Japan. **Introduction** Recent studies suggest that increasing age influences the fascicle-tendon interaction during walking (Mian et al. 2007) and jumping (Hoffrén et al. 2007). However, these studies examined only one exercise intensity (walking speed / dropping height) that was the same in absolute terms for both age groups. Because neural activation and therefore also fascicle-tendon interaction are intensity-specific in a non-linear fashion (Finni et al. 2001) and neuromuscular capacities of the young and the elderly are totally different, measuring only one exercise intensity may have influenced the interpretations. Therefore, the object of the present study was to examine occurrence and possible reasons for the age-specific behavior of fascicles and tendons and their interaction during hopping with different intensities. **Methods** Nine young and 24 elderly subjects performed repetitive hopping with maximal effort as well as with 50%, 65%, 75% and 90% intensities. During hopping joint kinematics and ground reaction forces were measured together with recordings of ultrasound images of both the fascicle and the muscle-tendon junction part of the gastrocnemius medialis muscle (GaM). **Results** The results showed that fascicle behavior during the braking phase of hopping was clearly age-specific in nature with more fascicle shortening in the young ( $p < 0.001$ ). In addition, the fascicle shortening increased in young subjects with increasing hopping intensity ( $p < 0.05$ ). At the instant of ground contact the elderly subjects demonstrated decreased fascicle length with increasing hopping intensity ( $p < 0.01$ ). Thereafter in the braking phase, the elderly showed much smaller changes in fascicle length as compared to the young. In contrast to the fascicles, the GaM outer tendon did not show major age-specific differences in stretching and shortening amplitudes during hopping although the peak tendon forces were clearly lower in the elderly ( $p < 0.001$ ). **Discussion** These results suggest that GaM outer tendon behavior is not influenced greatly with increasing age. It is further suggested that when aging modifies the fascicle-tendon interaction, it is primarily due to the age-specific difference in the fascicle level. This notion poses a question that as compared to the young, the elderly individuals may have a different fascicle behavior for optimal stretch-shortening cycle locomotion such as hopping. References Finni T, Komi PV, Lepola V (2001) Eur J Appl Physiol 85:170-176. Hoffrén M, Ishikawa M, Komi PV (2007) J Appl Physiol 103:1276-1283. Mian OS, Thom JM, Ardigo LP, Minetti AE, Narici MV (2007) Acta Physiol 189:57-65.

## RAPID STRETCHING OF THE ACTIVATED AGEING MUSCLE INDUCES FAVORABLE MECHANICAL, MORPHOMETRIC, AND HORMONAL CHANGES

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1: PTE (Pécs, Hungary), 2: PDK (Pécs, Hungary), 3: UG (Groningen, The Netherlands) Introduction In young populations stretch-shortening cycle (SSC) training has been used for about 50 years to improve athletic performance, and has been shown to increase explosive strength, power, elastic energy storage and reutilization (Sáez-Sáez de Villarreal et al., 2010), and muscle fiber cross-sectional area (Malisoux et al., 2006). We tested the hypotheses that (1) SSC training can induce favorable mechanical, morphometric, and hormonal changes in the ageing muscle, and that (2) the magnitude of these changes is different after SSC vs. eccentric training. Methods Sixty to seventy-year old physically active males performed either SSC (n = 8) or slow velocity eccentric (n = 8) quadriceps training contractions on Multicont II dynamometer 2 to 3 times per week for 10 weeks. Total work performed in the two groups was identical. The SSC training comprised contractions with high peak torque and low duration, while the eccentric training contractions were characterized by lower peak torque and longer duration. Maximal isometric torque, rate of torque development (RTD), eccentric impulse, and quadriceps cross-sectional area (CSA) were evaluated, and serum testosterone and cortisol responses to an acute resistance exercise were measured before and after the training program. Ratio of positive SSC work and pure concentric work was measured to assess elastic energy storage and reutilization. Results All mechanical variables improved uniformly after the two training regimens, except RTD, which improved only after SSC training. Quadriceps CSA increased more after eccentric vs. SSC training. Resting testosterone and cortisol were unchanged, but acute reductions in testosterone to cortisol ratio (induced by the acute resistance exercise) was smaller after both trainings. Conclusions SSC training is effective in improving various mechanical properties of the ageing muscle, however, except explosive strength, it was not superior to eccentric training. Eccentric training induced greater hypertrophy than SSC did, indicating that duration vs. peak torque in the contraction is more favorable stimulus. Acute testosterone to cortisol changes indicate favorable hormonal adaptations in both trainings. We conclude that SSC training is effective in the treatment of sarcopenia in healthy, physically active elderly. References Sáez-Sáez de Villarreal E, Requena B, Newton RU. (2010). *J Sci Med Sport*, 13, 513-522. Malisoux L, Francaux M, Nielens H, Theisen D. (2006). *J Appl Physiol*, 100, 771-779.

## COMPARATIVE ANALYSIS OF THE RHYTHMIC STRUCTURE FOR THE 400 METRES HURDLES EVENT AT THE WORLD CHAMPIONSHIPS OF DAEGU 2011 AND BARCELONA JUNIOR 2012

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Introduction Rhythmic structure (or stride pattern) on the 400 metres hurdles event can be defined as the number of strides an athlete takes between the hurdles. It's connected to the choice of the lead leg, which can have an impact on the final results achieved. Methods Purpose: To analyse the rhythmic structure in the 400 metres hurdles event at the IAAF World Championships, Daegu 2011 and Junior Barcelona 2012. The study sample was made up of all the 159 athletes participating at the 400 metres hurdles in both championships: 34 men and 38 women in Daegu; 51 men and 36 women in Barcelona. All the races were recorded using 5 Casio Exilim F1 high speed cameras placed in different spots along the stands. The images were analysed using Kinovea 0.8.4 software. The values analysed were the number of strides to the first hurdle, between hurdles, from the last hurdle to the finish line, lead leg at each hurdle, number of hurdles on the curve taken with left-leg lead, stride pattern repetition during the 3 races for the finalists, hurdle in which there is a pattern change and the number of rhythmic structures changes in both championships. Results Men: Daegu and Barcelona respectively, 63.18 % and 49.40 % of them used a left-leg lead (63.8 % and 51.21 % on the curve). Women: 51.86 % and 53.89 % (54.3 % and 58.13 %). At Daegu, there were 33 different stride patterns for men and 40 for women. At Barcelona, there was only one repetition of the stride pattern during the preliminary rounds, semi-final and the final for men. All the rhythmic structures used at the women's final round were different. None of the finalist women at both championships used the same stride pattern during the 3 races, and only 2 finalist men in Daegu and 1 in Barcelona did it. At the Junior championship, both men and women changed their stride pattern mainly on the 6th hurdle (the 7th in Daegu). Finalists in Barcelona changed their stride pattern less often than athletes at the preliminary and semi-final rounds. Discussion There are significant differences between the times achieved and the total number of strides in both championships ( $p < 0.05$ ). Junior athletes are advised to improve their strength in order to get a better take-off ability, as well as a better hurdle clearance technique. There are numerous well differentiated rhythmic structures in both championships. There are major differences ( $p < 0.05$ ) between the lead leg of choice during the whole event and the lead leg used on the curve by men and women at the final. Over 90% of the athletes, both men and women, change their stride pattern during the race at least once.

18:00 - 19:30

## Oral presentations

### OP-PM19 Neuromuscular Physiology [NP] 6

#### ANTICIPATORY REGULATION DURING REPEATED SPRINTS IS BASED ON LOCOMOTOR MUSCLE FATIGUE

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Introduction Factors influencing pacing or avoidance strategies have not been well examined during intermittent exercise. We previously reported the adoption of pacing strategies based on the knowledge of the number of sprints to be performed consecutively (Billaut et al., 2011). Here, we further tested the hypothesis that performance is determined by a mechanism of anticipatory regulation for the avoidance of excessive locomotor muscle fatigue. Methods Nine subjects performed four trials in random order, involving one (S1), two (S2), four (S4) or six (S6) sets of five 5-s sprints (power self-selected) with 25 and 120 s of rest between sprints and sets, respectively. Mechanical work

and total electromyographic intensity (summed quadriceps electromyograms, RMSsum) were calculated during every sprint. Peripheral muscle fatigue was assessed via pre- to post-exercise change in potentiated quadriceps twitch force ( $\Delta Q_{tw,pot}$ ). Voluntary activation (VA) was used to quantify completeness of quadriceps activation. Results Work performed in the first sprint (7.8%) and first set (5.2%) was lower in S6, compared to S1 ( $P < 0.05$ ). Average work performed across all sets was lower in S4 (9.1%) and S6 (12.3%), compared to S1 ( $P < 0.05$ ). Work done in the last set was not different between S4 and S6 ( $P = 0.99$ ). RMSsum data followed a similar pattern. Astonishingly,  $\Delta Q_{tw,pot}$  was not different across the four trials ( $\sim 40\%$ ,  $P = 0.55$ ). VA was more reduced in S4 (5.8%) and S6 (8.3%) than S1 ( $P < 0.05$ ). Discussion Results show that the decrease in performance during repeated sprints is not directly linked to energy stores. Rather, based on projected "finishing points" and afferent feedback, athletes regulate exercise intensity and hence metabolic rate to ensure the rate at which peripheral muscle fatigue develops is similar in all trials, so the organism can anticipate and avoid excessive fatigue. This supports the concept of integrative central regulation of effort (Marino et al., 2011). References Billaut F, Bishop DJ, Schaefer S, Noakes DT (2001). *Med Sci Sports Exerc*, 43(4), 665-672. Marino FE, Gard M, Drinkwater EJ (2011) *Br J Sports Med*, 45(1), 65-67.

### RESIDUAL FORCE ENHANCEMENT – A BENEFICIAL MUSCULAR PROPERTY?

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**INTRODUCTION** Although the phenomenon of residual force enhancement (RFE) is well known and has been systematically observed from single sarcomeres to in vivo human muscles, its relevance for everyday movements performed with submaximal efforts remains unclear. Therefore, the aim of this study was to investigate the idea of RFE being a more effective and energy saving muscular property during an everyday like submaximal multi-joint leg extension. **METHODS** Subjects ( $n = 13$ ) performed bilateral isometric (100° knee flexion) and stretch contractions (80-100° knee flexion at 60°/s with subsequent isometric contractions) in a motor driven legpress dynamometer at submaximal efforts of 30% vastus lateralis (VL) EMG (EMG-control) and 30% Fmax (force-control), respectively. Further, subjects performed purely isometric and stretch contractions at 50% force-control until time to failure. External reaction forces were measured by 3D force plates and activity of 9 lower leg muscles was assessed using EMG. Kinematics were analysed by a VICON system and inverse dynamics served for calculating ankle, knee, and hip joint torques. Visual feedback of VL EMG or external reaction force was given to control submaximal efforts. **RESULTS** For EMG-control we found no differences in VL activity between isometric and stretch contractions but significant RFE at the level of external reaction forces and joint torques. During isometric contractions after stretch, forces and joint torque exceeded the purely isometric references up to 22% and were present for up to 22s post stretch. For force-control preliminary results showed no differences in external reaction forces between contraction types but vice versa to EMG-control, less muscular activity was required to produce the given force of 30% Fmax during the isometric contraction after stretch. After stretch, activity of knee extensor and plantar flexor muscles was reduced up to 38% and 48% compared to the purely isometric contractions. The time to failure contractions showed that after stretch a given force of 50% Fmax could be maintained longer than during an isometric contraction without preceding stretch. **DISCUSSION** Although former studies demonstrated the existence of RFE for submaximal contractions, this is the first study to show RFE to occur during an everyday like multi-joint leg extension performed with submaximal effort. In the light of being beneficial for everyday movements the finding of reduced activity after stretch when producing a given force might be more important than the ability of generating higher forces during EMG-control. Further high correlations between time to failure and muscular O<sub>2</sub>-consumption suggest the mechanisms underlying RFE to be energy saving. **ACKNOWLEDGEMENTS** This work was funded by the German Research Foundation (SCHW1169/3-2) – www.dfg.de.

### NEUROMUSCULAR RECRUITMENT AND COMMON DRIVE OF THE KNEE EXTENSORS FOLLOWING ACUTE ACCENTUATED ECCENTRIC LOAD

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**Introduction** Resistance exercise performed with overload of the eccentric phase (AEL) can lead to superior strength gains compared to constant load (CL) exercise (Hortobagyi et al., 2001). Initially, strength adaptations occur from increases in neural drive (Selvanayagam et al., 2011); therefore, it is possible that acute altered neural responses could contribute to this stimulus. Our aim was to investigate motor unit recruitment and common drive (CD) (motor unit discharge rate) following AEL in comparison to CL protocols at 2 different eccentric velocities (4 or 2 seconds). **Methods** Ten healthy males attended the laboratory on 4 separate occasions in random order to perform a maximal isometric voluntary contraction (MVC) followed by a 10 second submaximal trapezoid contraction (70% of MVC)(TRAP) during which high density EMG (De Luca and Hostage., 2010) recorded firing rates of motor units from the vastus lateralis (VL). CD was then analysed from the 3-second plateau phase of the TRAP with the greatest reliability. Then, the participants either did CL (2s), AEL (2s), CL (4s) or AEL (4s). AEL and CL consisted of eccentric load at 120% and 85% of 3RM respectively. All conditions consisted of a concentric load of 85% of 3RM which consisted of 3 x 3, and then MVC and TRAP was repeated. Global EMG was also recorded from the VL during these contractions and was normalised to baseline dynamic strength tests. **Results** For all interventions no alterations were shown in MVC following exercise, also no differences occurred in concentric velocity between conditions. Normalised EMG amplitude (RMS) was significantly ( $p < 0.01$ ) greater in the eccentric phase in AEL vs. CL for both fast (f) and slow (s) contractions [AEL:  $193.7 \pm 6.5\%$  f  $192.7 \pm 6\%$  s CL:  $145.3 \pm 5\%$  f  $135.4 \pm 5\%$  s]. No differences were observed between conditions for CD. For all conditions peak cross-correlation histogram frequency appeared in the range of 0.6 to 0.7 and no differences were shown for maximum and mean peak cross-correlation coefficients ( $p > 0.05$ ). **Discussion** Despite the additional load maximal force capacity of the knee extensors was maintained following AEL. Although there was an increase in motor units recruited during the eccentric phase of AEL there was no alteration in common drive following the intervention. This has therefore demonstrated that AEL increases motor unit recruitment but not in residual common drive in response to a heavier load. Thus, it is likely that neuromuscular responses in the eccentric phase of AEL are responsible for superior adaptations previously reported. References De Luca CJ and Hostage EC. *J Neurophysiol* 2010;104(2):1034-1046. Hortobagyi T, Devita P, Money J, Barrier J. *Med Sci Sports Exerc* 2001;33(7):1206-1212. Selvanayagam VS, Riek S, Carroll TJ. *J Appl Physiol* 2011;111(2):367-375.

### ANKLE DESTABILISATION DEVICE FOR INJURY PREVENTION OR REHABILITATION IN SPORTS

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**Introduction** Numerous epidemiological studies demonstrated that lateral ankle sprain (LAS) is a recurrent problem in athletes (Hootman et al. 2007). Further to LAS, residual symptoms could arise and about 70% of the athletes who suffered from acute LAS develop chronic ankle instability (Hertel 2002). At the muscular level, evertor muscles strength is an essential factor in order to ensure ankle stability (Wilkerson et al. 1997). In this study, we proposed to investigate the modulation of the EMG activity of 6 ankle muscles (on the right and left leg) when wearing an ankle destabilisation device (ADD) in different situations. We hypothesized that ADD would significantly modify the amplitude of the EMG pattern of the ankle muscles, especially in peroneal muscles. **Methods** Twelve healthy active subjects without previous history of neuromuscular disease or acute LAS volunteered for the experiment. Subjects were required to walk forward and backward, on both sides and in circles, with or without the ADD. They were then asked to maintain unipodal equilibrium with a Freeman board. Kinematics and surface electrical activities were recorded on six muscles of both legs, namely the tibialis anterior, peroneus longus, peroneus brevis, gastrocnemius lateralis, gastrocnemius medialis and soleus. EMG activity recorded during each experimental condition was normalized by the EMG activities recorded during a maximal voluntary isometric contraction. **Results** Electromyographic recordings showed a significantly increased activity during dynamic equilibrium but also when wearing ADD during normal walk forward and backward, circle walking in both directions ( $P < 0.05$ ). **Discussion** Our findings evidenced that walking in different conditions with ADD generates a significant increase in electromyographic activity of tibialis and both peroneus muscles, and therefore suggest that ADD are a valuable resource for functional strength training, sensory-motor rehabilitation and prevention of the ankle injury. **References** Hootman JM, Dick R, Agel R. (2007). *J Athl Train*, 42: 311-9. Hertel J (2002). *J Athl Train*, 37: 364-375 Wilkerson GB, Pinerola JJ, Caturano RW (1997) *J Orthop Sports Phys Ther*, 26: 78-86.

### REDUCED TYPE IA AFFERENT FEEDBACK DOES NOT INFLUENCE QUADRICEPS MAXIMAL AND EXPLOSIVE ISOMETRIC FORCE PRODUCTION IN MAN

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**Introduction** The role of afferent feedback in maximal motor tasks remains poorly understood. Whilst it has been suggested that a reduced efficacy of the  $\gamma$ -loop following tendon vibration may impair maximal voluntary force, the limited previous studies have been equivocal in their findings. Furthermore, the effect of vibration, and attenuation of the  $\gamma$ -loop, on explosive force production is unknown. The aim of this study was to investigate the role of afferent feedback in maximum and explosive isometric force production of the quadriceps, using a prolonged tendon vibration to attenuate the Ia afferent- $\alpha$ -motoneuron pathway. **Methods** Eighteen healthy males ( $21 \pm 2$  years) performed a series of voluntary and evoked isometric unilateral knee-extensor contractions pre and post two separate 30-min intervention trials of: infrapatellar tendon vibration (80 Hz) and quiet sitting (control), 7 days apart. Participants performed six explosive and two maximal force contractions to assess volitional function, and supramaximal twitch and octet responses were evoked to assess the contractile properties of the muscle-tendon complex. The efficacy of the Ia afferent- $\alpha$ -motoneuron pathway was determined by assessing the H-reflex ( $H_{max}:M_{max}$  ratio of the vastus medialis) at rest, at the start and end of each series of volitional and evoked contractions, pre and post intervention (i.e. at four time points). Participants remained seated in a strength testing chair throughout the trials, with knee and hip angles of  $120^\circ$  and  $105^\circ$ , respectively. Force was measured via a strain gauge strapped perpendicular to the tibia, and surface EMG was recorded from six sites over the quadriceps and two over the hamstrings. **Results** Post-intervention  $H_{max}:M_{max}$  was 60% lower in the vibration trial vs. control, and remained 38% lower at the end of the post-intervention measurements (t-test, both  $P < 0.01$ ). In contrast, no trial  $\times$  time interactions were found for either maximum force (ANOVA,  $P = 0.92$ ) or explosive force (at 50, 100 and 150 ms after force onset; ANOVA, all  $P \geq 0.36$ ), or their corresponding mean agonist EMG amplitude (ANOVA, all  $P \geq 0.23$ ). Evoked responses were also unchanged following vibration (ANOVA, all  $P \geq 0.39$ ). Individual  $H_{max}:M_{max}$  depression did not correlate to changes in either maximum or explosive force (Spearman's Rank, all  $P \geq 0.54$ ). **Discussion** The reduction in H-reflex demonstrated that the vibration stimulus effectively attenuated the homonymous Ia afferent- $\alpha$ -motoneuron pathway for the duration of the post-intervention measurements. However, voluntary maximal and explosive force production remained unchanged. Therefore, Ia afferent feedback does not appear to contribute significantly to either maximal or explosive isometric force production of the quadriceps.

### TORQUE-ANGLE RELATIONSHIPS OF THE ELBOW FLEXORS AND EXTENSORS IN HEALTHY FEMALES

Pencheva, N., Kokova, M., Dencheva, S.

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**Introduction** The aims of this study are: (1) to obtain knowledge of the isometric torque-angle relationship of the elbow flexors and extensors; (2) to explore the impact of the elbow angle on the neuromuscular activity of the biceps brachii – long head (BB-LH) and triceps brachii – long head (TB-LH) by recording sEMG activity; and (3) to evaluate the correlations between the isometric flexor or extensor torque and RMS of the muscles tested. **Methods** Maximal isometric torque of flexors and extensors were measured (Biodex System 4) over a wide range of angles (15-150°) in ten females ( $21.2 \pm 1.4$  years). Agonistic EMG activity and the level of coactivation for BB-LH and TB-LH were also measured. The curve fitting and statistics were performed by Prism software. **Results** The isometric torque-angle curves of flexors and extensors were modeled with 4th order polynomial function. The maximal torque of flexors ( $28.0 \pm 7.5$  Nm) was generated at 90-105° position, while that of extensors ( $28.9 \pm 6.7$  Nm) at 60-75°. The flexors/extensors torque ratio was lower, equal or higher than 100% in the angular positions of 15-75°, 90° or 105-150° respectively. Agonistic EMG activity level of the BB-LH, as RMS, was correlated to measured torque of flexors, within the range of 75-150° (Spearman's  $r = 0.82$ ), while that of TB-LH did not correlate with extensor's torque. The antagonist activity for both muscles was low and did not result angle-dependent. **Discussion** In this study we found that the skew part (tail) of the non-linear, asymmetric torque-angle curve of flexors is situated in the left part of the measured range, while that of extensors, in the right one. These findings and the respective agonistic RMS-angle curves for BB-LH and TB-LH, seem to correspond at some extent to the force-length and to the moment arm-angle relationships (Ada et al., 2003; Pinter et al., 2010). However, the lack of correlation between extensor torque and activity of TB-LH can be explained by lower isometric functional capacity of the long head, which according to Murray et al. (2000) has shorter moment arm, as compared with that of BB-LH. Although, we found low and independent of elbow angle antagonistic activity of both muscles, it is hard to predict the size of crosstalk and the degree of underestimation of the maximal elbow torque, especially for extensors. **References** Ada L, Canning CG, Low ShL. (2003). *Brain*, 126, 724-731. Murray WM, Buchanan ThS,

Delp SL. (2000). *J Biomech*, 33 (8), 943-952. Pinter IJ, Robbert MF, van Soest AJ, Smeets JB. (2010). *J Electromyog Kinesiol*, 20, 923-931. Acknowledgement. The research was supported by the Internal Funding of Regulation 9 of South-West University projects, Group B (YMC(H)A).

**18:00 - 19:30**

## Oral presentations

### OP-SH10 Psychology [PS] 6

#### THE MEDIATION OF MASTERY ORIENTED CLIMATE BETWEEN COACH INITIATED PROSOCIAL FEEDBACK AND PROSOCIAL BEHAVIOR IN SPORTS

Wagnsson, S., Patriksson, G., Lindwall, M., Strahlman, O., Nyberg, C.

*Institution of health sciences*

**Introduction** Sport involvement has the potential both to improve and to inhibit youth's moral attitudes and behaviour. However, whether the path of development is positive or negative is largely dependent on the structure of their sport environment. Since coaches are one of the most salient socialization agents, variations in coaching approaches are thought to influence the direction of youth moral development. We therefore hypothesized that coach initiated prosocial feedback (CIPF) would positively be related to self-reported prosocial behavior (PB). Moreover, since variations in perceived motivational climate have shown to be associated with character building qualities, we hypothesized that different aspects of motivational climate would mediate the relation between CIPF and PB. **Methods** Longitudinal data were collected at two occasions (1 year between T1 and T2) including 808 Swedish youth sport participants (60% boys and 40% girls; M=13.9 years at baseline). The CIPF scale (T1) included five items (e.g., "My coach/coaches use to talk with us about the importance to obey rules"). Moreover, shortened versions of Perceived Motivational Climate in Sport Questionnaire-2 (Newton, Duda & Yin, 2000) and Prosocial Tendencies Measure (Carlo & Randall, 2002) were used to measure PMC (at T2) and PB (at T2) respectively. Mediation analyses with bootstrapping approach was conducted using the INDIRECT macro for SPSS. **Results** The path between CIPF and mastery oriented climate (MMC) was positive and significant ( $B=.10$ ,  $SE=.03$ ,  $p<.05$ ), as well as the path between MMC and PB ( $B=.21$ ,  $SE=.04$ ,  $p<.01$ ). Moreover, both the total effect ( $B=.09$ ,  $SE=.03$ ,  $p<.01$ ), and direct effect ( $B=.07$ ,  $SE=.03$ ,  $p<.05$ ), of CIPF on PB were significant. More importantly, the bootstrap analyses demonstrated significant indirect effects ( $\alpha\beta=.02$ ,  $SE=.01$ ,  $p<.05$ ) showing a mediating effect of MMC in the relationship between CIPF and PB. Significant paths for performance oriented climate (PMC) were only found in relation to PB ( $B=-.17$ ,  $SE=.04$ ,  $p<.01$ ). However, the indirect effect of PMC was not significant. **Discussion** Results from this study show that sport may have beneficial effects on youth's moral behaviour, both directly (i.e., having coaches discussing and promoting prosocial behaviors), and indirectly by influencing a MMC. Moreover, results indicate that endorsing a PMC will reduce youth's tendencies to act in a prosocial manner. Our study also highlights the important role of the coach when forming a sport environment that either facilitates or debilitates youth's moral development. **References** Carlo G, Randall BA. (2002). *J Youth Adolesc*, 31, 31-44. Newton M, Duda J L, & Yin Z. (2000). *J Sports Sci*, 18, 275-290.

#### QUALITATIVE ANALYSIS OF A SELF-DETERMINATION THEORY-BASED INTERVENTION IN SCHOOL TO PROMOTE PHYSICAL ACTIVITY

González-Cutre, D., Montero-Carretero, C., Beltrán-Carrillo, V.J., Sierra, A.C., Cervelló, E.

*Centro de Investigación del Deporte. Universidad Miguel Hernández de Elche*

**Introduction** Interventions to promote physical activity and its associated benefits are necessary from early ages, being the school and excellent environment to achieve this goal (Biddle et al., 2004). Self-determination theory (SDT) has been useful for the development of motivational strategies applicable to this type of interventions (Fortier et al., 2012). The purpose of this study was to analyze, from a qualitative perspective, the effects of a school-based intervention centered in satisfying the basic psychological needs for autonomy, competence and relatedness, and to develop positive motivation for the promotion of physical activity in adolescents. **Methods** The intervention was carried out with students in the last course of secondary school (15-16 years old), through a teaching unit in physical education (PE) for the promotion of physical activity and health (15 sessions); a voluntary extracurricular physical activity program of 6 months (three sessions of one hour per week); and three meetings with parents. The PE intervention and the physical activity program were conducted by two different teachers with training in the use of motivational strategies based on SDT. To analyze the intervention effects, a content analysis was carried out with the data coming from the following qualitative techniques: two focus groups with the students who showed the highest assistance rate to the physical activity program; a focus group with parents; and the research diary of the teacher of the physical activity program. **Results** The results showed the adolescents' satisfaction of basic psychological needs during the intervention, highlighting the need for relatedness. Furthermore, intrinsic motivation and identified regulation in PE and in the extra-curricular physical activity program was observed. The intervention produced the following positive effects: enjoyment and satisfaction, learning and personal improvement, and in some cases physical activity adherence. The effects were associated to the use of different motivational strategies. **Discussion** This study provides support for the use of SDT to design and implement interventions to promote physical activity (Fortier et al., 2012). Some strategies related to the intervention effectiveness were identified: students' participation in the decision making process; autonomy support for the participation in physical activity; novelty and variety in tasks; positive feedback centered in personal improvement; music use; teachers' involvement and caring climate. **References** Fortier MS, Duda JL, Guerin, E, Teixeira PJ (2012). *Int J Behav Nutr Phys Activ*, 9, 20. Biddle SJH, Gorely T, Stensel DJ (2004). *J Sports Sci*, 22, 679-701.

## MOTIVATION IN ADOLESCENTS' PHYSICAL ACTIVITY OF TWO EUROPEAN COUNTRIES

Aibar, A.1,2, Zaragoza, J.1, Generelo, E.1, Nicaise, V.3, Paillard, T.2, Bois, J.E.2

<sup>1</sup>University of Zaragoza (Huesca, Spain) <sup>2</sup>University of Pau and Countries of Adour (Tarbes, France) <sup>3</sup>University Claude Bernard (Lyon, France)

**Introduction** Self-determination theory (SDT; Ryan & Deci, 2000) has become a usual theoretical approach in order to understand the motivational factors that influence physical activity (PA; Teixeira et al., 2012). However, there remain some inconsistencies according to the relations between specific SDT constructs and PA (Teixeira et al., 2012). This study was aimed to improve the knowledge of motivational factors' impact on adolescent's PA of two European countries (France and Spain). **Method** The sample consisted of 806 adolescents (51% Spanish) with a mean age of 14.33±0.73 years. Objective PA was measured during a 7-day period by the GT3X accelerometer and subjective PA by the Assessment of PA Levels Questionnaire. The Sport Motivation Scale was used to measure PA motivation. After confirmatory factor analysis, four motivational latent variables (intrinsic, identified, introjected and external regulation) were included. A structural equation model (SEM) was built where motivational variables predicted subjective PA, which in turn predicted objective PA. Gender and age served as control variables. A multi-group analysis for testing measurement invariance across groups (Spain-France) was conducted. Mplus Version 6.1. was used to conduct all analysis. **Results** The SEM revealed good fit to the proposed model ( $\chi^2(325, N=806) = 988.47, p<.001$ ; CFI= .91, TLI: .89, RMSEA=.071, SRMR=.061). The subjective PA was found to positively predict objective PA. Whilst intrinsic and introjected motivation were significant predictors of subjective PA, external motivation showed a negative association. Relations between latent variables and observed variables were invariant across countries. **Discussion** More intrinsic levels of motivation were found to predict subjective PA (Barbeau et al., 2009). Despite the introjected regulation showed also positive associations, the strength of this association were lower compared to intrinsic regulation. Agreeing with the current literature (Teixeira et al., 2012), a negative association between external regulation and PA was revealed. These findings support the premises of SDT (Ryan & Deci, 2000). **References** Barbeau, A. Sweet, S.N. & Fortier, M. (2009). A path-analytic model of self-determination theory in a physical activity context. *J Appl Biobehav Res*, 14(3), 103-118. Ryan, R.M., & Deci, E.L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55, 68-78. Teixeira, P.J., Carraça, E.V., Markland, D., Silva, M.N., & Ryan, R.M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *UBNPA* 9:78

## EXPLORING STIGMATISATION OF EATING DISORDERS IN SPORT

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**Introduction** Recent studies have shown that stigma is the most significant perceived barrier to help seeking for young athletes (Gulliver, Griffiths, & Christensen, 2012). Stigmatising attitudes towards individuals with eating disorders have been found to exist in the general population and in more targeted populations such as professionals working in mental health care (Roehrig & McLean, 2010; Thompson-Brenner, Satir, Franko & Herzog, 2012). Little is known about the beliefs or attitudes of support staff working in the sport context towards eating disorders. Identifying the nature of stigmatizing attitudes associated with eating disorders in support staff is important in informing the implementation of initiatives targeted at stigma reduction. The aim of this study was to explore stigmatizing attitudes towards athletes with eating disorders amongst support staff in sport. **Methods** A mixed methods design using both quantitative and qualitative methods was employed. One hundred and fifty coaches, sport nutritionists, sport dieticians, physiotherapists and strength and conditioning coaches were recruited to complete an on-line survey. Participants read four vignettes describing athlete specific cases of Anorexia Nervosa, Bulimia Nervosa, Depression and Burnout and answered questions assessing stigma toward athletes with these four problem areas. Follow-up qualitative interviews were conducted with 15 support staff specifically targeted at exploring stigmatising attitudes towards athletes with eating disorders. **Results** While many of the attitudes expressed by service providers and coaches were generally positive, some negative attitudes were also apparent. Qualitative interviews allowed further exploration of stigmatizing attitudes in sport personnel and the ways in which stigma extended into language use and behaviour. **Discussion** Results support the need to adopt a system approach to target stigma reduction towards eating disorders in sport. Support staff need to be aware of the subtle ways stigma influences their language and their approach to working with athletes with eating disorders. **References** Gulliver, A., Griffiths, K. M., & Christensen, H. (2012). Barriers and facilitators to mental health help-seeking for young elite athletes: a qualitative study, *BMC Psychiatry*, 12, 157. Roehrig, J. P., & McLean, C. P. (2010). A comparison of stigma toward eating disorders versus depression. *International Journal of Eating Disorders*, 43, 671-674. Thompson-Brenner, H., Satir, D. A., Franko, D., L., & Herzog, D. B. (2012). *Psychiatric Services*, 63, 73-78.

## MOTIVATION, BODY WEIGHT CONTROL AND PHYSICAL EXERCISE: EVALUATION BETWEEN MEN AND WOMEN

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Universidade Federal de São Paulo

**Introduction:** Adherence to a regular physical exercise programme involves a number of factors that might influence the adoption and maintenance of the regular practise of physical activity. This study evaluated body weight control and its effect on the levels of motivation. **Methods:** 39 volunteers (16 men's and 23 women's) who were grouped by BMI into normal weight (NW n=16), overweight (OW n= 15) and obese (OB n=8) groups. A Bod Pod® device was used to establish the body mass of each participant with means Age (years) 34.2±8.77, Height (cm) 166.46±8.64, Weight (kg) 68.59±24.30 and BMI (kg/m<sup>2</sup>) 24.62±8.09. Level of motivation to begin a programme of physical exercise were assessed via a translated version of the BREQ-2 (Markland D, Tobin VA ,2004) and IMPRAF-54 (Barbosa MLL, Balbinotti AAM., 2006). **Results:** Male participants tended to have greater body weights (p<0.01), heights (p<0.01), amotivation scores (p<0.01) and competitiveness scores (p<0.01) compared with females. Females exhibited a higher percentage of body fat (p<0.01) than males. Comparisons among the participants according to the BMI group (NW,OW,OB) to which they belonged. Significant positive correlations between BMI and the stress control (r=0.30; p<0.05) and competitiveness (r=0.40; p<0.05) dimensions of the IMPRAF were found, as was a significant negative correlation between BMI and the health dimension of the IMPRAF (r=-0.36; p<0.05). There were also positive correlations between the body fat percentage, stress control (r=0.39; p<0.05) and competitiveness (r=0.45; p<0.05) dimensions of the IMPRAF. The external regulation scores from the BREQ-2 were negatively correlated with the IMPRAF stress control scores (r=-0.41; p<0.05), and the BREQ-2 scores for introjected and intrinsic regulation were positively correlated with the IMPRAF competitiveness (r=0.39; p<0.05) and stress control scores (r=0.42; p<0.05) **Discussion:** Males were less motivated by external influences, females had a stronger tendency to let emotional matters affect their level of involvement in physical exercise programmes. Cognitive-behavioural strategies are needed to increase and maintain the frequency or intensity of an exercise regimen, regardless of BMI (Dalle Grave et al.,2011). These strategies are

necessary because the regular practise of physical activity can result in countless physical and mental benefits for human beings.(De Mello et al., 2005). References: Markland D, Tobin VA. (2004). *J Sport and Exerc Psychol.*; 26, 191-196. Barbosa MLL, Balbinotti AAM. (2006) Federal University of Rio Grande do Sul Dalle Grave R, et.al.(2011). *J Obes.* ID 348293. de Mello MT et.al (2005). *Rev bras med esporte* [online].11(3), 203-207.

### **CONSIDERING TEMPORAL EVOLUTION OF DEPRESSIVE SYMPTOMATOLOGY: A LONGITUDINAL STUDY INVOLVING PHYSICAL ACTIVITY**

Vachon, H.1, Thomas-Ollivier, V.1, Sauvaget, A.2, Vanelle, J.M.2, Fortes-Bourbousson, M.1

1: UFR STAPS, Université de Nantes, 2: CHU, Nantes

**Introduction** Numerous studies highlight the effect of physical activity (PA) on depressive symptoms (for a review, see Mead et al., 2008). However, most of these studies only compared changes of psychological variables before and after PA programs. Such nomothetic approaches are limited to precisely characterize the role of PA on psychological functioning (Ninot et al., 2005). To go beyond, the Ecological Momentary Assessment (Shiffman et al., 2008) permits to assess within-subject psychological variations in the individual life's context and so to capture psychological variations due to exercise as soon as they occur. Because depressive symptomatology refers to a large spectrum, five psychological dimensions strongly implicated in depressive disorder were assessed: global self-esteem, rumination, anxiety, quality of life and depression. The purpose of this study is to identify the temporal evolution of depressive symptomatology when individuals are submitted to constraints in everyday life and to investigate the effect of a PA program. **Methods** Three groups participated to this study: control subjects without physical activity (GC; n=8), depressed patients without physical activity (GD; n=8) and depressed patients with physical activity (GDPA; n=8). All subjects self-evaluated through a short questionnaire assessing self-esteem, rumination, anxiety, quality of life and depression, twice a day during three months. GDPA participated to supervised exercises (active walking) for a one-hour session three times per week, during three months. Analysis of variance was performed on descriptive statistics (mean, SD, range), probability of acute change (PAC), and mean square successive difference (MSSD). **Results** Supervised physical activity is in progress and results of GDPA will be presented at the ECSS conference. Significant differences between GC and GD were observed for the five dimensions regarding mean ( $p < 0,001$ ), standard-deviation (pDep;Rum;Anx $< 0,001$ ; pGSE;QoL $< 0,05$ ), MSSD ( $p < 0,001$ ; pGSE $< 0,05$ ) and PAC ( $p < 0,001$ ; pGSE $< 0,05$ ). **Discussion** The effect of PA will be discussed through two orientations. First, we will identify if groups are different only when considering psychological variable levels (e.g. self-esteem means) or also for criteria considering temporal variability. Second, we will discuss if PA affects each variable in similar way or if some psychological dimensions are more influenced. **References** Mead, G.E., Morley, W., Campbell, P., Greig, C.A., McMurdo, M., and Lawlor, D.A. (2008). *Cochrane Database Syst Rev*, 4. Shiffman, S., Stone, A.A., and Hufford, M.R. (2008). *Ann Rev Clin Psychol*, 4, 1-32. Ninot, G., Fortes, M., & Delignières, D. (2005). *J Psychol*, 139, 315-330.

**18:00 - 19:30**

## **Oral presentations**

### **OP-PM42 Sports Medicine [SM] 3**

#### **EFFECTS OF SHORT-TERM EXERCISE-TRAINING ON TISSUE DOPPLER INDICES OF LEFT VENTRICULAR DIASTOLIC FUNCTION IN OVERWEIGHT AND OBESE INDIVIDUALS.**

Millen, A.M.E., Norton, G.R., Avidon, I., Woodiwiss, A.J.

*University of the Witwatersrand*

**Background:** Exercise training has consistently been shown to be unable to improve obesity-associated decreases in left ventricular (LV) diastolic function as assessed using chamber rather than myocardial function measurements. However, the effect of exercise training on LV diastolic myocardial function as assessed using Tissue Doppler Imaging (TDI) is uncertain. **Methods:** In the present study in 32 overweight (n=11) or obese (n=21), sedentary or recreationally active men and women (30–57years), we aimed to assess the effect of 6 weeks of exercise training either preceded (n=16) or followed (n=16) by a 6 week control period on TDI-derived parameters of LV diastolic function ( $e'$ ,  $e'/a'$  and  $E/e'$ ) (echocardiography). **Results:** Baseline measures of diastolic function were comparable with those noted in overweight and obese participants from a community sample (n=245) and 56% (n=18) had baseline  $e'$  values (early diastolic abnormalities) that were below the lower 95% confidence intervals of a lean and healthy cohort (n=60) of the community sample. Exercise training increased peak oxygen consumption from  $27.4 \pm 4.9$  to  $29.4 \pm 5.8$  mL.kg<sup>-1</sup>.min<sup>-1</sup> ( $p=0.0001$ ); but had no effect on body mass index ( $p=0.99$ ). No changes in TDI indices of LV diastolic function were observed after exercise training in all participants ( $e'$ :  $p=0.74$ ,  $a'$ :  $p=0.98$ ,  $e'/a'$ :  $p=0.85$ ;  $E/e'$ :  $p=0.26$ ), in participants with abnormal  $e'$  values (n=18) ( $e'$ :  $p=0.99$ ,  $a'$ :  $p=0.96$ ,  $e'/a'$ :  $p=0.91$ ;  $E/e'$ :  $p=0.97$ ) or in obese participants only (n=21) ( $e'$ :  $p=0.67$ ,  $a'$ :  $p=1.00$ ,  $e'/a'$ :  $p=0.78$ ;  $E/e'$ :  $p=0.11$ ). **Conclusion:** Exercise training alone, despite producing an improved cardiorespiratory fitness is unable to improve obesity-associated decreases in LV diastolic myocardial function.

#### **CARDIORESPIRATORY FITNESS AND RISK OF SUDDEN CARDIAC DEATH IN NORTH AMERICAN MEN AND WOMEN. A PROSPECTIVE STUDY**

Jiménez-Pavón, D., Artero, E.G., Lee, D.C., España-Romero, V., Sui, X., Pate, R., Church, T., Lavie, C.J., Moreno, L.A., Blair, S.N.

*University of Zaragoza*

**INTRODUCTION** Sudden cardiac death (SCD) is recognized as a relevant cause of death within the general population. Moreover, a good cardiorespiratory fitness (CRF) level is associated with lower risk of all-cause mortality in adults. However, little is known about the association of CRF and SCD. The present study was conducted (1) to examine the relation between CRF and SCD in a large population of adults. (2) To study the specific roles of hypertension, obesity and health status on the previous relationship. **METHODS** The current report is based on prospective data from the Aerobics Center Longitudinal Study (ACLS). A total of 55,456 individuals (13,507 women) with a mean age of 44.2 years, whose baseline examination took place between 1974 and 2002 were included in the study. The CRF was

assessed by a maximal treadmill test using a modified Balke protocol and categorized as low, moderate and or high according to gender- and age-specific distributions of maximal exercise duration from the ACLS population. The baseline assessment included an extensive physical examination and an array of clinical measurements such as age, sex, body mass index, physical activity, current smoking, alcohol intake, hypercholesterolemia, diabetes mellitus, hypertension, abnormal electrocardiogram, cancer and parental history of cardiovascular disease. Cox proportional hazard regression was used to estimate hazard ratios, 95% confidence intervals according to CRF categories after adjustments for the baseline assessment. RESULTS There were 109 deaths from SCD (average follow-up of 14.7 years). An inverse risk of SCD was found across CRF levels after adjustments for potential confounders. Participants in the middle and upper CRF levels had 43% and 48% significantly lower risk of SCD, respectively, compared with those in the lower level in the multivariate-adjusted model ( $p < 0.001$ ). The risk of SCD was 14% lower per 1-MET increase in the fully-adjusted model. Those participants identified as hypertensive, overweight or unhealthy and with moderate or high CRF levels had lower risks of SCD that ranged from 59% to 72% compared with those with the same medical conditions and low CRF. DISCUSSION The risk of SCD in men and women can be significantly attenuated by ensuring moderate to high CRF, and this benefit is independent of other risk factors. A highlight is that in particularly vulnerable groups such as hypertensive, obese or unhealthy individuals this protective effect of CRF may substantially lower the risk of SCD. CRF testing should be considered for SCD risk screening in asymptomatic men and women.

### RELATIONSHIP BETWEEN CARDIO-RESPIRATORY FITNESS, PHYSICAL ACTIVITY AND ARTERIAL STRUCTURE AND COMPLIANCE IN CHILDREN

Böhm, B., Elmenhorst, J., Müller, J., Barta, C., Oberhoffer, R.

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OBJECTIVE: Atherosclerosis can begin early in life [1] with endothelial dysfunction, arterial stiffening and wall thickening, whereas functional impairment is considered to be the earliest detectable manifestation. Evidence suggests that exercise enhances endothelial function in subjects with impaired function [3], also demonstrated in obese children, where exercise training enhances NO-mediated vasodilatation [2]. However, the complex mechanism between cardio-respiratory fitness, physical activity, endothelial function and structure is not yet fully understood in healthy children and investigations on possible relationships are rare. METHODS: 119 children (53 girls) with median age of 12.3 years; (interquartile range (IQR) 11.9 – 12.9 years) and median body mass index standard deviation score of 0.06 (IQR -0.93 – 1.18) were examined. Children had high-resolution ultrasound sonography (ProSound, Hitachi/Alokal) on the A. carotis communis measuring intima-media thickness (cIMT), arterial compliance (AC) and stiffness ( $\beta$  index). Flow-mediated dilatation (FMD) was measured at the A. brachialis using a continuous eTRACKING mode, analyzing changes in blood flow velocity and arterial diameter at baseline, after 5 minutes of ischemia and 3 minutes after vasodilatation. Cardio-respiratory fitness was tested by a symptom limited pulmonary exercise test on a bicycle ergometer (Ganshorn Medical). Physical activity was assessed using GT3x accelerometer (Actigraph, USA). RESULTS: Physical fitness (peak  $\text{VO}_2$ ) was inversely correlated to carotid ( $r = -0.246$ ,  $p = 0.012$ ) and brachial ( $r = -0.208$ ;  $p = 0.036$ ) stiffness indices. Time in sedentary lifestyle was inversely correlated to carotid AC ( $r = -0.210$ ;  $p = 0.034$ ); time in high intensive activity levels was negatively correlated with the brachial stiffness index ( $r = -0.286$ ;  $p = 0.004$ ). No significant relations between cIMT and physical fitness as well as physical activity exposed. Regarding brachial endothelial function girls revealed higher ( $p = 0.004$ ) arterial stiffness and lower arterial compliance ( $p = 0.004$ ) than boys. Furthermore, girls spent less time ( $p = 0.001$ ) in moderate activity than boys. CONCLUSIONS: This research is suggestive of the fact that cardio-respiratory fitness and physical activity are associated with arterial function but not with arterial structure. Girls seem to be at higher cardiovascular risk than boys due to less physical activity, demonstrating higher arterial stiffness and lower compliance. Further research need to clarify the mechanisms of early arterial (dys)-function and the impact of exercise intensity on them. [1] Tuzcu EM et al. *Circulation* 2001; 103, 2705-2710 [2] Woo KS et al. *Circulation* 2004; 109:1981-6 [3] Green DJ et al. *J Physiol* 2004; 561:1-25

### EFFECT OF EXERCISE AND PHYSICAL ACTIVITY COUNSELLING ON CARDIOVASCULAR RISK FACTORS

Mann, S., Beedie, C., Allgrove, J., Jimenez, A.

*University of Greenwich*

Background: Little research has examined fitness centres as hubs for community interventions aimed at increasing physical activity (PA) and reducing cardiovascular (CV) risk. The present study aimed to assess the effectiveness of fitness centre based interventions; unstructured (FREE) / structured exercise (STRUC) and physical activity counselling (PAC). Methods: Participants ( $n = 105$ , 73 female) were recruited for either PAC ( $n = 18$ -age= $44.5 \pm 4.96$ ) or fitness centre based exercise (FREE= $44$ -age= $42.5 \pm 4.89$  STRUC= $43$ -age= $43.39 \pm 4.27$ ). Participants underwent assessments measuring; predicted maximal aerobic capacity ( $\text{VO}_{2\text{max}}$ ), body composition, blood pressure (BP), cholesterol profile, resting heart rate (RHR) and muscular strength (predicted one-rep max (1RM)), before and after a 12 week intervention period. Participants received accelerometers. Results: Significant ( $P < 0.05$ ) improvements were found in systolic-BP (PAC: 132 – 129 vs FREE: 130 – 125 vs STRUC: 137 – 130 mmHg), body fat mass (PAC: 34.32 – 32.06 vs FREE: 28.48 – 26.73 vs STRUC: 32.85 – 30.85 kg), total cholesterol (PAC: 4.97 – 4.68 vs FREE: 4.46 – 4.35 vs STRUC: 4.85 – 4.82 mmol/L, RHR (PAC: 80 – 71 vs FREE: 71 – 67 vs STRUC: 78 – 73 bpm) and leg press strength (PAC: 91 – 126 vs FREE: 90 – 135 vs STRUC: 93 – 140 1RM kg) in all three groups. Significant differences were found between groups in chest press (PAC: 40.93 – 41.84 vs FREE: 43.77 – 48.45 vs STRUC: 39.01 – 48.89 1RM kg), lat pull down (PAC: 50.94 – 56.5 vs FREE: 54.68 – 61.15 vs STRUC: 52.08 – 60.82 1RM kg), and diastolic-BP which improved significantly in STRUC only (PAC: 80 – 80 vs FREE: 74 – 74 vs STRUC: 83 – 79 mmHg). Weekly energy expenditure increased significantly in all three groups; STRUC was the only group to produce a significant correlation between week and energy expended ( $r = 0.91$   $P < 0.01$ ). Conclusion: Fitness centre based interventions increased the PA levels of participants and improved CV risk factors. Fitness centres may be able to provide community hubs to increase PA and reduce CV risk.

### LONG-TERM EFFECT OF A PHYSICAL ACTIVE LIFESTYLE ON ARTERIAL STIFFNESS IN SAPALDIA 3

Endes, S., Caviezel, S., Dratva, J., Schindler, C., Schaffner, E., Gaspoz, J.M., Rochat, T., Kuenzli, N., Probst-Hensch, N., Schmidt-Trucksass, A.

*Institute of Exercise and Health Sciences*

Introduction: Lack of physical activity (PA) is one condition that is associated with increased arterial stiffness, and consequently with increased risk of cardiovascular events. Therefore, this study aimed at analysing the association between PA at baseline and arterial stiffness assessed by the cardio-ankle vascular index (CAVI) after a mean follow-up time of 8.34 yrs. Methods: CAVI was measured in the second follow-up of the Swiss Cohort Study on Air Pollution and Lung and Heart Diseases in Adults (SAPALDIA 3) using a VaseraVS-1500

vascular screening system (Fukuda Denshi) in supine position after 15 min of rest. A short questionnaire about PAs of the last 7 days was administered within SAPALDIA 2 to classify the subjects' PA level at baseline (inactive: <150 min getting out of breath and <2-3 hrs sweating per week due to PA; moderate: either ≥150 min out of breath or ≥2-3 hrs sweating; vigorous: both ≥150 min out of breath and ≥2-3 hrs sweating). The analyses involved ANOVA and multivariable regression models and included 1776 persons aged 49-81 yrs (868 males, 908 females, 63.4±7.9 yrs) with a normal ankle brachial index (0.9≤ABI≤1.3). Results: The PA groups did not significantly differ regarding the cardiovascular risk factors adjusted for in the final regression model: age, sex, BMI and systolic BP (of SAPALDIA 2 and 3) and baseline HDL cholesterol. The PA level at baseline was significantly associated with CAVI in SAPALDIA 3 with 8.56 (SD 1.1) in those with vigorous activity versus 8.68 (SD 1.09) among the inactive (p=0.005). CAVI did not differentiate between the PA levels "moderate" and "inactive" (p=0.388). Discussion: A physically active lifestyle may slow down or reduce arterial stiffening in an ageing population in the long-term if performed with a vigorous intensity. Future analyses will focus on changes of PA over time in association with CAVI and the promotion of cardiovascular health.

**18:00 - 19:30**

## Oral presentations

### OP-PM32 Physiology [PH] 9

#### REMOTE EFFECTS OF OCCLUSION TRAINING ARE ASSOCIATED WITH ELEVATIONS IN SALIVARY TESTOSTERONE

Beaven, C.M., Kilduff, L.P., Cook, C.J.

*Mid Sweden University*

Purpose: To examine the effects of moderate load resistance exercise with and without intermittent blood flow restriction (BFR) on strength, power and repeated sprint ability, along with acute and chronic levels of salivary hormones. Methods: In a cross-over design, twenty male semi-professional rugby union athletes were randomly assigned to a lower-body BFR intervention (an occlusion cuff inflated to 180 mmHg worn on the proximal thighs during all exercise sets) or a control intervention that trained without BFR. Experimental sessions were performed three times a week at the same time of day for three weeks with 5 sets of 5 repetitions of bench press, leg squat and pull-ups performed at 70% of 1-repetition maximum. Saliva was collected before and after the first experimental training session of each week. Strength and power, as well as repeated sprint performance was assessed prior to, and at the conclusion of the experimental period. Results: Significantly greater improvements in bench press (5.4 vs 3.3 kg), squat (7.8 vs 4.3 kg), leg power (168 vs 68 W), maximum sprint time (0.03 vs 0.01 s) and repeated sprint performance maintenance (1.01 vs 0.28%) were observed following the BFR intervention. Salivary testosterone (Effect Size: 0.84 to 0.61) and cortisol concentrations (ES: 0.65 to 0.20) were acutely elevated following the BFR intervention sessions compared to the controls; however the cortisol increase was attenuated across the training block (p=1.12x10<sup>-5</sup>). Baseline salivary testosterone was also significantly elevated across the 3 week training blocks with BFR training compared to the controls (p=0.0284). Exercise-induced elevations in testosterone were correlated to performance improvements for leg squat strength (r=0.68; p=0.0005), bench press strength (r=0.45; p=0.0233), and countermovement jump power production gains (r=0.46; p=0.0201). Conclusions: BFR training was shown to improve the rate of strength training gains and fatigue resistance in trained athletes, possibly allowing greater gains from lower loading which could be of benefit during high training loads or in competitive seasons. The clear improvement in bench press strength resulting from lower-body occlusion suggests a systemic effect of BFR training. It is of interest to note that there was an association between adaptation and alterations in acute and chronic salivary testosterone levels that could speculatively provide a simple correlative marker of the adaptive response.

#### EFFECTS OF EXERCISE-INDUCED ARTERIAL HYPOXEMIA ON CATECHOLAMINE RESPONSE TO MAXIMAL EXERCISE

Durand, F., Guezennec, C.Y.

*Performance Health and Altitude Laboratory*

Introduction Many athletes show significant exercise-induced arterial hypoxemia (EIAH) at maximal exercise. EIAH was primarily associated with an excessively widened alveolar to arterial PO<sub>2</sub> difference, which was not sufficiently compensated by hyperventilation (Hopkins 2006). Ventilatory response was insufficient to compensate for the underlying excessive alveolar to arterial O<sub>2</sub> difference (Durand et al. 1998). Elsewhere hypoxia increases sympathetic system activity via hypoxia-induced stimulation of the carotid chemoreceptor. This enhanced catecholamine response participate to hypoxia induced hyperventilation during physical exercise. It could be hypothesized that a reduced catecholamine response to intensive exercise could be involved in the mechanism of EIAH. Methods Twenty males endurance-trained subjects (mean age 26±1.2yr) divided in two group, one group (n=10) of athletes without exercise induced hypoxemia (HTN), one group (n=10) of athletes with a previously identified exercise-induced hypoxemia (HTH) performed an incremental exercise on ergocycle until exhaustion (30 w.min<sup>-1</sup>). Blood samples were drawn from brachial artery before the test and at the end of last load. The training volume was of 12.7±0.6 h. weeks<sup>-1</sup> in HTN and 16.3 ± 1.1h.weeks<sup>-1</sup> in HTH. Results The athletes reached same maximal oxygen consumption (62.2 ± 1.9 vs 63.8 ± 1.6 ml.min<sup>-1</sup>.kg<sup>-1</sup>) and same maximal ventilation (161 ± 4.5 vs 156.4 ± 1.6 L.min<sup>-1</sup>) with slightly lesser maximal power in HTH without statistical significance (360 ± 12 vs 343 ± 10 W). Blood gases analysis evidence a significant fall (p≤0.05) in PaO<sub>2</sub> of 16 ± 1.5 mmHg from rest to maximal exercise in HTH and higher PaCO<sub>2</sub> (p≤0.05) at the end of exercise (32.5 ± 1.2 vs 36 ± 1.6 mmHg). Plasma catecholamine assays evidences lesser increase at the end of exercise in HTH compared to HTN (Epinephrine 1203 ± 214 vs 1863 ± 355; Norepinephrine 5132 ± 708 vs 7565 ± 785.09 pg.ml<sup>-1</sup>). The difference remain after 5 min of recovery. Discussion These data evidence that EIAH is associated with a reduced sympathetic response to exercise. This could be responsible for an impaired ventilation/perfusion ratio at pulmonary level (Barman 1998) by the ways of an action on pulmonary circulation which need more investigations. The lesser catecholamine response observed here could be due to a possible overreaching in HTH athletes which is sustained by the lesser maximal power in spite of same aerobic capacity and greater training volume in HTH. References Barman SA. (1995). *J Appl Physiol*, 78(4):1452-8. Durand F, Mucci P, Préfaut C. (1998). *Med Sci Sports Exerc*, 32(5):926-32. Hopkins SR. (2006). *Adv Exp Med Biol*, 588:17-30.

### THE EFFECT OF PROLONGED ERYTHROPOIETIN EXPOSURE AND ENDURANCE TRAINING ON INTRAMYOCYLLULAR LIPID CONTENT IN YOUNG UNTRAINED INDIVIDUALS

Christensen, A., Nielsen, J., Nellemann, B., Vestergaard, P.F., Stødkilde-Jørgensen, H., Jørgensen, J.O.L., Christensen, B.  
*University of Southern Denmark*

**Introduction** It is well known that aerobic training increases the content of mitochondria and intramyocellular lipid (IMCL) within skeletal muscle (Hoppeler 1986). Recent studies indicate that recombinant human erythropoietin (EPO) may activate mitochondrial biogenesis (Carraway et al. 2010) and increase fat oxidation (Hojman et al. 2009). In the present study, we aimed to investigate the effect of EPO and endurance training on IMCL content of untrained individuals. We hypothesized that EPO and training would lead to increased IMCL content and that there would be an additive effect of the two interventions on IMCL content. **Methods** Young (range: 18-35 years), non-smoking, untrained men were randomly assigned to 1 of 4 groups: 1) placebo (PL) (n=8), 2) EPO (E) (n=8), 3) placebo and training (PLT) (n=8), and 4) EPO and training (ET) (n=7). Training consisted of supervised ergometer cycling for 40 min at 65% of maximal watt 3 times pr. week for 10 weeks. The EPO groups were given 40 µg rHuEPO (Darbepoietin alpha) for the first 3 weeks and 20 µg the last 7 weeks. IMCL of the anterior tibial muscle was assessed by <sup>1</sup>H magnetic resonance spectroscopy (Madsen et al. 2012). Data was log-transformed before analysis and values are presented as % of baseline (geometric means) and 95% confidence interval for the means. Results EPO treatment increased hematocrit by 12% in E and 13% in ET. There were no additive effect of EPO and endurance training (P = 0.32) or main effect of EPO (P = 0.80) on IMCL content (PL: 87% (60-127); E: 101% (59-170) ; PLT: 151% (90-256) ; ET: 116% (64-209)). However, endurance training tended to increase IMCL (PL and E: 93% (70-124); PLT and ET: 134% (94-189); P = 0.09). **Discussion** Our findings suggest that prolonged EPO exposure has no major effect on IMCL content in sedentary controls or any additive effect on endurance training-mediated increase in IMCL content as assessed by <sup>1</sup>H magnetic resonance spectroscopy. Thus, any effect of EPO on IMCL is less pronounced or different compared to the effect of endurance training. However, considerations of fiber phenotypes and subcellular localization of IMCL should be considered for a complete evaluation of the effect of EPO on IMCL content. **References** Carraway et al. (2010). *Circ Res*, 106(11),1722–1730 Hoppeler H. (1986). *Int. J Sports Med.*, 7,187-204. Hojman P et al. (2009). *Plos One*, 4,6,e5894 Madsen et al. (2012). *J Clin Endocrinol Metab*, 97(4),1227–1235

### TESTOSTERONE BUT NOT PROTEIN SUPPLEMENTATION INFLUENCES THE MAINTENANCE AND GROWTH OF SKELETAL MUSCLE FOLLOWING IMMOBILIZATION

Hanson, E.D., Betik, A.C., O'Connor, M., Truong, J., Hayes, A.  
*Victoria University*

**Introduction** The loss of testosterone with aging or as a consequence of prostate cancer treatment has adverse effects on muscle mass and function. Protein supplementation and resistance training both have been used to mitigate these declines. However, studies are lacking that combine these complementary therapies in hypogonadal populations and that examine the mechanism(s) responsible for hypertrophy in the absence of testosterone. Using immobilization and subsequent reloading as a model of resistance exercise, this study examined the effects of testosterone and protein supplementation on muscle mass and function as a means of reducing the side effects of androgen deficiency. **Methods** Fischer 344 male rats underwent castration or sham surgery and were allowed to recover prior to unilateral hind limb immobilization (Childs 2003). With immobilization and throughout the study, animals were randomized to receive a high protein diet (50%) with branched chain amino acids (150mg/kg/d) added to their drinking water or standard chow (20% protein). Following 10d of immobilization, casts were removed and the animals underwent limb reloading for 0, 6, or 14d before muscles were stimulated *ex vivo* to assess force production. **Results** Body mass was significantly lower in castrated animals following surgery. Immobilized muscle mass was significantly lower in extensor digitorum longus (EDL, -7.8%), gastrocnemius (-20.8%), plantaris (-17.2%), and soleus (-27.7%). Castration also decreased muscle mass (-5%) but there was no effect of diet. Immobilized muscle mass increased with reloading but was not completely restored. Force production (stimulated at 10-100 Hz) was reduced in both EDL (-21.4 to -26.0%) and soleus (-45.4 to -74.7%) with immobilization but only soleus force recovery was influenced by castration over the time course of the study with no influence of diet. **Discussion** Recent work in humans suggests that load-mediated muscle hypertrophy may be independent of testosterone (West 2010, Hanson 2012), which contradicts previous findings (Galvao 2006, Kvorning 2006). The group differences in total body and muscle mass and greater force declines with immobilization in castrated animals support the hypothesis that testosterone is important for maintaining skeletal muscle but similar mass and force measurements in sham and castrated rats after 14d of reloading suggests testosterone-independent hypertrophy. The lack of dietary influence on muscle mass is contradictory to previous findings (Baptista 2010, Yamamoto 2010), although this may be related to differences in dose and models of atrophy. **References** Childs, TE, Spangenburg EE, et al. (2003) *Am J Physiol Cell Physiol*. Hanson, ED, Sheaff AK, et al., (2012). *J Gerontol A Biol Sci Med Sci*. Galvao, DA, Nosaka, K, et al., (2006). *Med Sci Sport Exerc*. Kvorning T, Andersen, M, et al (2006). *Am J Physiol Endocrinol Metab*. West, DW, Burd, NA, et al. (2010). *J Appl Physiol*. Baptista, IL, Leal, ML, et al. (2010) *Muscle Nerve*. Yamamoto, D, Taki T, et al. (2010) *Muscle Nerve*.

### EFFECTS OF SHORT-TERM SIMVASTATIN TREATMENT ON MITOCHONDRIAL FUNCTION AND APOPTOSIS IN PRIMARY HUMAN SKELETAL MYOTUBES

Kwak, H.B.  
*Inha University*

**Introduction** Statins (3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitors) are cholesterol-lowering drugs widely used in the treatment of cardiovascular disease (Koh et al., 2011). However, statins also cause adverse side effects in skeletal muscle ranging from fatigue to fatal rhabdomyolysis. Recently, we found that long-term (48 h) treatment of simvastatin induced cell death due to impaired mitochondrial respiration and oxidative stress leading to mitochondrial apoptotic signaling in primary human skeletal muscle cells (Kwak et al., 2012). The purpose of this study was to determine the effects of short-term (24 h) simvastatin treatment on mitochondrial respiration, H<sub>2</sub>O<sub>2</sub> emission, apoptotic signaling, and morphological changes in differentiated human skeletal myotubes. **Methods** Primary myoblasts isolated from vastus lateralis in lean male (N=6) were grown and differentiated to myotubes (6 days), and then incubated in differentiation media (0.1% DMSO) with or without simvastatin (5 µM) for an additional 24 hours. The myotubes were harvested and permeabilized by digitonin (3 µg/10<sup>6</sup> cells) for determination of mitochondrial respiration and H<sub>2</sub>O<sub>2</sub> emission. In addition, markers of apoptosis (cell numbers, Bax and Bcl-2) and MnSOD protein levels were measured in primary human skeletal myotubes. **Results** After 24 hour incubation, simvastatin treated myotubes (STM) were not changed in morphology and total cell numbers compared with control. In permeabilized cells supported by palmitoyl-carnitine/malate (PCM, complex I and II substrate), basal respiration rate (non-ADP-

stimulated, state 2) was similar between STM and control. However, maximal ADP-stimulated (state 3) oxygen consumption rate showed lower trends ( $P=0.08$ ) in STM supported by PCM. Mitochondrial  $H_2O_2$  emission rate was not affected by short-term STM compared with control. Similarly, 24 h treatment of simvastatin did not have significant effects on the protein levels of Bax, Bcl-2, and MnSOD in primary human skeletal myotubes. Discussion Long-term (48 h) treatment of simvastatin impaired maximal ADP-stimulated mitochondrial respiration, induced mitochondrial oxidative stress, and increased mitochondrial-mediated apoptotic signaling and cell death in primary human skeletal myotubes (Kwak et al., 2012). However, these data demonstrated that short-term (24 h) treatment of simvastatin did not induce atrophy and cell death that is primarily associated with the impairment of mitochondrial function and the activation of mitochondrial apoptosis in primary human skeletal myotubes. References Koh K, Sakuma, I, Quon, M. (2011). *Atherosclerosis*, 215, 1–8. Kwak H, Thalacker-Mercer A, Anderson E, Lin C, Kane D, Cortright R, Bamman M, and Neuffer P. (2012). *Free Radic Biol Med*, 52, 198–207.

#### LACK OF A PHYSIOLOGICAL ROLE FOR ERYTHROPOIETIN IN HUMAN SKELETAL MUSCLE

Christensen, B.1,2, Nellemann, B.1, Thorsen, K.4, Pedersen, S.B.1, Ørnstrup, M.J.1, Jørgensen, J.O.L.1, Jessen, N.3,4  
*1,3,4 Aarhus University Hospital, 2 Aarhus University*

Background: Erythropoietin (Epo) is considered a pleiotropic hormone, but the presence of Epo receptor (Epo-R) in human skeletal muscle tissue has been debated, mainly due to a lack of specificity of the Epo-R antibodies used to identify Epo-R's in skeletal muscle tissue (1). In addition, we have previously shown no activation of the signalling pathways downstream of the Epo-R (2), further questioning a physiological role for Epo in human skeletal muscle tissue. Aim: The aim of the current study was to thoroughly evaluate Epo's prolonged effects on skeletal muscle; large-scale analysis of mRNA expression was performed by gene array analysis. Furthermore, a new and highly sensitive antibody evaluated Epo-R expression in human skeletal muscle tissue. Methods: Human skeletal muscle biopsies from two clinical studies were used to investigate; 1) gene expression in relation to prolonged treatment with rHuEpo (study A) evaluated by gene array, 2) Epo-R presence determined by western blotting using a new and sensitive antibody (A82, Amgen)(study B). In study A, nine healthy men received one weekly s.c. injection with rHuEpo for 10 weeks (Darbepoietin- $\alpha$ , Aranesp, Amgen); biopsies were collected before and after treatment. In study B, biopsies were collected from ten healthy young men under basal conditions. Results: When correcting for multiple testing, no significant changes in skeletal muscle gene expressions after a prolonged period of rHuEpo treatment were found. Therefore, Epo-R expression was evaluated. Unlike previous studies, with a new and sensitive antibody, A82, it was not possible to identify Epo-R's in human skeletal muscle tissue. Conclusion: In conclusion, prolonged rHuEpo treatment does not affect gene expression in human skeletal muscle, and a physiological role of Epo-R in skeletal muscle is unlikely. (1) Elliott S, Busse L, Bass MB, Lu H, Sarosi I, Sinclair AM, Spahr C, Um M, Van G, and Begley CG. Anti-Epo receptor antibodies do not predict Epo receptor expression. *Blood* 107: 1892-1895, 2006. (2) Christensen B, Lundby C, Jessen N, Nielsen TS, Vestergaard PF, Moller N, Pilegaard H, Pedersen SB, Kopchick JJ, and Jørgensen JO. Evaluation of functional erythropoietin receptor status in skeletal muscle in vivo: acute and prolonged studies in healthy human subjects. *PLoS one* 7: e31857, 2012.

Friday, June 28th, 2013

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08:30 - 10:00

## Oral presentations

### OP-PM10 Health and Fitness [HF] 6

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#### EFFECT OF "FUNCTIONAL FOOD" SUPPLEMENTATION ON MUSCLE GROWTH AND STRENGTH INDUCED BY 12 WEEKS OF RESISTANCE EXERCISE IN ELDERLY MEN

Hellelid, K.J., Bjørnsen, T., Salvesen, S., Berntsen, S., Stea, T.H., Lohne-Seiler, H., Paulsen, G.

*University of Agder*

**Introduction** Lack of dietary protein and micronutrients is often found amongst elderly. The aim of the present study was to investigate the effect of a mixed supplementation on muscle growth and strength after 12 weeks of strength training in elderly men. **METHODS** Thirty-three elderly males (60 – 81 yrs old) were included to either a supplemented group (N=16) or a placebo group (N=17) in a double blinded randomized placebo controlled trial. Muscle growth was assessed as changes in lean mass with DEXA and thickness of rectus femoris, vastus lateralis and arm flexors (brachialis and biceps brachii) with ultrasound imaging. Strength was measured as 1RM in leg press, knee extension and scott curl. A four day validated 18-page pre-coded food diary was completed. The supplementation was based on natural antioxidant-rich pomegranate juice with 22 g of carbohydrates, enriched with marine omega-3 fatty acids (900 mg), 15 µg vitamin D and 9 g whey protein isolate + 2 g of leucine and were administered twice daily. All participants conducted resistance exercise 3 times a week, following an undulating periodized program: 2/wk 8-10RM (1 min inter-set rest periods), 1/wk between 3-5RM (2 min rest) or 13-15RM (45 sec rest). The load was weekly adjusted, and the volume increased progressively throughout the 12 weeks of resistance exercise. Data was analyzed using non-parametric tests. **RESULTS** The supplemented group (mean±SD, 112g±39) had significantly higher protein intake at baseline compared to the placebo group (86g±20)(p=0.02), but not post. 1RM increased in the range of 15-20% in supplemented and placebo groups during 12 weeks of resistance exercise (p<0.001); no group differences were identified. Lean body mass increased for both the supplemented group (2.2 kg (median with 95% confidence intervals) (0.9-2.9)) and the placebo group (2.2 kg (1.5-3.3)) after 12 weeks of resistance training (p<0.01). However, the rectus femoris thickness increased more in the placebo group (16.2% (12.8-24.1)) than the supplemented group, (11% (4.1-17)) (p<0.05), while no significant differences between group were found for arm flexors and vastus lateralis thickness. **DISCUSSION** A mixed supplement with omega-3 fatty acids and whey protein did not have any additional effects on the adaptations to resistance exercise in elderly men. This might be due to an already sufficient intake of such nutrients, or insufficient levels of proteins in the supplementation to stimulate further muscle growth. Note: The Smartfish@ company partly financed this study.

#### A SIMPLE 45 SECOND SQUAT TEST CAN ACCURATELY PREDICT VO2MAX: PRELIMINARY RESULTS

Sartor, F., Bosio, A., Bonomi, A., Kubis, H.P.

*Philips Research*

**Introduction** VO<sub>2</sub>max is an important parameter to determine the functional capacity of the cardio-respiratory system. Its direct determination via maximal exercise testing may result not always feasible to perform, in particular in subjects with increased risk of cardiovascular diseases. Thus we have validated a simple and short sub-maximal test which does not require any type of equipment other than a heart rate (HR) monitor and a metronome and can be performed by anybody with no lower limbs limitations. **Methods** Eight male cyclists (Age: 19 ± 2 yrs; Height: 177 ± 7 cm; Weight: 65.4 ± 4.5 kg; Body Fat %: 8.36 ± 2.00%) underwent a Ruffier-Dickson test. This consisted of resting supine for 5 min, then standing up, and once the HR was stable, performing 30 squats in 45 s following a metronome set at 80 bpm. Once the squatting exercise was completed the participants laid down supine to recover for 3 min. HR was recorded throughout. After 3 min when HR ≤ initial resting HR the participants underwent a Vo<sub>2</sub>max test on the cycle ergometer. Body fat % was estimated via plicometry. **Results** The cyclists had a mean VO<sub>2</sub>max of 4.36 ± 0.44 L/min, 67.2 ± 6.2 mL/kg/min. Their VO<sub>2</sub>max significantly correlated with their height (r = 0.746, p = 0.03), and slope of HR increase during the squats (r = 0.705, p = 0.05). The best VO<sub>2</sub>max prediction via multiple linear regression showed high r = 0.977 and adjusted r<sup>2</sup> = 0.892, and small inaccuracy, Standard Error of Estimate (SEE) = 0.145 L/min, SEE% = 3.3. Eq.1: VO<sub>2</sub>max (L/min) = -2.489 + (0.0436 \* height (cm)) + (1.458 \* Slope Sq HR) - (0.00234 \* Recovery DeltaHR120 (bpm)) - (0.170 \* Fat %). If body fat % via plicometry is not available VO<sub>2</sub>max can be still predicted accurately using Eq.2: VO<sub>2</sub>max (L/min) = -1.788 + (0.0317 \* height (cm)) + (1.812 \* Slope Sq HR) - (0.00834 \* Recovery DeltaHR120 (bpm)); r = 0.812, adjusted r<sup>2</sup> = 0.405, SEE = 0.340 L/min, SEE% = 7.8. **Discussion** We have developed a model (Eq.1), which can accurately (3% error) predict VO<sub>2</sub>max in young male athletes from a simple 45s squat test. Although body fat % increases the prediction accuracy, if not available the accuracy of an alternative model (Eq.2) (7.8% error) is still in line with other sub-maximal tests (e.g. 9% Astrand-Rhyming cycling test, 11.4% Ebbeling treadmill test, 8% McArdle step test). We are currently testing more sedentary individuals to see whether these results can be generalized. Although these are preliminary results on only 8 participants and the error might increase when a large sample is considered, this 45s squat test seems to be very promising.

#### ASSOCIATION BETWEEN MOTOR COMPETENCE AND PHYSICAL ACTIVITY. A LONGITUDINAL STUDY IN CHILDREN

Lopes, V.P., Sousa, J.F.D., Rodrigues, L.P.

*Polytechnic Institute of Braganca*

**Introduction:** The aim of this study was to analyze the influence of motor competence on children's physical activity levels (PA). Motor skills proficiency and coordination levels were studied as predictors of children's PA levels during 4 years. **Methods:** This longitudinal study took place between 2009 and 2012, with a sample of 98 children. At the beginning of the study the sample was composed of 24 children with

six years old, 40 children with seven years and 34 children with eight years, who were followed over 4 consecutive years, performing annual assessments of anthropometric variables, PA, motor coordination and fundamental motor skills. Pedometer was used as an objective instrument for assessing PA, test of Körperkoordination Test für Kinder (KTK) to assess motor coordination and test of Gross Motor Development (TGMD-2) to assess the fundamental movement skills, composed by objects control skills and locomotor skills. For data analysis we used the hierarchical or multilevel modeling, in order to determine the predictors of PA through five successive adjustment models. Results: The children's PA levels significantly decreased over time. At baseline the girls had a PA level significantly lower than boys. The magnitude of the differences in PA levels between boys and girls has not changed significantly over the observations. Motor coordination levels and proficiency in object control skill were not predictors of PA, whereas the proficiency in locomotor skills was the only significant predictor of PA. There were a large percentage of children who did not comply with the minimum recommendations in the number of daily steps and this situation tends to worsen with increasing age, especially in girls. Conclusions: The locomotor motor skills were a significant predictor of children's PA levels along 4 years.

### EXERCISE HYDRATION KNOWLEDGE OF SINGAPOREAN YOUTH COACHES AND PHYSICAL EDUCATION TEACHERS

Chia, M., Mukherjee, S., Huang, S.H.

*National Institute of Education, Nanyang Technological University, Singapore*

Introduction Dehydration has deleterious effects on sport performance and contributes to heat-related illnesses. Singapore youth athletes are at a greater risk of dehydration-associated ailments due to the tropical climate, especially when training outdoors. Coaches and Physical Education (PE) teachers must possess adequate hydration knowledge to ensure optimal performance and sports safety in the youth athletes. The present study examines the exercise hydration knowledge of Singapore coaches and PE teachers. Methods 193 coaches (Beginning coaches n=129, certified coaches n=64) and 164 PE teachers (Beginning teachers n= 102, graduating teachers n=62) participated in the study. Participants completed a questionnaire based upon ACSM and NATA guidelines on fluid replacement for athletes (Casa et al. 2000; Sawka et al. 2007). The questionnaire consisted of pre-exercise, during-exercise and post-exercise hydration knowledge sections. Adequate hydration knowledge was accepted as a score of 80% and above (Ransone and Dunn-Bennett 1999). Results 70.3% of participants were coaching youth athletes. Average knowledge scores were: beginning coaches (BC)-61.76±12.36%; certified coaches (CC)-68.09±12.30%; beginning PE teachers (BT)-62.46±10.24%; graduating PE teachers (GT)-67.01±9.46%. There was a significant difference in the passing rates between BC and CC (BC-3.1% vs CC-17.2%,  $p < .05$ ). The difference in passing rates between BT and GT was not significant (BT-5.9% and GT-11.3%,  $p = < .05$ ). Even at 80th percentile, none of the groups attained passing scores. At 90th percentile, only the CC and GT attained passing scores. Discussion Results showed that the majority of coaches and PE teachers in Singapore have inadequate hydration and fluid replacement knowledge and they were largely unfamiliar with the NATA and ACSM guidelines on fluid replacement. The lack of adequate exercise hydration knowledge among coaches and PE teachers puts the health and well-being of youth exercising in the hot and humid climate of Singapore at risk. It is important to bridge current hydration knowledge gaps among coaching and PE practitioners and step up education programmes to empower youths with appropriate exercise hydration knowledge. Future studies focusing on coaches' education on hydration and fluid replacement are essential. References Casa DJ, Armstrong LE, et al. (2000). *Journal of athletic training* 35(2): 212-224. Ransone J & Dunn-Bennett LR (1999). *Journal of athletic training* 34(3): 267-271. Sawka MN, Burke LM, et al. (2007). *Medicine and science in sports and exercise* 39(2): 377-390.

**08:30 - 10:00**

### Oral presentations

#### OP-PM49 Training and Testing [TT] 3

### COMPARING HEART RATE MONITOR AND ACCELEROMETER TO DETERMINE ENERGY EXPENDITURE

Dyrstad, S.I, Hausken, K.2

*University of Stavanger*

Introduction Heart rate monitors are an accurate tool to measure heart rate response to physical activity. It has also become a common tool to measure energy expenditure. During the last 15 years accelerometers have become one of the most common objective methods to assess physical activity. Understanding how different tools measure physical activities differently is important in order to compare methods and interpret data correctly. The purpose of the study was therefore to compare the estimation of energy expenditure from heart rate monitors and accelerometer in interval running and zumba (a Latin dance-inspired fitness program). Methods A total of 26 sports students (15 females) with a mean age of 21.8±2.4 (SD) years, wearing both heart rate monitor and accelerometer, carried out two different training sessions: A 45 min interval running session containing 12 min warmup, 4x4 min running, 90-95% of max heart rate, with 3 min jogging, 70% of max heart rate between each interval, and 5 min cooldown. Zumba 60 min containing 5 min warmup, thereafter 50 min zumba, and 5 min cooldown. Polar RS 100 monitors with belts were used to measure the participants' heart rates. The participants measured their maximal and resting HR by a standardized protocol. ActiGraph GT3X was used to measure the participants' accelerometer counts, collected in 60-second epochs. The equations by Hiilloskorpi et al. (1999) and Sasaki et al. (2011) were used to determine the participants' activity energy expenditure from heart rate monitors and accelerometers, respectively. Results The mean vector magnitude counts per minute (cpm) were 8612±1101 cpm and 6704±1424 cpm for interval running and zumba, respectively. The mean working intensity in % of maximal heart rate was 82.5±3.3 % and 74.9±10.7 % for interval running and zumba, respectively. The mean energy expenditure during the running session was 11.51± 2.29 kcal/min and 9.26±1.86 kcal/min estimated by heart rate monitors and accelerometers, respectively ( $p < 0.0001$ ). Corresponding energy expenditure for zumba were 9.86± 2.68 kcal/min for heart rate monitors and 7.22± 1.73 kcal/min for accelerometers ( $p < 0.0001$ ). Discussion The main finding is the documentation of the large differences in the estimation of energy expenditure between heart rate monitor and accelerometer. Heart rate monitors estimated 24% and 37% higher energy expenditure in kcal/min than accelerometers in interval running and zumba, respectively. A greater difference during zumba could be explained by the fact that the participants perform large upper body movements not recorded by the accelerometer. References Hiilloskorpi H, Fogelholm M, Laukkanen R, Pasanen M, Oja P, Manttari A, Natri A. Factors affecting the relation between heart rate and

energy expenditure during exercise. *Int J Sports Med* 1999; 20: 438-443. Sasaki JE, John D, Freedson PS. Validation and comparison of ActiGraph activity monitors. *J Sci Med Sport* 2011; 14: 411-416.

### HEART RATE VARIABILITY THRESHOLD PREDICTS LACTATE THRESHOLD IN WORLD-CLASS ROAD CYCLISTS

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**Introduction** The vagal withdrawal of the heart, defined as the heart rate variability threshold (HRVT), and the blood lactate threshold (LT) have been observed to occur at similar relative exercise intensities (Chwalbinska-Moneta et al., 1989; Tulppo et al., 1996). However, the validity of the HRVT to estimate the LT in homogeneous groups of athletes with very high aerobic capacities has not been examined yet. **Methods** Twelve male professional world-class road cyclists performed a continuous maximal graded cycling test. Blood lactate concentration ([La-]), heart rate and RR intervals were monitored. The LT was defined as the workload corresponding to an elevation in [La-] of 0.2 mmol•l<sup>-1</sup> (Weltman et al., 1987). HRVTs were determined from the standard deviation of the instantaneous beat-to-beat RR intervals (SD1). Workloads associated with SD1 values of 1 ms above the lowest SD1 (SD1Tlow), and 3 ms and 0.5 ms above the SD1 value of the first exercise intensity at which there was a decrease in SD1 < 0.5 ms (SD1T0.5) or < 2.5 ms (SD1T2.5) were established. Results The LT and SD1Tlow were not statistically different and were strongly correlated ( $r = 0.88$ ;  $P < 0.001$ ). HRVTs robustly correlated with percentages of peak aerobic power (% Wpeak) ( $r = 0.94-0.97$ ;  $P < 0.001$ ) and percentages of peak heart rate (% HRpeak) ( $r = 0.87-0.95$ ;  $P < 0.001$ ) at which these thresholds occurred. **Discussion** A lower magnitude of correlation ( $r = 0.82$ ) between visually identified LTs and HRVTs has been previously reported in a heterogeneous (coefficient of variation, CV, of ~25%) group of male and female subjects (Karapetian et al., 2008). The present results indicate that the LT could be accurately and objectively estimated from the SD1Tlow in a homogeneous group (CV of Wpeak = 4.3%) of male world-class cyclists. A novel finding was the extremely large relationships observed between the SD1Tlow and the % Wpeak and % HRpeak at which SD1Tlow occurred. SD1T0.5 and SD1T2.5, two other mathematically determined HRVTs measurable during a non-fatiguing incremental test, also correlated with the LT, % Wpeak and % HRpeak at which these HRVTs occurred. **Conclusion** The LT can be accurately predicted from SD1 values during a maximal or submaximal, non-invasive, low-cost, incremental exercise test in world-class road cyclists. The LT might be coincidental with the vagal withdrawal of the heart. **References** Chwalbinska-Moneta, J., Robergs, R. A., Costill, D. L., & Fink, W. J. (1989). *J Appl Physiol*, 66, 2710-2716. Karapetian, G. K., Engels, H. J., & Gretebeck, R. J. (2008). *Int J Sports Med*, 29, 652-657. Tulppo, M. P., Mäkikallio, T. H., Takala, T. E., Seppänen, T., & Huikuri, H. V. (1996). *Am J Physiol*, 271, H244-H252. Weltman, A., Snead, D., Seip, R., Schurrer, R., Levine, S., Rutt, R. (1987). *Int J Sports Med*, 8, 401-406.

### RELATIONSHIP BETWEEN HEART RATE RECOVERY AND LACTATE THRESHOLDS IN ELITE SOCCER PLAYERS

Baumgart, C., Hoppe, M.W., Freiwald, J.

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**Introduction** In elite soccer players, the ability of the cardiovascular system to recover after high-intensity activities (HRrec) is mentioned as an important prerequisite (Stone & Kilding, 2009). Especially among practitioners, there exist an underlying believe that HRrec is related to aerobic endurance performance factors, such as lactate thresholds. With this in mind, the aim of this study was to investigate the relationships between HRrec and lactate thresholds in elite soccer players. **Methods** 122 male German soccer players from the 1st to 4th level (age 24±4 years, BMI 23.6±1.6 kg/m<sup>2</sup>) performed an incremental test on a 400 m tartan track to determine running velocities at 2 and 4 mmol/l blood lactate (v2 and v4). HRrec was defined as the decrease in heart rate from the end of the test to 10, 30 and 60 seconds after exhaustion. Additionally, HRrec was quantified relative as a percent of maximum heart rate (HRrec%). Descriptive statistics were calculated after checking for normality with the Kolmogorov-Smirnov test. Pearson product-moment correlation coefficients (r) were used to investigate the relationship between HRrec, HRrec%, v2, and v4. Statistical significance was set to  $p < 0.05$ . **Results** In elite soccer players, the assessed mean±SD values for HRrec, HRrec%, v2, and v4 were v2: 12.2±1.2 km/h; v4: 14.2±0.9 km/h; HRrec10: 2±1 bpm; HRrec30: 12±4 bpm; HRrec60: 32±8 bpm; HRrec10%: 1.3±0.8 bpm; HRrec30%: 6.1±2.2 bpm; and HRrec60%: 16.8±4.6 bpm, respectively. No correlations were found between HRrec values, v2, and v4 (all  $r < 0.13$ ,  $p > 0.05$ ) as well as between HRrec% values, v2, and v4 (all  $r < 0.15$ ,  $p > 0.05$ ). **Discussion** The results of this study revealed that v2 and v4 were not related to HRrec and HRrec% in elite soccer players. It is well known that endurance trained athletes have greater HRrec than sedentary individuals. Ostojic, Stojanovic, and Calleja-Gonzalez (2011) demonstrated a relationship between maximum oxygen uptake and HRrec only 10 and 20 seconds after exhaustion in young male soccer players, but not for 30 to 60 seconds. Anyway, the present study shows that elite soccer players possess high aerobic endurance performance factors do not possess faster heart rate recovery after exhaustion. **References** Ostojic, S. M., Stojanovic, M. D., & Calleja-Gonzalez, J. (2011). Ultra short-term heart rate recovery after maximal exercise: relations to aerobic power in sportsmen. *Chin J Physiol*, 54(2), 105-110. Stone, N. M., & Kilding, A. E. (2009). Aerobic conditioning for team sport athletes. [Review]. *Sports Med*, 39(8), 615-642.

### CARDIOVASCULAR EFFECTS OF PASSIVE LOWER LEG VIBRATION

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**Introduction** Whole body vibration (WBV) has been used as a novel form of exercise for both physical training and rehabilitation applications. WBV exercise at lower frequencies (<60 Hz) for short periods has been reported to have beneficial effects on the human musculo-skeletal system (Torvinen et al., 2002). WBV has also been observed to increase muscle blood flow (Kersch-Schindl et al., 2001). Whether this is a secondary effect in response to skeletal muscle activation or a separate effect on the cardiovascular system is not known. However, the potential for WBV to produce shear-stress is of interest for its angiogenesis inducing potential. The aim of this study was to investigate the potential vasodilatory effects of vibration independent of muscle activation by applying it in a passive manner. **Methods** Eighteen (9 male) healthy young adults aged (mean±SD) 22.0±2.3 years, height 1.72±0.09 m, body mass 70.1±13.0 kg were recruited to the study. Skeletal muscle activation was avoided by having subjects lie in a supine position on supporting foam mats with their lower legs resting on the vibrating platform (Nemes, Bosco System). Subjects visited the lab on two separate occasions and vibration and control treatments were applied in a randomised order. Vibration consisted of three 60 s bouts with 10 s between (40 Hz, 3 mm amplitude, 6.8 g RMS acceleration). Lower leg blood flow (LLBF) was measured using venous occlusion plethysmography (Hokanson System). Brachial blood pressure (BP) was measured using an automated monitor (Tango+, SunTech Medical) and ankle systolic BP measured manually in duplicate. Baseline measurements were made following 15 min of supine rest. All measurements were then made immediately after treatment and repeated at 3 min intervals thereafter. Data were analysed using repeated measures mixed model ANOVA. **Results** Mean

( $\pm$ SEM) LLBF at baseline was  $2.2\pm 0.1$  ml/100ml/min. After vibration LLBF was increased relative to the control values by  $+31.0\pm 7.9$ ,  $+6.2\pm 5.2$ ,  $+6.1\pm 6.6$ , and  $+9.9\pm 5.2$  % at 1, 4, 7, and 10 min respectively ( $P<0.05$ ). Mean ankle-brachial pressure index at baseline was  $1.01\pm 0.01$  and was reduced by  $-0.8\pm 2.9$ ,  $-6.5\pm 3.3$ ,  $-3.5\pm 3.7$ , and  $-0.6\pm 2.1$  % at the same respective time points relative to the control values ( $P<0.05$ ). Discussion The results of this study provide evidence for body vibration having cardiovascular effects independent of skeletal muscle activation. This means that WBV may be of use in helping to enhance blood flow during warm-up and/or recovery routines. Furthermore, the most likely mechanism underlying the vibration-induced increase in blood flow is increased shear stress, which may have potential as a novel training stimulus and therefore warrants further investigation. References Kerschman-Schindl K, Grampp S, Henk C, Resch H, Preisinger E, Fialka-Moser V, Imhof H. (2001). Clin Physiol, 21(3), 377-82. Torvinen S, Sievanen H, Jarvinen TA, Pasanen M, Kontulainen S, Kannus P. (2002). Int J Sports Med, 23(5), 374-9.

### EFFECTS OF A MULTISTAGE SHUTTLE RUN 15 METERS TEST ON HEART RATE, LACTATE AND RATING OF PERCEIVED EXERTION IN BEACH HANDBALL PLAYERS

Bago Rascon, P., Saez de Villarreal, E.

*Pablo de Olavide University*

Introduction Until 2016, beach handball will not be an Olympic event, and information on the physical characteristics and the physiological demands of elite players is limited. Beach handball is a sport that places high physiological demands on players (dry beach sand, ground deformation, intermittent nature of the game) (Billat, 2003). To run or any type of movement in dry sand races may result in an increase of 1.6 times the energy cost (Lejeune et al., 1998). The involvement of anaerobic glycolysis is the main pathway of energy production. The aims of this study are to determine the relevance of lactate as performance limiter, the relationships between heart rate (HR), rate of perceived exertion (RPE) and lactate as predictors of the level of effort and the adaptation of the Course-Navette test for beach handball. Methods We examined the response of three variables (HR, blood lactate and RPE) in dry sand beach in beach handball players through an adapted Course-Navette and the maximum speed test (15 m). 12 players aged  $21.4\pm 3.87$  years, weight of  $79.68\pm 13.87$  kg, height of  $1.78\pm 0.07$  meters and B.M.I. of  $26.24\pm 4.52$  were subject to two tests conducted in dry sand. Their profile on the beach handball experience comes with  $7.17\pm 2.86$  years in the sport;  $26.42\pm 11.34$  games played in the summer season of 2010 and  $6.46\pm 1.71$  hours per week training in conventional handball. Results The maximum speed obtained in the speed test was 2,49 sec, with an average of  $2.77\pm 0.19$  sec. Regarding lactate results, the baseline value was  $2.51\pm 1.49$  mmol/l, post-exercise  $11.06\pm 2.66$  mmol/l and after 3 recovery minutes  $13.49\pm 2.49$  mmol/l. The average HR during testing was  $177.9\pm 7.02$  bpm, the percentage of intensity on the theoretical maximum heart rate was  $95.70\pm 3.12$ %. The maximum RPE level was recorded at  $17.42\pm 1.08$  according to the Borg 15 degrees scale. Discussion The results show a clear relationship between the intensity of the HR, increased blood lactate concentration and subjective feelings of fatigue a beach handball player. Previous authors have found a similar blood lactate levels after high intensity training (Billat, 2003). The progressive running test on 15m round-trip of 10 minutes maximum duration was a valuable tool for obtaining data in HR, blood lactate and self-perceived effort. Test results show that physical work in sand for beach handball requires very high intensities heart rate ( $\sim 90$ %). These data are consistent with other studies in real game situation in beach football (Castellano and Casamichana, 2010). The results yield evidence that the Beach Handball is a mixed performance sport with high participation of anaerobic metabolism and the consequent production of lactic acid. The outcomes may help coaches and sport scientists formulate better guidelines and recommendations for athlete assessment and selection, training prescription and monitoring and preparation for competition.

### MONITORING RECOVERY DURING THE IN-SEASON COMPETITIVE PHASE IN ELITE SOCCER PLAYERS

Thorpe, R., Strudwick, A., Buchheit, M., Atkinson, G., Drust, B., Gregson, W.

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Introduction Balancing the stress of training and competition with sufficient recovery is a fundamental challenge in the training process. Therefore, knowledge about the effectiveness of non-invasive monitoring tools for assessing recovery status in athletes is paramount (Meeusen et al., 2006). Recovery markers should be sensitive to daily variability in training load, but research on elite team sport players is lacking (Buchheit et al., 2013). Therefore, our aim was to quantify the relationships between daily training load and a range of recovery indices in elite soccer players during the in-season competitive phase. Methods Training load (RPE-TRIMP, heart rate, total and high-intensity distance and the number of accelerations), perceived ratings of fatigue, muscle soreness, sleep quality, counter-movement jump height (CMJ), post-exercise heart rate recovery (HRR%) and heart rate variability (LnMSSD) were measured daily in 10 elite soccer players across a 14-day period during the in-season competitive period. Within-subjects stepwise multiple regression models were used to evaluate the influence of fluctuation in training load markers on fluctuation in recovery indices. Results Variability in fatigue ( $r=0.40$ ) and muscle soreness ( $r=0.38$ ) were correlated to variability in total high-intensity distance and total distance covered measured on the previous days respectively ( $P<0.001$ ). Variability in sleep quality was correlated to the most training load markers; these being RPE-TRIMP ( $r=0.24$ ;  $p=0.02$ ), total distance ( $r=0.33$   $p=0.01$ ) and high intensity distance ( $r=0.42$ ;  $p<0.001$ ). Variability in HRR% and LnMSSD were correlated to time above 80% HRmax ( $r=0.27$ ;  $p=0.04$ ) and the number of high accelerations ( $r=0.31$ ;  $p=0.03$ ) respectively. Correlations between variability in CMJ performance and all training load markers were negligible and not statistically significant. Discussion Perceived ratings of wellness, particularly sleep quality, along with heart rate recovery and heart rate variability were reasonably sensitive to daily fluctuations in training load experienced by elite soccer players. Therefore, these particular indices show the greatest promise for simple, non-invasive assessment markers of recovery status of elite soccer players during the in-season competitive phase. References Buchheit M, Racinais S, Bilsborough J, Bourdon PC, Voss S, Hocking J., Cordy J, Mendez-Villanueva A., and Coutts A.J. (2013). Journal of Science and Medicine in Sport, Epub ahead of print. Meeusen R, Duclos M, Gleeson M, Rietjens G, Steinacker J and Urhausen A. (2006). Prevention, diagnosis and the treatment of the Overtraining Syndrome. European Journal of Sports Science, 6, 1-14.

08:30 - 10:00

## Invited symposia

## IS-PM14 Hypoxia for health and fitness \*

## TRAINING IN HYPOXIA: DOES IT IMPROVE SEA-LEVEL PERFORMANCE?

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After more than four decades of research on the topic –many think that the few years before Mexico 1968 Olympics were the real beginning of it–, and more than 500 publications reported in PubMed and over 4,000 in Google Academics, altitude training effects on sea-level performance is a matter of live controversy. The first and only published meta-analytic review on this topic concluded –perhaps arguably by some– that the “enhancing protocols by appropriate manipulation of study characteristics produced clear effects with all protocols (3.5-6.8%) in subelite athletes, but only with [‘living high-training high’] LHTH (5.2%) and [‘living high-training low’] LHTL (4.3%) in elite athletes.” It also concludes that “in elite athletes, enhancement was possible with natural LHTL (4.0%; +/-3.7%), but unclear with other protocols”. Something definitely changed our views after the milestone work of Levine & Stray-Gundersen (1997). However, even the referenced paper summary includes expressions like ‘poor reporting’, ‘placebo, nocebo and training-camp effects’, ‘possible’, or ‘unclear’. On a very recent article (Lundby et al., 2012), a well recognised group of experts conclude that “Given that few studies have utilised appropriate controls, there should be more scepticism concerning the effects of altitude training methodologies”, and advocate for “well-controlled studies that will enhance our understanding of the mechanisms and potential benefits of altitude training”. Therefore, controversy is served and perhaps ready to go on for a few more years. In this critical review, new results from a recent international research project which involved 65 elite swimmers from eight nations in four continents will be summarized and put into perspective. The aim will be to stimulate the debate and to emphasise some of the crucial aspects surrounding the controversy, such as the extrapolation from physiological variables to actual sports performance and how realistic it is to conduct robust ‘gold standard’ experiments –such as randomized, double blind, controlled trials– immersed in the complex ‘ecological nest’ of elite sport. References Bonetti DL, Hopkins WG (2009). *Sports Med*, 39(2), 107-127. Levine BD, Stray-Gundersen J (1997). *J Appl Physiol*, 83(1), 102-112. Lundby C, Millet GP, Calbet JA, Bärtsch P, Subudhi AW (2012). *Br J Sports Med*, 46(11), 792-5.

## OXYGEN: A POSSIBLE TREATMENT FOR OBESITY?

González-Muniesa, P.1,2, Quintero, P.1,3, Martínez, J.A.1,2

*1. University of Navarra, 2. Carlos III Health Research Institute, 3. Pontificia Universidad Católica de Chile*

Oxygen is indispensable for cell metabolism, and in turn, tissue oxygenation is essential for all normal physiological functions in most living creatures. Diseases as relevant as cancer, respiratory dysfunctions, and others, such as obesity (Trayhurn and Wood, 2004), are related with a poor tissue oxygenation. On the other hand, several studies have reported that appetite suppression and body weight loss are frequently observed at high altitude. Based on these findings, it has been hypothesized the possible applicability of hypoxia and hyperoxia for the treatment of obesity and related disorders (Quintero et al, 2010). Hyperoxia treatment (95% O<sub>2</sub>, 48 h) on mature murine adipocytes (3T3-L1) seems to produce an inflammatory response probably related to the release of ROS and the upregulation of pro-inflammatory adipokines, such as IL-6 and MCP-1. On the other hand, hyperoxia may have an indirect effect on insulin sensitivity due to the upregulation of PPAR- $\gamma$  signaling as well as a possible modulation of both glucose and lipid metabolic markers, which is in agreement with Goossens and collaborators (Goossens et al, 2012). An intermittent hypoxia treatment was then tested (8% O<sub>2</sub>, 4 weeks of cycle hypoxia) on Wistar rats where a significant weight gain decrease was found compared to the normoxia group, unfortunately this loss was mainly of muscle tissue. At the moment, we are performing a trial with an acute hypoxia (15% O<sub>2</sub>) on obese patients practicing 2h of exercise simultaneously to the exposure to low oxygen levels (Urdampilleta et al, 2012). This project is funded by the EXPLORA Subprogramme, MICINN, Spain (SAF2010-11630-E). This new strategies may be useful and practical for clinical applications in obese patients. References 1. Trayhurn P, Wood IS. (2004). *Br J Nutr*, 92, 347-55. 2. Quintero P, Milagro FI, Campión J, Martínez JA. (2010). *Med Hypotheses*, 74, 901-7. 3. Goossens GH, Bizzarri A, Venticlef N, Essers Y, Cleutjens JP, Konings E, Jocken JW, Cajlakovic M, Ribitsch V, Clément K, Blaak EE. (2011). *Circulation*, 124, 67-76. 4. Urdampilleta A, González-Muniesa P, Portillo MP, Martínez JA. (2012). *J Physiol Biochem*, 68, 289-304.

08:30 - 10:00

## Oral presentations

## OP-PM01 Adapted Physical Activity [AP] 1

## BRISK WALKING INCREASES BONE MINERAL DENSITY IN CART-PATIENTS

Bonato, M., Bossolasco, S., Galli, L., Mandola, S., Pavei, G., Testa, M., Bertocchi, C., Galvano, E., Balconi, G., Lazzarin, A., Merati, G., La Torre, A., Cinque, P.

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Introduction In the general population, moderate intensity aerobic activity reduces the risk of obesity, cardiovascular disease, diabetes and may prevent bone loss. We evaluated the effects of brisk walking, with or without strength exercise, on bone mineral density in HIV-infected treated persons. Methods Thirty-four HIV-infected, cART-treated, sedentary subjects with were enrolled in a 12-week exercise program, consisting of 3 outdoor sessions/week of 60 min walking at 65-75% of HR (heart rate) max  $\pm$  30 min circuit training at 65% of 1-

RM (Repetition Maximum). Subjects were examined at baseline (BL) and 12 weeks (W12) by 6-minute walking test (6MWT), 1-RM test; and by dual energy X-ray absorptiometry (DEXA) to evaluate lumbar spine and femoral bone mineral density, and t- and z-scores, in addition to morphometric (BMI, waist, hip and leg circumference) and bloodexamination (cytometry, fastingtotal, HDL and LDL cholesterol, tryglicerides, glucose, insulin; AST/ALT, ALP, gGT, creatinine, CPK, HbA1c; CD4+ and CD8+, plasma HIV-RNA). Differences between BL and W12 were tested by Wilcoxon-signed rank test. Results Thirty-two of 34 (94%) participants completed the 12-week program with a median adherence of 64% (IQR 56-77). They were 25M, 7F; median 48 y-o, IQR 44-54. Twenty patients were enrolled in the 'walk' group and 12 in the 'walk and strength' group. At W12, participants showed significant improvement of distance by 6MWT ( $p<0.0001$ ), and of performance in all strength exercises (crunch  $p=0.0015$ , lat machine  $p=0.001$ , chest press  $p=0.0029$ , leg extension  $p=0.0303$ , sitting calf  $p=0.0015$ , leg press  $p=0.0024$ ). DEXA spine z-score improved significantly in the whole group ( $p=0.0222$ ) and in the walk strength group ( $p=0.0469$ ), and femoral z-scores in the 'walk' only group ( $p=0.0319$ ). At W12 BMI, waist circumference, and LDL were also significantly improved in the whole group, whereas no significant changes were observed for the other variables. Discussion The above 12-week program of brisk walking, with or without strength exercise, improved fitness and bone density in HIV-infected treated subjects, in addition to some morphometric variables and serum LDL. This kind of moderate intensity exercise might help control the long-term consequences of cART on bone metabolism. References Gregory et al 2009 Am J Lifestyle Med

### EXERCISE AUGMENTATION COMPARED TO USUAL CARE FOR POSTTRAUMATIC STRESS DISORDER. A RANDOMISED CONTROLLED TRIAL: RESULTS FROM THE REAP TRIAL

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1 The George Institute for Global Health (Australia) 2 St John of God Healthcare (Australia) 3 EMGO Institute for Health and Care Research (Netherlands)

Introduction People with posttraumatic stress disorder (PTSD) are more likely to suffer from poor physical health (Boscarino, 2004) and are less likely to be physically active (de Assis et al., 2008). Exercise can potentially improve both the primary psychiatric diagnosis and physical health simultaneously. To date no randomised controlled trials (RCTs) have evaluated the impact of exercise on PTSD symptoms. This study aimed to investigate the impact of a 12-week exercise program as an augmentation to usual care for PTSD patients. Methods An assessor-blinded RCT was conducted among participants with a DSM-IV diagnosis of PTSD recruited from St John of God Hospital (Australia) ( $n=81$ ; mean age 47.9 (12.1), 84% male). Participants were randomized to receive usual care ( $n=42$ ) or exercise augmentation in addition to usual care ( $n=39$ ). The intervention comprised resistance training and a pedometer-facilitated walking program. The primary outcome was PTSD symptoms, obtained through the Posttraumatic stress disorder Check List –Civilian version (PCL-C), a 17-item self-report measure. Scores range from 17- 85, with at least a 5-point change considered significant. Secondary outcome measures assessed depression and anxiety, waist circumference, physical activity and sleep quality. Linear regression analyses were conducted. Results 58 participants (72%) completed primary outcome follow-up assessments. The intervention group significantly improved compared to the control group for PTSD symptoms, (mean difference = 5.39, 95% CI 0.26 to 10.52,  $p=0.04$ ), however, the significant between-group difference was lost when missing data were imputed. There were significant between-group differences on the secondary outcomes at follow-up: depression ( $N=51$ ) (mean difference= 17.44, 95% CI 5.95 to 28.93,  $p=0.004$ ), waist circumference ( $N=37$ ) (mean difference = 3.56, 95% CI 0.17 to 6.95,  $p=0.04$ ) and sleep quality ( $N=55$ ) (PSQIA) (mean difference = 2.46 95% CI 0.07 to 4.86,  $p=0.04$ ). Mean adherence was 7 supervised sessions (range 1-11). Discussion This study provides preliminary evidence that exercise may be effective in reducing both PTSD and depressive symptoms, as well as improving body composition and sleep quality in PTSD patients. High proportion of participant loss-to-follow-up is a limitation of this study. This trial has important clinical implications and supports the inclusion of exercise programs within PTSD treatment facilities. References Boscarino, J. A. (2004). Ann NY Acad Sci, 1032, 141-153. de Assis et al (2008). Clinics (Brazil), 63(4), 473-478.

### CONCENTRIC AND ECCENTRIC TORQUE IN COPD PATIENTS VS. HEALTHY CONTROL

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Introduction Presence of muscle wasting is common in Chronic Obstructive Pulmonary Disease (COPD) patients across all disease stages (Seymour J.M., 2010) but eccentric (ECC) contraction results greater compared to healthy control (HC) subjects (Mathur S., 2007). The aim of our study is to outline a description of COPD strength performances as a function of contraction modalities and velocities. Methods Thirty-five COPD males (mean FEV1=64.76±20.08% of predicted; FEV1/FVC= 57.35±13.56% of predicted; age 67.21±4.7 years) and 25 HC males (FEV1= 115.06±17.43% of predicted; FEV1/FVC=101.87±6.62% of predicted; age 65.15±5.69 years) performed isokinetic knee extensors concentric (CONC) and ECC torque at 30 and 210 deg/s. Vastus lateralis muscle architecture, 6MWT and 1RM Leg press were performed. One way ANOVA and Pearson coefficient were used to detect significant differences between groups and correlation between variables. Results HC was significantly better in FEV1 ( $p<0.001$ ), FEV1/FVC ( $p<0.001$ ), 6MWT ( $p<0.001$ ) and 1RM Leg press ( $p<0.05$ ). Only CONC 30deg/s peak torque was significantly higher in HC compared to COPD ( $p<0.05$ ). No differences resulted in muscle architecture, fast CONC and ECC torque. Significant differences between groups ECC/CONC peak torque ratio (30 deg/sec  $p<0.001$ ; 210 deg/sec  $p<0.01$ ). Significant correlations were found between FEV1 and 6MWT (0.719  $p<0.001$ ), 1RM Leg press (0.449  $p<0.001$ ), peak torque contraction at 30 deg/sec (0.427  $p<0.01$ ; 0.280  $p<0.05$ ), at 210 deg/sec (0.285  $p<0.05$ ; 0.276  $p<0.05$ ) and ECC/CONC peak torque ratio at both velocities (-0.562  $p<0.001$ ; -0.292  $p<0.05$ ). Same results were observed between FEV1/FVC and parameters assessed. Discussion COPD patients showed lower health related parameters and performed lower CONC contraction compared to healthy controls. Interestingly, COPD preserved ECC contractions and fast CONC torque. ECC contraction seems to involve fast twitch motor units (Duchateau J., 2008) and COPD hypoxia leads fiber shift towards IIX fibers (Gosker H.R., 2002). Therefore, COPD males seem to develop favorable profile to minimize strength loss likely due to neural-muscular modification. References Mathur S. et al. Preservation of eccentric torque of the knee extensors and flexors in patients with COPD; J Cardiopulm Rehabil Prev. 2007; 27:411–6; Duchateau J. et al. Neural control of shortening and lengthening contractions: influence of task constraints; Physiol. 2008; 586:5853–64; Gosker H.R. et al. Skeletal Muscle fibre-type shifting and metabolic profile in patients with chronic obstructive pulmonary disease. Eur Respir J. 2002; 19:617-25. Seymour J.M. et al. The prevalence of quadriceps weakness in COPD and relationship with disease severity; Eur Respi J. 2010; 36: 81-88.

**CHANGES IN WALKING STEPS DURING PREGNANCY. A MULTI-ETHNIC POPULATION-BASED STUDY**

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Introduction: Pregnant women without medical contraindications are recommended to spend 30 minutes or more in moderate to vigorous intensity physical activity (PA) on most, if not all days of the week. However, most epidemiological research typically employ subjective reports of PA. The aims of the present study are (1) to describe PA change operationalised as objectively recorded daily steps in early gestation and gestational week (GW) 28, and, (2) to investigate the association between core set variables and steps in GW 28. Methods: Prospective data from a multi-ethnic cohort from Oslo/Norway (n=823) of pregnant women consisting of 40.8% from Western countries, 24.3% from South Asia, 15.3% from Middle East and 19.6% from other countries. Steps were recorded by the activity monitor SenseWear™ Pro3 Armband in early gestation (< 20 weeks) and in GW 28. Covariates in multiple linear regression analysis were steps in early gestation, BMI, pregnancy-induced emesis, subjective health, ethnicity, education, occupation, age and parity, while steps in GW 28 was the dependent variable. Results: Step data from 528 women with valid recordings from both visits were analysed. The ethnic group mean values for daily steps in early gestation ranged from 7183 to 9185, and Western women walked significantly more steps compared to all other ethnic groups (p<0.001). The percentage drop from early gestation to GW 28 ranged from 4.1% to 9.0%, and it was most pronounced for women from other countries and Western countries. In absolute terms, significant reductions were only seen in women from other countries (p=0.02) and Western countries (p<0.000). Ethnicity (p=0.01), occupation (p=0.04) and parity (p=0.03) were all significantly associated with steps at GW 28 but not after adjusting for steps in early gestation. Steps in early gestation explained 33% of the variance in steps at GW 28 (coefficient with 95% confidence intervals; 0.56 (0.49, 0.63) steps (p<0.001)). Discussion: Steps dropped markedly between early gestation and GW 28 across ethnic groups. Steps in early gestation was an important predictor for steps in GW 28, also after adjusting for other covariates, such as subjective health. Women with few steps in early gestation are at risk for low PA throughout pregnancy and interventions to promote PA in pregnancy should be tailored to their needs.

**08:30 - 10:00****Oral presentations****OP-BN07 Biomechanics [BM] 7****UNSTEADY HYDRODYNAMIC FORCES ACTING ON A ROBOTIC HAND AND ITS FLOW FIELD**

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Introduction Although an unsteadiness in the flow field during swimming must be considered (Matsuuchi et al. 2009), a quasi-static approach using the coefficients of drag and lift obtained under steady flow conditions has been the mainstream scientific method to predict fluid forces. Therefore, we attempted to directly measure the hydrodynamic forces, the pressure distribution, and the flow field around a hand by using a robotic arm and PIV. The advantages of using a robotic arm are that the obtained data are highly reproducible and that the experimental parameters (e.g., angle of attack and velocity of the hand) are computer controllable. At the first stage, we selected relatively simple hand motions to investigate systematically the effects of angle of attack, relative velocity, and acceleration for generating hydrodynamic force. By investigating the interactions among these data, we aimed to clarify the mechanism of generating unsteady force during swimming. Methods The robotic arm consisted of the trunk, shoulder, upper arm, forearm, and hand, and it was independently computer controllable in five degrees of freedom. The robotic arm was fixed above the flume with a two-dimensional (2D) load cell (LSM-B-SAI Kyowa). The elbow-joint angle of the robotic arm was fixed at 90°, and the arm was moved in semicircles around the shoulder joint, perpendicular to the water surface. Two-component PIV was used for flow visualization around the hand. Eight pressure sensors (PS-05KC KYOWA) embedded in the hand model to measure the pressure distribution on its surface. The data of the forces by the load cell and pressure acting on the hand by the pressure sensors were sampled at 200 Hz and stored on a PC. Results and Discussion When the maximum resultant force acting on the hand was observed, a pair of counter-rotating vortices appeared on the dorsal surface of the hand. A vortex attached to the hand increased the flow velocity, which led to decreased surface pressure, increasing the hydrodynamic forces. This phenomenon is known as the unsteady mechanism of force generation (Dickinson and Gotz, 1993). We found that drag force was 72% greater and that lift force was 4.8 times greater than values estimated under steady flow conditions. Measurement of a flow field has revealed that the behavior of certain kinds of vortices generated by unsteady hand movement plays an essential role in generating high hydrodynamic force. It is presumable that swimmers receive the benefits of this unsteady hydrodynamic force. Further studies are necessary to consider and analyze data obtained in realistic situations and reproducible by the robotic arm. In this way, a real swimming stroke pattern can be analyzed, making it possible to confirm the most efficient stroke technique. References Matsuuchi, K., Miwa, T., Nomura, T., Sakakibara, J., Shintani, H., Ungerechts, B.E., (2009). *Journal of Biomechanics* 42, 42-47. Dickinson, M.H., Gotz, K.G., (1993). *Journal of Experimental Biology* 174, 45-64.

**FASTER DISTANCE RUNNERS HAVE MORE COMPLIANT ACHILLES TENDONS**

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Introduction Previous work suggested that superior running economy would be a key factor of the great successful in distance running (Saltin et al. 1995). The running economy and performance would be significantly influenced by mechanical properties of muscle and tendinous tissues, but detailed information has been limited. In this study, we determined the indices of stiffness and Young modulus on both tissues in plantar flexors of distance runners, and then examined the effect of the variables on running performance and running kinematics. Methods Dependent on best official record of 5000m, high performance group (HPG: 14:33±0:21: 10 subjects) and normal performance group (NPG: 16:08±0:26: 10 subjects) with similar age, body height, and weight, were set for the experiment. Morphological parameters of lower limb (e.g. length of segments, muscle and tendinous tissues and their cross sectional areas) were measured. Then,

Stiffness Index defined as the slope of relation between torque and lengthening of tissues, and Young Modulus Index as the index of material property were determined. The lengthenings of tissues were evaluated by B mode ultrasound images, during passive dorsiflexion for muscle tissues, and during isometric voluntary contractions for tendinous tissues. Two-dimensional kinematic analysis of race pace running was also applied with high speed VTR. RESULTS AND DISCUSSION Morphological variables related to length and cross sectional area have no significant difference between HPG and NPG. The mechanical properties related to only tendinous tissues showed significant differences between HPG and NPG. The Stiffness Index and Young Modulus Index of tendinous tissues of HPG were more compliant by 40% ( $p < 0.01$ ) and by 41% ( $p < 0.01$ ) than those of NPG, respectively. However, no significant difference was observed in Induces of muscle tissue. The difference of not only Stiffness Index but also Young Modulus Index in tendinous tissues imply the difference in its material properties between HPG and NPG, which is originated in biomaterial composition like collagen type. In addition, HPG and NPG did not demonstrate significant difference in many kinematic variables such as joint angle changes and step frequencies, while HPG showed 8% larger step length, 12% shorter contact time, and 32% faster maximal angular velocity of plantar flexion in late contact phase significantly ( $p < 0.05$ ). These results in the present study imply that compliant tendon affects effective elastic energy re-use and muscle-tendon interaction, and, thus, contributes to higher power output by ankle joint especially in late contact phase. References Saltin B, Larsen H, Terrados N, Bangsbo J, Bak T, Kim CK, Svendsen J, Rolf CJ. (1995) *Scand J Med Sci Sports*, 5, 209-21.

## MEASUREMENT OF THE AERODYNAMIC DRAG OF TEXTILES WITH A NOVEL DEVICE

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Introduction In the past years, high speed sports such as speed skating, cycling and skiing were extensively studied from the aerodynamic point of view (Chowdhury et al., 2010; Oggiano et al. 2009). A number of authors previously studied how surface roughness affects the drag of cylinders. The acquisition of the drag data was always carried out in wind tunnel experiments. One important drawback of wind tunnel measurements is the high costs. In this study results of a novel measurement device allowing exact and economic studies are presented. Method The linear measurement system primarily consists of a 25 m long guidance beam and a cylinder with a height of 60 cm and a diameter of 15 cm mounted on a carriage. The carriage runs on the beam on a guideway on four rollers and is moved by a high torque electro motor via light fibre cables. The linear guidance system is located in a cooling chamber that can be adjusted in the range of  $-30^{\circ}\text{C}$  to  $30^{\circ}\text{C}$ . The distance from the cylinder to the carriage is 40 cm. The horizontal forces between the carriage and the cylinder are measured with two load cells and the position of the carriage is determined by an inductive length measuring system. The cylinder was covered with 2 different textiles. The drag force on the cylinder was measured at velocities from 5 to 20 m/s with a step size of 1 m/s with the linear measurement system and in an aeroacoustic wind tunnel (Audi, Ingolstadt, Germany). Every textile was tested 10 times at each speed with the linear measurement system to also assess the reliability of the system and 2 times in the wind tunnel. Results There is a good agreement between the wind tunnel data and the linear measurement system. The mean range of the 10 linear measurements is  $\pm 3.6\%$ . The reliability of the linear system was high with a correlation of 0.92. The range of the calculated  $c_d$  value at the different velocities was  $\pm 2.4\%$  with the linear system. In the wind tunnel experiments drag forces at the relevant velocities were in the range of  $\pm 10\%$ . Discussion The results of this work show that it is possible to determine the drag coefficient exactly with the new system. Especially at low velocities it is advantageous compared to automotive wind tunnels given the large velocity range required for the latter. Therefore in future it will be possible to analyze the effects of textile surfaces on the drag coefficient with a new, exact and economic method. References Chowdhury, Alam F, Subic A. (2010) *Proc. Eng.* 2, 2517-2522 Oggiano L, Troynikov O, Konopov I, Subic A, Alam F. (2009) *Sports Eng.* 12, 1-12

## THE EFFECT OF PLAYING LEVEL AND ENGAGEMENT METHOD ON FORCES GENERATED IN RUGBY SCRUMMAGING

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Introduction The scrum is an important phase of the rugby union game. During the scrum, players experience very peculiar biomechanical demands (high forces coupled with unstable balance) and repetitive mechanical stresses (Milburn, 1990; Preatoni et al., 2013), which may be a factor for both acute injuries and chronic degeneration of the spine. Since physical condition and technique likely play a fundamental role for both performance and injury prevention, the aim of this study was to analyse the effects of playing level and engagement conditions on forces generated in scrummaging. Methods Force measures were analysed as a function of: 6 playing levels (International, Elite, Community, Academy, Women and School), and 5 different engagement conditions (Hit&Hold, 3-Stage, FoldIn, 7+1 and 5+3). The different engagement conditions were designed in part to modify the loading conditions on players. Thirty-four teams participated in the study and performed 4-8 machine scrummaging trials for each of the 5 engagement conditions. A commercial scrum machine (Dictator, Rhino Rugby, UK), equipped with a bespoke force measurement system (Preatoni et al., 2012) measured the compression, lateral and vertical forces generated by the scrum pack. A set of parameters was selected to analyse applied forces in the subsequent phases of the engagement, from initial shock absorption to the sustained push. A mixed design ANOVA was used to assess main effects between and within groups and the playing level-engagement condition interaction. Results During the shock-absorption phase: (i) peaks of force (in all three directions) were lower in the FoldIn engagement than in the other conditions, and (ii) International and Elite teams produced higher peak compression forces than the other categories. For example, peak compression force ranged between 8.6 (2.0) kN for International and 4.2 (0.8) kN for School in the FoldIn engagement, and between 16.5 (1.4) kN for International and 8.7 (0.1) kN for Women in the Hit&Hold. Sustained compression force ranged between 8.53 (0.69) kN (International, 5+3) and 4.37 (0.15) (Women, 3-Stage), with greater sustained push for International and Elite, and the FoldIn engagement producing higher sustained compression force than the other conditions (significant for 3-Stage and 5+3). Discussion This study provides a more comprehensive picture of the influence of playing levels and engagement conditions on contemporary scrummaging biomechanics. It also informs practitioners and governing bodies about biomechanical factors that may influence performance and injury prevention. References Milburn PD. (1990). *J Sports Sci*, 8, 47-60. Preatoni E et al. (2012). *P I Mech Eng P - J Sports Eng Tech*, 226(3/4), 266-273. Preatoni E et al. (2013). *Scand J Med Sci Spor*, DOI: 10.1111/sms.12048. Acknowledgement Research funded by the International Rugby Board

**THE EFFECTS OF GRADED SLOPES AND WALKING SPEED ON LOWER EXTREMITY MUSCLE ACTIVITY**

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Introduction Walking on graded slopes requires exertion of greater forces across lower extremity joints. In the course of walking downwards, the knee joint absorbs up to 70 percent of the total negative work. This work is predominantly performed by the leg extensor M. quadriceps which is also expressed in the increasing tractive patella tendon and quadriceps force. When walking uphill, the rates of the performed work are equally balanced by the ankle, knee and hip joint (Schwameder et al., 2005). Despite increased attention to effects of inclination on human gait during the last years, many questions remain unresolved. On this account, this study has the main purpose of shedding further light on the muscular response to walking on various inclination levels and increased walking speed. Methods Twenty-six healthy male students with average age, height and weight of 25.4 ( $\pm 2.5$ ) years, 178.9 ( $\pm 6.5$ ) cm and 75.4 ( $\pm 9.2$ ) kg respectively, volunteered to complete this study. All participants were instructed to walk up and downhill on a treadmill at 4, 8 and 12 degrees and at walking speeds of 1.0 and 1.3m/s. Muscle activity was recorded of tibialis anterior (TA), soleus (SO), medial gastrocnemius (GA) and vastus (VA), medial (SM) and lateral hamstring (BF), rectus femoris (RF) as well as gluteus maximus (GL). Gait characteristics were obtained with Novel® Pedar insoles. Data was processed with a custom written Matlab® code and statistically analysed applying one-way ANOVA with repeated measures (Bonferroni,  $\alpha=0.05$ ). Results Significant differences were observed between ascending and descending inclination levels for all muscles regarding both mean activity and burst duration. During upslope walking, the mean activity of all muscles significantly and progressively increased from 4 to 12 degrees. GA revealed a significantly delayed activity onset and consequently decreased burst duration. With regard to BF, VA, RF and GL a significantly delayed offset and therefore increased burst duration was detected. However, when walking downwards the activity of BF set on significantly earlier while VA and RF revealed a tremendous increase in burst duration. The mean activity of VA and RF increased significantly at -8 and -12 compared to walking level. Between the walking speeds no significant differences were observed whether in terms of burst duration nor mean activity. Discussion The findings of the present study are in accordance with previously done research (Lay et al., 2007). It can be concluded that the extensor muscles namely SO, RF, GL, GA and VA responded most to the increase in inclination. TA, SM and BF however, served as co-contractors of the respective joints. When walking downhill, only the knee extensors absorbed the downwards moving body while the early onset of GA and BF evidently increases knee joint stability. References Lay A, Hass C, Nichols T, Gregor R. (2007). *J Biom*, 40(6), 1276-1285. Schwameder H, Lindenhofer E, Müller E. (2005). *Sports Biom*, 4(2), 227-243.

**BIOMECHANICAL DETERMINANTS OF LONG-STANDING ADDUCTION-RELATED GROIN PAIN IN FOOTBALL PLAYERS.**

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Background: Long-standing adduction-related groin pain (LSARGP) is common (Weir et al., 2011b). In football LSARGP accounts for 12%-16% of all injuries (Ekstrand and Hilding, 1999, Werner et al., 2009). It is associated with high recurrence and prolonged time off sport (Weir et al., 2011a). Muscle activation and kinematic strategies in LSARGP are not well understood. The aim of this research was to better understand the kinematics and muscle activation in professional and amateur footballers with LSARGP. Methods: 20 professional (10 unilateral pain) and 19 male amateur (9 unilateral pain) footballers were recruited. Surface electromyography (sEMG) and 3D motion capture (CodaMotion) were applied during standing hip flexion (SHF). Analysis focused on gluteus medius (GM) versus adductor longus (AL) muscle activation ratio and kinematics of the hip joint in early, middle and end phase of SHF while standing on a symptomatic leg. Results: GM vs AL ratio was significantly ( $p<0.01$ ) decreased in amateur but increased ( $p=0.02$ ) in professional symptomatic athletes compared to matched control groups. Kinematic analysis of professionals with LSARGP showed increased abduction compared to control group, while symptomatic amateurs were more internally rotated and flexed compared to control group. Discussion: Opposite results in symptomatic professionals and amateurs might be explained by differences in rehabilitation. Professionals have access to treatment that might be focused on gluteal muscles, whereas amateurs may not all have rehabilitation and adopt alternative strategies to maintain pelvic stability. The results might also be explained by study limitations as participants were not matched nor controlled for symptoms chronicity or level. These findings have implications for rehabilitation of athletes with groin pain. References: EKSTRAND, J. & HILDING, J. 1999. The incidence and differential diagnosis of acute groin injuries in male soccer players. *Scand J Med Sci Sports*, 9, 98-103. WEIR, A., DE VOS, R. J., MOEN, M., HOLMICH, P. & TOL, J. L. 2011a. Prevalence of radiological signs of femoroacetabular impingement in patients presenting with long-standing adductor-related groin pain. *Br J Sports Med*, 45, 6-9. WEIR, A., JANSEN, J. A., VAN DE PORT, I. G., VAN DE SANDE, H. B., TOL, J. L. & BACKX, F. J. 2011b. Manual or exercise therapy for long-standing adductor-related groin pain: a randomised controlled clinical trial. *Man Ther*, 16, 148-54. WERNER, J., HAGGLUND, M., WALDEN, M. & EKSTRAND, J. 2009. UEFA injury study: a prospective study of hip and groin injuries in professional football over seven consecutive seasons. *Br J Sports Med*, 43, 1036-40.

**08:30 - 10:00****Oral presentations****OP-PM13 Molecular Biology [MB] 3****SKELETAL MUSCLE GENE EXPRESSION OF THE NUCLEAR HORMONE RECEPTOR FAMILY NR4A IS INDUCED BY ACUTE AEROBIC EXERCISE AND REDUCES MYOSTATIN EXPRESSION DEPENDING ON TRAINING STATUS**

Velders, M., Beiter, T., Schumann, U., Hudemann, J., Schild, M., Mooren, F.C., Steinacker, J.M., Niess, A.M.

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Skeletal muscle responds to physical activity with altered gene and protein expression profiles. Repetitive physical activity ultimately leads to morphological and functional adaptations in skeletal muscle. The aim of this study was to determine the currently unknown effects of training status on skeletal muscle transcriptional responses to a bout of acute endurance exercise. Trained ( $VO_{2max} \geq 57$  ml/min/kg BW) and untrained ( $VO_{2max} \leq 47$  ml/min/kg BW) male study participants performed an exhaustive bout of high intensity cycling exercise (60

minutes at 80% VO<sub>2</sub>max). Muscle biopsies were taken from the vastus lateralis at rest, 30 minutes and 3h after exercise. Global mRNA expression profiling by microarray analysis (Affymetrix Human Gene 1.0 ST Array) revealed that expression of the nuclear hormone receptor (NR) family NR4A subgroup, Nurr77 (NR4A1) and Nor-1 (NR4A3) was significantly induced by the acute cycling bout in both T and UT. The NR4A family of orphan nuclear receptors regulates the expression of fiber type specific metabolic and structural genes. Nurr77 expression increased 4.3-fold ( $p < 0.01$ ) and 3.5-fold ( $p < 0.01$ ) compared to the resting state 30 minutes after exercise in T and UT, respectively. Nurr77 expression continued to increase in UT at 3h (6-fold vs. rest,  $p < 0.001$ ), while transcript levels dropped slightly in T (2.1-fold vs. rest,  $p < 0.05$ ). The highest gene induction in this study was measured for Nor-1 at 3h post-exercise (T= 32-fold vs. rest; UT= 52-fold vs. rest,  $p < 0.001$ ). Nor-1 responds to  $\beta$ -adrenergic signaling and reduces myostatin (Mstn) expression. Expression of the  $\beta$ -2 adrenoreceptor (ADRB2) was elevated 2.1-fold vs. rest ( $p < 0.01$ ) in both T and UT muscle 30 minutes post exercise. Mstn expression was 2.6-fold ( $p < 0.01$ ) higher at rest in UT vs. T and expression decreased only in UT after exercise (3.1-fold vs. rest UT 3h,  $p < 0.01$ ). Results suggest that the NR4A family rapidly respond to acute exercise in T and UT skeletal muscle to regulate metabolic and structural genes important for exercise recovery and adaptation. Mstn expression was only perceptible to elevated Nur77 and Nor-1 expression in UT muscle, which suggests that the responsiveness of Mstn to acute exercise is dependent on training status.

### RECOMBINANT ERYTHROPOIETIN TREATMENT ENHANCES MITOCHONDRIAL FATTY ACID OXIDATION IN HUMAN SKELETAL MUSCLE.

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Erythropoietin (EPO) is a hypoxia-induced hormone released by the renal cortex, where it promotes proliferation and differentiation of erythroid progenitor cells, regulating its number in the peripheral blood and thus increasing oxygen carrying ability of blood. Therefore, recombinant erythropoietin (rhEPO) treatment is widely used, albeit not legally, to enhance endurance exercise capacity. Parallel to these effects, an increase in resting energy expenditure (REE), as well as whole body fat oxidation (FAO) has been attributed to EPO. Skeletal muscle plays a role in REE, and is one of the main tissues responsible for fatty acid metabolism. This led to our hypothesis that a rhEPO-mediated increase in oxygen facilitation to the muscle increases mitochondrial FAO and could explain, at least in part, an increase in systemic REE and FAO. Methods. Human EPO was administered by muscular injection (5000 IU IM once weekly) in 6 healthy volunteers over 8 weeks, titrating the rhEpo dosage to maintain haematocrit level at ~50%. Oral iron (100 mg) supplementation was also given daily. Body composition was measured by DXA. Subjects performed two graded cycle ergometer exercise tests where VO<sub>2</sub>max, and maximal fat oxidation (MFO) were measured.  $\beta$ -hydroxy-acyl-CoA-dehydrogenase (HAD) and citrate synthase (CS) enzyme activity were measured fluorometrically. Mitochondrial respiration was measured in saponin permeabilized muscle using the following substrate-titration protocol: 2 mM Malate + 0.2 mM Octanoyl + 5 mM ADP + 10mM Pyruvate + 10 mM Glutamate/ + 10 mM Succinate. Results. As expected, rhEPO significantly increased blood haematocrit to 51%, and VO<sub>2</sub>max (from 54 $\pm$ 3 to 58 $\pm$ 3 ml·kg<sup>-1</sup>·min<sup>-1</sup>,  $P < 0.05$ ) without any exercise intervention. MFO and was not increased after rhEPO treatment, despite the higher intensity and duration of the exercise test. CS activity remained unchanged whereas HAD activity significantly increased after rhEPO ( $P < 0.05$ ). Maximal fatty acid mitochondrial capacity (MGPS3) was 1.4 fold higher after rhEPO treatment (from 59.5  $\pm$  10.6 to 82.7  $\pm$  20.8 pmol · s<sup>-1</sup> · mg<sup>-1</sup>  $P < 0.01$ ). Conclusion. Skeletal muscle mitochondrial respiratory and fat oxidation capacity is markedly higher after EPO treatment. Whole body MFO was not increased after rhEPO treatment, despite the higher intensity and duration of the exercise test. Our results suggest that the oxygen delivery capacity was not limiting the magnitude of maximal systemic fat oxidation. These findings may partially account for the enhancement of submaximal endurance performance.

### INVOLVEMENT OF OXIDATIVE STRESS IN PROSTATE CANCER PROGRESSION: A PREVENTIVE EFFECT OF PHYSICAL ACTIVITY AND/OR POMEGRANATE JUICE?

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Introduction Prostate cancer (PC) is the most common form of cancer affecting men in the Western world. Various studies suggest a decrease of PC evolution with exercise or antioxidants but the association of these two strategies has never been investigated. We hypothesize that oxidative stress is a key regulator factor of PC. In this context, we suppose that the potential decrease of oxidative stress (OS) induced by pomegranate juice (PJ) consumption alone, running training alone or the associated strategies could delay the development of PC. The objectives of this project are (1) to identify the effect of PJ and/or physical activity on PC progression in a rodent model; (2) to determine the molecular mechanisms involved in this prevention. Methods Forty male Copenhagen rats with subcutaneous prostate tumor are divided into four groups: (1) control, (2) daily consumption of pomegranate juice PJ, (3) daily running on a treadmill (training), (4) PJ + training. Each week, tumor growth is evaluated using a sliding caliper. Four weeks after the various treatments, the rodents are sacrificed. The tumors are resected and frozen. Muscles (EDL, soleus, gastrocnemus and tibialis) are removed as well as blood and urine. The levels of antioxidant vitamins, antioxidant enzyme activities, lipid peroxidation, carbonylated proteins and DNA oxidation are investigated and the signaling pathways are identified. Data are compared by analysis of variance (ANOVA) and the degree of significance is set at  $p < 0.05$ . Results PJ consumption alone or training alone decreases prostate tumor growth in the Copenhagen rat ( $p < 0.05$ ) but the association of the two strategies is not also effective. Indeed, tumor volume doubling time is respectively of about six days for control and PJ+ training, whereas it is of eight days for PJ alone or training alone. We observe a significant difference of reduced GSH and vitamin A between PJ and control groups ( $p < 0.05$ ). Moreover, training increases significantly GPx activity vs control and PJ groups ( $p < 0.05$ ). The combination of PJ and training inhibits antioxidant adaptations induced by each treatment. Discussion Although none study has demonstrated the benefits of both PJ and training, urologists recommend consumption of food antioxidants associated with physical exercise as chemoprevention for active monitoring PC patients. However our innovative study shows for the first time that combined effects of PJ and training may inhibit antioxidant adaptations and could prevent the modulation of redox-dependent signaling pathways involved in the prostate tumorigenesis.

### CIRCULATING MICRORNAS SPECIFIC FOR SKELETAL AND/OR CARDIAC MUSCLE ARE ENHANCED AFTER AN IRONMAN TRIATHLON RACE

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**Introduction:** MicroRNAs (miRNAs) have been shown to mediate adaptation to exercise by influencing many physiological processes [1,2]. Besides their specific abundance within different tissues, significant levels of miRNAs were detected in serum where they are remarkably stable [3]. It is assumed that muscle-specific miRNAs could serve as diagnostic markers for cardiac damage but the influence of mechanical stress due to exercise is questioned [4]. Therefore, the aims of this study were to investigate whether circulating levels of skeletal and cardiac muscle-specific miRNAs are detectable after extreme exercise and to correlate them with biochemical markers of skeletal and cardiac muscle damage. **Methods:** 18 male triathletes (age:  $40 \pm 9$  y, BMI:  $23 \pm 2$  kg/m<sup>2</sup>) participating at the Ironman Austria agreed to donate blood 1d before, immediately as well as 1 and 7d after the race (finishing time:  $11.8 \pm 1.1$ h). Total RNA was isolated from serum using the miRNeasy Serum Kit (Qiagen). After reverse transcription, miR-133a, -206, -208b, and -499-5p levels were quantified by qRT-PCR. Creatine kinase (CK), myoglobin (MYO), high sensitive troponin (hs-TNT), and NT-proBNP were determined on a COBAS 8000 system. Repeated measures ANOVA was used to detect differences between pre and post values and Pearson's correlation analyses served to describe correlations between single markers. **Results:** Muscle-specific miRNAs were highly enhanced directly after completing the race (miR-133a: 32-fold, miR-206: 61-fold, miR208b: 41-fold, miR-499-5p: 13-fold;  $p < 0.001$  for all comparisons). In general, levels decreased 24h thereafter but still were significantly higher than pre-race levels (miR-133a: 10-fold, miR-206: 10-fold, miR208b: 28-fold, miR-499-5p 12-fold;  $p < 0.001$  for all comparisons). 7d post-race all miRNAs returned to baseline levels. Markers for skeletal muscle damage peaked immediately (MYO: 35-fold,  $p < 0.001$ ) or 1d (CK: 21-fold,  $p < 0.001$ ) post-race. Cardiac stress markers (NT-proBNP, hs-TNT) were significantly enhanced immediately after the Ironman. Correlation analyses revealed high and significant correlations between muscle-damage markers and miRNAs. **Discussion:** This is one of the first studies revealing that intense exercise such as an Ironman triathlon causes increases in circulating muscle-specific miRNAs and that these increases are highly correlated to common markers of muscle-damage. It has to be proven whether they could serve as new diagnostic markers to clearly discriminate between skeletal (miR-206) and cardiac muscle damage (miR-208b). **References** [1] McCarthy J et al (2011). *Exerc Sport Sci Rev* 39(3):150-4. [2] Wessner B et al. (2010). *Exerc Immunol Rev* 16:22-39. [3] Chen X et al. (2008). *Cell Res* 18(10):997-1006. [4] Tijssen AJ et al (2012). *Am J Physiol Heart Circ Physiol* 303(9):H1085-95.

### GENES ENCODING PROTEOGLYCANS ARE ASSOCIATED WITH THE RISK OF ANTERIOR CRUCIATE LIGAMENT RUPTURES

Mannion, S.1,2, Mtintsilana, A.1, van der Merwe, W.4, O'Cuinneagain, D.4, Collins, M.1,3, September, A.V.1

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**Introduction** Anterior cruciate ligament (ACL) ruptures are one of the most detrimental injuries sustained in sports. Multiple risk factors, including genetic factors, are associated with the injury (September et al., 2007; 2012). Proteoglycan content is lowered in ruptured ACL tissue in comparison to non-ruptured controls (Young et al., 2011). Genes encoding proteoglycans thus form candidate genes to be investigated for an association with ACL injury risk. The aim of this study was to investigate whether sequence variants within the ACAN, BGN, DCN, FMOD and LUM proteoglycan genes are associated with risk of ACL injury. Aggrecan is a major structural constituent of cartilage, while the small leucine rich proteoglycans are important for collagen fibrillogenesis. **Methods** A case-control genetic association study was conducted. In total, 210 participants with surgically diagnosed ACL ruptures and 234 control participants without any history of ACL injury were genotyped for the following single nucleotide polymorphisms using standard PCR based methods: ACAN rs2351491, rs1042631, rs1516797; BGN rs1126499, rs1042103; DCN rs13312816, rs516115; FMOD rs7543148, rs10800912; and LUM rs2268578. Statistical analysis determined whether genotype or allele frequencies differed significantly between cases and controls. **Results** The GG genotype of ACAN rs1516797 was significantly overrepresented in ACL participants ( $p = 0.042$ , OR=2.018, 95% CI 1.015-4.015) when compared to controls. For BGN rs1126499 the TT genotype was overrepresented in ACL participants ( $p = 0.032$ , OR=1.515, 95% CI 1.037-2.215) while the CT genotype was overrepresented in controls ( $p = 0.004$ , OR=0.470, 95% CI 0.277-0.796). The AA genotype of DCN rs516115 was significantly overrepresented in female ACL participants ( $p = 0.022$ , OR=2.279, 95% CI 1.120-4.636) and interestingly the GG genotype was absent in female ACL participants ( $p = 0.008$ , OR=0.063, 95% CI 0.004-1.096). No other significant genotype or allele associations were noted. **Discussion** Preliminary evidence suggests that ACAN rs1516797, BGN rs1126499 and DCN rs516115 are associated with ACL injury risk. This novel study highlights the potential role of proteoglycans in ACL ruptures. **References** September AV, Schwellnus MP, Collins M. *Br J Sports Med* 2007;41:241-6. September AV, Posthumus M, Collins M. *Recent Pat DNA Gene Seq.* 2012;6(3):216-23. Young K, Samiric T, Feller J, et al. *Knee* 2011;18:242-6.

### PROTEIN ADJUSTMENTS OF GLUCOSE UPTAKE AND MITOCHONDRIAL RESPIRATION FOLLOWING DOWNHILL SKIING IN THE ELDERLY

Flück, M.1,2, Amami, M.2, van Ginkel, S.2, Dela, F.3, Niederseer, D.3, Niebauer, J.4, Müller, E.4,5

*1Balgrist University Hospital (CH), 2Manchester Metropolitan University (UK), 3Xlab University of Copenhagen (De), 4Institute of Sports Medicine of the State Salzburg, 5University of Salzburg (Au)*

**1** The Institute for Biomedical Research into Human Movement and Health, Manchester Metropolitan University, UK **2**Xlab, Department of Biomedical Sciences, Center for Healthy Aging, Faculty of Health Sciences, University of Copenhagen, Copenhagen, Denmark **3** Institute of Sports Medicine of the State of Salzburg, **4** Department of Sport Science and Kinesiology, University of Salzburg, Salzburg, Austria Downhill skiing of the elderly increases maximal oxygen uptake (VO<sub>2</sub>max) and moderately carbohydrate but not lipid handling (Dela et al 2011). The contribution of skeletal muscle, as a main determinant of activity-induced metabolic adjustments, to improved aerobic fitness with skiing is not understood. We hypothesized that adjustments in aerobic capacity in the main knee extensor muscle, m. vastus lateralis, but not capillary-mediated glucose uptake would explain the improved VO<sub>2</sub>max with skiing. **Methods** 28 healthy elderly subjects (age  $67.5 \pm 2.9$  years) entered a supervised 3-months downhill ski-training program including an average of 28.5 days of guided skiing. Anthropometric measures were carried out before and after training, including the measure of VO<sub>2</sub>max, glucose and lipid handling and muscle thickness. Biopsies of vastus lateralis muscle were analysed from 19 subjects (10 males, 9 females) whom completed the training. Cryosections were prepared and capillary density was determined using lectin-based morphometry. Total protein was extracted and subjected to the analysis of the concentration of markers of respiratory chain components (INDUFA9, SDHA, UQCRC1,

ATP5A1) and the mediator of contraction induced glucose transport, GLUT-4, using SDS-PAGE based immunoblotting with commercially available antibodies. Statistical significance of changes was assessed with a one tailed paired T-test at a p-value of 5%. Results VO<sub>2</sub>max was increased by 7%, and the HOMA2 index for insulin resistance, but not plasma glucose (p=0.23), decreased by 21% with ski training. A trend for an increase in the concentration of respiratory chain complexes III (UQCRC1; +60%) and V (ATP5A1, +32%) and capillary density (+12%) was noted. GLUT-4 protein (p=0.49) were not altered. None of measured metabolic proteins correlated with VO<sub>2</sub>max at either stage of training. Discussion The observations indicate that recreational downhill ski training has a borderline effect on muscle's aerobic capacity but leaves glucose uptake capacity unaffected. The disconnection between changes in local aerobic capacity and glucose uptake after downhill skiing remains to be explored. References Dela F, Niederseer D, Patsch W, Pirich C, Müller E, Niebauer J. Glucose homeostasis and cardiovascular disease biomarkers in older alpine skiers. *Scand J Med Sci Sports* 21 S1: 56-61, 2011.

**08:30 - 10:00**

## Oral presentations

### OP-PM04 Biochemistry [BC] 1 Biochemistry

#### EFFECT OF A FUTSAL MATCH ON LYMPHOCYTE SURFACE MARKERS FOR APOPTOSIS AND ROS PRODUCTION

Hatanaka, E.1, Cury-Boaventura, M.F.1, Gorião, R.1, de Moura, N.R.1, Santos, V.C.1, Bortolon, J.R.1, Murata, G.M.1,2, Borges, L.S.1, Momesso, C.S.1, Curi, R.2, Pithon-Curi, T.C.1

*1ICAFE, Cruzeiro do Sul University (São Paulo, Brazil), 2ICB, University of São Paulo (São Paulo, Brazil)*

**Introduction.** After intense exercise, the athlete's immune response is characterized by suppressed neutrophil function and increased lymphocyte death, resulting in immunosuppression [1,2]. The purpose of this study was to measure necrosis and apoptosis of lymphocytes (DNA fragmentation, surface expression of CD95 and phosphatidylserine) and ROS release in athletes prior to and after a competitive futsal match. **Methods.** Blood samples were taken from 16 futsal players (19±1 yrs, 68±6 kg, 51±2.6 ml•kg<sup>-1</sup>•min<sup>-1</sup>) before and immediately after a futsal match. Lymphocytes were isolated from the players' peripheral blood using Histopaque®. Lymphocyte necrosis, expression of CD95 and phosphatidylserine, DNA fragmentation and ROS production in lymphocytes were assessed using a flow cytometer. **Results.** The futsal match induced lymphocytosis and apoptotic death of lymphocytes, as indicated by phosphatidylserine externalization (9.5-fold), CD95 expression (1.5-fold), and DNA fragmentation (1.1-fold). In addition, after the futsal match, lymphocytes spontaneously released higher amounts of ROS (3.6-fold). **Discussion.** Our results demonstrate that playing futsal induces lymphocyte apoptosis. During a futsal match, lymphocytes are exposed to pro-apoptotic signals that include augmented levels of inflammatory cytokines and ROS, which elicit changes at the molecular level, leaving lymphocytes more susceptible to both intrinsic and extrinsic pathways for apoptosis. In the extrinsic pathway for apoptosis, the activation of death receptors such as CD95 causes recruitment and oligomerization of the adapter molecule FAS-associated protein with the death domain within the death-inducing signaling complex. Also during apoptosis, membrane asymmetry is lost and phosphatidylserine translocates to the external leaflet of the cell surface, and the cells undergo DNA fragmentation. **References.** [1] de Moura NR., Cury-Boaventura MF., Santos VC., Levada-Pires AC., Bortolon J., Fiamoncini J., Pithon-Curi TC., Curi R., Hatanaka E. (2012). *J Strength Cond Res*, 26(9):2507-2514. [2] Walsh NP., Gleeson M., Shephard RJ., Gleeson M., Woods JA., Bishop NC., Fleshner M., Green C., Pedersen BK., Hoffman-Goetz L., Rogers CJ., Northoff H., Abbasi A., Simon P. (2011). *Exerc Immunol Rev*, 17:6-63.

#### SALIVARY HORMONAL PROFILE IN RELATION WITH BONE-MUSCLE ACTIVITY OVER A CYCLING STAGE RACE

Lombardi, G.1, Lanteri, P.1, Corsetti, R.2, Grasso, D.1, Di Bernardo, C.1, Colombini, A.1, Graziani, R.3, Banfi, G.1,4

*I.R.C.C.S. Istituto Ortopedico Galeazzi*

1: IRCCS Istituto Ortopedico Galeazzi (Milano, Italy), 2: Liguigas-Cannondale (Pordenone, Italy), 3: CEDAL (Gallarate, Italy), 4: University of Milano (Milano, Italy) **Introduction** Cycling stage races are strenuous performances affecting the homeostasis of many tissues, such as bone (Lombardi et al., 2012; Lombardi et al., IN PRESS) and muscles (Colombini et al., 2012). Although explored, the hormonal changes supporting this response is not fully elucidated. Serially measuring the hormonal levels allows a more accurate profiling; this opportunity could be reached with the use of saliva, since salivary steroid hormones are known to reflect type, duration and intensity of exercise (Gatti and De Palo, 2011). **Aim** of the study was to determine the temporal changes and the reciprocal relationship of salivary steroid hormones, bone-muscular markers and the metabolic effort, during a cycling stage race. **Methods** Nine pro-cyclists participating in 2012 Giro d'Italia were recruited; daily anthropometrical features and power output/energy expenditure were recorded. Diet was kept constant. Saliva was collected at days -1,4,8, 12, 14, 19, 23; blood and urine were collected at days -1, 12 and 23. Salivary cortisol, DHEA, testosterone and estradiol, serum LDH, AST and CK activities and urinary calcium and phosphorous were measured. Plasma volume changes were determined. **Results** While cortisol remained constant, testosterone significantly decreased at day 4, estradiol and DHEA increased in the first part of the race to then returned to basal levels. Salivary hormones levels were not correlated with plasma volume shifts. LDH, CK, and AST increased over the race as well as the urinary excretion of calcium and phosphorous. Correlations were found between DHEA and estradiol and the indexes of metabolic effort and the bone-muscular markers. **Discussion** The present findings on muscular and bone activations are consistent and confirmed those previously published (Lombardi et al., 2012; Lombardi et al., IN PRESS; Colombini et al., 2012). The known co-activation of bone and muscle (Zofkova, 2008) is related to the power output and the energy expenditure and seems to be sustained by the changes in DHEA and estradiol. Saliva represents a useful tool to allow a serial monitoring in the athlete's hormonal asset even during competitions. We confirm the presence of an hormonal co-regulation of bone and muscle metabolic activities driven by the metabolic effort. **References** Lombardi G, Lanteri P, Graziani R, et al. (2012). *PLoS ONE*, 7, e42077 Lombardi G, Corsetti R, Lanteri P, et al. *Scand J Med Sci Sports* IN PRESS Colombini A, Corsetti R, Machado M, et al. (2012) *Clin J Sport Med*, 22, 408-413 Gatti R & De Palo EF (2011). *Scand J Med Sci Sports*, 21, 157-169 Zofkova I (2008). *Physiol Res*, 57(S1), 59-69

### THE EFFECTS OF NAC SUPPLEMENTATION ON REDOX STATUS IN PEOPLE WITH G6PD DEFICIENCY

Jamurtas, A., Liakos, Y., Theodorou, A.A., Zalavras, A., Deli, C.K., Fatouros, I.G., Koutedakis, Y.

*University of Thessaly*

**Introduction** Glucose 6 phosphate dehydrogenase deficiency (G6PD) is the rate limiting step in the pentose phosphate pathway that results in the formation of NADPH which is the driving power for the recycling of glutathione. N-acetylcysteine (NAC) has been used to prevent the decline of glutathione under oxidative stress conditions (Vats et al., 2008) and hypothetically could be efficient under conditions where glutathione levels are reduced such as in G6PD deficiency. Therefore, the purpose of this study was to examine the effects of NAC supplementation on redox status in people with G6PD deficiency. **Methods** Ten young people (8 males and 2 females) with G6PD deficiency (D) and 10 matched controls with normal levels of the enzyme (N) participated in the study. All subjects received NAC (600 mg per day) for 14 days. Before and after supplementation blood was collected from all participants. Reduced (GSH) and oxidized glutathione (GSSG), thiobarbituric reactive substances (TBARS), bilirubin and uric acid were assessed. Results G6PD levels were 150 times higher in N compared to D ( $N = 9.27 \pm 1.9$  U/g Hb vs.  $D = 0.62 \pm 0.55$  U/g Hb). There were differences in GSH for group ( $F_{1,9} = 6.25$ ,  $p < 0.05$ ) and time ( $F_{1,9} = 11.73$ ,  $p < 0.005$ ) with N showing significantly higher levels before ( $N = 3.36 \pm 0.86$   $\mu\text{mol/g Hb}$  vs.  $D = 2.75 \pm 0.55$   $\mu\text{mol/g Hb}$ ) and after ( $N = 3.80 \pm 0.90$   $\mu\text{mol/g Hb}$  vs.  $D = 2.98 \pm 0.50$   $\mu\text{mol/g Hb}$ ) supplementation compared to D. No group X time interaction was found for GSH. No significance for group ( $F_{1,9} = 2.22$ ,  $p = 0.17$ ), time ( $F_{1,9} = 0.009$ ,  $p = 0.93$ ) or group x time was observed for GSSG levels. GSH/GSSG ratio was not significant for group ( $F_{1,9} = 0.19$ ,  $p = 0.67$ ) but approached significance for time ( $F_{1,9} = 4.205$ ,  $p = 0.07$ ). No significance for group, time or group x time was observed for TBARS, bilirubin or uric acid levels. **Discussion** These results indicate that short term supplementation with NAC can alter GSH levels in G6PD deficient individuals with no changes in lipid peroxidation or antioxidant indices. Further research is needed in order to examine the effects of longer supplementation with NAC on redox status and the response of these individuals following a stressful condition such as exercise. **References** Vats P, Singh VK, Singh SN, Singh SB (2008). Glutathione metabolism under high altitude stress and effect of antioxidant supplementation. *Aviat Space Environ Med* 2008; 79: 1106 – 11.

### MUSCLE FIBRE TYPE DOES NOT EXPLAIN POOR MUSCLE STRENGTH IN MCARDLE PATIENTS

Kohn, T.A., Noakes, T.D., Rae, D.E., Rubio, J.C., Santalla, A., Lucia, A.

*University of Cape Town, Hospital 12 de Octubre, Pablo Olavide University, European University of Madrid*

**Introduction** Previous research showed that McArdle patients had a higher surface electrical activity (as measured by electromyography (EMG)) at the same relative workload compared to healthy individuals (2). This suggested that more fibres were activated to fulfil the required work. As muscle fibre type plays an important role in overall muscle function, with type IIa and IIx fibres associated with generating more force than type I fibres, it was hypothesized that McArdle patients would have a predominance of type I myosin heavy chain (MHC) isoforms and less MHC IIa and IIx isoforms compared to healthy individuals. **Methods** Muscle biopsies were obtained over a 10-year period from male and female patients diagnosed with glycogen storage myopathy V (McArdle disease). Nine biopsies from the biceps brachii (BB) (+ 3 healthy controls) and 8 from the vastus lateralis (VL) (+10 healthy controls). These samples were analysed for myosin heavy chain isoform content using SDS-PAGE. The latter provides a relative measure of muscle fibre type. Data (mean  $\pm$  SD) were analysed using a non-parametric one-way ANOVA. Results In all the samples analysed, all three MHC isoforms were found, namely MHC I, MHC IIa and MHC IIx. No difference in isoform expression was found between McArdle and control VL (MHC I:  $33 \pm 19$  vs.  $43 \pm 7\%$ ; MHC IIa:  $52 \pm 9$  vs.  $40 \pm 7\%$ ; MHC IIx:  $15 \pm 18$  vs.  $17 \pm 9\%$ ). Similarly, the BB isoform content did not differ significantly between the two groups (MHC I:  $33 \pm 14$  vs.  $29 \pm 12$ ; MHC IIa:  $46 \pm 17$  vs.  $39 \pm 5$ ; MHC IIx:  $21 \pm 13$  vs.  $32 \pm 14\%$ ). **Discussion** This study evaluated whether a difference in muscle fibre type existed between patients diagnosed with McArdle disease and healthy participants. The results showed that the proportion of isoforms expressed in VL and BB are similar to muscle groups from healthy individuals and thus, cannot explain the higher EMG activity recorded. Furthermore, atrophy of muscle fibres from McArdle patients was only reported for type I fibres (1). Therefore, it is speculated that McArdle disease may also affect the contractile apparatus of the skeletal muscle. **References** 1. Felice KJ, Grunnet ML, Sima AA. Selective atrophy of type I muscle fibers in McArdle's disease. *Neurology* 47: 581–583, 1996. 2. Rae DE, Noakes TD, San Juan AF, Pérez M, Nogales-Gadea G, Ruiz JR, Moran M, Marín MA, Andreu AL, Arenas J, Lucia A. Excessive skeletal muscle recruitment during strenuous exercise in McArdle patients. *Eur. J. Appl. Physiol.* 110: 1047–1055, 2010.

### THE EFFECT OF SOCCER TRAINING AND EXERCISE ON DNA STABILITY AND OXIDATIVE STRESS STATUS

Baralic, I.1, Djordjevic, B.2, Andjelkovic, M.1, Dikic, N.1, Kotur Steviljevic, J.2, Sopic, M.2, Antic, T.1, Vukasinovic-Vesic, M.1, Radojevic-Skodic, S.3

*1: Sports Medicine Association of Serbia, 2: Faculty of Pharmacy, University of Belgrade, 3: School of Medicine, University of Belgrade*

**Introduction** The purpose of the current study was to determine whether soccer exercise is able to cause oxidative stress and DNA instability. Also, we sought to investigate if adaptive response will be developed during 90 day training period and to what extent. **Methods** 14 male elite soccer players, members of soccer team "Teleoptik" participated in the study. Blood samples were collected at the onset of the study and after 90 days of regular training in pre-exercise and post-exercise conditions. We used comet assay to investigate leukocyte DNA stability. The results were presented as DNA score and percent of cells with medium and high damage. Oxidative stress was estimated through blood levels of superoxide anion ( $\text{O}_2^{\bullet-}$ ), total oxidative status (TOS), total antioxidative status (TAS), sulphhydryl groups (SH) and redox balance. The effect of time and exercise and of the combined factors (interaction) on each parameter was analyzed using ANOVA repeated-measures, with time (onset of the study vs. end of the study) and exercise (pre-exercise vs. post-exercise) as the two within-subject factors. Results DNA score did not change significantly in response to soccer exercise. Soccer exercise induced significant increase in the percent of cells with medium and high damage ( $p < 0.05$ ), but only at the beginning of the observational period. However, this parameter, as well as DNA score decreased significantly after 90 days of training period (main time effect,  $p < 0.05$  and  $p < 0.001$ , respectively).  $\text{O}_2^{\bullet-}$  levels increased as a result of regular soccer training over the 90 days (main time effect,  $p < 0.001$ , respectively). Soccer players experienced significant increase in  $\text{O}_2^{\bullet-}$  levels in response to exercise at the end of the study (main exercise effect,  $p < 0.01$ ; exercise x time effect,  $p < 0.05$ ). Following 90 days of regular training, TOS and redox balance significantly decreased (main time effect,  $p < 0.001$ ). There was significant time and exercise interaction effect ( $p < 0.01$ ), since we noticed increase in TOS levels post-exercise at the end of the study, but no change at the beginning. We observed a remarkable decrease in TAS in response to exercise both at the beginning and at the end of the study (main exercise effect,  $p < 0.001$ ). Total SH groups content at rest increased significantly after 90 days of regular training (main time effect,  $p < 0.01$ ). **Discussion** Soccer players are exposed to increased levels of oxidative stress at the beginning of the training season, which might compromise DNA stability and decrease capacity of antioxidant defense. However, regular soccer

training can have a protective effect due to upregulation of antioxidant defense system, causing lower oxidative stress and DNA damage, despite increased production of free radicals. Fisher-Wellman K, Bloomer RJ. (2009). *Dynamic Med*, 8, 1-25.

### **BLOOD LACTATE KINETICS AND MUSCLE POWER FOLLOWING ONE SESSION OF HIGH INTENSIVE INTERVAL TRAINING AND HIGH INTENSIVE TRAINING IN YOUNG AND ADULT MALE ATHLETES**

Engel, F., Stockinger, C., Härtel, S., Bös, K.

*Karlsruher Institute of Technology*

**Introduction** Recovery from High Intensive Interval Training (HIIT) and High Intensive Training (HIT) is faster in children than in adults but the exact mechanisms for the difference in recovery remain unclear (Ratel et al., 2006). However, recovery of blood lactate kinetics and muscle power following HIIT and HIT in trained boys remains relatively unknown. The present study aimed to determine the recovery from HIIT and HIT on blood lactate kinetics and performance in young and adult male athletes. **Methods** Twenty-one trained boys (11.5±0.8 years) and 19 trained men (29.6±4.8 years) performed (a) four consecutive Wingate Anaerobic Tests (HIIT) and (b) one single Wingate Anaerobic Test (HIT). Blood lactate concentration (BLC) was measured after each of the four Wingate Anaerobic Tests in HIIT and after HIT and for 30 minutes of recovery in both tests. The individual BLC recovery curves were fitted to a biexponential time function:  $LA(t) = LA(0) + A1(1 - e^{-\gamma_1 t}) + A2(1 - e^{-\gamma_2 t})$ , where  $\gamma_1$  and  $\gamma_2$  describe the abilities to exchange lactate between the previously active muscle and the blood and to eliminate lactate from the organism, respectively (Freund and Zouloumian, 1981). Performance was measured throughout both tests. **Results** In both tests peak BLC was significantly lower in boys (HIIT: 12.2±3.6 mmol/l; HIT: 8.7±1.8 mmol/l) than in men (HIIT: 16.1±3.3 mmol/l; HIT: 11.5±2.1;  $p < 0.01$ ). Higher  $\gamma_1$  and  $\gamma_2$  values were observed in boys in both tests ( $p < 0.01$ ). Decrease of performance from 1st to 4th Wingate Anaerobic Test in HIIT was lower in boys than in men ( $p < 0.01$ ). **Discussion** It was concluded that both abilities, the faster lactate exchange and the better elimination of lactate from the organism, in boys while and after HIIT and HIT leads to diminished peak BLC. The better lactate removal in boys subsequent to HIIT and HIT represents a faster recovery following HIIT and HIT. The faster recovery enables the boys to a better efficiency to maintain muscle power during HIIT. The fast lactate removal shown in boys in the present study is most likely one mechanism for the fast recovery after HIIT and HIT in children that remained undefined by Ratel et al. (2006). **References** Freund H, Zouloumian P (1981). Lactate after exercise in man. *Eur J Appl Physiol Occup Physiol* 46:121–176. Ratel S, Duché P, Williams CA (2006). Muscle fatigue during high-intensity exercise in children. *Sports Med*. 36(12):1031-1065.

**08:30 - 10:00**

## **Oral presentations**

### **OP-SH04 Physical Education and Pedagogics [PP] 3**

#### **JOINING UP THE DOTS: WHO ARE THE BEGINNING TEACHERS?**

Queirós, P., Batista, P., Ferreira, A.M.

*University of Porto / Faculty of Sport*

**Introduction** To understand how the pre-service teachers turn themselves into teachers and how they develop their professional identity during the practicum is not an easy task. It is important to uncover the transformations that occur during the practicum, namely the linkage between structure and agency (Giddens, 1984). Trying to better understand how the pre-service teachers developed their professional identity the aim of this study is to describe the main characteristics of a group of 4 pre-service teachers in the beginning of their practicum. **Methods** Data collection The data collection resulted from a participant observation made between 21st September 2012 and 5th February 2013 in a practicum group of Physical Education pre-service teachers that works in a secondary public school of Porto, Portugal. The researcher developed an ethnographic study and stays 4 days each week in the school with the group of pre-service teachers observing their classes, staff reunions, collective and individual seminars and other school activities. During the observation period field notes were taken and informal interviews were done in order to clarify some specific situations or uncover particular meanings attributed by the pre-service teachers. **Data analysis** The concept of metaphors (based on the field notes and in the informal interviews) was used to outlining the initial profile of each pre-service teacher. Tannehill and MacPhail (2012) stated that "generally, we think of a metaphor as a figure of speech or something that we use to replace 'normal' words in order to help others understand or enjoy our message." (p. 3) A different metaphor for each pre-service teacher was used to inform the readers about the type of teachers I (as researcher) interpret them as beginning teachers. **Results and Discussion** Although they all work within the practicum group, the pre-service teachers tend to expose different characteristics, which can define them as novice teachers. These different features are related to their personal beliefs, values and teaching perspectives. Even though, there are also some characteristics that are common to all pre-service teachers. In fact, the pre-service teachers mostly tend to act based in what they think the cooperating teacher expect, just applying what is prescribed. Understanding agency as the capacity to act independently and to take responsibility for our actions (Giddens, 1984), it is noticeable that in the earlier stage of the practicum the structure wins. **Acknowledgements** This study is part of a project funded by the Foundation for Science and Technology (FCT) with the following reference: PTDC/DES/115922/2009. **References** Giddens A. (1984). *The Constitution of Society*, Stanford, CA: Polity. Tannehill D, MacPhail A. (2012). What examining teaching metaphors tells us about pre-service teachers' developing beliefs about teaching and learning. *Physical Education and Sport Pedagogy*, 1–15.

#### **THE HIDDEN LEARNING OBJECTS IN PE – PROBLEMATIC OR NOT?**

Redelius, K., Öhman, M., Quennerstedt, M.

*The Swedish School of Sport and Health Sciences*

Throughout its history Physical Education (PE) has been regarded as a 'practical' subject, with a focus on doing gymnastics, sport or play. Students generally think that the subject is important, but they have a hard time stating what they should learn in PE, and that does not only apply to students. Teachers too have difficulties articulating what the students are supposed to learn (Redelius, Fagrell & Larsson, 2009); (Quennerstedt, Öhman, Ericsson, 2008). The aim was to scrutinize how teachers frame the teaching in terms of whether the make

the purpose and the learning outcomes explicit to their students or not. Central questions were: What aspects of learning do teachers articulate and highlight before the lessons? What aspects of learning do teachers articulate and highlight in the teaching, when presenting the content of the lesson to students? Methods The theoretical framework in which this study is grounded is a socio-cultural perspective on teaching and learning (Lave & Wenger, 1991). The participants were teachers and students from three secondary and three upper secondary schools in Sweden. The schools were located in three different cities spread out from north to south. In all, six PE-teachers and about 150 students participated in the study. At each school, at least three PE lessons were videotaped (in total 24 PE-lessons). In addition, six PE teachers and 24 students were interviewed. Results The analysis reveals that two of the teachers are both quite clear about the aims, purposes and outcomes of the lessons and they also communicate this to their students, two teachers express the aims, purposes and outcomes of the lessons in the pre interviews, but they did not communicate this to their students. The third group of teachers had difficulties in communicating learning outcomes with both in interviews and in front of the students. Discussion In the study the socio-cultural perspective was used as a way to direct our attention towards how teachers situated and framed the lesson by communicating the purposes, aims and learning outcomes of the PE-lessons. The results show that if students are to understand what they are supposed to learn in PE, then teachers must communicate the learning goals to students. References Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, MA: Cambridge University Press Quennerstedt, M., Öhman, M., Ericsson, C. (2008) Physical Education in Sweden – a National Evaluation, Education-line: 2008, 1-17. Redelius, K., Fagrell, B. & Larsson, H. (2009) Symbolic capital in Physical Education: To be, to do or to know? That is the gendered question, *Sport, Education and Society*, 14(2), 245-260

### **EFFECTS OF A SHORT-TERM SERVICE LEARNING EXPERIENCE ON PHYSICAL EDUCATION PRESERVICE TEACHERS' CULTURAL COMPETENCY AND TEACHING SKILLS.**

Peralta, L.R., O'Connor, D., Cotton, W.G., Bennie, A.

*The University of Sydney*

Introduction Although service learning has the potential to address school and community needs while providing valuable learning experiences that enhance preservice teachers' culturally responsive pedagogical skills (Buchanan, Baldwin, & Rudisill, 2002), not one service learning experience (SLE) has focused on preservice physical education (PE) teachers and Australian Indigenous students. Hence, the purpose of this study was to investigate the effects of a community and school-based service learning experience (SLE) on preservice PE teachers' cultural competency. Methods A mixed methodology approach was utilised. Final year preservice teachers enrolled in a core unit of study (n=56; age 21.9[8.3] years; 10.7% from low SES) were invited with 98% consenting to participate in a 6-week service learning experience. Measures included baseline and follow-up reflective journals (individual [n=55] and group [n=18]), multicultural teaching competency scales (n=55) and a follow-up focus group interview (n=8). Results Findings revealed that there were statistically significant increases in cultural competency (p=0.000), multicultural knowledge (p=0.000), and skills (p=0.000) from baseline to follow-up. Qualitative analyses identified that preservice teachers were more able to appreciate cultural differences, challenge existing stereotypes, use a student-centred teaching style and design culturally relevant pedagogies and activities, set high expectations and link theory and practice, as a result of their participation in the SLE. Discussion These findings provide evidence that there are benefits such as improved cultural competency and teaching quality, and broadened perspectives through bridging the theory and practice divide, for preservice teachers experiencing service learning opportunities with Indigenous Australian youth. References Buchanan, A. M., Baldwin, S. C., & Rudisill, M. E. (2002). Service learning as scholarship in teacher education. *Educational Researcher*, 31(8), 30-36.

### **THE SOCIAL CONSTRUCTION OF PEDAGOGIC DISCOURSE IN PHYSICAL EDUCATION AND SCHOOL SPORT POLICY DURING A DECADE OF CHANGE IN ENGLAND, 2000-2010**

Jung, H., Pope, S., Kirk, D.

*Institute for Sport and Physical Activity Research*

Over the past decade in the UK, the rise in salience to government of PE and school sport-related policy interventions has been remarkable for the wide-ranging array of objectives that these interventions have been expected to realize (Phillips, 2008). In light of increasing government intervention and interest in physical education and school sport, we analyse and evaluate the Physical Education, School Sport and Club Links (PESSCL) strategy which is one of the most significant sport policies in 2000s. Drawing on Basil Bernstein's (1990,1996) theory of the social production of pedagogic discourse, the primary aim of this presentation is to identify the physical cultural discourses that have informed the PESSCL strategy and its implementation in terms of sport organisation between 2000 and 2010. We have conducted a documentary analysis (Halperin & Heath, 2012), analyzing discourses embedded in PE and school sport policy documents (n=9) and adapted grounded theory approach (Glaser, & Strauss,1967) in order to conceptualize how notions of physical culture are produced and reproduced across primary and recontextualizing fields in which specific agents and agencies operate. This is combined with conducting semi-structured interviews (n=8) with these agencies and an analysis of the outputs of various media (n=467). We identify a number of physical cultural discourses within these policy and other documents and sources, including discourses of health and obesity, good citizenship and volunteering, and elite sport development with a particular concern for the London 2012 Games. Moreover, we discover evidence, consistent with Goodson's (1990) thesis about the social construction of school subjects, of struggles and contestation among vying groups, in this case between agencies such as Youth Sport Trust and Sport England to take the lead in implementing government policy (ie. PESSCL). In conclusion, we question whether there is any connection between government policies, commissioned evaluation reports (eg. by Ofsted, TNS-BMRB and the Loughborough Partnership), and the practice of forms of physical education and school sport. References Glaser, B. G., & Strauss, A. L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago: Aldine Publish. Goodson, I.F. (1990). Studying curriculum: towards a social constructionist perspective. *Journal of Curriculum Studies*, 22(4), 299-312. Halperin, S., & Heath, O. (2012). *Political Research: Methods and Practical Skills*. Oxford: Oxford University Press. Phillips, L (2008). Sport development and young people in England. In B. Houlihan and M. Greenleeds.) *Routledge handbook of sport development*. London: Routledge.

## PE TEACHERS' CONSTRUCTIONS OF SOCIAL AND BODILY DIVERSITY AND THEIR INFLUENCE ON TEACHING PROCESSES IN MULTI-CULTURAL PE CLASSES IN SECONDARY SCHOOLS IN THE NETHERLANDS

Van Doodewaard, C.L., Knoppers, A.E.

*Windesheim, university of Applied Sciences, Zwolle*

Introduction Over the years Dutch Physical Education (PE)-classes have become more ethnically mixed (Statistics Netherlands, 2009a) and diversity in behavioral and physical competences has increased (Statistics Netherlands, 2009b). This is placing greater demands on PE teachers (Bax, et al., 2010). Purpose of this project is to gain insight in the way PE teachers (re)construct social and physical differences in multicultural (MC) classrooms and how these constructions influence teaching processes of inclusion and exclusion. We use a social constructionist perspective to investigate the nature of the interactions between teachers and students that reflect cultural traditions and general patterns of action (Grenier, 2007). Research questions are: How do PE teachers construct diversity? Which strategies do PE teachers use to manage diversity in the gym? How do these constructions and strategies inform processes of inclusion and exclusion in PE classes? Methods Thirteen semi-structured and video stimulated interviews were conducted with PE teachers of MC classrooms. We used qualitative data analysis software to analyze the interviews. The outcomes were discussed and confronted with research literature. Results Four meta themes emerged from the data: relating to students, dealing with cultural identities, engaging in leadership, and assessing performance. Results indicated that PE teachers developed close ties with their students. It seems that they construct a set of deviations in maintaining and releasing classroom rules to include MC students. Moreover, they use these constructions in connection to the cultural backgrounds of students. Thereby, they construct appreciation and acceptance for building an own identity as very important. Discussion Teachers' pedagogical aims seem to conflict with their constructions about managing student behavior in relation to authority themes and assessing students learning improvements. The model for pedagogic discourse of Evans and Davies (2004) seems useful to describe the tensions and constructions, which influence inclusion and exclusion processes of students. For theory development and PETE it is advised to pay attention to the role that modes and constructions seem to play on (deviations from) social and physical standards for the learning opportunities of students. References Bax, H, van Driel, G, Jansma, F. & van der Palen, H. (2010). Beroepsprofiel leraar lichamelijke opvoeding. Zeist: Jan Luiting Fonds. Evans, J. & Davies, B. (2004). Endnote: The embodiment of consciousness. Bernstein, health and schooling. In J. Evans, B. Davies, & J. Wright (Eds.), *Body Knowledge and Control: Studies in the sociology of physical education and health* (pp. 207-217). London: Routledge. Grenier, M. (2007). Inclusion in physical education: From the medical model to social constructionism. *Quest*, 59, 298-310. Statistics Netherlands (2009a). Jaarrapport 2009 Landelijke Jeugdmonitor. Den Haag, Nederland: CBS. Statistics Netherlands (2009b). Jaarboek Onderwijs in cijfers 2009. Den Haag: Nederland: CBS.

## FACTORS INFLUENCING PARENTS'S INVOLVEMENT IN A SCHOOL-BASED INTERVENTION FOR THE PROMOTION OF PHYSICAL ACTIVITY AND HEALTHY EATING

Beltrán-Carrillo, V.J., Sierra, A.C., González-Cutre, D., Cervelló, E., Montero-Carretero, C.

*Universidad Miguel Hernandez*

Do not insert authors here Introduction School-based interventions are common and efficient strategies for the promotion of healthy lifestyles among youth (Story et al., 2009). Parents' involvement in this kind of interventions is considered crucial for their effectiveness (Golley et al., 2010), but achieving parents' participation is not an easy matter. This qualitative study analyzes the factors influencing parents' participation in the activities addressed to them as part of a 6-month school-based intervention for the promotion of physical activity and healthy eating. Methods The intervention with parents consisted of three meetings (theoretical presentation and debate) and a trekking day trip with parents and pupils. These activities were addressed to the parents of 104 pupils aged 14-16 years old and belonging to the same school centre. The data for this study came from the research diary of the person in charge of the fieldwork, who took notes of the events and conversations she attended during the activities with the parents. Four focus groups with pupils and a focus group with parents also served as sources of qualitative data for this study. The data were analyzed with the support of the software Nvivo, following a conventional content analysis (Hsieh and Shannon, 2005). Results The parents' attendance to the different activities was low (5-8 parents). A lack of communication between pupils and parents was a barrier for their participation, although the attendance to the last meeting remained low (17 parents) after a direct contact with parents by phone. Work and family duties were identified as other barriers for their participation in the different activities, but according to some parents and pupils, many parents did not participate because of a lack of interest. However, parents who took part in the activities were satisfied with them, especially with the trekking day trip, and asked for longer interventions in their children's school. Discussion New technologies could favour the direct contact with parents in this kind of interventions. More socially interactive activities could increase parents' attendance and help to create a collaborative social network for a real promotion of healthy lifestyles at school. This social network composed by parents, pupils, researchers and teachers, and based on strong social links between the different agents, needs time to be built. According to these findings, only long-term interventions lasting several years could obtain this purpose. References Golley RK, Hendrie GA, Slater A, Corsini N. (2010). *Obes Rev*, 12, 114-130. Hsieh HF, Shannon SE. (2005). *Qual Health Res*, 15(9), 1277-1288. Story M, Nannery M, Schwartz MB. (2009). *Milbank Q*, 87(1), 71-100.

**08:30 - 10:00**

### Oral presentations

#### OP-SH08 Psychology [PS] 4

### THE INTERRELATION OF SPORT PSYCHOLOGY AND SPORT SCIENCES IN THE PREPARATION OF ELITE PERFORMERS.

Fink, C., Balague, G.

*University of Illinois at Chicago, YSC Sports*

Introduction It is understood that sport psychology plays an important role in the preparation of elite level athletes. What has not received enough attention is the need for sport psychology interventions to incorporate information from the other sport sciences. A sport psychologist who is unaware of specific exercise physiology, biomechanics, and/or training principles risks designing interventions that may

actually interfere with performance. Interactions of Sport Psychology and Sport Sciences: The body of the presentation will describe the ways in which the specific requirements of the training phase, such as the physiological demands or biomechanical elements of the task, must be considered when determining the psychological needs of the athlete and possible interventions. A psychologist without knowledge of the various components of sport sciences may mistake the response to heavy training loads as clinical depression, thus wrongly pathologizing a situation. Interventions widely used in sport psychology, such as imagery and visualization must be considered within the context of the training phase. Often, sport psychology training is done only during the beginning of the season because of time constraints. Asking the athlete to create a multi-sensory image of the actions required at peak competitive time is contrary to the information being registered at the muscular level during the heavy conditioning phase (i.e., training phase). Therefore, it is likely that the intervention will not be helpful or learned correctly. Biomechanical knowledge of the demands of the movement is also important when working with an athlete on a centering routine or a focal point identification. For instance, in some sports, choosing a focal point on the ground may make the athlete lower his or her head at the beginning of a motion that requires a straight posture to be effective. Specific examples of all of these situations in a variety of sports will be presented. Discussion The importance of integrating the sport psychologist within the sport scientists and coaching team will be discussed. The presentation will also discuss identifying some of the specific needs of the athlete-sport psychologist relationship that also need to be protected, such as confidentiality. Implications for the training of sport psychologists will be highlighted and the idea of an integrated working model discussed.

### **IDENTITY FORMATION IN PROFESSIONAL YOUTH TEAM FOOTBALL ENVIRONMENTS**

Mitchell, T.O.I., Nesti, M.S., Richardson, D.J., Littlewood, M.A.

*University Centre Doncaster & Liverpool John Moores University*

Introduction Practitioners, such as coaches, play a significant role in influencing the working environment created and also in determining the ideal player characteristics (Identity). A strong, flexible sense of self may be most suitable for young players to meet their potential and maximise chances of progression (Nesti & Littlewood, 2009). Football environments have been characterised as; dominant, authoritarian and masculine (Parker, 2001). Such features may not facilitate the development of a strong, flexible identity. The aim of this study was to gain a critical understanding of ideal player characteristics required for progression to professional status and to understand organisational strategies influencing such characteristics. Methods Nineteen (N = 19) youth development practitioners from 10 (N = 10) English professional football clubs undertook semi-structured interviews exploring perceptions of ideal player characteristics. Interviews were transcribed verbatim and exposed to notions of content analysis (Strauss & Corbin, 1998). Discussion Practitioners required players to have a deep self belief, be mentally resilient, have their own agenda and possess emotional stability. Such notions resonate to the work of Erikson (1968) on Identity, and more specifically, knowing who and what you are as an individual. Practitioners employed strategies to promote such characteristics whilst acknowledging some ideal characteristics were predetermined and beyond the influence of the club. Traditional notions of conformity, discipline and professionalism remain prevalent increasing risk of Identity foreclosure (Pepitas, 1978) which may inhibit development of a strong sense of self. Practitioners must be aware that at critical moments, such as transition, such foreclosure can increase psychological discomfort (Nesti, 2004). This may ultimately reduce chances of progression into first team environments. References Erikson, E.H. (1968) *Identity: Youth and Crisis*. New York: Norton. Nesti, M.S. (2004). *Existential Psychology and Sport: Theory and Application*. (London: Routledge) Nesti, M.S. and Littlewood, M. (2009) Psychological preparation and development of players in premiership football: practical and theoretical perspectives. In *International Research in Science and Soccer*. (eds) Riley, T., Williams, A.M., and Drust, B. London: Routledge. Parker, A. (2001). Soccer, Servitude and Subcultural Identity: Football Traineeship and Masculine Construction. *Soccer and Society*, 2 (1) pp 59-80. Pepitas, A., (1978). Identity Foreclosure: A Unique Challenge. *Personnel and Guidance Journal*, 56, 558-561. Strauss, A. & Corbin, J. (1998). *Basics of qualitative research. Techniques and procedures for developing grounded theory* (2nd Edition). Thousand Oaks, CA: Sage.

### **BREAKING WAVES: THE WITHIN-CAREER TRANSITIONS EXPERIENCED BY A HIGH PERFORMANCE ADOLESCENT SWIMMER.**

Lyons, D., MacPhail, A.

*University of Limerick*

Introduction An athletic career is determined by developments within sporting, psychological, psychosocial and academic/vocational domains (Wylleman & Lavallee, 2004). Within-career transitions are turning phases in the course of an athletic career (Stambulova, Alfermann, Statler, & Côté, 2009). Alongside transitions that can be expected, such as the move from junior to elite-level sport, athletes also face less predictable transitions such as the loss of a coach. The aim of this study is to explore the within-career transitions experienced by an adolescent high performance swimmer, Kelli, as she made the transition from school to university. Methodology This exploratory case study employed a life history methodology. The study began with the use of a retrospective life history grid (adapted from Côté, Ericsson, and Law, 2005) to trace Kelli's development in sport. Over the next two years data from qualitative interviews and observations were collected to gain an insight into Kelli's life, her choices, decisions and their consequences. The results were analysed using a constant comparative method of inductive data coding. Findings During the two years of the study Kelli experienced a number of transitions both planned and unpredicted across all the domains of her athletic career including the move from junior to senior level sport, the loss of a coach, a change of club, the move from school to university, injury and the maturation from adolescence into young adulthood. Kelli's micro-system consisting of herself, her parents, coaches and peers, and their interaction, were the main facilitators in her successful negotiation of the transitions experienced. As Kelli had made decisions on her future academic life based on her swimming goals the loss of her coach and the subsequent move to a new club resulted in her changing her choice of university and programme of study. Negotiating multiple transitions concurrently was a major source of stress for Kelli. Conclusion Using in-depth case studies to explore the transitions experienced by talented young athletes can help us understand the complexities of athletes' decision making and the ultimate consequences that play out. Macro levels, contextual factors such as the sports system, cultural factors and education policy played a significant role in how Kelli, and her parents, coach and peers made decisions that impacted on her athlete career. These contextual factors need to be considered when designing programmes for young talented athletes to facilitate development, reduce talent loss and maximise athletes' potential. References Côté, J., Ericsson, K.A. & Law, M.P. (2005). *J Appl Sport Psychol*, 17, 1-19. Stambulova, N., Alfermann, D., Statler, T., & Côté, J. (2009). *IJSEP*, 7, 395 - 412. Wylleman, P., & Lavallee, D. (2004) in M. Weiss (Ed.), *Developmental sport psychology*, 507-527.

## A QUALITATIVE EXPLORATION OF ATHLETES' EXPERIENCES OF A THREE TIER POST OLYMPIC DEBRIEFING PROGRAMME.

Moore, P.1, McArdle, S.2, Lyons, D.3

1: MMU/IIS (Manchester, England; Dublin, Ireland), 2. DCU (Dublin, Ireland), 3. IIS (Dublin, Ireland)

**Introduction** The challenges of the Post Olympic Games transition process has been well documented (McCann, 2000). Despite this very little attention has been given to the development and evaluation of post Games psychological support services. To support Irish Olympians and Paralympians in the post Games transition process, the Irish Institute of Sport (IIS) developed a three Tier debriefing programme. This programme included supportive contact with athletes three to four days after their event, an individual debrief and/or athlete led support groups four to five weeks post the games and follow-up psychological support if requested or agreed by the athlete. Given the lack of research on psychological interventions targeted at the post Games transition process (both within and end of career), the aim of this study was to conduct a process evaluation on the IIS debriefing programme. **Methods** Employing a qualitative study design, a purposive sample of 10 Irish Olympic athletes (4 females and 6 males) who participated in the IIS programme were recruited to participate in semi-structured interviews. The topic guide focused on examining participants' overall experience of the programme as well as their views on programme implementation and structure. A thematic analytic approach was employed to identify key themes in the data. **Results** Athletes reported that they had no clear expectations for the debriefing programme but were positively surprised by the experience. In this regard they suggested that more effective communication was required to encourage greater uptake of the support and acknowledged the challenges associated with reaching the Olympic cohort. Perceived benefits experienced included changes in mood (e.g., increased positive affect, decreased anxiety) and increased motivation. All of the athletes indicated that the normalisation of their cognitive and emotional responses in the post Olympic period was one component of the programme that had significant utility. Timing of initial contact by service providers was a prevalent theme with most athletes agreeing that enough time should be allowed for reflection and emotional recovery before discussing their Olympic experience. **Discussion** These findings contribute to the existing literature by elucidating the importance of post-Games psychological support and specific challenges to effective engagement and therefore have implications for future service delivery and implementation. **References** McCann, S. C. (2000). Doing sport psychology at the really big show. In M. B. Anderson (Ed.), *Doing Sport Psychology* (pp. 223-234). Champaign, IL: Human Kinetics.

## THE MOTHER'S PSYCHOLOGICAL SUPPORT IN HIGH LEVEL SPORT

Palomo, M., Ruiz, L.M., García, V.

*Universidad de Castilla La Mancha*

**Introduction** The research on the role of the family in the sport has recently determined how parents play a vital and varied support in sport development, holding different roles in it (Wolfenden and Holt, 2005). In a concrete way the family psychological support provided to children athletes has been defined in the literature as a positive attitude to sport key to the enjoyment of the sport itself (Camire, Trudel and Forneris, 2009), other authors have defined it as a support related to motivation given to the children for sports (Keegan, Harwood, Spray and Lavallee, 2009) or that family being considered as the first source of encouragement (Kesend, 1991). **Aim:** Therefore, the objective of this research was to define the role and counseling of the mother in the reach of the high level of young athletes. **Method:** To that end 20 high-level athletes and 17 of their mothers were interviewed. We used a qualitative methodology, inductive, based on technical and typical procedures of Grounded Theory (Corbin and Strauss, 2008). **Results:** The results establish that psychological support as an assistance provided by the mother to her child athlete referred to mind control and reach the maximum potential and performance in their sport, set in an attitude for success. Psychological Support category consists, in turn, of four dimensions: General Psychological Support, refers to how the mother helps from a mental point of view and in a global mode in order to make sure her child is in top condition and reaches the maximum athletic performance. It is a support based on mood, confidence, giving freedom, stay positive ... Psychological Support for the competition, is the assistance provided by the mother referred to counseling focused on the competition. Psychological Support in High Level, is the support of the mother during a particular stage of the sport development. Adolescence Psychological Support, the support at this stage is focused on helping in a difficult period, in which the doubts, fears and worries are constant. **Conclusion:** In general it can be concluded that the mother helps her child from the psychological point of view showing different ways and periods in which such support varies, modifies or increases its intensity depending on the needs of the young athlete.

## MOTIVATIONS OF MASTERS SURF LIFESAVERS

Reddan, G.

*Griffith University*

**MOTIVATIONS OF MASTERS SURF LIFESAVERS** **Introduction** An understanding of the reasons people participate in sport and exercise is fundamental to the promotion of a healthy lifestyle. Attitudes to physical activity and competition have changed significantly, resulting in the development of masters' games competitions. The aim of this study was to determine the factors that motivate masters surf lifesavers to participate in competition. **Methods** The Motivations of Marathoners Scales (Masters, Ogles & Jolton (1993) consider four general categories: physical health motives; social motives; achievement motives; and psychological motives. The Scales were modified (Ogles and Masters, 2003) and forwarded to all competitors throughout Australia. 142 responses were received – 114 male and 28 female. These were divided into young (30-49) and old (50+) competitors, with 78 and 64 in each respective category. Means and standard deviations were used to identify the most important motives for competition, as well as for each age group and gender. **Results** General Health Orientation was considered the most important motive for participation. These items focused on improving one's health, prolonging life and becoming more physically fit. The second most important motive cited was Affiliation. The items denoting this motive including socializing with friends and sharing a group identity. The old competitors indicated General Health Orientation to be the most important motive. Personal Goal Achievement was considered the second most important motive, with Affiliation rated third by this age group. The younger competitors similarly rated General Health Orientation as the most important, but not to the same degree. Interestingly, this group rated Affiliation second and Personal Goal Achievement third from the nine scales. Differences were demonstrated between the old and young competitors in regards to the importance of Personal Goal Achievement and Self-Esteem. Female competitors rated Affiliation as the most important motive, followed closely by General Health Orientation and Personal Goal Achievement. Males rated General Health Orientation as clearly the most important motive, ahead of Affiliation and Life Meaning. Significant differences between the genders were found only in the rating of Life Meaning. **Discussion** Although ageing causes inevitable physical changes, physical activity associated with sports competition for older adults becomes even more important (Cox & Reed, 2007). This research indicates

specific motives that are considered most important for participation. Leaders of activity programs need to match this diversity to ensure wide participation and a satisfying experience for all participants. References Cox & Reed (2007). *J Sport Behavior*. 30(3), 307-330. Masters, Ogles & Jolton (1993). *Research Quarterly in Exercise & Sport*, 64, 134-143. Ogles & Masters (2003). *J of Sport Behavior*. 26(1), 69-85

## 08:30 - 10:00

### Oral presentations

#### OP-SH11 Sociology [SO] 1

##### SPORT SCIENCE IN EUROPE: FIRST STEPS IN A "SCIENCE STUDIES <1>, <2>" RESEARCH PROJECT

Camy, J.

*University Claude Bernard, Lyon*

Our purpose is to present a research project framework and some preliminary results on "Sport Science as an academic discipline in a European context". Science studies is an interdisciplinary research area that seeks to situate scientific expertise in a broad social, historical, and philosophical context. It is concerned with the history of scientific disciplines, the interrelationships between science and society, and the alleged covert purposes that underlie scientific claims. In Sport Sciences, Historians (5), (6), (7) and philosophers (3), (4), have already paved the way, underlying multiple national and international ideological and institutional conflicts between different theories, movements and professional bodies. We intend here to introduce and illustrate four key topics belonging to the science studies area : - The definition of the field of sport science as it has been controversially discussed by players: which object (sport, exercise, physical activities...)? Which relations with existing disciplines? Which specificity for Sport Science? Which paradigms to mobilize? - The outcomes of sport science, analysis of the "products" such as presentations in Sport Science Congresses and publications in related Journals and the ways they are evaluated; - The community of sport scientists, a systematic approach of the individual "producers" (where do they come from and how do they build their professional careers?) and of the institutional framework into which they operate (research teams and institutions, scientific societies...); - The research activities frameworks (research production processes), the way research activities are planned, financed and organized, the operational cooperation with field players (such as the "sport and physical activities stakeholders") and decision makers... That framework will be put under discussion as well as each of its components. References: (1) Bloor, David; Barnes, Barry & Henry, John, *Scientific knowledge: a sociological analysis*, Chicago: University Press, 1996. (2) Latour. B. *Science in Action: How to Follow Scientists and Engineers through Society*, Cambridge, Mass.: MIT Press, 1987 (3) Mc Fee G.: *Knowledge, Ethics and Truth in Sports Research, An Epistemology of Sport*, Routledge, 2009. (4) McNamee, M. J., (Ed) *Philosophy, and the Sciences of Exercise, Health and Sport: critical perspectives on research methods*, Routledge, 2004. (5) Park, R.J., Eckert, H.M. (Eds): *New possibilities, new paradigms?* (American Academy of Physical Education Papers no. 24), Champaign Il: Human Kinetics, 1991. (6) Renson, R.: *From physical education to kinanthropology: a quest for academic and professional identity*. *Quest* 41: 235-256, 1989. (7) Renson, R.: *History of sport science: hanging together or hanging separately?* Presentation to the ECSS Congress, Copenhagen, 2001.

##### COACHES' ALTERNATIVE DEFINITIONS OF THEIR PROFESSIONAL SUCCESS

Dumitriu, D.

*National School of Political Sciences and Public Administration*

**Introduction** An important part in the dynamics of sport social field is built around the relationship between the representational sphere and the corollary sphere of action. How we perceive things is important and, moreover, is the mere input for how we act. Therefore, the way sport actors define and relate to the competitive framework becomes decisive in explaining their professional practices and level of engagement in sport acts. Focusing on the representational pole of this cognitive-action dyad, the main aim of this study is to lay stress on the way Romanian handball coaches define professional success. What or who brings coaches their success? Is coaches' professional success based solely on the winning-losing track record? When can we speak of successful coaching career? These are the guiding lines that settle the research framework for the present study. **Methods** The research design of this case study combines a qualitative exploration of Romanian handball coaches' social representations upon professional success with a quantitative approach meant to highlight the level of convergence and the dominant positions inside handball coaches' community. Thus, the 23 in-depth interviews and the survey conducted on a 118 handball coaches' sample should be understood in terms of methodological complementarity. **Results** While the quantitative results place success mainly in relation to the task goal orientation and the passion trigger beyond sport engagement, the qualitative approach brings out a more contextualized definition of professional success, providing alternative paths in reaching it: from a result oriented definition of professional success, to a pedagogic-formative framing of success. **Discussion** Both the quantitative and the qualitative approaches converge in laying emphasis on the team-dependency condition of coaches' success. This success' component that seems to be off coaches' control, works also as a self-esteem protective mechanism, leaving room for an endless problematization of success. To sustain this convenient value of coaches' limited responsibility towards their own professional success, the qualitative research brings out a significant duality in terms of public discourse and actual convictions of Romanian handball coaches. The public pressure associated with the moral and social desirability standards makes coaches embrace a soft definition of success, favoring the task goal orientation as a rational response to the perceived social expectations. However, results and track records remain coaches' ultimate proof of success, acting as the most powerful success indicator both in and outside the sport professional community. **Note:** The author of this study is beneficiary of the Doctoral Scholarships for a Sustainable Society Project, co-financed by the European Union through the European Social Fund, Sectoral Operational Programme Human Resources and Development 2007-2013

**SPORT ATTITUDES AND MOTIVATIONAL CLIMATE IN TWO CONTRASTING FOOTBALL CLUBS**

Domingues, M., Gonçalves, C.E.

*Faculty of Sports Science, University of Coimbra*

**Aim:** To investigate the relationship between perceived motivational climate, sportspersonship, social-moral functioning and team norms in a sample of young male Portuguese football players as well as to verify possible contextual factors mediating that relationship. **Design:** It was expected that motivational climate of the social club would be associated with lower levels of social-moral functioning, sportspersonship and the perceptions of team norms that would approve of illegitimate behaviors in football. Alongside this, a more mastery-oriented climate by the POC was hypothesized to be beneficial with respect to social-moral functioning, sportspersonship and morally constructive team norm perceptions. **Method:** A cross-sectional study of 125 male football players (aged 13–17 years) was conducted in which players responded to a questionnaire measuring different dimensions of social-moral functioning namely sportspersonship behaviors and team norm perceptions. The players also responded to their perception of coaches motivational climate regarding a more mastery oriented or inversely, a more performance dictated sporting climate. **Results:** Results show consistent higher scores both in SAQ and PMCSQ-2 in POC youth athletes with clear task orientation and a more pro-social acceptance of sport, importance of personal improvement, cooperation and collective sense. SOC and POC showed similar results in ego orientation which might be conducive of different intricate ego orientations. **Conclusion:** The findings illustrate the importance of studying motivational climate in contrasting sporting environments in order to provide an understanding of social-moral functioning and social-moral team norms in youth football and also a way to determine interpersonal relations that are key to establish a good climate.

**PHYSICAL EDUCATION TEACHER EDUCATION IN FINLAND – FOUNDATION BUILT FOR HIGHER EDUCATION IN THE 1960'S**

Lahti, J.

*University of Jyväskylä*

**INTRODUCTION** Physical activity is an important part of Finns' lives. Finland ranks among the top nations in sport participation. Elite sport is also socially significant in the Finnish society. Finland is one of the few countries in Europe where qualified physical education teachers are required to have a master level education. This dates back to 1963 when physical education teacher education (PETE) became an academic discipline at the University of Jyväskylä, which still is the only place in the country with higher PE teacher education. This paper is a part of the doctoral study that examines the changes and developments of the PETE in its 50 years' history in Finland. This presentation scrutinizes the first decade of the PETE in Finland. The aim is to search for the underlying starting points of the content formation of PE teacher education. This will be conducted in the framework of historical research. **DATA and METHOD** The data consists of the official and public resources; documents of the curriculum criteria and interviews of the key persons in the development of PETE in Finland. Legislation concerning education together with archive materials, magazine and newspaper articles are also important sources of research material. The data is analyzed with the method of document analysis. **RESULTS** In 1963 when the PETE started, the curriculum was rather practically oriented. At that time students usually graduated in three years, whereas now, PE teachers study approximately five years. In the very beginning, PETE was based on the guidelines of a committee report by the government. In addition, the content of the curriculum was influenced by individual staff members of the Department of Education. Especially at the early stages of PE education in Jyväskylä the pioneers of educators had an important role in shaping the curriculum. **DISCUSSION** University of Jyväskylä is the only place in Finland where PE teachers are educated. This brings both advantages and challenges. On one hand, Jyväskylä holds a nationwide educational task which is supported by public resources. On the other hand, with its monopoly position as the only PETE unit in the country, there is a risk that "healthy" competition with quality improvements is scarce. Historical analysis of the foundation and the first decade of PETE in Finland become interesting not only because of the curricula changes with their societal linkages during the 50 years' of education. The first decade of PETE serves research attention also as it brings to light facts, persons and incidences that have had substantial and long term consequences in the way sport and physical activity are taught, participated and valued in a society that is one of the most physically active in the whole world.

**08:30 - 10:00****Oral presentations****OP-PM44 Sports Medicine [SM] 5****BENEFITS OF FIFA 11+ PROTOCOL DURING FIVE SEASONS, A PRELIMINARY STUDY IN YOUNG PROFESSIONAL SOCCER PLAYERS**

Olla, S.1,2,3, Scorcu, M.1,2, Piras, F.1,2, Cugia, P.1,2, Angius, L.3,4

*1:F.M.S.I., Cagliari, Italy; 2:Cagliari Calcio S.p.a., Cagliari, Italy; 3:Laboratory of Sport Physiology, University of Cagliari, Italy; 4:School of Sport and Exercise Sciences, University of Kent, UK*

**Introduction and aims:** Football as most of the team sports involves alternation of low and high phases of running intensity. As consequence, a higher increase of injuries is present during match or training. According to this, technical and medical staff work to prevent the onset and the increment of injuries. Numerous protocol of prevention have been proposed to reduce the amount of injuries. The aim is to monitor the application of FIFA 11+ protocol in a young professional football academy during five seasons. **Methods:** a sample of 820 young-players aged between 10-21 years old, was monitored during five Italian championship seasons (from 2007/08 to 2011/12) both during training and match sessions. FIFA 11+ protocol was applied only during the first four season except during the last (2011/12). All the injuries were examined by the medical staff and subsequently classified according to: number of injury, role and condition. A one-way analysis of variance (ANOVA) were used to check differences between each seasons. Significance was set at  $p < 0,05$ . **Results:** the total amount of injuries during the five seasons was 380 (81, 80, 75, 60 and 84). The case report shows a greater incidence in defenders compared to midfielders, strikers and goalkeepers ( $32.00 \pm 7.25$ ,  $20.20 \pm 4.66$ ,  $16.40 \pm 4.39$  and  $7.40 \pm 3.05$ ). Number of injuries during

training was (61, 65, 56, 45 and 51) while during match was (20, 15, 19, 15 and 33). Discussion: Defenders and midfielders were the most affected roles because of the higher density of players in those areas of the pitch. Interestingly this analysis shows a progressive decline of the total number of injury through each season except for the 2011/12. Same decline has been found during training sessions. Results indicates that application of the FIFA 11+ protocol is able to reduce the onset of injury. On the contrary when the protocol was not used, an increment has been observed. In conclusion we can affirm that prevention strategies are important to preserve the physical integrity of players. References: 1. Backous DD, Friedl KE, Smith NJ, et al. *Am J Dis Child* 1988;142(8):839-42; 2. Koutoures CG, Gregory AJ. *Pediatrics* 2010;125 (February (2)):410-4.

### **INJURIES IN GERMAN ELITE MEN'S HANDBALL - VIDEO ANALYSIS OF MATCH INJURIES**

Luig, P., Klein, C., Henke, T.

*Ruhr-Universität Bochum*

Introduction: Elite Men's Handball is undoubtedly a physically demanding team sport with intense body contact and highly intermittent running stressing the athlete's cardiovascular, metabolic and musculoskeletal systems. The first two German national leagues promote themselves as best leagues of the world and are home to numerous international top players. However, among German professional sports handball ranks absolutely high in national injury statistics. This fact endangers game operations of the clubs through steadily increasing insurance rates. Methodology: Registered injuries from the insurer's injury database as well as resulting costs and disabilities are analyzed for three consecutive first and second league seasons (2010-2013). Moreover, identifiable match injuries are assessed through video analysis to objectify the circumstances and situations that frequently lead to injuries. Gathered information will be used to reveal key areas for prevention and to tailor targeted counter-strategies for elite clubs, coaches and athletes. Results: During the first two seasons (2010-2012) 3,732 injuries were registered causing direct medical costs of 4.25 million and 33,000 days of disability. 65 % of injuries need medical treatment only, 35 % cause time-loss (disability). Each player sustained 2.4 injuries per season (0.9 time-loss injuries/season). Injury incidence in league games was 63.7 injuries/1000h (23.7 time-loss injuries/1000h). Knee (12.9 %), ankle (11.6 %) and shoulder (9.5 %) were most frequently affected. Most severe injuries were knee injuries that, on average, induced 52 days of disability and 3,250 costs, followed by hand injuries (49 days, 1,500) and shoulder injuries (38 days, 1,500). Preliminary results of the video analysis show that single-leg landings from jump shots or blocks and side-cutting moves in "1 on 1"-situations, with or without contact, provoke lower extremity injuries. By contrast most upper extremity, trunk and head injuries are caused by direct physical impact through opposing players, falls and ball hits. Discussion: Men's handball on elite level bears a high injury risk. As the primary goal of professional athletes is to maximize performance, preventive measures can best be integrated as standard components in sport-specific performance enhancement programmes and warm-up routines. This includes technique training for crucial handball movement patterns that typically lead to match injuries in both contact and non-contact situations. It is essential to have injury prevention modules included on all levels of athletes' and coaches' education to increase the chances of sustainable inclusion of injury prevention measures in training and coaching. Moreover, federations, clubs and coaches are certainly in charge to protect their athletes best possible. Sufficient preparation and regeneration, especially prior to and after major international events, is of highest priority.

### **DO ELITE RUGBY PLAYERS WITH REPEATEDLY INJURED HAMSTRINGS DEMONSTRATE ALTERED GLUTEAL-HAMSTRING RECRUITMENT PATTERNS WHEN SPRINTING?**

Brett, A.N., McGuigan, M.P.

*University of Bath*

Introduction Acute hamstring injuries are the most prevalent muscle injuries in sport, and recurrence figures remain high. Gluteal-Hamstring recruitment has been proposed as a potential risk factor for hamstring injury susceptibility (Jonkers et al., 2003), and delayed activation of gluteus maximus was demonstrated in hamstring injured vs non injured legs during a single-leg stance (Sole et al., 2011). No recent research has addressed activation and recruitment patterns during sprinting, the main provocative event in many hamstring injuries. The aim of this study was therefore to investigate the timing and magnitude of activation of gluteal and hamstring muscle groups during sprinting in elite rugby players, with and without a history of hamstring injury. Methods A two-way repeated measures design assessed the effect of injury on gluteal activation delay and the magnitude of activation, at different phases of the sprint. Two groups of elite rugby players were used: a control group with no previous history of hamstring injury (n=9); and a hamstring-injured group who had a history of more than one hamstring strain but were currently fit for selection (n=6). EMG signals from gluteal and hamstring muscles were recorded at 1000Hz using Myontec Pro EMG shorts (Myontec, Finland), during three maximal 50m sprints on an outdoor artificial grass surface. EMG data were analysed for the relative timing of the onset of the gluteal muscles compared to the hamstring muscles and the average rectified EMG (AREMG) over a stride for both muscle groups during the acceleration, maximal velocity and deceleration phases of the sprints. Results When considering all phases of the sprint together there were no significant differences in outcome measures between the hamstring injury and control groups. However, there were large effect sizes for a greater delay in gluteal activation onset (d = 0.88) and greater gluteal AREMG (d = 0.93) in the hamstring injury group compared to the control. Discussion Although there were no significant differences between the two groups, the large effect size for a delay in gluteal activation in the hamstring injury group provides some support to the hypothesis, and suggests that the question warrants further investigation with a larger sample size. The large effect size for a greater mean gluteal AREMG in the hamstring injured group compared to the control group suggest that professional rehabilitation and return to play programmes, with a strong gluteal re-education emphasis may have been effective in increasing gluteal activation, but not in initiating this prior to the hamstrings. References Jonkers, I., Stewart, C., Spaepen, A. (2003) *Gait and Posture* 17, 264-272 Sole, G., Milosavljevic, S., Nicholson, H., Sullivan, S.J. (2012) *BJSM* 46, 118-123

### **PROPENSITY OF CONTACT EVENTS TO CAUSE INJURY IN RUGBY UNION**

Stokes, K.A., Roberts, S.P., England, M., Trewartha, G.

*University of Bath*

Introduction Approximately 80% of all injuries sustained during rugby union matches are associated with contact events. Typically, injury incidence rate is reported per unit of time (e.g., per 1000 player hours), but expressing incidence rate per contact event gives an indication of the relative risk of each type of event. The aim of this study was to determine the propensity of specific contact events to cause injury in rugby union. Methods Injury data were reported by medical staff at participating English community level rugby clubs in the 2009/10 (n=46), 2010/11 (n=67), and 2011/12 (n=76) seasons. Injury diagnoses for any injury resulting in an absence from full participation in match

play for one match or more from the day of the injury were recorded using the Orchard Sports Injury Classification System. Injury severity was estimated based on the number of matches missed (accurate to one week / match). Injury data for all seasons were combined for analyses. 30 community rugby matches were filmed and the number of contact events (tackles, collision tackles, rucks, mauls, lineouts and scrums) was recorded using match analysis software (SportsCode Pro, Sportstec, Australia). Significant differences were assumed where 95% confidence intervals (CI) did not overlap. Results There were 370 (95% CI; 364-378) contact events per match of which 141 (137-145) were tackles, 115 (111-119) were rucks and 32 (30-33) were scrums. Tackles resulted in the greatest injury incidence rate [2.3 (2.2-2.4) injuries/1000 events] and severity [16 (15-17) matches missed/1000 events]. Being tackled resulted in a higher incidence rate [1.3 (1.2-1.4) injuries/1000 events] than tackling [1.0 (0.9-1.1) injuries/1000 events]. Collision tackles (illegal tackles involving a shoulder charge) were associated with an incidence rate of 15.0 (12.4-18.3) injuries/1000 events and severity of 83 (68-101) matches missed/1000 events which were higher than any other event. Additional analysis of the scrum in the 2011/12 season showed that collapsed scrums accounted for only 5% of all scrums, but the injury incidence rate was 2.9 (1.5-5.4) injuries/1000 events compared with 0.6 (0.4-0.8) injuries/1000 events for scrums that did not collapse and the severity was 22 (12-42) matches missed/1000 events compared with 3 (2-5) matches missed/1000 events. Discussion Continued focus on injury prevention in the tackle is required through coaching of effective technique when both making tackles and being tackled. In addition, the results support strict enforcement of existing laws in relation to illegal collision tackles. Furthermore, given that the scrum is a relatively controllable phase of contact, further attempts should be made to reduce the frequency of scrum collapses. Acknowledgement Research funded by the Rugby Football Union

## THE ANALYSIS OF MOTOR SKILLS, FUNCTIONAL MOVEMENT AND PREVENTION OF INJURY IN ELITE YOUNG SOCCER PLAYERS

Zalai, D., Bobák, P., Csaki, I., Hamar, P.

*Semmelweis University*

Introduction Over the course of past few years soccer players have progressed tremendously in terms of physical performance. During a competitive game players frequently perform activities that require rapid development of force such as sprinting and fast change in direction (Sporis, 2011). The increasing demand for players has emphasized the importance of motor skills, quality of functional movements and injury prevention. The purpose of this study was to examine the characteristics and impact of motor skills, functional movements on performance and establish risk factors for injuries among elite young soccer players. Methods The participants (N=60) were tested by Functional Movement Screen™ (FMS) system, that determined the muscle strength, flexibility, range of motion, coordination, proprioception and identified athletes limitations and functional asymmetries in movement patterns that are considered to be the most significant risk factors for injury (Kiesel, 2007). Findings in motor skills were analyzed further in relation to players position during a game. Goalkeepers (GK), defenders (DEF), midfielders (MID), and forwards (FW) were investigated regarding their lower limbs explosive strength (LLES) for the horizontal and vertical plane, and the sprint ability (SA) in 5, 10 and 30 meter. Results We have found statistically significant correlations between test LLES ( $r=0,584$ ) and test SA on 5m and 10m ( $r=0,797$ ) in relation to players anthropometric parameters (height,  $185,4\pm 5,65$ cm; weight,  $82,8\pm 6,76$ kg; BMI,  $24,08\pm 1,27$ ). Findings in DEF showed significant differences concerning sprint ability in 10 and 30 meters ( $p<0,05$ ) compare to other groups. The FMS (mean score,  $15,47\pm 1,93$ ) tests have not established substantial link to the anthropometric variables ( $r=-0,236$ ) and sprint abilities ( $r=-0,143$ ), but 41% of players examined demonstrated movements asymmetry and limitations. Discussion The observations made by this study emphasize the importance of timely and detailed evaluation and selection of football players at the beginning of their academy training. It has also verified the incidence and type of functional asymmetry in player's movement patterns. Athletes with lower limb asymmetry have an increased risk to develop non contact injury (Kiesel, 2008). This has also been demonstrated in a previous milestone study by FIFA F-Marc that revealed the non contact nature of injuries in 54% of cases. References Kiesel K, Plisky P, Voight ML. (2007). *North Am J Sports Phys Ther.*, 3, 147-158. Kiesel K, Plisky P, Kersey P. (2008). *Med Scie Sports Exerc.*, 5, 40-48. Sporis G, Milanovic Z, Trajkovic N, Joksimovic A. (2011). *Acta Kinesiologica*, 5, 36-41.

**10:20 - 11:50**

## Invited symposia

### IS-PM02 ACSM Exchange symposium: Exercise - Thermoregulation \*

#### HEAT TRANSFER FROM SKIN TO ENVIRONMENT IN HYPERTHERMIC HUMANS

Havenith, G.

*Loughborough University*

This second invited presentation of the ECSS-ACSM exchange will look at the heat transfer outside the body, i.e. from the skin outwards, and at recent insights in this process. Starting from the classical heat balance approach, which mostly treats the body as a uniform surface, the presentation will look at regional variation in dry and evaporative heat transfer across the body, linking heat transfer to local body movements, local blood flow and to the local generation of sweat. Body heat loss and sweat production maps produced in the last few years have improved the modelling of heat exposure and have also contributed to the design of sex-specific garments, incorporating the information obtained. Finally the role of clothing and protective gear in this heat transfer will be discussed and the effect they have on heat strain. Promises made in innovative clothing fabrics will be briefly addressed too.

#### INTERNAL HEAT TRANSFER IN EXERCISING HUMANS

Kenney, W.

*Penn State University*

The first in a sequence of two presentations, this invited lecture discusses metabolic heat (M) generation and its requisite transfer from working muscle to the skin. M can be extremely high in exercise, sport, and work scenarios due to intensity of effort and inefficiency of external work produced. Adiabatic exercise would limit exercise duration to minutes in most circumstances, illustrating the need for

convective transfer of heat to the skin. Convective heat transfer is a function of (1) specific heat of blood, (2) the core-to-skin temperature gradient, and (3) skin blood flow, and only the latter is physiologically regulated. Active cutaneous vasodilation involves sympathetic cholinergic co-transmitter release. Further, nitric oxide (NO) bioavailability is a downstream requirement for full reflex cutaneous vasodilation. In older exercising subjects, as well as those with vascular dysfunction (hypertension, hypercholesterolemia) NO-mediated dilation is reduced, with the potential consequence of attenuated heat loss.

## 10:20 - 11:50

### Oral presentations

#### OP-PM45 Sports Medicine [SM] 6

##### **PERSISTENCE OF EXERCISE ADAPTATIONS AFTER ONE MONTH OF DETRAINING IN METABOLIC SYNDROME PATIENTS**

Hamouti, N., Ortega, J.F., Fernández-Elías, V.E., Mora-Rodríguez, R.

*University of Castilla-La Mancha*

**Introduction:** High-intensity aerobic interval training is associated with the removal of some of the factors that constitute the metabolic syndrome (MetS) (1). However, it is unclear which of the adaptations are long-term maintained and which are less persistent after exercise training cessation. The STRRIDE study revealed that, after 2 weeks of detraining, the training-induced improvements on insulin sensitivity (2) and HDL-c (3) in sedentary overweight adults persist when exercise is intense enough. To our knowledge, training cessation beyond 2 weeks has not been explored yet in MetS patients. **Material and methods:** Forty-eight sedentary MetS patients (22 men and 26 women, 52±8.8 yrs old) underwent 16 weeks of 3 days per week of supervised cycle-ergometer high-intensity aerobic interval training (HIAIT). Training sessions were composed of 4x4 min bouts of pedaling at 90% HRmax interspersed by 3 min at 70% HRmax. MetS factors, blood metabolites, cardio-respiratory (VO2max) and metabolic (maximal fat oxidation, MFO) fitness and insulin resistance (HOMA-IR) were measured when subjects were sedentary and at 48 h and 33 days after the final training bout. **Results:** Waist circumference was reduced with training (2.4 cm) and remained at trained values after 33 days of detraining. Systolic, diastolic blood pressure and HDL-c improved with 4 months of training (13±3; 12±8% and 12±10% respectively, P<0.05) and returned to the 3 months of training values with detraining. In contrast, the gains in HOMA-IR, VO2max and MFO were almost completely lost after 33 days of detraining. **Conclusions:** Training improvements on body composition were held after 1 month of detraining. The blood pressure and HDL-c improvements decreased with detraining at a rate of 1 to 1 (i.e., 1 month of detraining, cancels out the last month of training). However, insulin sensitivity and cardio-metabolic fitness evaluated during exercise decreased with detraining at a rate of 1 to 3 (i.e., 1 month of detraining cancels out 3 months of training). Surprisingly, some important training adaptations that reduce the risk of cardiovascular diseases (i.e., blood pressure and HDL-c) were persistent to 33 days of detraining. 1. Tjonna AE, et al. Aerobic interval training versus continuous moderate exercise as a treatment for the metabolic syndrome: a pilot study. *Circulation* 118:346-54, 2008. 2. Bajpeyi S, et al. Effect of exercise intensity and volume on persistence of insulin sensitivity during training cessation. *J Appl Physiol* 106: 1079-1085, 2009. 3. Slentz CA, et al. Inactivity, exercise training and detraining, and plasma lipoproteins. STRRIDE: a randomized, controlled study of exercise intensity and amount. *J Appl Physiol* 103: 432-442, 2007.

##### **CDC34+ CIRCULATING PROGENITOR CELLS AFTER DIFFERENT TRAINING METHODS**

Niño, O., Javierre, C., Blasi, J., Balagué, N., Aragonés, D., Corral, L., Miguel, M., Gaitán-Peñas, H., Viscor, G., Ventura, J.L.

*University of Barcelona*

**Introduction** Circulating progenitor cells (CPC) are bone marrow-derived cells that are mobilized to the circulation and incorporated in the sites of injury. Exercise is a powerful mediator of hematopoiesis but the CPC increases and their schedule after different types of exercise are contradictory. Moreover, there is a lack of studies comparing different training methods, including resistance, in the possible changes in CPC concentrations. **Methods** Forty-three healthy male subjects physically active, (age 21.2 ± 2.4 years) were randomly distributed in four different training groups: aerobic (AET), resistance (RET), mixed (MIX) and control (CON). They were trained for six weeks except the control group. Peripheral blood samples were collected by puncture of an antecubital vein and CD34+ CPC analysed according to a previously described method (Viscor G), in different days: pre-training, post-training and three weeks after finishing the training period. **Results** No significant CPC differences were observed between the different training groups, but with a tendency to higher values post training and a big dispersion intra and intergroups. We detected an inverse lineal relationship between the % of post-training CPC changes and the pre-training values (R=0.826, F=189.8, p<0.001). In the CPC values 3 weeks after training this inverse relationship was maintained but at lower extent (R=0.566, F=52.2, p<0.001). **Discussion** The different training methods applied in this study do not seem to be able to increase the CPC concentration in a stable form. The way differences in individual responses seem to influence the global training response. **References** Asahara T et al (1997) *Science* 275:964-967 Koutroumpi Met al (2012) *World J Cardiol* 4:312-326 Viscor G et al (2009) *J Transl Med.* Oct 29; 7:91

##### **AEROBIC AND ANAEROBIC THRESHOLD RESPONSES TO A TRAINING PERIOD WITH DIFFERENT STIMULUS**

Alamo, J.M.1, Niño, O.1, Aragonés, D.2, Balagué, N.2, Cos, F.2, Guillamó, E.1,2, Ventura, J.L.1, Javierre, C.1

*University of Barcelona*

**Introduction** The purpose of this study was to evaluate the changes in the aerobic respiratory threshold (T1) and in the anaerobic respiratory threshold (T2) after different training types: aerobic (AET), resistance (RET) and both (MIX). **Methods** Forty-three healthy subjects physically active, (age 21.2 ± 2.4 years) were distributed in four randomized training groups: AET, RET, MIX and CON and they were trained during six weeks except the CON (control group). Three evaluations were conducted: pre-training, post-training and three weeks after finishing the training period, and included workload and metabolic-respiratory data in a graded exercise test until exhaustion. **Results.** A/ With regard to the evolution of T1 we observed changes in the MIX group between the 1st and the 2nd evaluation of workload (1st: 84.1 ± 36.8 W; 2nd: 127.8 ± 29.4 W, p=0.024) and between the 1st and the 2nd evaluation of % of the maximal workload (1st: 30.7 ± 12.1; 2nd:

43.2 ± 11.1 %W, p=0.048). In addition, in the AET group % of maximal workload showed statistical differences between the 2nd and the 3rd evaluation (2nd: 32.8 ± 9.2; 3rd: 38.6 ± 6.6 %W, p=0.049). B/ Moreover, when the evolution of T2 was analyzed, changes in the MIX group respect to: the workload between the 1st and the 2nd evaluation (1st: 221.2 ± 34.2 W; 2nd: 255.1 ± 20.9 W, p=0.002), the 1st and the 3rd evaluation (3rd: 257.9 ± 19.2 W, p=0.002) and % VO<sub>2</sub>max between the 2nd and the 3rd evaluations (2nd: 78.8 ± 10.6; 3rd: 86.7 ± 4.07, p=0.04) were found. The AET group showed differences in %VO<sub>2</sub>max between the 2nd and the 3rd evaluation (2nd: 79.1 ± 6.4; 3rd: 86.3 ± 5.6, p=0.002). In the RET group the changes appeared at workload between the 1st and the 2nd evaluation (1st: 211.2 ± 25.8 2nd: 229.2 ± 23.6 W, p=0.042) and between the 1st and the 3rd evaluation (3rd: 228.2 ± 26.4 W, p=0.023). CON group showed changes in the workload between the 1st and the 3rd evaluation (1st: 251.9 ± 36.4 W; 3rd : 273.9 ± 36.0 W, p=0.001) and the 2nd and the 3rd (2nd: 252.0 ± 36.4 W, p=0.006), % workload between the 1st and the 3rd (1st: 81.5 ± 3.8 ; 3rd: 89.9 ± 3.2, p=0.002), between the 2nd and the 3rd (2nd: 83.1 ± 5.5 ; 3rd: 89.9 ± 3.2, p=0.003), %VO<sub>2</sub>max between the 1st and the 2nd evaluation (1st: 80.4 ± 8.1; 2nd: 89.2 ± 6.9, p=0.004) and between the 1st and the 3rd (3rd: 91.0 ± 4.7, p=0.001). Discussion MIX training, under the conditions of the present study, seems to produce greater and more lasting improvements in both thresholds. References Dal Maso F, Longcamp M, Amarantini D.(2012) Exp Brain Res 220:287-295. Wasserman K, Mc Ilroy MB (1964) Am J Cardiol 14:844-852.

### MONITORING WORKLOAD DURING A TRAINING PROGRAM IN A WEIGHT LOSS INTERVENTION IN BREAST CANCER SURVIVORS.

Guillamó, E.1,2, Travier, N.3, Oviedo, G.4, Roca, A.1, Delicado, M.C.1, Niño, O.1, Cos, F.2, Agudo, A.3, Barbany, J.R.1, Javierre, C.1

*University of Barcelona*

Introduction Exercise intensity is an important parameter in exercise programs. As part of a study, in breast cancer (BC) survivors, to promote weight loss through a dietary intervention and a physical exercise program, we propose to design a test to control and adjust the training intensity of each participant along the intervention. Methods Forty two BC survivors (women aged 54.8±8.6 years) overweight and obese, started an intervention with an exercise program, including 5 weekly sessions for 12 weeks (two sessions in the laboratory and the other three at the participant's home). Aerobic exercise combined with strength training were the main components of this physical exercise program. Aerobic exercise was completed cycling and doing aerobics choreography sessions. The test to control the intensity was carried out cycling. The test was integrated into the training sessions. It consisted of two cycles of 8 and 6 minutes, cycling at an intensity of 13-14 on a rate of perceived exertion. Heart rate (HR) and workload were registered every two minutes. Values of the last four minutes of the second cycle of exercise were used to calculate the participant's capacity in each test. This result was assimilated to 70% of the maximum capacity of the participant and used to schedule work intensities for each participant during the next sessions. This test was performed at weeks 3, 5, 7, 9 and 11. Results An increase in power output achieved was observed in the 5 tests (week 3: 80.1 ± 24.5 W, week 5: 84.0 ± 27.4 W, week 7: 88.0 ± 28.3 W, week 9: 90.5 ± 31.5 W and week 11: 93.9 ± 30.2 W), being different from those observed at the beginning from week 7, 9 and 11 (p <0.05). Changes in HR were not monitored during the physical test. Discussion The test carried out two series of 8 and 6 minutes cycling at an intensity chosen by the subject, later introduced as training load in the program. This test seems to be a good method to assess workloads required during the exercise program. The HR for these workloads could be a parameter to complete the information about the best power output requested during the physical program. Future research is needed to confirm these results. Reference 1. Franklin, B., & Swain, D. (2003). New insights on the threshold intensity for improving cardiorespiratory fitness. Preventive Cardiology, 6(3), 118.

**10:20 - 11:50**

### Invited symposia

#### IS-PM15 Can exercise damage the heart \*

##### CARDIAC SCREENING BEFORE MARATHON?

Scherr, J.

*Technical University Munich*

It is well known that participation in regular, moderate-intensity exercise reduces mortality and cardiovascular and malignoma-associated morbidity. However, it is still an object of debate whether intense and prolonged exercise (such as marathon running and the associated training) results in an in- or decrease in mortality because the reports of marathon-related sudden cardiac death, especially in the lay press, are increasing. Therefore, in the last few years, a discussion has been raised whether pre-marathon participation screening should be performed, with some even arguing that they be mandatory. Furthermore, if screening is to be performed, the extent of screening is currently being discussed controversially, even within expert cardiovascular societies. The World Health Organization (WHO) published several criteria in 1968 which have to be met to justify a pre-participation screening procedure. In accordance to these criteria, the currently discussed pros and cons regarding several potential examination modalities used for pre-participation screening of marathon runners (resting-ECG, exercise testing, echocardiography) are presented with a special focus on different subgroups.

##### DOES MARATHON INCREASE INCIDENCE OF SUDDEN DEATH?

Halle, M.

*Technical University Munich*

Numbers of participants in city marathons have continuously increased over the last decades. This is observed for males and females alike. Interestingly the age >40 years of the participants has also steadily increased from 26% in 1980 to 46% in 2010. This has a substantial impact on the the number (7-fold increase) and cause of sudden cardiac deaths as coronary heart disease is becoming significantly more prevalent and a major cause of exercise induced death beyond the age of 35 years. These fatal events occur mostly during the end of the race beyond mile 22nd. Mechanisms and underlying causes for these events differ substantially. Genetic disease including myo-

cardial hypertrophy, conduction problems, myocarditis of coronary heart disease are mostly found in autopsies. Therefore, understanding the short-term and long-term effects of long-distance endurance sports is mandatory and should lead to a more sophisticated medical screening in leisure time and elite athletes alike in order to reduce the incidence of sudden cardiac deaths during marathon running.

### EVIDENCE FOR CARDIAC STRAIN DURING A MARATHON

George, K.

*Liverpool John Moores University*

Over the last three decades a range of studies have assessed two linked and controversial concepts; (1) exercise-induced cardiac fatigue and, (2) exercise-induced cardiac damage. Whilst these topics were initially developed and assessed in an academic setting there has now been cross-over into the lay press. This has raised substantial awareness and debate within the endurance sports world as to the safety of marathon training and competition for all participants. Both concepts have been studied in a range of endurance-based activities but a significant amount of evidence has been derived from "marathon studies". Marathon racing is exceptionally popular with the number of participants worldwide still growing. One interesting facet of marathon races is that the participants range from the elite to the "weekend warriors" often running for charity. Consequently the marathon (and other similar events) provides a relatively heterogeneous "laboratory" to study the impact of acute endurance exercise on the heart. The structure of this review covers a range of topics related to marathon racing studies of cardiac fatigue and damage. Firstly, we will define exercise-induced cardiac fatigue and damage and detail a number of technical approaches to assess both concepts. We will then assess the available evidence for cardiac fatigue and damage associated with marathon performance. This evidence base will be critically analyzed in relation to the limitations of field-based marathon studies. The impact of personal characteristics such as age and training status will also be examined. Finally, we will look at ongoing technical developments and where this field will progress to in the future. As a consequence of this broad debate we will attempt to draw some conclusions as to the clinical relevance of any change in cardiac function or biomarkers observed after running a marathon.

### IMMUNONUTRITION SUPPORT FOR ATHLETES: BENEFIT OR HAZARDS?

Nieman, D.

*Appalachian State University, North Carolina*

Prolonged and intensive exercise has transient but significant, wide ranging effects on the immune system. The exercise-induced immune perturbations and associated physiologic stress are associated with an elevated risk of acute respiratory infections (ARI), especially during the 1-2 week period following competitive endurance races. Immunonutrition support for athletes is an active area of research endeavor, and this lecture will summarize the efficacy of various nutritional products in countering exercise-induced immune dysfunction, oxidative stress, and inflammation. The value of using immunonutrition support for athletes has been questioned because blocking the transient oxidative stress, inflammation, and elevations in stress hormones following heavy exertion potentially interferes with important signaling mechanisms for training adaptations. Another viewpoint is that even the most effective immunonutrition support systems only partially block exercise-induced physiologic stress indicators, analogous to the beneficial use of ice packs to reduce swelling following mild injuries. In the end, the value of immunonutrition support for athletes during periods of heavy exertion and competitive races will be evaluated by whether or not the athlete has improved recovery, lowered ARI, reduced muscle damage and soreness, and enhanced overall athletic performance.

**10:20 - 11:50**

## Invited symposia

### IS-PM04 Mitochondrial structural organization, dynamics and function

#### SKELETAL MUSCLE MITOCHONDRIAL NETWORKS – STRUCTURAL ORGANIZATION AND ADAPTATIONS TO PHYSICAL ACTIVITY / INACTIVITY

Dahl, R., Larsen, S., Helge, J.W., Dela, F., Prats, C.

*The Panum Institute, University of Copenhagen*

The mitochondria are highly dynamic organelles that continuously adjust to cellular demands. The morphology of a mitochondrion is not always the classically accepted ellipsoid shape. In most cells, mitochondria are formed by highly interconnected tubular mitochondria. Mitochondria undergo frequent morphological changes, altering the mitochondrial network organization. Reorganization of mitochondrial networks is the result of coordinated processes of mitochondrion fusion and fission, which ensures the proper distribution of mitochondria to fulfill cellular energetic requirements. Dysregulation of mitochondria fusion and fission results in bioenergetic deficiencies and/or production of damaging reactive oxygen species (Park & Choi, 2012). Changes in mitochondrial network organization have been described in a variety of diseases, such as diabetes and obesity (Bach et al., 2003; Makino et al., 2010; Sebastian et al., 2012). The complexity and shape of skeletal muscle mitochondria networks is fiber type dependent. We have developed an immunohistochemical technique to perform 3D reconstructions of skeletal muscle mitochondria networks in human single muscle fibers. The results show that in type I muscle fibers mitochondria are complex interconnected tubular shaped, while in type II muscle fibers the structural organization of mitochondrial network was more diverse; from individual ellipsoid mitochondrion with few connections to tubular interconnected mitochondrial networks. Two percent of type I muscle fibers contained ellipsoid-shaped mitochondrion. Interestingly, in both type I and type II fibers the different morphological variants could be found within the same muscle fiber. Thus, skeletal muscle fibers present both profusion state mitochondria (ellipsoid) and profusion phenotype mitochondria (tubular interconnected) in different fiber types, which have different energetic demands. This makes skeletal muscle the optimal tissue to investigate the regulation processes regulating mitochondria fission and fusion. The effect of one leg immobilization on mitochondrial network organization and the implications of skeletal muscle mitochondrial network organization and dynamics on the currently used methods to assess mitochondrial function will be discussed. Bach D et al.

(2003) *J Biol Chem* 278, 17190-17197. Makino A, Scott BT, & Dillmann WH (2010) *Diabetologia* 53, 1783-1794. Park J & Choi C (2012) *Commun Integr Biol* 5, 81-83. Sebastian D et al. (2012) *Proc Natl Acad Sci U S A* 109, 5523-5528.

### MITOCHONDRIAL FUNCTIONAL ADAPTATION TO EXERCISE TRAINING

Dela, F.

*University of Copenhagen*

The effect of physical activity and inactivity per se on muscle mitochondrial respiratory capacity per mitochondrion in humans is largely unknown. What is well-known is the several fold increase in skeletal muscle mitochondrial content that occurs in response to (primarily) aerobic training. In this sense the respiratory capacity is enlarged, but whether there is a qualitative adaptation of mitochondrial respiration in response to training is less well studied. The effect of physical inactivity is even less studied, and given the fact that physical inactivity is associated with the prevalence of type 2 diabetes and some types of cancer and is an independent predictor of mortality, there is clearly a need. It is possible that the detrimental effects of physical inactivity are mediated through a lack of adequate muscle oxidative capacity.

### ROLE OF MITOCHONDRIAL FUSION PROTEINS ON MUSCLE METABOLISM

Zorzano, A.

*IRB Barcelona - University of Barcelona - CIBERDEM*

Mitochondrial fusion and fission are key processes regulating mitochondrial morphology. Mitochondrial fusion is catalyzed by Mfn1, Mfn2 and OPA1 in mammalian cells whereas mitochondrial fission is operated by Drp1, Fis1 and Mff proteins. Mfn2 protein seems to play a specifically complex role in mitochondria. It regulates mitochondrial morphology, and in addition, it also controls endoplasmic reticulum morphology and function. Mfn2 expression is exquisitely regulated in skeletal muscle. It is up-regulated in skeletal muscle response to chronic exercise and upon cold exposure. In contrast, Mfn2 is repressed in muscle from high-fat fed mice or in obese or in type 2 diabetic individuals. Changes in Mfn2 expression have a marked impact on mitochondrial metabolism. Skeletal muscles obtained from Mfn2 KO mice show a reduced respiratory control ratio, which occurs in the absence of significant changes in state 3 and state 4 oxygen consumption. Mfn2-ablated soleus muscles also show reduced glucose oxidation, and reduced expression of some OXPHOS subunits. Additional evidence indicating that Mfn2 deficiency causes mitochondrial dysfunction comes from studies in muscle cells in culture. The content of hydrogen peroxide was also enhanced in skeletal muscle upon Mfn2 depletion or in Mfn2-silenced muscle cells. These results occurred in the presence of a normal anti-oxidant defense. Skeletal muscle Mfn2 KO mice also show susceptibility to develop insulin resistance in response to a high fat diet or to aging. In keeping with this, a defective insulin signaling is detected in Mfn2-deficient mice treated with a HFD in response to in vivo insulin administration. Mfn2 knockdown muscle cells also show an impaired capacity to respond to insulin. In all, available data indicate that Mfn2 regulates metabolism and insulin signaling in skeletal muscle, and it may contribute to the pathophysiology in obesity and type 2 diabetes.

**10:20 - 11:50**

## Invited symposia

### IS-BN07 New trends in motor learning

#### ROBOTICS AS A TOOL TO UNDERSTAND HUMAN MOTOR LEARNING

Stein, T.

*Karlsruhe Institute of Technology*

In 2010 Wolpert and Flanagan gave an overview of how robotics advanced research in neuroscience. Based on this work I will focus in my talk on the question of how robotics advanced research in human motor learning and how research in the field of human motor learning could benefit from robotics in the future. In the seminal experiment of Shadmehr and Mussa-Ivaldi (1994) subjects grasped the end of a robotic device while performing 2D point-to-point reaching movements in the horizontal plane. Meanwhile the device could apply forces to the subject's hand. Numerous experiments have shown that subjects can learn to compensate for the novel dynamics, thereby restoring their movements to normal after a short training period. This compensatory adjustment in motor output is thought to reflect a change in the neural representations related to the dynamics of the musculoskeletal system and external objects. The robotic devices used in these experiments can simulate objects with novel dynamical properties in real time (Wolpert & Flanagan, 2010). In the first part of my talk I will present the classic experimental design of motor adaptation experiments and the underlying theoretical considerations. Based on this, I will give a brief overview of current research topics and findings in the field of motor adaptation. In addition to their use in motor adaptation tasks, robotic devices could also be valuable for research in other fields, such as skill acquisition in sports (Reinkensmeyer & Patton, 2009). However, the upper limb movements occurring in sports take place in 3D space. Moreover, the forces occurring during sports movements are much greater than the forces occurring in the previously described motor adaptation experiments. At the moment the relationship between motor adaptation and skill learning in sports is far from clear (Yarrow et al., 2009). In the second part of my talk I will concentrate on the topic robotics and skill learning. I will present new robotic devices that can be used to investigate skill learning in more natural movement tasks (Bartenbach et al., 2013). Based on these developments, I will present ideas on how the existing experimental designs need to be enhanced to be able to investigate skill learning with robotic devices. References Bartenbach, V., Sander, C., Pöschl, M., Wilging, K., Nelius, T., Doll, F., Burger, W., Stockinger, C., Focke, A. & Stein, T. (2013). *J Neurosci Methods*, 213, 282–297. Reinkensmeyer, D. & Patton, J. (2009). *Exerc Sports Sci Rev*, 37(1), 43–51. Shadmehr, R. & Mussa-Ivaldi, F. (1994). *J Neurosci*, 14 (5), 3208–3224. Wolpert, D. & Flanagan, J. (2010). *BMC Biol*, 8:92. Yarrow, K., Brown, P. & Krakauer, J. (2009). *Nat Rev Neurosci*, 10, 585–596.

**IMPLICIT MOTOR LEARNING: A NEW TREND OR AN OLD ATTRIBUTE?**

Masters, R.

*University of Hong Kong*

An important distinction that arises from cognitive approaches to learning is between conscious and unconscious aspects of human behavior. Much human interaction with the environment takes place at a non-conscious level of awareness, yet humans display a pervasive tendency to acquire not only procedural knowledge but also declarative knowledge when learning motor skills. Usually, this knowledge is accrued by explicit hypothesis testing during an extended trial-and-error process of resolving a motor problem. Instructions from an agent (such as a coach) may add to the quantity of declarative knowledge that is accrued. The ability to test hypotheses and to store and manipulate information that can be used to make motor responses is made possible by the information processing capabilities of the brain. Implicit motor learning tries to discourage hypothesis testing about motor responses or to disrupt storage of information that can be used for hypothesis testing, thereby limiting the amount of declarative knowledge that is accumulated during learning. While it is unlikely that any form of human motor learning is purely implicit or explicit, implicit motor learning techniques appear to augment the role of non-conscious processes in motor performance and thus reduce potential destabilization of automatic movement by conscious thought processes.

**INFLUENCE OF SLEEP ON CONSOLIDATION IN MOTOR LEARNING**

Van der Werf, Y.

*Netherlands Institute for Neuroscience*

Sleep enhances memory for learned skills. Typically, humans acquire motor skills by forming a motor memory through performance. Motor skills can also be learnt through observation. We investigated whether sleep aids learning by action observation, and whether the enhancement of the motor memory depends on the time of observation relative to sleep. Our results show that sleep is necessary for the enhancement of a motor skill by prior observations. This effect happened only if sleep occurs within a limited time window upon observation. The results indicate that observed activity might undergo sleep-dependent re-activation leading to consolidation and subsequent enhancement of motor programs, possibly through a mechanism involving the human mirror neuron system.

**10:20 - 11:50****Oral presentations****OP-PM17 Neuromuscular Physiology [NP] 4****MECHANICAL PROPERTIES OF THE RECTUS FEMORIS MUSCLE IN PROFESSIONAL FOOTBALLERS FROM START TO MID-SEASON**

Warner, M.1, Mullix, J.1, Gimpel, M.2, Stokes, M.1

*(1): Faculty of Health Sciences, University of Southampton, UK. (2): Southampton Football Club, Southampton, UK.*

Introduction Quadriceps' strain is the second most common injury in football players, accounting for 5% of all injuries (Ekstrand et al., 2011). Musculoskeletal screening tests are important to help avoid overtraining and injury (Gabbe et al., 2004). However, measurements of muscle are often made using subjective palpation and observational techniques. Novel technology enables objective measurement of tone and mechanical properties of muscle using a hand-held device (MyotonPRO), and has recently been used to examine thigh muscles in young males (Mullix et al., 2012). The present study aimed to quantify the stability of mechanical properties of the rectus femoris (RF) muscle in professional football players from start to mid-season. Method Nine English Premier League male football players (aged 22-30 years) were studied at the start and mid-way through the season. The MyotonPRO device (Myoton Ltd, London) applied brief mechanical impulses to the resting RF muscle belly on the dominant side, eliciting damped oscillations, which were recorded via the device's accelerometer. Parameters of non-neural tone (frequency), elasticity (logarithmic decrement) and stiffness (N/m) were calculated automatically. None of the participants suffered an injury during the study period. A paired-samples T-test assessed for statistical differences between the two testing sessions. Results There were no significant differences in the mechanical parameters tested between the start and mid-season ( $p > 0.05$ ; tone  $15.9 \pm 0.6$  to  $15.6 \pm 0.7$  Hz; stiffness  $277.7 \pm 11.4$  to  $283.3 \pm 15.7$  N/m; elasticity  $1.3 \pm 0.1$  to  $1.3 \pm 0.2$  decrement). On average there was only a -0.5% change in muscle tone, 3.4% in stiffness, with an 8.3% change in elasticity. Discussion These preliminary data suggest that the mechanical properties of the RF muscle remained constant during the first-half of a football season in players that had not suffered an injury. Monitoring changes in these parameters over the course of a season may provide an indication of injury risk. Further studies are warranted to develop large databases of normal reference values in professional footballers and to document abnormal parameters in injured muscles. References GABBE, B., BENNELL, K. L., WAJSWELNER, H. & FINCH, C. F. 2004. *Phys Ther Sport*, 5, 90-97 EKSTRAND, J., HÄGGLUND, M. & WALDÉN, M. 2011. *Br J Sports Med*, 45, 553-558. MULLIX, J., WARNER, M., STOKES, M. 2012. Working Papers in the Health Sciences, 1, 1-8.

**METABOLIC AND NEUROMUSCULAR FATIGUE IN HEALTHY WOMEN DURING A WINGATE TEST**

Kokova, M., Pencheva, N., Kitanoska, D.

*South-West University*

Introduction The reasons for the anaerobic fatigue, the power limitation factors and the factors that could improve performance have been studied mostly on trained subjects. Such data on untrained subjects especially females are scarce and insufficient. The aim of this study is to evaluate the heart rate responses, blood lactate and glucose concentration changes, sEMG RMS and MPF profiles of six muscles involved in cycling as factors for the anaerobic performance and fatigue in healthy untrained women. Methods Nine women ( $24.0 \pm 3.4$  years) performed a 30-s Wingate cycling test (load 0.075W/kg). Lactate and glucose levels were determined before and after the test. The sEMG activity of the following muscles of the right lower limb : vastus lateralis (VL), rectus femoris (RF), semitendinosus (ST),

biceps femoris (BF), lateralis gastrocnemius (GL), and tibialis anterior (TA) was recorded before, during, and after the test. EMG analysis included RMS and  $\Delta\%$ MPF determination. Results The values of the calculated anaerobic parameters were: maximum anaerobic power  $2163 \pm 787$  W, relative anaerobic power  $5.7 \pm 1.4$  W/kg, total anaerobic power  $1454 \pm 466$  kg-m/min and coefficient of anaerobic fatigue  $55.9 \pm 16.9$  %. Heart rate values (bpm) were: during warm-up -  $160 \pm 24$ , end of test -  $170 \pm 11$ , and recovery -  $180 \pm 15$ . Lactate levels increased from  $2.1 \pm 0.7$  to  $11.0 \pm 2.3$  mmol/l, while glucose levels remained statistically unchanged ( $4.5 \pm 0.9$  to  $4.2 \pm 0.6$ ). RMS values (normalized) at the beginning and at the end of the test were as follows: VL  $1.19 \pm 0.37$  and  $1.25 \pm 0.52$ ; RF  $1.28 \pm 0.19$  and  $1.46 \pm 0.39$ ; ST  $1.17 \pm 0.17$  and  $0.99 \pm 0.34$ ; BF  $1.12 \pm 0.18$  and  $1.16 \pm 0.51$ ; GL  $1.11 \pm 0.17$  and  $0.83 \pm 0.17$ ; and TA  $0.95 \pm 0.16$  and  $0.96 \pm 0.34$ .  $\Delta\%$ MPF values were: VL -  $5.2 \pm 12.7$ ; RF  $+0.9 \pm 21.9$ ; SM  $-7.4 \pm 4.2$ ; BF  $-12.5 \pm 11.8$ ; GL  $-3.6 \pm 10.6$ ; TA  $+7.9 \pm 18.4$  %. Discussion The results demonstrate a low anaerobic performance of the tested subjects. The fact that heart rate values rise significantly after the test indicates oxygen debt which is common for anaerobic tests (Weinstein et al., 1998). The significant change in lactate concentration ( $p=0.002$ ) clearly shows the metabolic origin of fatigue under the tested conditions, although glucose levels reveal a lack of exercise-induced hypoglycemia. Moreover, no significant changes occurred in RMS and MPF (Gerdle et al., 2000, Öberg, 1995) showing that the neuromuscular fatigue is not a limiting factor for performance. References Gerdle B, Larsson B, Karlsson S. (2000). *J Electromyogr Kinesiol*, 10, 225-232. Öberg T. (1995). *J Electromyogr Kinesiol*, 5 (4), 239-243. Weinstein Y, Bediz C, Dotan R, Falk B (1998). *Med Sci Sports Exerc*, 30 (9), 1456-1460. Acknowledgement. This research was supported by the Internal Funding of Regulation 9 of South-West University projects, group B (YMCHIA).

### NEUROMUSCULAR FATIGUE INDUCED BY REPEATED WINGATE TESTS

Place, N., Girard, S., Ivarsson, N., Cheng, A.J., Neyroud, D., Mekideche, A., Truffert, A., Westerblad, H.

*University of Geneva*

Introduction It has recently been suggested that leaky ryanodine receptor (RyR) channels (Ca<sup>2+</sup> release channel in the skeletal muscle) might account for the reduced force generating capacity (i.e. muscle fatigue) after prolonged exercise in humans (Bellinger et al. 2008). As peripheral fatigue predominates after high intensity exercise (Place et al. 2009), the present study was designed to test the hypothesis that muscle fatigue following a strenuous, high intensity exercise, will be mainly of peripheral origin, because of altered RyR function. Methods Eleven healthy males ( $27 \pm 7$  yrs,  $VO_{2max}$   $52 \pm 8$  ml.min<sup>-1</sup>.kg<sup>-1</sup>) were recruited to perform 6 Wingate tests (duration 30 s, 0.7 N.m.kg<sup>-1</sup>) on a cycle ergometer, with 4 min recovery between each repetition. Neuromuscular function of the dominant quadriceps muscle was investigated before and immediately after exercise and consisted in measurement of maximal voluntary contraction (MVC) force, voluntary activation level (VAL, twitch interpolation technique), M-wave properties of the superficial knee extensors as well as potentiated doublet amplitude at 100 Hz (PS100). During neuromuscular testings, subjects were seated on a chair equipped with a force transducer with a knee angle of 90° and supramaximal electrical stimuli were delivered over the femoral nerve. A muscle biopsy was collected from the non-dominant vastus lateralis muscle before and about 10 min after the last Wingate test to analyse eventual changes at the RyR level. Results MVC force was considerably reduced after the repeated Wingate tests ( $-40.8 \pm 5.2\%$ ,  $P < 0.01$ ). A small but significant reduction in VAL was also observed ( $-7.3\% \pm 3.7\%$ ,  $P < 0.05$ ). PS100 was decreased by  $38.6 \pm 7.6\%$ , with only minor changes in M-wave properties for vastus lateralis muscle. Muscle biopsies are in the process of analysis. Conclusion This exercise induced considerable muscle fatigue, as evidenced by the large decrease in MVC force. Although VAL -common index of central fatigue- slightly decreased, the large reduction in PS100 seems to indicate that peripheral (muscular) mechanisms mainly account for the impaired maximal force generating capacity. Further, as muscle excitability seems to be relatively well preserved after the exercise, as revealed by the M-wave properties, it seems that processes distal to muscle action potential were impaired (Place et al. 2009). We hypothesize that impaired RyR function, resulting in impaired Ca<sup>2+</sup> handling, explains our findings. The analysis of muscle samples will allow to test our hypothesis shortly. References Place et al. *Clin Exp Pharmacol Physiol* 36(3):334-9, 2009 Bellinger et al. *Proc Natl Acad Sci* 105(6):2198-202, 2008

### FUNCTION OF THE VASTUS LATERALIS MUSCLE FIBERS DURING A RAPID KNEE EXTENSION

Ogiso, K., Naruse, K.

*Kogakkan University*

Introduction Shortening of the muscle fibers and increase in pennation angle (PA) contract the pennate muscle. Force generated by the muscles is transmitted to the tendons and finally attain a motor task by rotating the joints. However, the muscle fiber behavior does not seem to be uniform during the contraction, because irregular filament overlaps (Brown and Hill, 1991; Edman and Tsuchiya, 1996), regional differences in strain of the aponeurosis (Kinugasa et al., 2008) and asymmetry in fascicle cross-section deformation (Kinugasa et al., 2012) have been observed. Unexpected and rapid movement we often experience may make the muscle fiber contraction more irregular. The present study was designed to examine function of the vastus lateralis muscle fibers (VL) during a rapid maximal knee extension. Methods Eighteen male subjects performed a 10-consecutive isokinetic knee extension (90 deg/s) that comprised 7 passive and 3 maximal voluntary contractions (MVC) twice. They were asked to relax their muscles and exert MVC as quickly as possible only when a light turned on at 60 deg of the knee joint angle (0 deg = full extension) in the 3rd, 6th and 9th repetitions (C1) or 3 times in random order (C2). VL-EMG activity was monitored to check relaxation before the light stimulus. A point (P) where a fascicle arose from the deep aponeurosis and PA were measured on ultrasonic images of VL. Results The time course of active shortening after the light stimulus was different from that of passive shortening. PA and muscle thickness sharply increased about 200ms after the light stimulus in active shortening, especially near point P. The increase in PA was significantly larger in C1 than in C2. Premotor reaction time, electromechanical delay and total reaction time were also significantly shorter in C1 than in C2. Discussion VL contracted at MVC just as if the fascicle bit on the deep aponeurosis tightly, which was made quicker and larger by expecting the light stimulus. This markedly differs from the fascicle movement during isometric and slow isotonic contractions. Conduction velocity of the action potential becomes gradually slow near the tendon (Iwata, 1983; Kusama, 1987). Therefore, the biting movement might result from wave summation near the deep aponeurosis, which might lead to irregular behavior of the muscle-tendon complex. This may explain why most of muscle strain injuries occur at myotendinous junction (Garrett, 1990). References Brown LM, Hill I (1991) *J Muscle Res Cell Motil*, 12(2): 171-182. Edman KAP, Tsuchiya T (1996) *J Physiol*, 490(1): 191-205. Garrett WE (1990) *Med Sci Sports Exerc*, 22(4): 436-443. Iwata K (1983) *Chiba Med J*, 59: 171-179. Kinugasa R et al. (2012) *J Appl Physiol*, 112(3): 463-470. Kinugasa R et al. (2008) *J Appl Physiol*, 105: 1312-1320. Kusama T (1987) *Chiba Med J*, 63: 103-111.

**10:20 - 11:50****Invited symposia****IS-BN03 Biomechanical human-environment interaction****THE EFFECT OF DIFFERENT SKI-SNOW INTERACTION MODES ON THE HUMAN BODY**

Kröll, J., Spörri, J., Müller, E., Schwameder, H.

*University of Salzburg*

In order to turn and regulate speed, a skier must manipulate the orientation and loading pattern of the skis to generate adequate reaction forces from the snow surface. Therefore, a deeper understanding of this ski-snow interaction is an essential component for equipment development. The overall ski performance is primarily affected by the side cut and the torsional and bending stiffness of the skis. Consequently the tuning of these properties may be essential for performance, comfort and injury prevention issues. The principle influence of different ski-snow interaction modes can be demonstrated by theoretical considerations. Hence, the first part of the talk will deal with theoretical models of ski-snow interaction mechanics which already have been described and tested using numerical simulations and physical models. However those models only superficially account for the effect of different Ski-Snow interaction modes on the human body. In order to better understand the effect of different ski-snow interaction modes on the human body it is necessary to consider experimental data from in vivo field studies as well. Therefore, empirical data from an intervention study will then be presented. The aim of this study was to quantify the evolution of total external and internal loads of elite athletes arising from different ski equipment designs under simulated competition conditions. Based on the recent changes of FIS equipment rules, ski side cut radii with 27m (GS 27) were compared against ski side cut radii with 35m (GS 35). Ski ground reaction forces (Pedar Insoles), kinematics (IMU Sensors) and muscle activity (EMG) were determined simultaneously. Comparing GS35 and GS27, force distribution alters forces in a manner that the outside leg forces decrease substantially with GS35 towards the end of the turn. However, an opposite behavior was observed on the inside leg where forces increased slightly at the end of the turn. From a neuromuscular perspective, one would expect that the alterations in external load are directly reflected in the leg extension muscle group. However, the neuromuscular alterations are only partially linked to external load, but in some cases are closely linked to functional aspects of the used ski. This can be observed in the tibialis anterior muscle where an increased activity on both inside leg and outside leg can be observed during the GS35 trial which is seen as "less functional" in a carving ski function. For the final part of the talk, the influence of the theoretical and in vivo approaches will be related along with the potential and limitations to our ski-snow interaction understanding.

**ESTIMATING AND ADJUSTING FOR EFFECTS OF ENVIRONMENTAL FACTORS IN SPORT RESEARCH**

Hopkins, W.G.1, Hume, P.A.1, Hollings, S.C.1, Hamlin, M.J.2, Spencer, M.3

*1: AUT University (Auckland, New Zealand). 2: Lincoln University (Christchurch, New Zealand). 3: Norwegian School of Sport Sciences (Oslo, Norway).*

Environmental and other venue-related factors (e.g., weather, surface conditions, altitude) can have important effects on performance, injury and related dependent variables. As such, they are also nuisance variables that modify the dependent variable in studies of other factors affecting performance or injury. Appropriate inclusion of environmental factors in a linear model not only provides estimates of the effects of the environment but also improves the precision of estimates of other effects and adjusts them to chosen values of the environmental factors. When the environment differs between but not within athletes (e.g., single performances by different athletes at different venues), the effects of environmental differences can be estimated with a covariate in a traditional ANOVA linear model. Such models require hundreds of athletes on each level of the environmental variable to estimate effects with sufficient precision for adjusting outcomes of the main dependent variable. When the environment differs within athletes (e.g., multiple performances by the same athletes at different venues), the changes in the environment are represented by a covariate that changes within each subject. Such within-subject covariates cannot be included in ANOVA models, but mixed linear models allow for them and thereby usually provide adequate precision with smaller sample sizes. There are several options to specify covariates in linear models. A simple linear effect is specified with a numeric covariate. A potentially non-linear effect should be investigated by parsing the covariate either into quantiles or other appropriate subgroups, then specifying the covariate as a nominal variable and estimating the means and differences between means of the different levels. The covariate can also be specified as a quadratic or higher-order polynomial, especially when the aim is to estimate the value of the covariate that maximizes or minimizes the main dependent variable. It is also possible to specify two discontinuous linear effects (e.g., one slope over a low range and another over a high range of an environmental variable) by interacting dummy variables with covariates representing the two linear effects; the transition value of the covariate can then be found by iterative analysis. Non-linear mixed models are another option with such data. Some of these analyses will be illustrated with data from recent studies of the effects of environment on performance of track-and-field athletes and downhill skiers.

**GROUND-SHOE-FOOT INTERACTION TO BIOMECHANICS OF THE MUSCULAR-SKELETAL SYSTEM IN LOCOMOTION**

Brüggemann, G.P., Willwacher, S.

*German Sport University Cologne*

In human locomotion like running the ground shoe foot interaction is frequently used to distinguish between running styles. Runner's striking behavior has been shown to affect the mechanical loading conditions of the lower extremity during the braking phase of stance. Barefoot running leads to a more plantar flexed striking behavior of the, which could be a strategy to reduce local pressures underneath the heel during the initial contact phase or to decrease the tibia and knee joint acceleration during initial stance. Changing the hardness of the surface or the midsole of a shoe affects the contact area as well as the time during which the impact energy is absorbed. Consequently, running on soft surfaces like natural grass has been shown to reduce peak plantar pressures underneath the foot, the peak impact force or at least the rate of impact force. A soft running surface might therefore allow for the maintenance of a more dorsi-flexed foot strike pattern in the absence of soft cushioning materials underneath the heel. Most published studies on barefoot and shod running or on running biomechanics in general did not alter the material properties of the running surface and therefore fail to clarify possible

interactions between footwear and surface conditions. Competitive as well as recreational running is regularly performed on surfaces with different mechanical properties. A recent study investigated the effects of running shoes and surface conditions on the striking behavior and lower leg biomechanics in the sagittal and frontal planes of movement of male and female runners. Gender effects occurred mainly in shank and thigh frontal plane orientation and knee flexion angle. On harder surfaces and when running barefoot, subjects tended to land with a more plantar flexed foot position and ankle angle as well as a more vertical shank alignment. Different adaptation strategies to running surfaces were observed between barefoot and shod conditions. It seems that touchdown behavior is adapted to compensate for the force distributing and energy absorption potentials of distinct surface by shoe combinations. If the combined compliance of the shoe plus surface combination exceeds a certain level, touchdown kinematics seem to be adapted to improve joint stability during early stance. The surface shoe foot strongly interacts with the biomechanics of the muscular skeletal system at least with that of the lower extremity in human locomotion. Running habits (barefoot or shod) might play a role in this interaction but it is not finally understood.

**10:20 - 11:50**

## Invited symposia

### IS-SH06 Ethico-legal perspectives on justice in sport

#### PRIVACY VS. ANTIDOPING POLICIES

Nicolás, P.

*University of País Vasco*

Introduction The antidoping controls necessarily include medical analyzes and obtaining data concerning the health. It is needed also the availability of the athletes to undergo screening. The legal framework for the collection and use of personal data in Spain is primarily established in the Organic Law 15/1999, which states that data collection should be proportional to the legitimate aim pursued. It also establishes that health data may only be collected and processed and transferred when for reasons of general interest is required by a law or when the subject gives her express consent. Methods To examine the legal basis and legitimacy of the establishment of antidoping controls and the mechanisms that have been articulated in this context (Law 7/2006 of 21 November on the protection of health and the fight against doping in sport and other development regulations), it is necessary to analyse whether these measures are proportionate in relation to the legitimate aims pursued. This test requires a balancing of the interests and rights involved: privacy and data protection, health protection and interest relating to the sport in general. Another issue directly related to this, concerns the fairness of the publication of the results of the analysis, either by public institutions or media. Discussion and results Spanish legislation corresponds to international standards. The incorporation of these measures into our legislation has raised litigation in court and doctrinal discussion as well as a critical report of the General Attorney. The legislation is in the process of reform and the trend to increase control mechanisms does not appear to decrease. References Agencia Mundial Antidopaje. Código Mundial Antidopaje. 2009. Atienza, E. Control Antidoping y derecho a la intimidad, dos realidades difíciles de conjugar. *Iusport*. 2013. Consejo Fiscal. Informe sobre Anteproyecto de Ley Orgánica por la que se modifica la Ley Orgánica 7/2006, de 21 de noviembre, de protección de la salud y de lucha contra el dopaje, y de Anteproyecto de Ley, por la que se modifica la ley orgánica 7/2006, de 21 de noviembre, de protección de la salud y de lucha contra el dopaje. Rodríguez García, J. El deber de localización de los deportistas y su derecho a la intimidad: especial referencia al consentimiento. *Revista jurídica de deporte y entretenimiento: deportes, juegos de azar, entretenimiento y música*. 2011, (31): 181-248 UNESCO. Convención internacional contra el Dopaje en el Deporte. París, 19 de octubre de 2005 VV.AA. Comentarios a la Ley antidopaje en el deporte. Aranzadi. 2007. Ley Orgánica 7/2006, de 21 de noviembre, de protección de la salud y de lucha contra el dopaje en el deporte. Proposición de Ley Orgánica por la que se modifica la Ley Orgánica 7/2006, de 21 de noviembre, de Protección de la Salud y de Lucha contra el Dopaje en el Deporte. (122/000007).

#### VALUE PLURALISM IN SPORTS: JUSTICE AND CHEATING

Tamburrini, C.

*University of Stockholm*

Sports games are regulated by a number of rules which determine how the game should be played. Some of them are constitutive, in the sense that they create the game. Others are merely regulatory, as they tell sport practitioners which actions are permitted and which actions are to be abstained from when performing the game. Particularly regulatory rules are open to different interpretations, depending on how the game is understood by different actors (sport practitioners, sport officials, sports experts and journalists, the public, to cite some of them). On grounds of this, it is often affirmed that, besides the formally written rules of a game, there is "an unofficial systems of conventions which determines how the official rules of the game will be applied in various concrete circumstances". This informal system of conventions is usually called "the ethos of the game". (D'Agostino, Fred, "The Ethos of the Game", 1981). In this presentation, I will first argue that, besides this traditional ethos of the game, there is a wider normative framework that evolves directly from how the game is practiced by sportspersons. This enlarged sport ethos rests on a notion of value pluralism and is highly receptive to the influence of ethical relativism, at least in one of its forms. Finally, I will raise the question of the normative relevance to be given to this enlarged, practitioners-based sport ethos.

#### LUCK EGALITARIANISM, JUSTICE AND SPORT

Pérez Triviño, J.L.

*Pompeu Fabra University*

If we used the Rawlsian strategy to propose the principles of justice in a well-ordered society, in other words, the original position, to design the principles that must govern sport practices, which would be these? My purpose here is not so ambitious. I will reduce my goal to examine which should be the paper of the luck in sport. As it is well known, Rawls was concerned also by luck with his known appeal

to the natural lottery and the idea that some factors of social disadvantage must be socially compensated. Other authors have tried to explain and offer a list of factors that prevent that in the sport win always the best athlete. Dixon pointed out several of these circumstances: the refereeing errors, cheating, gamesmanship, the inferior performance by superior athletes and the bad luck. My aim will be to analyse the paper that should be attributed to the luck in sport unlike the social scheme and which luck factors have to be compensated in an athletic competition.

## 10:20 - 11:50

### Invited symposia

#### IS-SH02 Body projects and the embodiment of gender and ethnicity

##### CONTESTED BODIES – CONFLICTS AND CONTROVERSIES ABOUT DRESS CODES AT INTERNATIONAL SPORT COMPETITIONS

Pfister, G.

*University of Copenhagen*

In spring 2011, the International Badminton Federation decided to make skirts mandatory for female players, obviously, to increase the glamour quotient in this sport and to attract a larger audience. Bikinis in beach volleyball and increasingly “stunning” attire in tennis seemed to have enhanced the public interest in these sports. At the same time, sport organizations from Islamic countries demand that Muslim women be allowed to compete in all sports and events wearing the hijab. A third party in the struggle about the dress code is the Atlanta Plus Committee and its supporters who addressed the IOC in 2010 with the demand to exclude NOCs who force female athletes to wear “restrictive garments” such as the hijab. In this paper I will explore the arguments and reasons as well as the political and ideological background of the various initiatives and groups involved in the “battle” about the bodies of female athletes. In addition, I will approach the dress issue from the perspectives of various groups of women. Drawing on constructivist concepts of gender, religion and ideology, sport and taste, I will try to unpack the politics and policies of the dress codes as well as the open and hidden meanings of the body presentations. Do not insert authors here

##### THE TRANSNATIONAL FLOW OF BODY CULTURES: THE GLOBALIZATION OF MODERN YOGA IN THE 20TH CENTURY.

Vertinsky, P.

*University of British Columbia*

Modern transnational yoga has increasingly become understood as a predominantly Anglophone phenomenon in spite of its Asian inspirations - one of the first and most successful products of globalization. Now one of the fastest growing health and fitness activities, said to be ‘oxygen for the modern soul,’ modern yoga can be found everywhere among the affluent, educated and especially women. This paper will discuss how interest in yoga thought and practices began to grow in the late 19th century as the result of an ongoing dialogical exchange between modern body culture techniques originating in the West and the various discourses of modern Hindu yoga that circulated throughout the nineteenth century. It will focus especially upon the feminization of hatha yoga as it was reframed and incorporated into female physical culture practices in the West during the 20th century and examine claims about some of the risks and benefits which have flowed from this classic example of Hobsbawm’s ‘invention of traditions.’ As Anne Harrington reminds us in relation to the history of mind-body medicine, eastward journeys rarely take us into another world for they are located within colonial cultural discourses and narratives that have already established themselves as familiar. They simply take us deeper into ourselves.

##### CHALLENGING THE NORM? PHYSICAL IMPAIRMENT, ACTIVE AGING AND SPORTING BODIES

Knoppers, A., Van Amsterdam, N.

*University of Utrecht*

The purpose of this paper is to explore how discursive practices of active aging and physical disability overlap and (re)produce gendered hierarchies in the valuing of athletic and physically active bodies. More than 100 years ago the bodies of women, the ‘elderly’ and those with visible physical impairments were considered to be unsuited for participation in elite sport. The normal sporting body was young abled and male. Currently, the increasing attention paid to and visibility of elite women’s sport and events such as the Paralympics and Senior Games suggest that the acceptance of athletic bodies has expanded to include a diversity of bodies beyond that of the young abled male. Such global events have expanded opportunities for individual athletes to participate in sport and in that sense can be seen as emancipatory and as challenging existing hierarchies in valued bodies. Yet normative sport discourses often implicitly represent both old age and physical impairment in negative terms. We argue that dominant discursive practices of active ageing and physical disability have similar subtexts related to gender, ability, health, sport and meritocracy. Together these subtexts (re)produce body hierarchies that continue to normalize the sporting body towards that of the young abled male.

10:20 - 11:50

## Oral presentations

### OP-PM02 Adapted Physical Activity [AP] 2

#### PARENTAL SOCIO-ECONOMIC POSITION AND BEHAVIOR INFLUENCING HABITUAL PHYSICAL ACTIVITY AMONG 6-YEAR OLD CHILDREN. A REPRESENTATIVE COMMUNITY STUDY

Aspvik, N.P.1, Wichstrøm, L.2

*Norwegian University of Science and Technology*

**Introduction** High socio-economic position (SEP) has been shown to be an important determinant of health and physical activity (PA) in adults, whereas results for children and adolescents are less consistent (Kolle 2009, Kelly et al., 2006). There is also a dearth of studies concerning other parental determinants of child PA. Therefore, the aim of this study was 1) to examine the extent to which how parent's SEP is related to young children's PA, 2) identify the mediators of parental SEP, and 3) identify parental characteristics associated with child PA. **Methods** The participants is a representative sample of 6-year olds living in the city of Trondheim, Norway (N=680). Children wore the ActiGraph accelerometer GT3X for 7 consecutive days to obtain objective assessment of physical activity. PA was measured as mean counts per minute. Data were considered valid if a child had at least 3 d of at least 480 min•d<sup>-1</sup> (Kolle 2009). Determinants of PA were collected through questionnaire. Data were subjected to a path analysis using Mplus. **Results** Parents' level of education, income and job position (SEP) had no direct significant effect on their child's PA. Nevertheless, there was an effect of mother's education on the child's PA, which was mediated through time spent outdoors with the child. Furthermore, parent self-reported physical activity was not correlated with child PA. **Discussion** Finding parental SEP to have no direct effect on their 6-year-old children's PA is in accordance to other studies of young children (Kelly et al. 2006, Riddoch et al. 2007), but in contrast to studies on older children/adolescents (Mo et al. 2005). It may be that parents' SEP first and foremost is associated with organized physical activities, which is a small contributor to overall PA in young children than in older children. The amount of time parents spend outdoors together with their child strongly influence child PA, a finding corroborated by other findings (Hinkley et al., 2008). This may be due to the fact that children are 2.5 more active when outside than when inside (Cooper et al., 2010). The present findings thus strongly suggest that facilitating parents going outside with their children may increase young children's PA. **References** Cooper, A.R. et al. *International Journal of Behavioral Nutrition and Physical Activity* 7 (2010). Hinkley, T. et al. *American Journal of Preventive Medicine* 34, 435-441 (2008). Kolle E. (2009). Dissertation from the Norwegian school of sport sciences. Oslo. Kelly L.A. et al. (2006). *Arch Dis Child*, 91(1), 35-38. Riddoch C.J. et al. (2007). *Arch Dis Child*, 92:963-969. Mo F. et al. (2005). *International Journal of Adolescent Medicine and Health*, 17(1): 49-56.

#### POSITIVE INFLUENCE OF ACOUSTIC FEEDBACK FOR ADAPTIVE ELITE ATHLETES IN ROWING

Schaffert, N., Mattes, K.

*University of Hamburg*

**Introduction** Rhythmic information provided audibly as acoustic feedback (AF) supports the timing of movement-execution subliminally (Thaut, 2005) based on the physical characteristics of sounds and movements and their time-based-inseparability. Particularly in high performance technique training, time-critical structures are of crucial importance for the precision of successfully executed movements. An online AF-concept for elite athletes has previously been described and empirically investigated during on-water rowing training (WRT) sessions. Assuming beneficial effects for visually-impaired athletes (VIA), AF was implemented into the direct preparation for the Paralympics with the German National Adaptive Rowing Team (ART). The investigation aimed at optimizing the boat run and enhancing athletes' perception for executing the rowing movement. **Methods** The coxed mixed four (LTA4+) (N=6) was accompanied during WRT-sessions with Sofirow (AF-system). Boat acceleration (aB) was measured (MEMS-acceleration sensor  $\geq 125\text{Hz}$ , 1% accuracy,  $\pm 2\text{g}$ ), parameter-mapping-based sonified (audibly converted) and provided online to ART and their coach. Statistical analysis considered two different training intensities (TI) at stroke rate (sr)  $\pm 19.6$  strokes/min. (EXA 1) and  $\pm 22$  strokes/min. (EXA 2). AF was presented in 500-m-blocks (with and without AF) alternately. Standardized questionnaires examined AF's functionality and athletes' perception of it. **Results** Analysis of variance showed significantly increased mean boat velocities (vB) with AF compared to sections without AF for EXA 1 (F1.8=7.59;  $p=0.00$ ;  $\eta^2 p=0.43$ ) and EXA 2 (F1.1=5.92;  $p=0.38$ ;  $\eta^2 p=0.46$ ). Intra-cyclical analysis revealed qualitative changes within the aB-time trace. AF was perceived from ART as a supportive training-aid, providing important functional information about the boat run independently from vision. **Discussion** The results show how AF can affect the mean vB immediately in WRT of ART providing relevant information as well for VIAs by supporting the movement execution and enhancing the feeling for the rowing cycle (rc). Audible presentation of the information from the captured-data, made it directly and intuitively intelligible for ART. The sound reflected the rhythm of rc by providing detailed information of its characteristic phases, yielding to improved crew synchronization. Results reinforced previous findings with elite athletes and were consistent with initial assumptions, showing that AF provides assistance for ART in terms of enhancing their perception for rc more effectively. AF enables access for VIAs to the existing visually-based biomechanical analysis by providing the information audibly. The AF-concept has been integrated into the WRT of ART in preparation for the Paralympics and World Championships. **References** Thaut, M.H. (2005). *Rhythm, music and the brain: Scientific Foundations and Clinical Applications*. New York: Routledge Chapman & Hall.

#### UPPER BODY TRAINING AND EXERCISE: LOW INTENSITY HAND CYCLING

Hettinga, F., Monden, P.G., van der Woude, L.H.V.

*University Medical Center Groningen/ University of Groningen*

**Purpose:** How to optimally train the upper body is a particularly relevant question for those in a wheelchair. Though ACSM guidelines can be used as a basis to train the upper body, risks on overuse injuries are present when training at too high intensities too soon. Early in their rehabilitation process, patients with traumatic injuries are usually not familiar with arm propulsion, and care must be taken with prescribing adequate training. Therefore, the purpose of this study was to determine whether lower intensity (30%HRR) handcycling training improves physical capacity and whether this is perceived as achievable (low perceived discomfort and effort) in untrained able-bodied women. **Methods:** 19 able-bodied, untrained healthy females (age 18-23) were included. Nine participants received handcycling

training (experimental group (EG); 7 weeks, 30% HRR, 30 min per session, three times per week) and 10 received no training (control group (CG)). All subjects performed an incremental pre- and post-test performed on an add-on handbike on a motor driven treadmill. Peak values for oxygen uptake (VO<sub>2</sub>), peak power output (PO), ventilation (VE), heart rate (HR), and submaximal values for mechanical efficiency (ME) at 41W, as well as HR and VO<sub>2</sub> (at 55W) were assessed during both tests. Local perceived discomfort (LPD) and rate of perceived exertion (RPE) were measured. Results: The TG showed an improvement in PO<sub>peak</sub> (pre: 81.1 ± 11W; post: 97.4 ± 11.3W) and HR<sub>peak</sub> (pre: 182 ± 11 bpm; post: 188 ± 11 bpm) in comparison with the CG. Also improvements for submaximal ME (pre: 12.7 ± 0.7; post: 16.6 ± 1.7), VO<sub>2</sub> (pre: 1148 ± 117 ml/kg/min; post: 955 ± 133 ml/kg/min), VE (pre: 37.6 ± 6.1 l/min; post: 28.3 ± 4.5 l/min) and HR (pre: 163 ± 15 bpm; post: 154 ± 12 bpm) were found. The participants scored on average low on RPE (7.1 ± 0.5; very very light) and LPD (3.4 ± 1.6; no discomfort) during the training sessions. Conclusion: Low intensity handcycling training resulted in an increased PO<sub>peak</sub>, while LPD and RPE during the training sessions were very low. Also, literature has shown that handcycling is less straining and requires lower peak forces compared to handrim propulsion. Low intensity handcycling training thus seems to improve physical capacity with a relatively low risk on shoulder injuries. However, VO<sub>2peak</sub> did not increase and fitness thus did not seem to improve. Lastly, at submaximal level, ME increased after low intensity training. This allows greater mobility and possibilities in 'daily life' sub-maximal exercise intensities. It thus seems that, in particular early in the rehabilitation process, when risks on injuries are high, low intensity handcycling training provides interesting opportunities in pursuing a healthy lifestyle.

### REAL-TIME ANALYSIS OF HEART RATE INTENSITY AND MOTOR T-PATTERNS IN EXERCISE PROGRAMMES FOR THE ELDERLY: A MULTILEVEL MIXED METHODS DESIGN

Saüch, G., Castañer, M., Prat, Q., Hilenó, R., Camerino, O.

*INEFC-University of Lleida*

**Introduction** People in Western society are living longer and this raises the need to reconsider the content of exercise programmes for the elderly. With the aim of obtaining information that would help optimize these programmes we used a mixed methods design to analyse heart rate intensity and patterns of motor behaviour, simultaneously and in context. **Methods** Eight female participants (age: 81±4.02 years) were studied over a period of 50 min each. Using the mixed methods design known as Multilevel Triangulation (Camerino et al., 2012) we collected and triangulated: a) quantitative data obtained from heart rate monitors (Polar RS800), tabulated according to the Classification of Exercise Intensity of the American College of Sports Medicine (ACSM, 2011); b) qualitative data on patterns of motor behaviour, organized according to the category system set out in OSMOS (Castañer et al., 2009) and sequentialized (into T-patterns) by means of THEME 6.0; and c) qualitative data derived from a content analysis (using NVIVO 0.8) of participants' answers to open-ended questions about their levels of fatigue. **Results** Regarding the relationship between motor skills (locomotion [LOC], stability [ST]) and HR categories (light [LIG], moderate/vigorous [MV]) the chi-squared test yielded a value of 1.68 (p>0.05). In the analysis of adjusted residuals there were no Z scores >1.96 (p<0.05), although values close to this (Z=1.3, p>0.05) were detected between LOC and LIG, and between ST and MV. Analysis of the T-patterns detected by THEME showed that stability skills are used when HR shifts to MV, after having made use of locomotion skills. The qualitative data derived from the open-ended questions corroborated these findings. **Discussion** Heart rate intensity was directly related to the pattern of motor behaviour, namely locomotion, manipulation and stability (Castañer et al., 2009), as well as to the capacities of resistance, strength and speed. The study confirms the utility of mixed methods designs for evaluating, in context, the heart rate intensities associated both with specific patterns of motor behaviour and with perceived fatigue among participants. We believe that research of this kind can help to ensure that exercise programmes for the elderly are physiologically tailored to the heart rate intensities recommended by the ACSM. **References** ACSM (2011). *Med Sci Sports Exerc*, 43(7), 1334-1359. Camerino O, Castañer M, Anguera MT (2012). *Mixed Methods Research in the Movement Sciences. Cases in Sport, Physical Education and Dance*. UK: Routledge. Castañer M, Torrents C, Anguera MT, Dinušová M, Jonsson GK (2009). *Behav Res Methods*. 41(3), 857-867.

### INFLUENCE OF ANATOMICAL PLACEMENT OF ACCELEROMETERS ON PREDICTION OF PHYSICAL ACTIVITY ENERGY EXPENDITURE IN WHEELCHAIR USERS

Nightingale, T.E., Walhin, J.P., Thompson, D., Bilzon, J.L.J.

*University of Bath*

**Introduction** Physical activity energy expenditure (PAEE) is inherently difficult to measure in free-living conditions, particularly in populations where movements and movement patterns are atypical, such as manual wheelchair users. The aim of this study was to (i) assess the mechanical reliability of the Actigraph GT3x+ (Actigraph, USA) accelerometer and (ii) assess the influence of its anatomical placement on PAEE estimation in manual wheelchair users. **Methods** Mechanical reliability: Ten GT3x+ units were attached to a multi-axis shaker table. A testing schedule which comprised various acceleration conditions to replicate a range of physiological movements was conducted along each of the three measurement axes. Human validity: Eleven manual wheelchair users (mean ± SD: 34 ± 11 years, time since injury: 13 ± 15 years, body fat: 25 ± 13 %) completed five activities; deskwork and wheelchair propulsion (2, 4, 6, 8 km.hr<sup>-1</sup>). A GT3x+ accelerometer was worn on the right wrist, upper arm and waist. The relationships between physical activity counts (PAC) from each unit and metabolic rate (Cosmed K4b2, Italy) were subsequently assessed and bias ± 95 % limits of agreement (LoA) calculated. **Results** Mechanical reliability: CV ranged from 0.2 to 4.7 % (intra-unit) and 0.9 to 5.2 % (inter-unit) in all axes. ICCs were 1.0 for all stages in each axis. The absolute bias ± 95 % LoA values within units were 0.4 ± 4.1 counts.5 s<sup>-1</sup>, -0.1 ± 4.6 counts.5 s<sup>-1</sup> and 0.3 ± 4.2 counts.5 s<sup>-1</sup> for x, y and z axes respectively. Human validity: PAC at each anatomical location were significantly (p < .01) associated with metabolic rate (wrist; r = .96, upper arm; r = .91, waist; r = 0.73). The SEE for each correlation was 2.88, 4.15, and 6.89 KJ.min<sup>-1</sup> for wrist, upper arm and waist respectively. Using the generated regression equations the absolute bias ± 95 % LoA values were 0.46 ± 5.71 KJ.min<sup>-1</sup>, 0.33 ± 8.18 KJ.min<sup>-1</sup> and -0.03 ± 13.56 KJ.min<sup>-1</sup> for wrist, upper arm and waist respectively. **Discussion** The findings of the mechanical reliability testing demonstrate that the Actigraph GT3x+ is a reliable tool for assessing accelerations within the physiological range of interest. Of the three anatomical locations considered, a wrist-mounted accelerometer provides the most valid prediction of PAEE in manual wheelchair users. Future studies should assess the validity of such devices and anatomical positions for predicting PAEE during more complex representative daily activities performed by manual wheelchair users.

**"CALCIAPENSIERI" PROJECT: AN ADD-ON TREATMENT IN THE MANAGEMENT OF SUBJECTS WITH SCHIZOPHRENIA**

Battaglia, G.1,2, Alesi, M.1, Inguglia, M.3, Roccella, M.1, Caramazza, G.2, Bellafiore, M.1,2, Palma, A.1,2

1: University of Palermo, Italy; 2: Regional Sports School of CONI Sicilia, Italy. 3: Local Health of Palermo, Italy.

**Introduction** If physical activity is a pivotal component of good health for everyone, there is an increasing emphasis on its importance for psychiatric patients affected from schizophrenia, Alzheimer's dementia, major depressive disorder (Knochel et al. 2012). The aim of this study was to investigate the effects of soccer practice on the self reported health quality of life (SRHQL) and sports performance (SP) in psychotic subjects. **Methods** Eighteen schizophrenic male patients were randomized into either a trained (TG) and control group (CG). TG was trained for 12 weeks by two soccer training sessions/week. CG did not perform any regular sports activity during experimental period. Anthropometric measurements, SRHQL, personal time records in 30-meter sprint test (30-mST) and slalom test running with ball (STB) were evaluated before and after the experimental period. SRHQL was assessed using SF-12 questionnaire measuring physical (PCS-12) and mental (MCS-12) component summary scores. **Results** After the training period, TG showed a relevant reduction by 4.6% in body-weight (BW) and body mass index (BMI) compared to baseline. On the contrary, CG showed an increased BW and BMI by 1.8% from baseline to post test. Moreover, at 12 weeks we found that control patients increased significantly their BW than trained ones ( $\Delta= 5.4\%$ ;  $p<0.05$ ). After the training period, comparing baseline TG's SF-12-scores to post-test results, we found an improvement by 10.5% and 10.8% in PCS and MCS respectively. In addition, 30-mST and STB performances of TG improved significantly ( $p<0.05$ ) from baseline to post-test compared to CG. **Discussion** Soccer practice appears to be able to improve psychophysical health in schizophrenic subjects (Pringle, 2009). Indeed, our study showed that programmed soccer physical activity could reduce antipsychotic medication-related weight gain and improve SRHQL and SP in psychotic subjects. To sum up, the results of this study suggest some interesting implications on the educational and clinical field on the psychiatric rehabilitation. We suggest that it might be worth looking further into the need to plan multifaceted interventions aimed at combining traditional pharmacologic treatments and alternative behavioural methods such as physical activity. **References** Knochel, C, Oertel-Knochel V, O'Dwyer L, Prvulovic D, Alves G, Kollmann B, Hampel H. (2012). *Prog Neurobiol.* England, 2011 Elsevier Ltd. 96: 46-68. Pringle, A. (2009). *J Psychiatr Ment Health Nurs.* England. 16: 553-557.

**10:20 - 11:50**

## Oral presentations

### OP-PM41 Sports Medicine [SM] 2

#### **ANKLES BACK IN CONTROL: BRACES VERSUS NEUROMUSCULAR EXERCISES FOR THE SECONDARY PREVENTION OF ANKLE SPRAINS**

Janssen, K.W., van Mechelen, W., Verhagen, E.A.L.M.

*EMGO+ VUmc Amsterdam*

**Introduction** Ankle sprains are the most common sports and physical activity (PA) related injury. There is extensive evidence that there is a twofold increased risk for injury recurrence for at least one year post injury. Recurrences result in about 50% of all cases in chronic complaints requiring prolonged medical care. Therefore, ankle sprain recurrence prevention is essential. Evidence shows that despite different working pathways, braces and neuromuscular training (NMT) are both effective in reducing ankle sprain recurrence risk. We aimed to evaluate the preventive effectiveness of the combined use of braces and neuromuscular training (NMT) against the individual use of either braces or NMT alone. **Methods** This study was designed as a three-way randomized controlled trial with one year follow-up. Adult active sports participants who had sustained a lateral ankle sprain within the preceding two months were eligible for inclusion. After participants finished ankle sprain treatment by means of usual care they were randomized to one of three study groups. Participants in group 1 received an eight week NMT program (Hupperets et al, 2009); participants in group 2 received a sports brace (Aircast A60) to be worn during all sports activities for the duration of one year; and participants in group 3 received a combination of the NMT program and a sports brace to be worn during all sports activities for the duration of eight weeks. The primary outcome measure was injury rate of ankle sprain recurrences, which was registered prospectively through monthly follow-ups. **Results** 384 athletes with an ankle sprain were included and randomly assigned to the three intervention groups. Injury rate of ankle sprain recurrences was 29% for the NMT group, 18% for the brace group and 20% for the combination group. The OR for having a recurrent injury was 1,96 (95% BI 0,85-3,22) for the NMT group compared to the brace group and 1,64 (95% BI 0,67-2,32) for the NMT group compared to the combination group. **Discussion** Current findings indicate braces to be at least equally effective, and potentially superior to NMT. The accumulating evidence on the effectiveness of bracing supports the use of bracing as a (cost) effective secondary preventive measure for ankle sprains (McGuine 2011). In our practical RCT adherence to the different interventions was mediocre (Full adherence: NMT 45%, sports brace 23% and combination 28%). There seems to be more public support for the use of NMT in sports but the support for brace use is often lacking. Therefore we advise future research to focus on the implementation of the effective preventive measures for ankle sprains. **References** McGuine et al. *Am J Sp Med* 2011;39(9):1840-8. Hupperets et al. *BMJ* 2009;339:b2684.

#### **MORPHOLOGICAL CHARACTERISTICS OF THE FOOT WITH JONES FRACTURE IN UNIVERSITY SOCCER PLAYER**

Fujitaka, K.1, Otuki, S.2, Takemura, M.3, Okubo, M.4, Tanaka, Y.5

1: Osaka Sangyo university of Graduate School, 2: Osaka Sangyo University, 3: Hyogo College of Medicine, 4: Biwako Seikei Sport College, 5: Nara Medical University, Orthopedic surgery

**Introduction** The purpose of this study was to investigate morphological characteristics of the foot with Jones fracture in university soccer players. **Methods** Male university soccer players were investigated. Radiographs of 12 feet (injury group) of 11 players with Jones fracture and those of 10 normal feet (control group) of 10 players were compared. Anterior-posterior non-weightbearing foot radiographs were taken for all subjects. Radiographs of injured feet in the injury group and those of a non-dominant leg (The player itself used the dominant leg as the leg of the side which is found in soccer and kicks a ball) in the control group were analyzed. The lengths of the first metatarsal and fifth metatarsal were measured. In addition, the angle between the axes of the first and fifth metatarsals (M1M5 angle)

was measured. The axis of each metatarsal was a line that connected the mid-point of the proximal and distal ends of its metaphysis (Y. Tanaka et al., 1995). The ratio of the first metatarsal length to the fifth metatarsal length (length ratio of the fifth metatarsal) was calculated. Mann-Whitney test was performed to compare differences between the two groups. Results In comparing the length ratio of the fifth metatarsal, the injury group ( $1.35 \pm 0.10$ ) was significantly greater than the control group ( $1.25 \pm 0.05$ ) ( $p < 0.05$ ). The values of the M1M5 angle were  $24.1 \pm 2.7^\circ$  in the injury group and  $24.4 \pm 4.8^\circ$  in the control group. There was no statistical significance. Discussion The fifth metatarsal is longer than the first metatarsal in the foot with Jones fracture. There is a possibility that rotational stress and stress from the lateral side may increase in the foot with the long fifth metatarsal. In addition, stress may concentrate on the plantar side of the fifth metatarsal base during contraction of the toe flexors. References Tanaka, Y., Takakura, Y., Kumai, T., Samoto, N., Tamai, S. (1995). J. Bone and Surg, 77(2), 205-213.

## **SPORTS INJURIES AMONGST UNIVERSITY PHYSICAL EDUCATION STUDENTS – A PROSPECTIVE EPIDEMIOLOGICAL INVESTIGATION**

Mukherjee, S.

*National Institute of Education*

**Introduction** The university physical education (PE) programme is rigorous and exposes the students to increased risks of sports injuries. The higher risk of injuries in the university PE students is a concern as it can adversely affect their teacher training and also interfere with their professional career in the long term. Therefore, keeping the PE programme safe by minimising the injury risks should be of prime concern to the programme organisers and the institute. This study was a prospective epidemiological investigation of sports injuries in university PE students. **Methods** 327 students from different PE programmes participated in the study. Sports-related injuries during a 12 week semester were reported once every three weeks on an injury registration form. The form was adapted from the NCAA injury surveillance system (Dick et al., 2007). Injuries sustained during intramural (curriculum sports lessons and voluntary practice) and extramural sports participation were documented. Severity of injuries was classified based on absenteeism and medical attention. **Results** A total of 82 injuries were documented during the 12 week semester. The students in the first semester of the PE programmes sustained the majority (70%) of injuries. 55% of the 82 injuries were sustained during the intramural activities and 45% during extramural participation. Male and female students sustained 70% and 30% of the injuries respectively. 79% were new injuries, 16% were recurrent and 5% were aggravations of pre-existing injuries. Lower limb was the most commonly injured part (49%) followed by the upper limb (28%) and the head and face (12%). Ankle was the commonest body part to be injured (18%) followed by the knee (16%) and fingers (13%). Sprain was the commonest type of injury (29%) followed by contusion (15%) and muscle-tendon strain (11%). Of the injuries sustained during curriculum sports lessons, majority of injuries were sustained on artificial turf (44%) and cement (31%) surfaces. Contact with another player was the cause of 29% of the injuries while contact with equipment caused 23% of the injuries. With regard to medical attention, 68% injuries were classified as mild, 27% as moderate and 5% as severe injuries. In terms of absenteeism, 76% injuries were mild, 23% moderate and 1% was severe injury. **Discussion** Injury prevention programmes are critical for safety in training and safeguarding professional careers of university PE students. This study provides useful information on epidemiology of sports injuries in university PE students. Evidence from the present study can be used to identify the modifiable risk factors to develop and implement injury prevention strategies to minimize the risk of injuries in university PE students. Future studies on elucidation of intrinsic and extrinsic risk factors and implications of intervention programmes in this population are desired. Reference Dick R, Agel J, Marshall SW (2007). Am J Sports Med, 42, 173-182.

## **EPIDEMIOLOGY OF INJURIES IN MIXED MARTIAL ARTS: A SYSTEMATIC REVIEW WITH META-ANALYSIS**

Lystad, R.P., Gregory, K., Wilson, J.

*Macquarie University*

**Introduction** Mixed martial arts (MMA) is an increasingly popular sport that involves unarmed, full contact contest with minimal rules. Graphic images of caged combatants often evoke visceral responses, and medical associations have repeatedly called for an outright ban on MMA tournaments (White, 2007; Ball & Dixon, 2011). Despite safety concerns, no epidemiologic evidence-synthesis is currently available. Thus, the aim of this systematic review was to provide pooled estimates of incidence, severity, injury patterns and risk factors for injury in MMA. **Methods** Studies were identified by electronic searching of PubMed, Scopus, CINAHL, EMBASE, AMED and SPORTDiscus databases. Eligibility and quality were assessed independently by two reviewers, and relevant epidemiologic data were subsequently extracted and compiled. Random-effects models were used to obtain weighted incidence rate (IR), injury proportion (IP), incidence rate ratio (IRR) and odds ratio (OR) estimates with 95% confidence intervals (CI). Heterogeneity was evaluated with Cochran's Q and  $I^2$  statistics. **Results** The searches returned 2,248 citations (1,416 unique), of which only six studies were eligible for inclusion. Pooled estimates suggested the overall IR and concussion IR to be 226.6 [CI 184.5, 278.2] and 21.5 [CI 9.2, 50.1] per 1000 exposures, respectively. No studies reported on injury severity. The most commonly injured anatomical region was the head/neck (61.2%) followed by the upper limb (21.9%). Common types of injury included laceration (29.4%), fracture (12.2%) and concussion (10.2%). Losing fighters had significantly greater risk of injury compared to their winning counterparts (IRR 2.20 [CI 1.56, 3.11]; OR 2.59 [CI 1.96, 3.43]). **Discussion** The IR in MMA is higher than in other popular combat sports, perhaps with the exception of professional boxing (Zazryn et al, 2003). While the IP of head injuries in MMA is smaller than in professional boxing, it is far greater than in other popular combat sports. The dearth of injury severity data in MMA precludes any comparison with other sports. The conclusions about pooled estimates in this review are limited by heterogeneity, which is most likely owing to the low number of included studies and differences in methodology (e.g. operational injury definitions and data collection methods). The scarcity of quality data underscores the urgent need for more epidemiologic research upon which evidence-informed decisions concerning the regulation of MMA can be made. References Ball CG, Dixon E. The consensus statement on mixed martial arts: emotion, not evidence-based. Can J Surg 2011;54:e1-e2. White C. Mixed martial arts and boxing should be banned, says BMA. BMJ 2007;335:469. Zazryn TR, Finch CF, McCrory P. A 16 year study of injuries to professional boxers in the state of Victoria, Australia. Br J Sports Med 2003;37:321-324.

## AN ANALYSIS OF HOW TWO DIFFERENT FRONT FOOT POSITIONS INFLUENCE PELVIC ROTATION AND LOWER EXTREMITY MOTION IN THE TENNIS BACKHAND GROUNDSTROKE

Iwamoto, S.1, Fukubayashi, T.2, Hume, P.3

1: Toyo University (Tokyo, Japan), 2: Waseda University (Tokyo, Japan), 3: AUT (Auckland, New Zealand)

**Introduction** When a tennis player steps forward to hit a backhand groundstroke in closed stance, modifying the direction of the front foot relative to the net may reduce the risk of ankle injury and increase performance. This study evaluated the relationship between pelvic rotation and lower extremity movement during the backhand groundstroke when players stepped with toes parallel to the net (Level) or with toes pointed towards the net (Net). **Methods** Eighteen high school competitive tennis players ( $16.8 \pm 0.8$  years, all right-handed) performed tennis court tests comprising of five maximum speed directional runs (Michikami, 2004) to the court intersection line to hit an imaginary ball with forehand or backhand swings. This study analyzed the front stepping foot contact phase (FSFCP) of backhand groundstroke (BHGS). Based on the data collected, researchers classified the participants as either Level or Net. Using data from the FSFCP, positions of the landmarks were manually digitized using a motion analyzer (Frame-DIAS, DKH, Japan) and then three dimensional coordinates were calculated using a direct linear transformation method (Abdel-Aziz and Karara, 1971). **Results** For both groups, forefoot values increased during the early phase of FSFCP, leveled off during the middle phase, and then decreased during the late phase. However, those values for the Level group changed less than the Net group and were always negative. The foot values for both groups were initially positive, and became negative at approximately 25% FSFCP. The max rotational velocity of pelvis and the max acceleration of pelvis rotation for the Net group was in the first half of FSFCP. However, max rotational velocity of pelvis for the Level group was in the second half of FSFCP. **Discussion** Fong et al. (2007) point out that plantar flexion and supination are the injury mechanisms of inversion ankle sprain. This study suggests that the direction of the front stepping foot in BHGS may influence the risk of inversion ankle sprain. According to the results, after approximately 25% FSFCP for both groups, the foot angle is negative which means that the ankle is in planter flexion. As for the movement of the forefoot, the Net group showed a pattern of supination-pronation-supination during FSFCP, and the Level group, while displaying a similar pattern, was only in supination of various degrees during FSFCP. **References** Abdel-Aziz and Karara, (1971). In Proceedings A.S.P. Symposium on Photogrammetry 1-19. Fong et al. (2007). Sports Medicine, 37(1), 73-94. Michikami, (2004). The Journal of Clinical Sports Medicine, 21, 70-73.

**12:00 - 13:15**

### Plenary sessions

#### PS-PL03 The choreography of movement and the brain

##### WHITHER SPORT SCIENCE? THE CHALLENGE OF UNDERSTANDING LIVING MOVEMENT

Scott Kelso, J.A.

Florida Atlantic University & The University of Ulster, N.Ireland

Sport Science is an applied field that draws its concepts, methods and tools from other disciplines that do not have the word 'science' in their names such as physics, chemistry, biology and so forth. Consider 'Testing Ronaldo'. The focus is primarily on measurement and different ways to capture various aspects of what makes Ronaldo a great footballer. Interesting though it is, lacking is a broad framework of ideas with which to interpret and integrate findings from the many different levels and scales of observation involved in typical sports settings. At each level of complexity, from the cellular to the social who are the players, what are their properties and what are the rules of the game? How do we go about it? A first step is to identify significant units on a chosen level. Due to the tremendous degeneracy of living things, where the same outcome may be produced by different combinations of elements, evidence suggests that the significant units are context-dependent coordinative structures. In such level-independent coordinative structures different elements are ordered in space and time sometimes recruiting new pathways to serve a particular function. Perturbing them in one place may produce a remote effect somewhere else. All the parts of the coordinative structure are weakly interacting, often bidirectionally coupled and interdependent. Over the last 25 years or so, theory and experiments on a variety of different systems at neural, behavioral and social levels reveal that WICS (Weakly Interacting Coordinative Structures) are truly emergent. They are collective states whose spatiotemporal dynamics prove to be extremely rich, including interesting transient regimes that are neither fully ordered nor disordered in space and time. Collective states and their dynamics can span old 'splits' and dichotomies that science has created: the separation of animal and environment, sensory and motor, perception and action, structure and function, even mind and matter. It may be that sport science, rather than being viewed as an applied interdisciplinary field of study, is at the core of something physics (the science of inanimate matter and motion) has left virtually untouched, namely animate, living movement. Though in some cases, such as the HKB model and its extensions, it has proved possible to derive collective states at one level from (nonlinear) interactions between component processes at another, evidence suggests an alternative or at least complementary picture: namely that the laws of collective states in living things --coordination dynamics-- are sui generis. That is, coordination dynamics deals with collective behaviors that emerge from and depend on more microscopic levels, but may not be deducible from them. This does not mean that sport science or the life sciences in general should not try to understand the relationships between different levels of observation. Rather, the task is to come up with lawful descriptions that allow us to understand collective, emergent behavior at all levels and to respect the autonomy of each.

##### CHOREOGRAPHIC THINKING TOOLS

Delahunta, S.

Coventry University

How might we develop new ways of augmenting movement creativity in dance? Can we better connect intellect, imagination and the physical body and enrich their relationship? The dance field is already rich in choreographic expertise that is constantly seeking new means of movement related innovation. Can a scientific understanding of the organisation of the mind provide clues and ideas that can be put into practice in this field? This presentation will outline some of the challenges that need to be addressed and specific illustrations

of current studio practices and tasks. The illustrations will focus on research on the use of multiple forms of imagery in movement creation being explored in R-Research (the research arm of Wayne McGregor | Random Dance).

**14:00 - 15:00**

## Mini-Orals

### PP-PM29 Nutrition [NU] 3

#### A COMPARISON OF TECHNIQUES TO INDICATE ACUTE HYDRATION STATUS AND THE EFFECT OF SAMPLE STORAGE ON MEASUREMENTS

Carter, J.M., Rollo, I., Randell, R.K., Jeukendrup, A.E.

*Gatorade Sports Science Institute*

**Introduction** The importance of adequate hydration for physical and cognitive performance is well known (Sawka et al., 2007). There is a need for assessing hydration status non-invasively, but many techniques using urine analysis, although in widespread use, are not always supported by appropriate validation studies (Carter et al., 2012). Therefore, the present study compared two non-validated methods (Osmocheck, Vitech Scientific Ltd, UK; Urine Reagent Strips, IND Diagnostic Inc, Canada) with a criterion measure and other commonly used techniques. In addition, the stability of urine samples at different storage temperatures was determined. **Methods** Three sequential daily midmorning urine and saliva samples were provided by 13 male athletes (age:  $25 \pm 4$  yr) and analysed for: urine specific gravity (Usg); urine colour (Ucol); urine reagent strip (Urs); saliva osmolality (Sosmo); urine osmolality determined by a handheld refractometer (Uochek). All were compared using regression analysis against the criterion measure of urine osmolality determined by freezing point depression osmometry (Uosmo – Advanced Osmometer 2020; Advanced Instruments, USA). Urine samples were subsequently stored at a range of temperatures (20 °C; 3 °C; -20 °C; -80 °C) for 10 days before being re-analysed and compared to baseline values using a repeated measures ANOVA. **Results** All measures, apart from Sosmo ( $p=0.10$ ), correlated well with Uosmo ( $p<0.0001$ ): Uochek  $R^2=0.94$ ; Usg  $R^2=0.94$ ; Ucol  $R^2=0.75$ ; Urs  $R^2=0.46$ ; Sosmo;  $R^2=0.07$ . The proportion of samples correctly identified as mildly-to-significantly dehydrated ( $>700$  mOsmol/kg;  $\geq 1.020$  Usg; Sawka et al., 2007) was as follows: 100% (Uochek); 96% (Usg); 93% (Ucol); 82% (Urs); 68% (Sosmo). Samples remained stable regardless of storage conditions, with no significant difference from baseline values ( $p>0.05$ ). **Discussion** Urine analysis is a common method to assess body water status in young adult male athletes. The results of the present study confirm that the Osmocheck handheld refractometer and Atago Master-Sur refractometer (Japan) are both strongly associated with urine osmolality, as measured by freezing point depression osmometry. Urine colour remains an adequate and easy-to-use field technique, while urine reagent strips may be used as a marker of hydration when more sensitive methods are unavailable. Finally, if immediate analysis is not possible, urine samples remain stable for at least 10 days at a range of ambient temperatures. **References** Carter, JM, Loney, T, Blacker, SD, Nicholson, GF, Wilkinson, DM. (2012). *Int J Sport Nutr Exerc Metab*, 22, 257-266. Sawka, MN, Burke, LM, Eichner, ER, Maughan, RJ, Montain, SJ, Stachenfeld, NS. (2007). *Med Sci Sport Exerc*, 39, 377-390.

#### EFFECTS OF PREVIOUS INGESTION OF COCONUT WATER ON FLUID BALANCE AND PHYSICAL PERFORMANCE IN THE HEAT

Laitano, O., Menezes, E.S., Marins, D.M., Reis, G.S.

*Federal University of Vale do Sao Francisco, Petrolina*

**Introduction:** It is well established in the literature that exercise in the heat impairs physical performance largely due to dehydration. Therefore, drinking strategies that may counteract this impairment on performance are warranted. Coconut water (CW) is a natural drink found in the coconut and due to its composition may improve performance. However, CW is usually hypertonic which may cause gastrointestinal distress if consumed during exercise. Thus, the aim of the present study was to assess the effects of previous ingestion of CW on fluid balance and aerobic performance in the heat. **Methods:** To achieve this, eight physically active men were recruited (age  $23 \pm 3$  years, height  $176 \pm 6$  cm, body mass  $78 \pm 7$  kg) and performed three time to exhaustion trials on a cycle ergometer in the heat ( $34 \pm 1^\circ\text{C}$ ) ingesting either of the three drinks in a randomized fashion: a) plain water (PW), b) flavored drink (FD), and c) CW. **Results:** There was a greater time to exhaustion in the CW session (PW = 1121 s; FD = 1141 s; CW = 1366 s;  $p=0.029$ ). Likewise, participants had a higher maximal heart rate in the CW session when compared to the other trials (PW =  $183 \pm 5$  bpm, FD =  $184 \pm 8$  bpm, and CW =  $189 \pm 8$  bpm;  $p<0.05$ ) followed by a reduced urine output after the CW ingestion (PW  $214 \pm 85$  ml, FD  $267 \pm 90$  ml, and CW  $161 \pm 73$  ml,  $p<0.05$ ). **Discussion:** The greater time to exhaustion observed with the CW ingestion might be related to the greater hydration capacity, as observed by the reduced urine output. Also, this might have an impact in the cardiovascular limit achieved during the CW trial as shown by the greater maximal HR when compared to plain water and favored drink. **Conclusion:** In conclusion, the results demonstrated that previous ingestion of coconut water improved physical performance in the heat and provided a higher hydration capacity in comparison to plain water and flavored drink.

#### INTAKE OF MACRONUTRIENTS AND FLUIDS DURING AN ULTRA-ENDURANCE BICYCLE RACE: AN OBSERVATIONAL FIELD STUDY

Konrad, M., Karner-Rezek, K., Wallner, D., Simi, H., Knechtle, B.

*FH JOANNEUM*

**Introduction** Ultra-endurance bicycle events are becoming increasingly popular but offer various physiological challenges. The competitors can expect to face extreme nutrient demands and a variety of practical challenges to achieve their fluid and fuel replacement goals. In particular the ingestion of the right amounts and the recommended mix of multiple transportable carbohydrates (CHO) during ultra-endurance bicycle events leads to higher oxidation rates of exogenous CHOs and thus to a higher rate of total CHO-oxidation. The performance in ultra-endurance events is associated with the ingestion of the right mix of CHOs during the race in a dose-dependent manner (1). The aim of this study was to compare the subject's carbohydrate intake during an ultra- endurance race with the recommenda-

tions (2). Methods An observational field study was conducted during the 1188 km Race around Slovenia. The nutritional intake was recorded by using a standardized food-log. All of the foods and fluids consumed were weighted and recorded. Each of the 6 athletes had to provide his own race provisions and to rely on a support crew to meet the planned nutritional intake. Anthropometric data are based on self-reports of the subjects. All the food-logs were calculated with DGE-PC software. Results The energy and fluid intake of six male finishers (age  $36,5 \pm 9,1$  years; weight  $76,8 \pm 8,8$  kg; height  $181 \pm 7,0$  cm; BMI  $23,3 \pm 1,4$  kg/m<sup>2</sup>;  $21,6 \pm 8,0$  average training hours per week; weekly training distance of  $595,8 \pm 296,0$  km; with  $6,6 \pm 3,4$  years of experience in ultra-cycling and no nutrition-related diseases) was  $72,52 \pm 12,71$  MJ and  $29,78 \pm 7,65$  l of fluids in total, respectively. Of the total caloric intake,  $72,0 \pm 11,9$  % derived from carbohydrates,  $15,4 \pm 11,2$ % from fat,  $13,8 \pm 2,9$ % from protein. The average energy intake in solid form was  $14,3 \pm 13,2$ %, the energy intake in form of liquids  $85,7 \pm 13,2$ %. Per hour the subjects consumed  $1,52 \pm 0,27$  MJ and drank  $0,62 \pm 0,12$  l of fluids. The CHO intake per hour was  $68,4 \pm 15,5$ g. Discussion The recommendations of 90 g of CHO per hour (2) in endurance events lasting 2,5 h or more could not be reached by any competitor, thus a CHO intake plan is crucial even for experienced cyclists. The guidelines for fluid intake are highly individual (3) and not evaluated. Therefore, the nutrition plan has to be carefully designed and to contain a fair amount of liquids over time. To the competitors it was important to alternate between sweet forms and savory choices of carbohydrates. References (1) Smith JE, Zachwieja JJ, Peronnet F, Passet DH, Massicotte D, Lavoie C, Pascoe DD (2010). *J Appl Physiol*, 108, 1520-1529. (2) Burke LM, Hawley JA, Wong SH, Jeukendrup AR (2011). *J Sports Sci*, 29 (Supl.1), 17-27. (3) Maughan RJ, Shirreffs SM (2008). *Int J Sport Nutr Exerc Metab* 18(5). 457-472.

### POST-EXERCISE REHYDRATION: EFFECT OF BEER CONSUMPTION ON FLUID BALANCE

Wijnen, A., Steennis, J., Catoire, M., Wardenaar, F., Mensink, M.

*Wageningen University*

Introduction Among amateur team-based sports, it is common to drink moderate to large amounts of alcoholic beverages, mainly beer, after training or competition. Alcohol is known to increase urine output, which could interfere with adequate rehydration after exercise. Only a few studies addressed the effect of alcohol on rehydration after exercise (Shirreffs; Hobson). Results suggested that the diuretic effect of alcohol is blurred when the body is dehydrated. Beer contains - besides alcohol - water, carbohydrates and a small amount of electrolytes. The final consequences of beer consumption for rehydration and fluid balance are not completely clear. Therefore, we assessed the effect of beer consumption, with a range of alcohol content, on fluid balance after exercise-induced mild dehydration. The rehydration capacity of the beers was compared with isotonic sports drink and water. Methods Ten healthy males were included in this cross-over intervention study (age  $24.7 \pm 5$  yrs, body weight  $75.9 \pm 3.1$  kg,  $VO_{2max}$   $57.7 \pm 6.4$  ml/kg/min). Each subject underwent five experimental conditions: non-alcoholic beer, 2% alc beer, 5% alc beer, an isotonic sports drink and water. They exercised until mild dehydration, i.e. 1% body mass reduction ( $\sim 750$  mL). Thereafter, in random order, one of the experimental beverages was consumed, in an amount equal to 100% of their sweat loss. Up till 5 hours after the last consumption urine was collected at regular intervals. Urine output was measured, and fluid balance was calculated. Results Beverage consumption clearly affected urine output. After 1 hour, urine production was significantly higher for 5% beer compared to the isotonic sports drink ( $308 \pm 148$  mL vs  $101 \pm 70$  mL;  $p < 0.01$ ). At the end of the 5-hour observation period fluid balance was negative for all conditions, with the poorest balance for 5% beer ( $-606 \pm 178$  mL,  $\sim 19\%$  rehydration) and the best balance for the isotonic sports drink ( $-452 \pm 252$  mL,  $\sim 40\%$  rehydration). Non-alcoholic beer, 2% beer and water respectively resulted in a fluid balance of  $-495 \pm 229$  mL (31%),  $-534 \pm 289$  mL (32%) and  $-499 \pm 193$  mL (33%). Conclusion Beer with an alcohol content of 5% had a negative impact on fluid balance and rehydration after exercise. While low alcoholic beer (2%) and non-alcoholic beer led to a comparable fluid balance as plain water, indicating that the diuretic effect of a low dose of alcohol is limited. Drinking an isotonic sports drink, however, appeared to be the best option for rehydration. References Shirreffs, S.M. and R.J. Maughan, *J Appl Physiol.*, 1997. 83(4): p. 1152-1158. Hobson, R.M. and R.J. Maughan, *Alcohol Alcohol.*, 2010. 45(4): p. 366-373.

### EFFECT OF GREEN TEA EXTRACTS SUPPLEMENTATION ON FATTY ACID OXIDATION AND MOLECULAR MECHANISM INVOLVED IN GLYCOGEN SYNTHESIS IN EXERCISED HUMAN SKELETAL MUSCLE

Cheng, I.S., Chen, H.W., Lai, H.P., Liu, H.C.

*National Taichung University of Education*

Introduction In Taiwan, green tea has been habitually consumed as one of the most popular beverages. Green tea contains GTEs of polyphenolic flavonoids known as tea catechins (TC), which comprise epigallocatechin gallate (EGCG), epicatechin gallate, and gallic acid. In human and animal studies, green tea extract (GTE) has been shown to increase the proportion of whole body fat utilization by activating PPAR $\gamma$  and increases CPT1 expression (Dulloo et al., 1999; Venables, Hulston, Cox, & Jeukendrup, 2008). Little study is regarding to whether GTE administration is expected to cause metabolic consequence in turn to result in improvement of glycogen synthesis in exercised human skeletal muscle. The purpose of this study was to demonstrate the effect of green tea extracts supplementation on fatty acid oxidation and molecular mechanism involved in glycogen synthesis in exercised human skeletal muscle. Methods Eight male athletes (aged  $22 \pm 0.6$  years) will be participated in this crossover designed study, and served as placebo and GTE trials (130 mg GTE/day for 8-week). Then, subjects will be crossed-over again with separation of 8 weeks. On the day of the experiment, a single bout of 60-min cycling exercise at 75 % ( $VO_{2max}$ ) will be performed and subjects consume a carbohydrate meal (2 g carbohydrate/kg body weight, 80 % carbohydrate, 8 % fat, 12 % protein) immediately after exercise. Biopsied muscle samples will be obtained from vastus lateralis immediately and 3 h after exercise. Simultaneously, blood sampling and gas analysis will be performed before and after exercise. Results The significant glycogen synthesis were shown in GTE trial compared to placebo trial in exercised human skeletal muscle ( $p < .05$ ). Yet, all parameters which included blood glucose, NEFA, glycerol and serum insulin or RER, carbohydrate oxidation rate and fat oxidation rate were no significantly different between GTE and placebo trials. Discussions The results of this study concomitant with the evidences in animal study that GTE enhance the glycogen synthesis after exercise (Murase, Haramizu, Shimotoyodome, Tokimitsu, & Hase, 2006). Therefore, the molecular mechanisms underlying on muscle glycogen synthesis with GTE supplementation will be examined in next four months. The study showed that GTE significantly influenced metabolic consequence, which in turn affects the glycogen re-synthesis in exercised human skeletal muscle. We suggested that GTE could be as ergogenic aid to athletes who are training for competitions. References Dulloo, A. G., Duret, C., Rohrer, D., Girardier, L., Mensi, N., Fathi, M., . . . Vandermander, J. (1999). *The American journal of clinical nutrition*, 70(6), 1040-1045. Murase, T., Haramizu, S., Shimotoyodome, A., Tokimitsu, I., & Hase, T. (2006). *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 290(6), R1550-R1556. Venables, M. C., Hulston, C. J., Cox, H. R., & Jeukendrup, A. E. (2008). *The American journal of clinical nutrition*, 87(3), 778-784.

**EFFECT OF DEHYDRATION ON BASKETBALL SKILL PERFORMANCE IN FEMALE PLAYERS**

Brandenburg, J.

*University of the Fraser Valley*

Introduction Basketball is characterized by repeated bouts of high-intensity effort and requires the execution of complex sport-specific motor skills. Thus, players are at risk for developing dehydration and experiencing dehydration-related decrements in skill performance. In experienced male players, dehydration reduced basketball skill performance (Baker et al.). Whether skilled female players are similarly affected by dehydration is unknown. Thus, the purpose was to examine the effect of dehydration, induced by simulated game play, on shooting accuracy, agility, and perception of effort (RPE) in female basketball players. Methods Participants were 10 female basketball players (174.4 ± 7 cm; 21 ± 1 y; 78.3 ± 13 kg) from a nationally ranked university team. Participants completed a 40-min simulated game on 2 different days. During one game, players ingested water at a rate to match fluid losses (EUH) where as no fluid intake was permitted during the other game (DEH), with the order randomized. Prior to each game, urine samples were collected to ensure players started adequately hydrated. To determine the degree of dehydration (% loss in body mass), body mass was assessed before and immediately after each game. Body mass was also monitored regularly during EUH to ensure fluid ingestion matched fluid losses. Throughout both games RPE were monitored. Shooting performance (2- and 3-point jump shots) and agility (using the T-test) were assessed following each game. Paired sample t-tests were performed to examine if differences between EUH and DEH were significant and effect sizes (ES, Cohen's d) were calculated to determine the magnitude of the differences. Results Pregame urine specific gravity for EUH equaled 1.009 ± 0.007 and was 1.008 ± 0.007 for DEH. The degree of dehydration was significantly greater in DEH (1.3 ± 0.3%) than in EUH (0 ± 0%). Players made 68.8 ± 9% and 63.8 ± 12% of 2pt shots in EUH and DEH, respectively (p=0.07, ES = 0.46). In EUH, players made 49.2 ± 13% of 3pt shots while 47 ± 14% were made in DEH (p=0.45, ES = 0.16). There were no differences in the time to complete the T-test (EUH= 10.3 ± 0.5 s; DEH= 10.2 ± 0.6 s). RPE was significantly higher during DEH (15.2 ± 1.2) than in EUH (14.6 ± 1.3) (p=0.02, ES = 0.5). Discussion The modest degree of dehydration experienced by female players during simulated game conditions did not affect 3pt shooting accuracy as well as agility. Regarding 2pt shooting performance, the moderate effect size and a EUH vs. DEH difference (5%) that approached significance suggest 2pt shooting accuracy experiences a meaningful decrement as a result of dehydration. Dehydration also increased the perception of effort, and practically, these greater feelings of fatigue may translate into a drop in playing intensity. Baker et al. 2007. *Med Sci Sports Exerc*, 39, 1114-23.

**BEER AS A SPORTS DRINK? MANIPULATING BEER'S INGREDIENTS TO REPLACE LOST FLUID.**

Desbrow, B., Murray, D., Leveritt, M.

*Griffith University*

Purpose: To investigate the effect of manipulating the alcohol and sodium content of beer on fluid restoration following exercise. Method: Seven male volunteers exercised on a cycle ergometer until 1.96±0.25% body mass (mean±SD) was lost. Participants were then randomly allocated a different beer to consume on four separate occasions. Drinks included a low alcohol beer (2.3% ABV) [LightBeer], a low alcohol beer with 25 mmol.L<sup>-1</sup> of added sodium [LightBeer+25], a full strength beer (4.8% ABV) [Beer] or a full strength beer with 25 mmol.L<sup>-1</sup> of added sodium [Beer+25]. Volumes consumed were equivalent to 150% of body mass loss during exercise and were consumed over a 1h period. Body mass and urine samples were obtained before and hourly for 4h after beverage consumption. Results: Significantly enhanced net fluid balance was achieved following the LightBeer+25 trial (-1.02±0.35 kg) compared to the Beer (-1.59±0.32 kg) and Beer+25 (-1.64±0.28 kg) treatments. Accumulated urine output was significantly lower in the LightBeer+25 trial (1477±485 mL) compared to the Beer+25 (2101±482 mL) and Beer (2175±372 mL) trials. Conclusion: A low alcohol beer with added sodium offers a potential compromise between a beverage with high social acceptance and one which avoids the exacerbated fluid losses observed when consuming full strength beer.

**EFFECT OF ARG1+ AND MULTI MACA FOOD SUPPLEMENTS ON SPORTSMEN'S PHYSICAL AND FUNCTIONAL CAPACITY**

Milasius, K., Dadeliene, R.

*Lithuanian Educational Science University*

Introduction Preparing athletes it is important to have scientifically based recommendation about consumption possibilities of concrete nutrition and food supplement. Therefore the aim of the present study is to determine the effect of food supplement ARG1+ and ARG1+ in combination with Multi Maca on physical and functional capacity of athletes to work in various energy production zones. Methods Thirty-six physically active men were randomly divided into three groups. First group (E1) subjects took the supplement ARG1+ 10g/day for 20 days. Second group (E 2) subjects took the supplement ARG1+ 10g/day and Multi Maca 2 tablets/day for 20 days. Third group (C) subjects consumed lactose as a placebo. Subjects performed two testing sessions. We tested single muscle capacity power, anaerobic alactic muscle power and aerobic capacity. Heart rate was assessed at rest, after standard physical load and after 60s recovery period. Results Supplementation of ARG1+ in combination with Multi Maca more effectively influenced cardiovascular system capacity and aerobic capacity than supplementation ARG1+. Use of ARG1+ and ARG1+ in combination with Multi Maca has not significant influences on athletes' single muscle capacity power, anaerobic alactic muscle power, absolute and relative maximal moment muscle capacity. These data of the group E1 subjects increased more than group E2 subjects. However, in comparison of groups E1 subjects and E2 group subjects with group C subjects after supplements consumption these data had significant differences. Discussion We have found that food supplement ARG1+ has more appreciable influence on increasing single muscle capacity power and anaerobic alactic muscle power than ARG1+ in combination with Multi Maca. As reported by Álvares et al., 2011, dietary supplements, containing L-arginine, helps to increase muscle strength, their recovery after anaerobic and aerobic exercise. The results of our study show the influence of dietary supplements ARG1+ and ARG1+ in combination with Multi Maca to aerobic capacity of young sportsmen. These results generally comply with the results of previous studies (Bailey et al., 2010). Our and Fahs et al. (2009) studies did not show any significant increases in cardiovascular system functional capacity. References Álvares T, Meirelles C, Bhambhani Y, Paschoalin V, Gomes P. (2011). L-Arginine as a potential ergogenic aid in healthy subjects. *Sports Med*, 41(3), 233-248. Bailey S, Winyard P, Vanhatalo A, Blackwell J, DiMenna F, Wilkerson D, Jones A. (2010). Acute L-arginine supplementation reduces O2 cost of moderate intensity exercise and enhances high-intensity exercise tolerance. *J Appl Physiol*, 109(5), 1394-1403. Fahs C; Heffernan K, Fernhall B. (2009). Hemodynamic and vascular response to resistance exercise with L-arginine. *MSSE*, 41(4), 773-779.

### FLUID INTAKE HABITS AMONG BRAZILIAN HIGH-SCHOOL WRESTLERS

Capitani, C.D.1, Viveiros, L.2, Moreira, A.3, Zourdos, M.C.4, Vidal, J.A.A.1, Aoki, M.S.3

1-University of Campinas, Limeira, Brazil; 2-Brazilian Olympic Committee, Rio de Janeiro, Brazil; 3-University of Sao Paulo, Sao Paulo, Brazil; 4-Florida Atlantic University, Boca Raton, USA

**Introduction** Traditionally, competitive wrestlers have applied various methods to lose weight quickly to fit a particular weight class. These methods include different exercise modes, accompanying by fasting and dehydration practices. It is reasonable to postulate that dehydration practice resulting in rapid short-term weight loss may cause deleterious effects on performance, however, there is little information regarding the fluid intake by young wrestlers during training and prior to competition. Therefore, the aim of this study was to describe the hydration and fluid intake practices among Brazilian high-school wrestlers. **Methods** Thirty-one high-school wrestlers, female (n=16; 13±2 yrs) and male (n=15; 13±2 yrs) agreed to participate in the study. Immediately following the official weigh-in, which was conducted 24h prior to the competition, subjects answered a hydration and fluid intake habits questionnaire. The standardized questionnaire was composed by 8 multiple-choice questions. Subjects completed the questionnaire in less than 10 minutes in a private room where only the investigator was present. **Results** Of the 31 respondents 81% reported that they had previously received educational information regarding proper hydration habits, while 82% agreed that hydration habits are important to health and performance. The most popular liquids for hydration were water, soft drinks and sports drinks, which were ingested by 96%, 25%, and 22% of respondents, respectively. Additionally, most of the athletes attested that they are concerned about fluid intake during training (51%) and competition (62%). Finally, regarding the time of ingestion, 45% of subjects reported ingestion of liquid before they get thirsty, while 41% reported waiting until after thirst sets in to drink. **Discussion** The majority of athletes seem to recognize the importance of proper fluid intake during training and competitions to optimize performance, and also acknowledge receiving educational information regarding proper hydration habits. Despite these factors, a significant amount of respondents still demonstrated poor choices of liquid ingestion (i.e. soft drinks) and inappropriate timing of fluid intake (i.e. after thirst occurs). Ultimately, coaches and parents should engage in educational programs in order to promote improved fluid intake habits to benefit health and performance in young wrestlers.

### 'EFFECTS BETWEEN A DRINK MILK AND ISOTONIC IN REHYDRATION AFTER EXERCISE'

Astudillo, S., Castro, M., Jorquera, C.

*Universidad Mayor*

**Introduction** One of the principal variable ones in the sports performance is the dehydration. Opposite to this decrease of electrolytes, we can meet a hyponatremia faced, and not only to affect the performance of the sportsman, but also to affect the health of this one. In conditions of rest an individual loses about 95,9 ml/h and in conditions of long exercise it can manage to lose 1.321 ml/h. The study that we have carried out tries to confirm the rehydrating capacity of two drinks, a drink isotónica, opposite to a lacteal drink descremada, to understand and to take up office which is the most suitable drink later to a session of exercise. **Methods** The sample corresponded to 14 males, with an average of age of 23 years, with an average stature of 1,74 cms. one to which lacteal descremada was managing the affairs for the tipsy rehydration flavor chocolate and to another group drink was supplied him isotónica. There has been applied the capture of sample of simple urine to be analyzed by means of the MINI ISE, automatic analyzer of electrolytes, the analyzed electrolytes were sodium and potassium. Also the gravity was evaluated it specifies in urine. **Results** The comparison between the sodium in urine, later to the exercise and the sodium in urine later to the rehydration with lacteal drink descremada, finding very significant differences  $p < 0,007$  evaluating to  $p < 0,05$ . The comparison between the potassium in urine, later to the exercise and the potassium in urine later to the rehydration with drink isotónica, not being significant differences  $p < 0,64$  evaluating to  $p < 0,05$ . The subjects that they re-hydrated with drink isotónica retained 25 % of the quantity of ingested drink and the subjects that descremada re-hydrated with lacteal drink retained 71 % of the ingested drink. **Discussion** The recommendations for a drink re-hydrate, are orientated to the quantity of electrolytes and carbohydrates and not always the value has relation with the quality. When proteins join him to these solutions the retention of liquid can improve for better the assimilation of the electrolytes, for end milk them it transforms in an excellent option as sports drink. (Brattan C 2001). ) **References** Coyle E. (2004). Fluid and fuel intake during exercise. *J sports Sci*, vol 22, 39- 55. Hartman W, Tang J, Wilkinson S, Tarnopolsky M, Lawrence R, Fullerton A & Phillips S (2007). Consumption of fat-free fluid milk after resistance exercise promotes greater lean mass accretion than does consumption of soy or carbohydrate in young, novice, male weightlifters. *Am J Clin Nutr* 86, 373–381. Ivy J. (2003). Effect of a carbohydrate-protein supplement on endurance performance during exercise of varying intensity. *International Journal of Sport Nutrition and Exercise Metabolism*, 13, 382-95. Shirreffs S, Watson P. (2003), 'Milk as an effective post-exercise rehydration drink', *Volume 98, Pages 173-180, British Journal of Nutrition*.

### BODY COMPOSITION CHANGES AND EATING BEHAVIOR IN RECREATIONAL MALE IRONMAN TRIATHLETES

Ghiani, G., Lantini, T., Marongiu, E., Tocco, F., Degortes, N., Concu, A.

*University of Cagliari*

**Introduction** Ironman triathletes appear to profit from low body fat (Knechtle et Al. 2011). The aim of this study was to investigate eating habits and body composition in a group of recreational male Ironman, who were in the preparing season for an imminent competition. They trained for about 20 hours/week. **Methods** Five recreational male Ironman triathletes participated in the study. Each of them completed a food frequency questionnaire (FFQ) to assess their usual diet (Fidanza et Al.,1995) and attended a small interview, so that their daily physical activity level (PAL) was determined. PAL was obtained by dividing Total Energy Expenditure by Base Metabolic Rate (Black et al. 1995). For each subject Fat Mass percentage (FM%) was detected twice by mean of plicometry: eight and one weeks before the competition (Durnin and Womersley, 1974). Dietary recommendations were given to each of them in order to correct their diet as to perfectly fit their needs in term of calories and nutrients. **Results** Processing of the FFQ emphasized that energy requirements were not fulfilled. In detail, their PAL was about 2, but there was more than 1000 Kcal difference between average intake and average needs, mostly from calories derived from complex carbohydrates, so that their diet was adjusted to fit their needs. In the second detection, made one week before the race, each participant modified his body composition reducing his FM%. **Discussion** Results of the present investigation show that the dietary status of our sample of triathletes lacked both in term of food quantity and quality. Taking into account that Ironman competition highly recruit the energetic sources of athletes, it is possible to speculate that they may take advantage from a correction of their eating habit by a proper dietary counseling. **References** Knechtle B, Knechtle P, Rüst CA, Rosemann T (2011) *J Sports Sci*, 29(13):1373-80. Fidanza F, Gentile MG, Porrini M. (1995), *Eur J Epidemiol*, 11;163- 170. Black AE, Coward WA, Cole TJ, Prentice AM, (1996) *Eur J Clin Nutr*, 50 (2); 72-92. Durnin JV, Womersley J (1974), *Br J Nutr*, 32(1);77-97.

## FOOD DISORDERS IN ATHLETES OVER 10 YEARS OLD OF ANTIOQUIA SKATING AND GYMNASTIC LEAGUES, COLOMBIA

Quiroz, O.

*INDEPORTES ANTIOQUIA*

Introduction Athletes, who require low weight and fat percentage, have been recognized as a population with an increased risk of Eating Behavior Disorders (EBD). This is more difficult in women growth and development stages, with psychophysical changes that make them vulnerable to present EBD or inadequate response to desired body image, having impact on their health. Studies in Antioquia, in Medellin adolescent women, 2003, showed a prevalence of 17.7% and 33.3% EBD at risk of suffering. The study was conducted in the Department of Nutrition for Sports Medicine Indeportes Antioquia, Colombia, through the application of EAT-26 questionnaire. Methods: 37 athletes were surveyed, all of them over 10 year's old, practicing figure skating, rhythmic gymnastics and artistic women in the city of Medellin. We searched literature on the subject. The pilot study was developed and carried out test EAT 26. Analysis of the results was socialized with staff of Department's Leagues. Statistical analysis was made with Epi-Info 6.04. Results: The EAT-26 average was 18 • 8 points. 13 athletes (35%) had a score greater than or equal to 20, which implies risk of a EBD. The average age of 16.2 • 3.3 years in athletes at risk of EBD was higher than those who didn't have, that was 13.7 • 3.0 years. BMI was higher for athletes at risk: 20.7 • 2.6 units, compared with athletes who didn't have EBD risk: 18 • 8.2 units. There was a prevalence 35% of risk within 37 athletes tested. Ten of the 13 people with risk of EBD were women. No significant differences that relate to the type of sport practiced with the risk of EBD. Conclusion Obtained data with EAT 26 test are a contribution to the characterization of the population at risk of EBD related to nutrition. References: 1.Eating Disorders: Facts about Eating Disorders and the Search for Solutions. URL: <http://www.nimh.nih.gov/publicat/schizkids.cfm>. Cited 2004 February 24. NIH Publication Number: NIH 5124. Fecha de acceso Junio 12 / 2005. 2.De la paz D, Celeste C. Trastornos de la conducta alimentaria en mujeres adolescentes de bajos recursos: El paradigma de la pobreza. URL: [www.ama-med.org.ar](http://www.ama-med.org.ar) 3.Zagalaz M, Romero S, Contreras O. La anorexia como distorsión de la imagen corporal. Programa de prevención desde la educación física en la provincia de JAEN - ESPAÑA •sitio en Internet•. URL: [www.campus-oei.org](http://www.campus-oei.org) Fecha de acceso Abril 19 / 2005. 4.Mendoza P, Posada E. Prevalencia y población afectada de anorexia, bulimia y otros trastornos de la alimentación. URL: <http://aupec.univalle.edu.co/piab/prevalencia.html>

## WEIGHT LOSS PRACTICES OF GERMAN ATHLETES IN OLYMPIC WEIGHT CLASS SPORTS

Braun, H.1,2, Werkner, J.2, Koehler, K.1,2, Mester, J.2, Thevis, M.1, Schaenzer, W.1

*German Sport University Cologne*

Introduction Rapid weight loss is a common method in weight class sport. To limit negative consequences on health and performance athletes are advised not to exceed bodyweight >3% of competition weight. Furthermore, young athletes are discouraged to use rapid weight loss methods (Sundgot-Borgen et al. 2011). To our knowledge data on weight loss practices of German athletes don't exist. Therefore, the aim of this study was to examine weight loss practices of German athletes in Olympic weight category sports. Methods & Subjects A closed-ended questionnaire was developed based on the questionnaire used by Oppliger et al. (2003). In June 2012 the questionnaire was sent per Email as an online version to athletes and coaches. Finally, 106 athletes answered the questionnaire (Judo n=33, Boxing n=27, Wrestling n=34, Taekwondo n=12). Subjects were grouped into adult (A: ≥18 yrs, n=58) and young (Y: <18 yrs, n=48) athletes. Results Asking the athletes at which age they started to apply weight loss methods, we found the young athletes started significant earlier (age: 12.9 ±4.6 yrs; p<0.001) compared to the adults (15.1±5.3 yrs). Regarding the past season 90% of young athletes (A: 93%) reported to make weight, whereas 52% (A: 74%) stated a weight loss >3% with respect to their competition weight. The frequency of weight loss in young athletes was found to be 4.7±4.0 times (A: 6.3±4.7; p=0.07) in the past season. The weight loss methods young athletes were using at minimum 3-4 times per week were: increased training 33% (A: 47%), dieting 25% (A: 55%), sweat suits 19% (A: 41%) and fluid restriction 15% (A: 17%). Young athletes named coaches (50%), parents (23%), team staff (17%), teammates (17%) (A: 41% coaches, 21% team staff, 21% teammates), whom influences them largely regarding weight loss methods. Discussion In contrast to recent recommendation on rapid weight loss, we found a large number of young athletes using questionable weight loss methods regularly. Furthermore, half of the young athletes reported to cut weight >3% of bodyweight. The young athlete in this day seems to start earlier using rapid weight loss methods than in the past. Therefore, it is important to elucidate coaches and parents about the risks of weight loss methods and include sports dietitians in a long term weight loss strategy. However, to approve the data and to identify possible sports specific differences a study with a larger number of participants should be done in the future. References Sundgot-Borgen, J, Garthe, I, (2011). *J Sp Sci*, 29(S1), S101-S114 Oppliger, RA, Steen, SN, Scott, JR, (2003). *Int J Sp Nutr Exerc Met*, 13, 29-46

**14:00 - 15:00**

## Mini-Orals

### PP-PM36 Physiology [PH] 3

#### EFFECT OF AEROBIC EXERCISE IN SKELETAL MUSCLE REVASCULARIZATION AND FIBER TYPE CHANGES.

Moretto, D.1, André, A.1,3, Lopes, A.4, Paiva, A.4, Pinto-Pereira, S.1, Fontes-Ribeiro, C.A.1,2, Tavares, P.1,2

*1-Faculty of Sport Sciences and Physical Education, 2-Faculty of Medicine -IBILI, University of Coimbra. 3-Coimbra College of Health Technology. 4-Portuguese Institute for Blood and Transplantation.*

Introduction It has been demonstrated that aerobic exercise may change skeletal muscle fiber type. However, the mechanisms underlying this change are still controversial. Nevertheless, an association between an increase in muscle capillaries and circulating endothelial progenitor cells (EPCs) has been reported, being nitric oxide and VEGF probably implicated on the above mechanisms. This work aimed to study after aerobic exercise the relationship of changes of skeletal muscle fiber type with increased number of capillaries, taking into account nitric oxide synthases (NOS) and VEGF levels. The exercise influence over EPCs as well as their relationship with NOS and VEGF were also studied. Methods An animal model was used. All the animals' experiments and treatments were in agreement with the na-

tional and international guidelines regarding the experimental use of animals. Eighteen male Wistar rats (with about 250 g) performed an aerobic training for 8 weeks in a treadmill; a control group without training was also used. At the end of this period the training efficiency was assessed. Blood was collected from the jugular vein, being all the animals sacrificed by anesthetic overdose after this. The soleus muscle was removed and stored for further analyses. To evaluate the soleus muscle fiber type a myosin-ATPase staining was performed. EPCs were determined on whole blood samples by flow cytometry using anti-CD45, -CD34, -CD133 and -CD146 antibodies. The expression of the NOS isoforms was assessed by western-blotting using the antibodies against iNOS and cNOS (Santa Cruz). The serum VEGF concentration was quantified by an ELISA commercial kit (R & D systems). Results The results showed that the aerobic training increased the number of type I fibers and decreased the type II fibers number. In the soleus muscle these changes were associated with increased iNOS and principally cNOS. By using the biomarkers for EPCs in an undifferentiated state (anti-CD34+ and anti-CD133+) no differences were observed (related to control). However, the percentage of cells with biomarkers for the endothelial phenotype (anti-CD146+, anti-FLK1+) decreased in the trained group. In addition, in comparison with controls an increase in the capillaries/fiber type ratio was observed, as well as an increase in the serum VEGF concentration. Discussion These results suggest that aerobic exercise promotes the exchange of fibers type II to type I in rat soleus muscle. This fiber exchange was associated to an increase in muscle revascularization. Thus, the decrease in blood differentiated EPCs may indicate an increase of EPCs mobilization into skeletal muscle. This seems to be supported by the increase in muscle blood flow and C:F ratio, which could be regulated by nitric oxide and VEGF. Support: FCT, Strategic Project (Ref: PEst-C/SAU/UI3282/2011), and COMPETE.

### PERCEIVED EXERTION DURING DIFFERENT SET CONFIGURATIONS IN BENCH PRESS AND ITS RELATIONSHIP WITH BLOOD PRESSURE AND POWER OUTPUT

Mayo, X., Iglesias-Soler, E., Carballeira, E., Sánchez-Otero, T., Castro-Gacio, X.

*UDC (A Coruña, Spain)*

Introduction Interest in the use of ratings of perceived exertion to regulate resistance exercise has increased in recent years. OMNI-RES is a newly scale developed specifically to resistance exercise, and different studies have demonstrated that OMNI-RES is able to distinguish among protocols with different volumes and intensities (Lagally & Robertson, 2006). However, differences in the set design were not largely studied. The aim of the present study was to evaluate the differences between three different protocols with the same total volume and intensity, but with different set configuration. Methods 9 healthy subjects (24.0±1.5 y; 173±7 cm; 67.6±9.2 kg) performed 5 sets to failure with the load of 10RM and with 180 seconds between sets (failure session, FS). On separate days in a counterbalanced order, subjects performed the same volume but with the repetitions clustered in groups of 5 (i.e. 5[10]; Sánchez-Medina et al., 2011) (5S) or with rests between each repetition (1S). The total rest of the FS, 720 seconds, was distributed between each group of 5 repetitions or each repetition. OMNI-RES with memory anchoring procedures for the active muscles was obtained at the end of each set or coincident repetition. Systolic blood pressure (SBP) was measured at the same time than OMNI-RES and Power output (PO) was recorded for each repetition. Results Friedman's test with Friedman post-hoc analysis was realized to compare OMNI-RES. Mean OMNI-RES was higher in FS in comparison with 5S and 1S (8.44±1.19; 6.66±0.84; 6.22±1.23, respectively;  $p < 0.01$ ). In the OMNI-RES coincident after the first set of FS, FS was higher than 1S ( $p < 0.05$ ). At the end of all sets, higher values for FS were also observed in comparison with 5S and 1S ( $p < 0.01$ ). Mean BP and PO were analysed using repeated measures ANOVA followed by post-hoc Bonferroni tests. Higher values in FS was observed for BP among protocols ( $p < 0.05$ ) but post-hoc analysis only showed a tendency between FS and 5S ( $p = 0.077$ ) and between FS and 1S ( $p = 0.093$ ). PO in FS was lower than both 5S and 1S ( $p < 0.01$ ). A positive correlation was observed between Mean OMNI-RES and Mean BP for FS (Spearman's  $\rho = 0.69$ ,  $p < 0.05$ ) whereas a negative correlation was found for 1S (Spearman's  $\rho = -0.88$ ,  $p < 0.01$ ). Discussion FS elicited a greater perceived exertion response than 5S and 1S while PO was lower in FS than in 5S and 1S. These results indicate that OMNI-RES could be used to monitor sessions with different set configuration. In addition, correlations between OMNI-RES and BP suggest that perceived exertion could be used to control BP responses in weight exercise. Surprisingly, different type of correlations were found in relationship with the set configuration. Further studies must be carried out to define the relationship between these two variables. Lagally KM & Robertson RJ (2006) *J Strength Cond Res*, 20(2), 252-6. Sánchez-Medina L & González-Badillo JJ (2011). *Med Sci Sports Exerc*, 43(9), 1725-34.

### SEX AND AGE DIFFERENCES ON LIPID PROFILE CHANGES AFTER INTERVENTION OF WEIGHT LOSS: THE PRONAF STUDY.

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Introduction Cardiovascular disease (CVD) is markedly more common in men than in women [1, 2]. In both sexes, CVD risk increases with age, but the increase is sharper in women [3]. Clinical trials have already shown the relevant role of healthy habits as balance diet, no smoke and regular physical activity to protect and decrease CVD risk [4, 5]. However, there are few studies that compare men and women response of the lipid profile to a weight loss intervention. Objective The aim of this study was to compare men and women response of the lipid profile to a weight loss intervention. The secondary aim was to determine if aging influences also on the effect of weight loss on the lipid profile. Methods One hundred and eighty (96 women and 84 men) overweight and obese participants aged 18–50 years participated in a weight loss intervention program based on diet and exercise (PRONAF Study). The intervention period was 22 weeks (3 times/wk of training for 22 weeks and 2 weeks for pre and post evaluation). All subjects followed a hypocaloric diet (25-30% less energy intake than the daily energy expenditure estimated by accelerometry). Multivariate analysis of variance (MANOVA) was used to compare for sex and age and differences in baseline and post-training values. Bonferroni's post-hoc test was employed to locate specific differences. To analyze the gender and age specific interaction the sample was classified by sex and age into responders or no-responders group. Results: There were significant differences between men and women to HDL levels. Women decreased HDL concentrations significantly. Men obtained a significant increase for HDL values. In baseline, LDL values showed differences between men and women ( $p = 0.001$ ). For TG concentrations there were significant differences between men and women in baseline and trend to significant in post-training ( $p = 0.001$ ;  $p = 0.082$ ). TC showed significant differences between men and women in baseline ( $p = 0.013$ ). After intervention, men and women showed a significant decreased to TC. Discussion When the response on lipid profile is compared by sex after weight loss intervention in our study, men achieved a better change than women. In the literature, we found reviews and epidemiological studies that try to explain the gender-specific differences to lipid profile abnormalities treatment. Due to fat distribution there is different response on lipid profile in men than in women [1, 6]. In conclusion, men achieved a positive greater change on lipid profile than women. Moreover, the favorable lipid profile response decreases with increasing age.

### REDUCTIONS IN RESTING BLOOD PRESSURE AFTER ISOMETRIC EXERCISE TRAINING ARE NOT RELATED TO SHEAR STRESS.

Smith, J., Willes, J., Swaine, I., Coleman, D.  
*Canterbury Christ Church University*

**Introduction** The training stimulus responsible for blood pressure reductions after isometric training remains equivocal. It has previously been suggested that increased exposure to shear stress during isometric exercise may mediate endothelial adaptations, similar to that seen in dynamic exercise training. This may lead to a reduced peripheral resistance and thus a lower resting blood pressure (McGowan et al, 2007). However the role of shear stress in isometric training induced blood pressure reductions remains uninvestigated. The purpose of this study was to train participants at two intensities that either elicited a high or low shear stress stimulus to determine the role of conduit femoral artery shear stress in blood pressure reductions after an isometric leg training intervention. **Methods** 35 male normotensive participants (age = 23.79 ± 6.30 yrs, height = 180 ± 5.71 cm, mass = 75.70 ± 11.11 kg) were allocated to one of three groups: high shear stress (HI), low shear stress (LO) or control (CON). The HI and LO groups undertook an 8 week training programme of 4 x 2 minute bilateral-leg isometric contractions, 3 times per week. Mean shear rate (MSR), peak shear rate (PSR) and change in shear rate ( $\Delta$ SR) were used as an estimation of shear stress, and was measured using doppler ultrasound during training intervention in the common femoral artery. Resting systolic (SBP), diastolic (DBP) and mean (MAP) blood pressure parameters were measured at baseline, mid-point (4 weeks) and post-training (8 weeks). **Results** Repeated measure ANOVA demonstrated that the changes in SBP after training were not significant in any group. There were significant differences in DBP for the LO group pre-mid, mid-post and pre-post ( $P < 0.05$ ). Significant differences in MAP were observed in the LO group pre-mid and in the HI group mid-post ( $P < 0.05$ ). However correlation coefficient analysis revealed no significant correlations between these sub-group blood pressure reductions and MSR, PSR, and  $\Delta$ SR ( $P > 0.05$ ). **Discussion** These results suggest that training according to different levels of shear stress in the common femoral artery does not provide a strong training stimulus for reductions in resting blood pressure after isometric leg exercise intervention. Although shear stress is accepted as an important training stimulus in dynamic exercise, these findings indicate that shear stress might not be the main stimulus for reductions in resting blood pressure after isometric training. **References** McGowan, C.L., Levy, A.S., McCartney, N., MacDonald, M.J. (2007). *Clin Sci*, 112, 403-409.

### GREATER VISCOSITY AND SMALLER ELASTICITY OF CENTRAL ARTERY IN RESISTANCE-TRAINED YOUNG MEN

Kawano, H., Gando, Y., Asaka, M., Ise, R., Higuchi, M.  
*Waseda University*

**Introduction:** Arterial mechanical characteristics include both elastic and viscous properties. Arterial elastic property, such as dynamic arterial compliance, beta-stiffness, and pulse wave velocity, are often used for assessment of vascular health, and arterial elasticity is attenuated by resistance training, leading to increases in risk of cardiovascular diseases. On the other hand, arterial wall viscosity is a source of energy dissipation, considering viscosity as an energy-dissipating phenomenon during mechanical transduction (conversion of cardiac pulsatile energy into arterial elastic energy). It remains unclear, however, whether arterial wall viscosity is affected by habitual resistance training. Accordingly, the purpose of the present study is to compare elasticity and viscosity of central artery between resistance-trained and sedentary men. We hypothesized that if resistance-trained men have less elasticity of artery, there is greater viscosity in them. **Methods:** Twelve resistance-trained (age, 21.0 ± 2.7 yrs; height, 167.6 ± 5.9 cm; body weight, 75.2 ± 12.2 kg) and 12 sedentary control peers (age, 22.3 ± 1.8 yrs; height, 174.3 ± 5.6 cm; body weight, 65.7 ± 8.9 kg) were participated in this study. All resistance-trained men had been performing moderate to high-intensity 'full-body' resistance training involving large muscle groups. All subjects were normotensive (< 140/90 mmHg), non-obese and smoker, and free of overt chronic diseases as assessed by medical history, physical examination and complete blood chemistry and haematological evaluation. All participants were measured as follows; static and dynamic compliance, beta-stiffness index, and wall viscosity in carotid artery. **Results and Discussion:** Resistance-trained men had smaller static arterial compliance and carotid beta-stiffness index compared with sedentary control men ( $P < 0.05$  for both), but not statistical difference in dynamic arterial compliance ( $P = 0.0655$ ), which suggests habitual resistance training may induce dysfunction of elastic artery. On the other hand, carotid arterial wall viscosity in resistance-trained men is greater than control peers (1700 ± 548 vs 1296 ± 355 mmHg·s/mmHg,  $P < 0.05$ ). This result indicates that chronic resistance training augments to dissipate pulsatile energy from heart, leading to less elasticity of central artery. **Conclusion:** The present study first examined the impact of resistance training-induced arterial stiffening on wall viscosity carotid artery, and found that there were greater wall viscosity and smaller elasticity of artery in resistance-trained men compared with sedentary young men.

### 7 DAYS ISCHEMIC PRECONDITIONING IMPROVES LOCAL AND SYSTEMIC ENDOTHELIAL FUNCTION AND MICROCIRCULATION IN HEALTHY HUMANS

Jones, H., Hopkins, N.D., Bailey, T.G., Green, D.J., Cable, N.T., Thijssen, D.H.J.  
*Liverpool John Moores University*

**Introduction:** Ischemic preconditioning (IPC) is able to protect tissue against ischemia-induced injury within and beyond the ischaemic area. We examined the hypothesis that daily exposure to IPC leads to improvement in endothelial function and skin microcirculation in the arm exposed to IPC, but also in the contra-lateral arm. Given that late phase of protection from IPC has been shown to be evident for up to 4 days, we hypothesised that improvements in vascular function would remain for 7 days following the daily IPC intervention. **Methods:** Thirteen healthy young males (age 22.5 ± 2.5 yrs; BMI 22.8 ± 1.0 kg/m<sup>2</sup>) completed a 7-day IPC-intervention, consisting of daily exposure of the arm to an IPC protocol (4x5-min at 220 mmHg with 5 min deflation). Bilateral assessment of brachial artery endothelial function (flow-mediated dilation (FMD)) and forearm microcirculation (cutaneous vascular conductance (CVC) calculated from skin flux (laser-Doppler) and blood pressure at rest and during local heating) was performed before (pre) and after 7 days of IPC (post). Bilateral assessment allowed for examination of the local (i.e. intervention-arm) and remote (i.e. contralateral-arm) effect of IPC. Since the late phase of protection from IPC extends up to 4 days, we repeated tests 8 days following cessation of the intervention (post+8). FMD and forearm microcirculation were also examined in a no intervention group (control) of 8 healthy males (age 26.0 ± 4.8 yrs; BMI 26.4 ± 2.0 kg/m<sup>2</sup>), on two occasions separated by 15 days. Differences over time and between arms were analysed using repeated measures general linear models. Data are presented as mean ± SD. **Results:** Brachial artery FMD increased during the 15 day protocol ( $P = 0.03$ ). FMD was significantly elevated at Post+8 (7.0 ± 1.6%) when compared to pre (5.2 ± 1.5%;  $P < 0.01$ ). Forearm resting CVC also increased during the protocol ( $P = 0.006$ ). CVC was elevated at Post+8 (0.16 ± 0.04 mV/mm Hg) when compared to pre (0.13 ± 0.04 mV/mm Hg) ( $P = 0.01$ ). No interaction

between IPC arm and time were evident ( $P > 0.05$ ), indicating similar changes in both the IPC and contralateral arm. The IPC-intervention did not effect CVC-responses to local heating in either arm ( $P > 0.05$ ). No significant changes were evident in the control group across the 15 day time period in FMD or CVC. Conclusion: These data indicate that daily exposure to 7-days of IPC leads to local (IPC arm) and systemic (contra-lateral arm) improvements in brachial artery endothelial function and resting skin microcirculation that remains after cessation of the intervention and beyond the late phase of protection. These novel findings may have clinical relevance, as our data suggest local and systemic potency for the IPC-stimulus to improve endothelial function in small and large arteries both acutely and chronically.

### ACUTE RESPONSES OF HEART RATE VARIABILITY AFTER BLOOD FLOW RESTRICTION EXERCISE

Chacon-Mikahil, M.P., Souza, L.C., Bonganha, V., Souza, G.V., Ferreira, M.L.V., Andrade, M.P.C., Rocha, J., Cavaglieri, C.R., Ugrinowitsch, C., Libardi, C.A.

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Introduction Resistance exercise with high-intensity (RE-HI) ( $> 70\%$  1-RM) has been recommended to increase in skeletal muscle mass. It is suggested that high-intensity resistance training may induce orthopedic and cardiovascular problems (1). On the other hand, resistance exercise low intensity (e.g.  $20\%$  1-RM), with restriction of blood flow (RE-RBF) seems to promote increased muscle mass similar to RE-HI (2). Although the RE-RBF promotes a lower stress on joints, and its efficacy is well established (3), little is known about its effect on the cardiovascular system, especially in autonomic function after exercise. One way to measure the cardiovascular stress is the measuring behavior of heart rate variability (HRV) after exercise. Indeed, sympathetic hyperactivity or reduced cardiac vagal tone (4) after exercise may represent a greater cardiovascular risk (5) and underlie ischemic heart disease and the pathogenesis of malignant ventricular arrhythmias and sudden cardiac death. Therefore, the purpose of the present study was to determine the effect of the RE-HI and RE-RBF in the sympathetic and parasympathetic balance by the HRV analyses. Methods Fifteen middle-age men ( $47.6 \pm 5.28$  y,  $76.81 \pm 10.95$  kg,  $1.74 \pm 0.08$  m), non-physically active performed 3 sets of 10 at  $80\%$  1-RM (RE-HI) and 3 sets of 15 at  $20\%$  1-RM (RE-RBF) in leg press, with the session randomized, counterbalanced order with 72h between session. The rest intervals between sets were 1 min. The cuff pressure used during the RE-RBF was determined as  $50\%$  of the necessary pressure for complete blood flow restriction in a resting condition. Autonomic measures were made before and during 60min after session. Random coefficient growth curve analysis allowed comparison between slopes during the 60 minute recovery for R-R interval, RMSSD, SDNN, LF, HF and LF/HF ratio. Results The random coefficient growth curve analysis identified greater increase post-exercise in LFnu for RE-HI compared to RE-RBF ( $P = 0.004$ ). The RE-HI also showed greater reduction in HFnu compared to RE-RBF ( $P = 0.004$ ). In addition, there was a tendency for higher LF/HF ratio for RE-HI ( $P = 0.059$ ). No differences between slopes for R-R interval, RMSSD, SDNN. Discussion The results suggest that sympathetic hyperactivity and greater reduction cardiac vagal tone after RE-HI may represent a greater cardiovascular risk compared RE-RBF. These results may be important especially for aging people and patients with various disorders, seen that the RE-RBF may promote increased skeletal muscle mass similar to RE-HI (2), but with less cardiovascular stress as seen by the sympathetic and parasympathetic modulation in the HRV analyses. References 1) Williams et al. (2007). *Circulation*, 116:572–584. 2) Takarada et al. (2000). *J Appl Physiol*, 88, 2097–2106. 3) Loenneke (2012). *Acta Physiol Hung*, 99(3):235-50. 4) Billman (2002). *J Appl Physiol*, 92: 446–454 5) Albert et al. (2000). *The New England J of Med*, 343 (19): 1355-1361

### EFFECTS OF ENDURANCE TRAINING ON THE INTERNAL CAROTID AND VERTEBRAL ARTERY BLOOD FLOW RESPONSES TO GRADED DYNAMIC EXERCISE

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Introduction Blood supply to the brain originates from the internal carotid artery (ICA) and vertebral artery (VA). Our recent study has demonstrated that there appear to be different in blood flow responses to dynamic exercise between ICA and VA (Sato and Sadamoto 2010). In addition, because endurance training attenuates the increase in cerebral metabolic rate and rating of perceived effort (RPE) during submaximal exercise (Seifert et al. 2009), it is hypothesized that endurance training affects distribution of ICA and VA blood flow during dynamic exercise. The purpose of the present study was, therefore, to assess the effect of endurance training on ICA and VA blood flow during graded dynamic submaximal exercise. Methods Twelve healthy women [ $20 \pm 1$  yr,  $163 \pm 5$  cm,  $54 \pm 3$ kg, and peak oxygen uptake ( $VO_{2peak}$ ):  $35.8 \pm 4.8$  ml/kg/min] participated in this study. The subject performed interval cycle training 4 days a week for 4 weeks, and each training lasted  $\sim 40$  min (exercise intensity:  $30 - 90\%VO_{2peak}$ ). The graded cycling exercise before (Pre) and after (Post) training at workloads corresponding to  $30\%$ ,  $50\%$  and  $70\%VO_{2peak}$  with each loads lasting 5 min. The measurements of ICA and VA blood flow were carried out during the exercise by ultrasonography. Results Endurance training caused  $9.0 \pm 6.3\%$  increase in  $VO_{2peak}$ . The ICA and VA blood flow responses from rest to  $30\%$  and  $50\%VO_{2peak}$  exercise was not change between before and after training. However, the change in ICA blood flow from rest to  $70\%VO_{2peak}$  exercise was increased after training (Pre  $\Delta 81 \pm 33$  vs. Post  $\Delta 117 \pm 58$  ml/min), while VA blood flow significantly decreased (Pre  $\Delta 55 \pm 27$  vs. Post  $\Delta 38 \pm 20$  ml/min). Discussion The change in blood flow from rest to  $70\%VO_{2peak}$  exercise was different between ICA and VA in the present study. The ICA blood flow increases despite the decrease in VA blood flow after training, indicating that anterior and posterior cerebral circulation differently adjusted to the endurance training. These contrasting results are probably due to different responses of the vascular bed in the territories supplied by the ICA and VA. In addition, the cerebral  $CO_2$  reactivity and/or neurometabolic demand may be changed by training. References Sato K & Sadamoto T (2010). *J Appl Physiol* 109, 864-869. Seifert T, Rasmussen P, Brassard P, Homann PH, Wissenberg M, Nordby P, Stallknecht B, Secher NH & Nielsen HB (2009). *Am J Physiol Regul Integr Comp Physiol* 297, R867-R876.

### ACUTE CARDIOVASCULAR RESPONSES TO RESISTANCE AND AEROBIC BLOOD-FLOW RESTRICTION EXERCISE

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Introduction Low-load resistance exercise with blood-flow restriction (BFR) increases muscle strength and hypertrophy (1). However, for safety in 'clinical' use it is important to understand the cardiovascular responses to BFR exercise that have only been examined in comparison with similar light-load exercise without BFR and not high-load resistance exercise (2). Similarly, the cardiovascular responses to aerobic BFR exercise (walking, cycling) have not been compared with high-intensity aerobic exercise (3, 4). Therefore, the aim of this study was to measure the cardiovascular stress of both resistance and aerobic BFR exercise compared with equal-intensity and high-intensity non-BFR exercise. Methods Participants ( $n=14$ ) completed two exercise trials in a randomized crossover design. Each trial comprised 3

exercise bouts completed in order (light-intensity [LI]; LI+BFR; high-intensity [HI]). Each bout comprised 4 sets. Rest between sets was 1-min, and rest between bouts was 10 min. The exercise for one trial was a seated 45 degree inclined double-led press (LP) where intensity was 20% 1 RM for the LI and LI+BFR bouts (30, 15, 15 and 15 repetitions), and 80% 1 RM for the HI bout (8 repetitions per set). The other trial was treadmill exercise (TM) where intensity was 4 km/hr for the LI and LI+BFR bouts, and 80% VO<sub>2</sub>max for the HI bout. All TM sets were 2 min. CO, SV and HR were measured prior to each bout, and during set 2 and 4. BP was measured immediately following set 2 and 4. Results Typical responses were observed for all variables (BP, HR, SV, CO) in all bouts over time (rest-to-exercise) in both TM and LP. For the TM LI+BFR bout sBP, HR, SV and CO were lower than HI but similar to LI. In LP, BP was generally similar between LI and HI bouts. However, for the LI+BFR bout, despite sBP being similar MAP and dBP were higher than in HI. CO was lower in the LI+BFR bout compared with HI but similar to LI, while HR was between LI and HI. SV in the LI+BFR bout was not different to LI or HI. Discussion These data show that the cardiovascular stress of BFR resistance exercise is more similar to traditional high-intensity resistance exercise while aerobic BFR exercise is more akin to light-intensity aerobic exercise. This suggests aerobic BFR exercise to be more suitable in 'clinical' populations than BFR resistance exercise to maintain/increase muscle mass and functional capacity. References 1. Wernbom M, et al. (2008). *Scand J Med Sci Sport.* 18(4), 401-16. 2. Takano H, et al. (2005). *Eur J Appl Physiol.* 95(1), 65-73. 3. Renzi CP, et al. (2010). *Med Sci Sports Exerc.* 42(4), 726-32. 4. Ozaki H, et al. (2010). *J Sport Sci Med.* 9(2), 224-30.

### **BRIEF CYCLING EXERCISE DOES NOT ALTER THE COMPLIANCE OF SUPERFICIAL AND DEEP VEINS IN RESTING UPPER ARM**

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**Introduction** Venous vessels have a large elasticity and compliance. Prolonged cycling exercise decreased venous compliance of forearm, which is caused by sympathetic venoconstriction that indicates an elevation of venous vessel tone (Fortney et al. 1983). The increase in sympathetic nerve activity (SNA) during prolonged exercise is caused by both exercise-induced factors (central command and reflex neural control from exercising muscle) and the unloading of cardiopulmonary which is due to the decrease in central blood volume with the increase in sweating and skin blood flow. However, the increase in SNA related to only the former one does not alter venous compliance during static exercise. Thus, it is hypothesized that brief dynamic exercise, which causes the increase in SNA related to the exercise-induced factors, does not change the venous compliance. To test our hypothesis, we assessed the venous compliance from pressure-cross sectional area (CSA) of vein curve during brief cycling exercise (Halliwill et al. 1999). In addition, we measured compliance of superficial and deep veins in resting upper arm, because the function and structure are different between both veins. **Methods** In 14 young subjects, the venous compliance was evaluated during resting (REST) and a 5-min cycling exercise at two loads with 35% (EX35) or 70% (EX70) of peak oxygen uptake. CSA in a superficial basilic vein and a deep brachial vein was measured by ultrasound technique during gradual deflation in the pressure (P) of cuff being inflated to 60 mmHg at 1 mmHg/s to provide a uniform pressure in the vein for the CSA measurement. The relation curve of  $CSA = \beta_2 \times (P)^2 + \beta_1 \times (P) + \beta_0$  was determined in each vein and thereafter the venous compliance equation was obtained as the compliance =  $\beta_1 + 2 \times \beta_2 \times (P)$ . **Results** Cuff pressure-superficial venous CSA curve shifted to downward according to exercise intensity. Cuff pressure-deep venous CSA curve during EX70% was also lower than that during REST. However, compliance of both superficial and deep vein did not differ among conditions. **Discussion** Cuff pressure-CSA curves of superficial and deep veins during exercise were lower than those during REST, indicating an elevation of venous vessel tone during exercise. However, compliance of both veins was not changed by the exercise. This result suggests that brief dynamic exercise, which causes the increase in SNA due to central command and reflex neural control from exercising muscle, induces the venoconstriction but it does not alter the venous compliance of both superficial and deep veins. **References** Fortney SM, Wenger CB, Bove JR, Nadel ER. (1983). *J Appl Physiol*, 55, 884-890. Halliwill JR, Minson CT, Joyner MJ. (1999) *J Appl Physiol*, 87, 1555-1563

### **BLOOD FLOW RESTRICTED LOW-LOAD RESISTANCE EXERCISE INDUCES TYPE 1 FIBRE SPECIFIC CHANGES IN HEAT SHOCK PROTEINS AND GLYCOGEN CONTENT IN HUMAN SKELETAL MUSCLE**

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**Introduction** Heat shock proteins (HSP) have been identified as important chaperones for repair and stabilisation of stressed and damaged proteins (1). It appears that HSP70 expression increase after both damaging- and non-damaging muscle contractions, whereas the small HSP  $\alpha$ B-crystallin seems to be more specifically responsive to muscle damaging exercise (2). Furthermore, submaximal isometric contractions have been shown to increase mostly HSP70 in type 1 fibres (3). In blood flow restricted resistance exercise performed with low loads the first part of the work is covered by mainly type 1 fibre recruitment. However, when each set is performed to failure, both fibre types will be recruited at some stage (4). It is therefore intriguing to study whether there are fibre type differences in the HSP response after blood flow restricted exercise. **Methods** Nine young healthy subjects performed unilateral knee-extensions at 30 % of 1RM. One leg was exercised with partial blood flow restriction (BFRRE) induced by a pressure cuff (90-100 mm Hg), while the other leg was exercised with normal blood flow (free-flow). The exercise consisted of 5 sets to failure in the BFRRE leg (45 sec rest between sets) and the corresponding number of repetitions in the free-flow leg. Muscle biopsies were sampled from m. vastus lateralis at pre, 1h, 24h and 48h post exercise. Muscle biopsies were cut in 8  $\mu$ m thick cross sections and stained against HSP70,  $\alpha$ B-crystallin and myosin heavy chain 1. Glycogen content was visualised with PAS-staining. **Results** Type 1 fibres showed significantly higher HSP70 and  $\alpha$ B-crystallin staining intensity at baseline than type 2 fibres. Relative to pre exercise values, a significant increase in HSP70 staining intensity was seen in type 1 fibres at 24 and 48 hours post exercise in the BFRRE leg. These changes in staining intensity were significantly larger than in the free-flow leg. Fibres displaying high staining intensities against HSP70 showed low glycogen content, most prominent at 48 hours post exercise.  $\alpha$ B-crystallin staining intensity was not significantly altered in any leg compared to pre exercise values. **Conclusion** Immunohistochemical analysis demonstrated that BFRRE performed to fatigue induced an increase in HSP70 staining intensity in type 1 fibres at 24 and 48 hours post exercise, as previously shown after submaximal isometric contractions (3). Although strenuous low-load BFRRE recruits both fibre types (4), our study demonstrates that the type 1 fibres are more stressed during this type of exercise, probably because of more fatigue than in the type 2 fibres. Interestingly, glycogen content was very low in the stressed type 1 fibres 48 hours after exercise. **Reference list** 1) Noble (2008). *Appl Physiol Nutr Metab*, 33: 1050-1065. 2) Morton (2008). *Sports Med*, 39: 643-662. 3) Tupling (2007). *J Appl Physiol*, 103: 2105-2111. 4) Krstrup (2009). *Scand J Med Sci Sports*, 19: 576-584.

## TEMPORARY IMPACT OF BLOOD DONATION ON PHYSICAL PERFORMANCE AND HAEMATOLOGICAL PARAMETERS IN WOMEN

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Purpose: No former studies have examined how blood donation influences physical performance in women and whether being a female athlete is compatible with donating blood. The aim of this study was to clarify how  $\text{VO}_2\text{peak}$ , time trial (TT) performance and haematological parameters are affected in women with normal iron stores (P-ferritin  $>40\mu\text{g/L}$ ) and women with low iron stores (P-ferritin  $12\text{--}35\mu\text{g/L}$ ) following a standard 450ml blood donation and when they can expect to be back to their physical performance level again. Methods:  $\text{VO}_2\text{peak}$  measured by an incremental cycle ergometer test, performance in a 3km treadmill TT and blood parameters were measured at baseline, 3, 7, 14, 21 and 28 days after blood donation in 14 women with normal iron stores and 6 women with low iron stores. Anthropometrics were measured at baseline and day 28. Results: Mean age was  $34.1 \pm 2.2$ . Mean body weight was  $62.0 \pm 1.2$ . There was no difference between the two groups in anthropometrics at baseline or at day 28. Body fat decreased 3.2% otherwise anthropometrics did not change in the study period.  $\text{VO}_2\text{peak}$  was reduced by 6.9% from  $2951 \pm 79$  at baseline to  $2758 \pm 71$  mL/min 3 days after blood donation and remained below baseline through the study period ( $P < 0.001$ ). TT performance was attenuated by 5.6% from baseline ( $868 \pm 28$ s) to ( $917 \pm 26$ s) at day 3. Blood haemoglobin (B-Hgb) declined ( $P < 0.001$ ) 6.4% from  $8.4 \pm 0.1$  to  $7.9 \pm 0.1$  mmol/L from baseline to day 3, respectively. Both TT and B-Hgb were recovered 14 days after blood donation ( $P < 0.001$ ). There was no difference in  $\text{VO}_2\text{peak}$ , TT and B-Hgb between the two groups at baseline or in response to blood donation. Plasma ferritin (P-ferritin) at baseline was  $66 \pm 7$  in the women with normal iron stores and  $28 \pm 3\mu\text{g/L}$  in the women with low iron stores. P-ferritin dropped to a nadir of 65% 28 days after blood donation in the group with normal iron stores, whereas P-ferritin in the group with low iron stores remained unchanged in response to blood donation. Conclusion:  $\text{VO}_2\text{peak}$  was not fully recovered 28 days after a blood donation despite of the normalization of B-Hgb and TT performance 14 days after blood donation. Since iron plays a key role in muscle mitochondrial enzymes and respiratory proteins, low iron availability might explain the observed dissociation between recovery in B-Hgb and  $\text{VO}_2\text{peak}$ . Female athletes should expect more than 28 days to recover from blood donation before entering competition. Female athletes being blood donors should be advised to take iron supplementation to prevent iron depletion, deficiency or anemia and to secure optimal physical performance.

## EFFECT OF KINESIOLOGY TAPE ON FOREARM BLOOD FLOW

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Introduction Kinesiology tape (KT) reportedly has several therapeutic effects including correction of joint misalignment, pain reduction, lymphatic flow facilitation and enhanced peripheral blood flow. Evidence to support such claims is insufficient, and the mechanisms through which KT exerts its effects are unknown. This study aimed firstly to determine whether KT affects skin blood flow (SkBF), and secondly, to establish whether SkBF effects are mediated by a nitric oxide (NO) endothelial response. Methods Baseline and maximal thermally stimulated SkBF responses were assessed using laser Doppler flowmetry in 13 healthy, elite, adolescent male soccer players ( $14.7 \pm 0.6$  yrs, Tanner stage 3-5). Participants completed two experimental trials; during trial 1 the arm was taped at the volar aspect of the dominant forearm, using a single 15cm strip of Kinesio® Tex Gold™ applied with 10% stretch. Forearm SkBF was measured on the volar aspect of the forearm, within the taped area (KT), and also in the collateral area, 3cm lateral to the taped area (control 1). During trial 2 no tape was applied to either site (NKT and control 2). Trials were performed within 7 days, in a randomised crossover design. SkBF, measured in perfusion units (PU) and mean arterial pressure, recorded at 5-minute intervals throughout the testing protocol, were used to calculate cutaneous vascular conductance (CVC). Maximum CVC (CVCmax) was identified and data was subsequently expressed as a percentage of this value (%CVCmax). Results There was no significant difference for baseline SkBF between KT ( $11.09 \pm 5.46$ PU) and NKT ( $9.53 \pm 3.94$ PU), or %CVCmax between KT ( $11.68 \pm 5.49\%$ ) and NKT ( $9.21 \pm 3.22\%$ ). Similarly, no significant difference was identified for maximal SkBF between KT ( $118.36 \pm 73.46$ PU) and NKT ( $113.23 \pm 51.80$ PU), or CVCmax between KT ( $1.50 \pm 0.91$ PU/mmHg) and NKT ( $1.54 \pm 0.77$ PU/mmHg). Finally, there were no significant differences between KT and control 1 for baseline SkBF ( $11.09 \pm 5.46$ PU and  $12.37 \pm 9.33$ PU) and %CVCmax ( $11.68 \pm 5.49\%$  and  $11.73 \pm 7.04\%$ ), or for maximal SkBF ( $118.36 \pm 73.46$ PU and  $111.29 \pm 40.29$ PU) and CVCmax ( $1.50 \pm 0.91$ PU/mmHg and  $1.42 \pm 0.48$ PU/mmHg) respectively. Discussion These findings suggest that in a population of healthy, elite, trained adolescent males, KT is not associated with increased forearm SkBF either at the taped site or collateral area. It is therefore, unlikely, that any therapeutic effects of KT are mediated through an upregulation of the cutaneous circulation. Further investigation is warranted into the effects of KT on alternative vascular beds and the mechanisms by which such effects, if any, are achieved.

## EFFECT OF BLOOD FLOW RESTRICTION TIMING IN ENHANCING INTRAMUSCULAR METABOLIC STRESS DURING RESISTANCE EXERCISE

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Background/aim: In recent years it has been reported that increases in muscle size and strength equivalent to those with high intensity load can be achieved even with low intensity loads (20–40% of 1 repetition maximum, RM) using blood flow restriction (BFR) together with resistance training (Abe T. Clin Physiol Funct Imaging 2012). However, there is a possibility that continuous BFR will markedly increase blood pressure and induce the development of blood clots (Manini TM. Exerc Sport Sci Rev 2009, Nakajima T. Int J KAATSU 2006). There are also reports showing a high rating of perceived exertion (Wernbom M. J Strength Cond Res 2006). Therefore, the aims of this study were to investigate the efficacy and timing of intermittent BFR procedures during low-intensity resistance exercise. Methods: Seven healthy men performed 3 sets of 1-min unilateral plantar flexion (30 repetitions) with 1-min intervals under 4 different conditions: low intensity resistance exercise (L, 20% 1-RM) without BFR (L-noBFR), L with BFR during rest periods (L-reBFR), L with BFR during exercise periods (L-exBFR), and L with continuous BFR during both exercise and rest periods (L-conBFR). Based on the results of this experiment, additional moderate intensity resistance exercises (40% 1-RM) with intermittent BFR (M-reBFR and M-exBFR) were performed in four of the seven subjects. Intramuscular metabolic stress, defined as phosphocreatine depletion and intramuscular pH decrease, was evaluated by  $^31\text{P}$ -magnetic resonance spectroscopy. Results: Phosphocreatine depletion and intramuscular pH decrease in L-conBFR were significantly greater than those in L-noBFR, L-reBFR and L-exBFR ( $p < 0.05$ ), while those changes in L-reBFR and L-exBFR were equal and tended to be greater than those in L-noBFR. By contrast, those changes in M-reBFR and M-exBFR were similar to those in L-conBFR. Subject's exertion after BFR during exercise was lower in L-reBFR and L-exBFR than in L-conBFR, and was tended to be lower in L-reBFR than in L-exBFR.

Conclusion: In low intensity resistance exercise with BFR, continuous BFR can successfully increase muscular metabolic stress and might be the most effective method when the goal is improved muscle strength and size. However, an equivalent metabolic load can also be obtained with intermittent BFR exercises by increasing the exercise load. Regarding subject's exertion, moderate intensity with rest periods BFR could be useful method and applicable to resistance training.

### BETA-ALANINE IMPROVES JUMP PERFORMANCE AND AFFECTS ENERGY METABOLISM DURING HIGH INTENSITY EXERCISE IN JUNIOR ALPINE SKIERS

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Introduction: Competitive alpine skiing is a very high intensity sport which taxes muscular strength and aerobic as well as anaerobic energy supply systems of the athletes to the max. Improvements in high intensity performance, muscle buffer capacity and muscle contractility were shown after beta-alanine supplementation in humans and animals (1, 2). It was hypothesized that beta-alanine supplementation of alpine skiers improves performance and affects their muscle energy metabolism. Methods: 11 male junior alpine skiers agreed to participate in this double blinded study (age:  $19.5 \pm 1.2$  y; height:  $179 \pm 4.8$  cm; body weight:  $76.5 \pm 5.5$  kg). They were randomly assigned to beta-alanine (Bal: 4.8g beta-alanine/day) or placebo group (Pla). Before and after the 5-week supplementation phase, exercise tests were performed to assess jump performance (counter movement jump: CMJ) as well as high intensity exercise performance (90s high-box jump: HB90) and energy metabolism (90s high intensity fixed-load cycling test: CLT). Muscle biopsies were taken from M. vastus lateralis to determine buffer capacity. Results: Maximal power output during CMJ was improved in Bal ( $+7 \pm 3\%$ ,  $p=0.01$ ) but not in Pla ( $+1 \pm 3\%$ ,  $p=0.57$ ; between group effect:  $p=0.03$ ). Performance during the last third of HB90 was increased in Bal only ( $+7 \pm 4\%$ ,  $p=0.02$ ) but not in Pla ( $0 \pm 12\%$ ,  $p=1.00$ ; no between group effect:  $p=0.28$ ). Fatigue-index was in a tendency improved for Bal from  $-13\%$  to  $-7\%$  ( $p=0.06$ ) and declined non-significantly in Pla from  $-4\%$  to  $-11\%$  ( $p=0.25$ ; between group effect:  $p=0.03$ ). Spirometric measurements in CLT showed small effects of beta-alanine on high-intensity metabolism. Namely, developments in the oxygen deficit (Bal:  $-2.5 \pm 7.5\%$ ; Pla  $+6.6 \pm 2.8\%$ ;  $p=0.05$ ) and aerobic energy contribution (Bal:  $+1.3 \pm 2.9\%$ ; Pla:  $-2.1 \pm 1.3\%$ ;  $p=0.06$ ) were in tendency different between the groups. Muscle buffer capacity did not change in either group. Discussion: We show for the first time, that well trained competitive alpine skiers can increase explosive strength of their leg muscles when supplemented with beta-alanine. Together, improved performance during the last third of the HB90 and small metabolic shifts during the CLT indicate, that beta-alanine might positively affect aerobic energy supply during high intensity exercise. Beta-alanine's effects on intramuscular calcium sensitivity and turnover might possibly explain these results. References: 1. Everaert I, et al. Effect of beta-alanine and carnosine supplementation on muscle contractility in mice. *Med Sci Sports Exerc* 45, 2013. 2. Harris RC, and Sale C. Beta-alanine supplementation in high-intensity exercise. *Med Sport Sci* 59, 2012.

14:00 - 15:00

## Mini-Orals

### PP-PM41 Physiology [PH] 8

#### THE SAME EQUATION CAN BE USED FOR BOTH SEXES TO PREDICT RESTING ENERGY EXPENDITURE IN JAPANESE ATHLETES

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Introduction It is important to know a total energy expenditure (TEE) for determination of energy requirement. Though REE is needed to know TEE, it is difficult to measure an actual REE. Therefore, some estimation equations of REE have developed. Currently, the equation for athletes published by Japan Institute of Sports Science (JISS equation,  $REE(kcal/day)=28.5 \times FFM(kg)$ ) have widely used to estimate REE of athletes in Japan. However, this equation was not established based on the measured REE (REEm) of athletes. In our previous study, it was found that estimated REE (REEe) by JISS equation was significantly different from REEm. On the other hand, REEe by Taguchi's equation ( $REE(kcal/day)=27.5 \times FFM(kg)+5$ ) was similar to the REEm of female athletes. The purpose of this study was to examine whether the estimation equation developed for female athletes can be used to predict REE for male athletes. Methods Sixty collegiate male athletes (48 football players and 12 swimmers) were participated in this study (height  $174.2 \pm 5.7$ cm, body weight (BW)  $80.3 \pm 11.5$ kg, and fat free mass (FFM)  $67.2 \pm 7.1$ kg). REE was measured by indirect calorimetry using Douglas bag technique, and body composition was estimated by dual energy X-ray absorptiometry. The REEe was calculated from Taguchi's equations based on a FFM and JISS equation. Paired t-test, estimation error, total error and systematic error by Bland-Altman plots were used for analysis. Results REEe by Taguchi's equation was not significantly different from REEm for male athletes. Whereas REEe based on the JISS equation for male athletes was significantly different from REEm. There is a high correlation between REEm and REEe from Taguchi's equation ( $r = 0.76, p < 0.001$ ). Bland-Altman analysis of Taguchi's equation did not show any systematic error. Discussion It was found that Taguchi's equation for Japanese female athletes can be used to male athletes. Most of predicted equations of REE are based on metabolic rate per body weight (BW). In previous studies, it was suggested that REE are more highly correlated with FFM than BW. Sexual difference exists in body composition that male individual generally have larger FFM than female. Metabolic rates per FFM remove the influence by a sexual difference in body composition. Taguchi's equation uses FFM as variable not BW. Therefore, this study suggested that Taguchi's equation can be used for male athletes. In conclusion, this study suggested that Taguchi's equation can be used to predict REE not only for female athletes but also for male athletes. Reference 1) Taguchi M, Ishikawa-Takata K, Ouchi S, Higuchi M. (2011). *Jpn J Phys Fitness Sports Med*, 60(4), 423-432

## INFLUENCE OF REGULAR TRAINING ON RESPIRATORY SYSTEM ADAPTATION

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Introduction Among many physiological adjustments during exercise, respiratory adaptation seems to be one of the most complex. It is well known that aerobic exercise can increase oxygen consumption by 10-20 folds in whole body, and 100-200 folds in working muscles, increasing the demand for gas exchange. The ventilatory response to exercise is well documented but mixed results have been reported for the 'airways response' (Silverman et al, 2005). Expiratory flow limitation can lead to an inability for increasing alveolar ventilation and together with diaphragmal fatigue are common in endurance trained athletes, resulting in diminished endurance exercise performance. The aim of this work was to examine the effect of regular training on respiratory function parameters. Methods Experiment included 30 regular trained sportsmen and 30 sedentary students. Spirometry measurements were obtained in both groups at rest and included ventilatory parameters (forced vital capacity-FVC, forced expiratory volume in 1 second-FEV1, FEV1/FVC ratio) and air flow parameters (peak expiratory flow-PEF, forced expiratory flow: FEF-25-75, FEF25, FEF50, FEF75). Results Estimated results in sportsmen group were (% of predicted value): FVC=105,9%; FEV1=106,3%; FEV1/FVC=101,2%; PEF=97,2%; FEF-25-75=102,2%; FEF25=90,1%; FEF50=96,4% and FEF75=88,5%. Similar results were obtained among sedentary students: FVC=101,5%; FEV1=101,8%; FEV1/FVC=101,7%; PEF=92,8%; FEF-25-75=99,6%; FEF25=90,4%; FEF50=93,7% and FEF75=86,7%. Discussion It is clear that results didn't show significant difference between any of examined parameters pointing that there were no changes in respiratory function in rest between trained people and sedentary one. Similar results were found by (Boutellier et al, 1992). The efficiency of the respiratory system presents significant limitation factor of the body's ability to perform exercise. Effect of the increased work of breathing, respiratory muscle fatigue and dyspnea point to the importance of respiratory muscle training. Conclusions Sportsmen under regular training in state of rest showed no significant difference in respiratory function parameters compared to sedentary healthy persons.

## YOGA PRACTICE HAS MINOR INFLUENCE ON RESPIRATORY FUNCTION AT REST IN MEN AND WOMEN

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Introduction Yoga breathing (pranayama) is an important part of health and spiritual practices (Brown R.P, Gerbarg PL.,2009). Yoga induces long-term changes in respiratory function and control (Bernardi L. et al., 2007). Yogic practices are low intensity exercises within lactate threshold and has the potentiality to train the respiratory system in such a way that it helps an individual to cope with the respiratory demand (Ray et al., 2011). Methods Pulmonary function was measured by means of the gas analyzer „Oxycon Mobile“ (Germany) before and after 6 month yoga training in men (YPM) (n=11) (age - 30,8 (7,06), BMI - 25,6 (2,6)) and women (YPW) (n=11) (age - 28,9 (6,86), BMI - 22,5 (2,3)) practicing yoga and control subjects (n=22) of similar age. Results Pulmonary function measures forced expiratory flow rate (FEF) 75/85 (L/s) (p = 0,036), forced vital capacity inspiration (FVC IN) (L) (p = 0,014), forced inspired volume in one second (FIV1) (L) (p = 0,045) were significantly higher in yoga practicing than in control women group, and vital capacity (VC MAX) (%) (p = 0,018), forced expiration volume in one second (FEV1) (%) (p = 0,041), forced expiratory flow rate (FEF) 25% (L/s) (p = 0,017), FVC IN (L) (p = 0,002) in practicing yoga men, than in non practicing yoga men group. They also demonstrated higher values of maximum voluntary ventilation (MVV) (L/min) (p = 0,068) and forced vital capacity (FVC) (L) (p = 0,050). After 6 month of yoga practicing we found higher FEF50% (L/s) (p = 0,003), in women group and VCMAX (%) (p = 0,028) in men group. We also found tendency to increase of VCMAX (L) (p = 0,053), peak inspiration flow (PIF) (L/s) (p = 0,051), FVC IN (L) (p=0,061), FIV1 (L) (p = 0,064) indexes in men and PIF (L/s) (p = 0,072), FVC IN (L) (p= 0,076) in women. Conclusions Yoga practise seems, to have minor influence on respiratory function at rest in men and women of middle age. References Bernardi L, Passino C, Spadacini G, Bonfichi M, Arcaini L, Malcovati L, Bandinelli G, Schneider A, Keyl C, Feil P, Greene RE, Bernasconi C. (2007). Reduced hypoxic ventilatory response with preserved blood oxygenation in yoga trainees and Himalayan Buddhist monks at altitude: evidence of a different adaptive strategy? *Eur J Appl Physiol.* 99(5). Brown RP, Gerbarg PL. (2009). Yoga breathing, meditation, and longevity. *Ann N Y Acad Sci.* 1172:54-62. Ray US, Pathak A, Tomer OS (2011). Hatha yoga practices: energy expenditure, respiratory changes and intensity of exercise. *Evid Based Complement Alternat Medicine.*

## PEAK VO2 IN YOUNG SWIMMERS DURING A TREADMILL INCREMENTAL TEST UNTIL EXHAUSTION

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Introduction Children's participation in competitive sports often begins at an earlier age, undergoing through training and competition process (Armstrong & McManus, 2011). Therefore, it's important to understand the physiological responses to exercise and training in young athletes. The aim of this study was to analyze the Peak VO2 in pubertal swimmers and compare it with participants not involved in any regular sport practice. Methods In the study 20 young male were evaluated: 10 young swimmers (age, 14.0 ± 1.33 yr.; height, 169.91 ± 7.71 cm; weight, 55.83 ± 9.09 kg; tanner's stage, 3.9 ± 0.32), with an average of 4.3 ± 1.77 years of training practice and competition; and 10 participants not involved in any regular sport practice (age, 14.0 ± 1.25 yr.; height, 165.32 ± 6.22 cm; weight, 64.87 ± 16.35 kg; tanner's stage, 3.9 ± 0.32). Peak VO2 was measured directly (Cosmed K4b2, Rome, Italy), during a continuous progressive treadmill protocol (Modified Balke) where the participants ran until exhaustion (volitional fatigue or maximum criterion was achieved). Normality (Shapiro-Wilks test) and homogeneity (Levene's test) were satisfied for a significance level of .05. To compare the groups, the Student's t test (two-tailed) was used (Statistical Package for Social Sciences, version 17.0), with a significance level of p < 0.05. Results Young swimmers shown higher relative Peak VO2 (75.91 ± 7.75 vs. 55.45 ± 10.03 ml • kg<sup>-1</sup> • min<sup>-1</sup>) compared with the group of young boys not involved in any regular sport practice (p = 0.000). Discussion It was observed a significantly higher relative Peak VO2 in young swimmers and that may be due to the differences in sport practice between the groups. A high Peak VO2 is essential for elite performance in many sports (Armstrong, Tomkinson, & Ekelund, 2011), and the results of the present study were in agreement with improvement of aerobic performance following a period of training in young swimmers (e.g., Faude et al., 2008). Peak VO2 is an important variable for coaches and is also required to access this parameter from sport specific tests. Surely it will be useful for young people to practice regular sport or physical activity in order to achieve a healthier lifestyle. References Armstrong N, McManus AM (2011). *Med Sport Sci*, 56, 1-22. Armstrong N, Tomkinson G, Ekelund U (2011). *Br J Sports Med*, 45, 849-58. Faude O, Meyer T, Scharhag J, Weins F, Urhausen A, Kindermann W (2008). *Int J Sports Med*, 29, 906-912. Tanner JM (1962). *Growth at adolescence*, 2nd ed. Oxford: Blackwell.

### PEAK VO<sub>2</sub> AND PEAK POWER OUTPUT IN YOUNG SOCCER PLAYERS

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**Introduction** Children's morphological and functional specialization has concerned the investigators for the past years (Malina, Bouchard, & Bar-Or, 2004). Therefore, the aim of this study was to analyze the evidence of the metabolic specialization in pubertal soccer players. **Methods** Ten young male soccer players (age,  $14.1 \pm 0.88$  yr.; height,  $171.37 \pm 9.02$  cm; weight,  $60.77 \pm 9.84$  kg; tanner's stage,  $3.7 \pm 0.48$ ) participated in the study, with an average of  $6.7 \pm 2.7$  years of experience. An incremental treadmill test to exhaustion (Modified Balke) was used to assess Peak VO<sub>2</sub>, with direct gas analysis, breath-by-breath (Cosmed K4b2, Rome, Italy). To assess Peak Power Output, participants performed the Wingate Anaerobic Test (Monark 894E), with a resistance of 75 g/kg (7.5% of body weight). Statistical analysis was carried out with Statistical Package for Social Sciences, version 17.0. The data was presented as means and standard deviation, and correlations were made (Pearson Correlations) in order to determine the relationships between the Peak VO<sub>2</sub> and Peak Power Output. **Results** The absolute and relative Peak VO<sub>2</sub> was  $3748.57 \pm 659.02$  ml • min<sup>-1</sup> and  $61.66 \pm 3.93$  ml • kg<sup>-1</sup> • min<sup>-1</sup>, respectively. The absolute and relative Peak Power Output was  $517.4 \pm 83.02$  W and  $8.56 \pm 0.89$  W • kg<sup>-1</sup>, respectively. Results showed a strong correlation between absolute Peak VO<sub>2</sub> and Peak Power Output ( $p = .778$ ), but no correlation between relative Peak VO<sub>2</sub> and relative Peak Power Output ( $p = -.346$ ). **Discussion** It was observed that the players who achieved the best results in absolute Peak VO<sub>2</sub> also achieved better performance in absolute Peak Power Output, although no relationship was found in relative to body mass. Those results were in agreement with results of non-athletes (Falk & Bar-Or, 1993) and shown that these young soccer players were not metabolic specialized. The issue of metabolic specialization in young athletes is still unclear, but the results may suggest that the metabolic specialization begins in late puberty. Further studies should take into account allometric scaling to evaluate the physiological performance of young soccer players. **References** Falk B, Bar-Or O (1993). *Pediatr Exerc Sci*, 5, 318-331. Malina R, Bouchard C, Bar-Or O (2004). *Growth, maturation and physical activity*, 2nd ed. Champaign: Human Kinetics. Tanner JM 1962. *Growth at adolescence*, 2nd ed. Oxford: Blackwell.

### DIVING RESPONSE IN ELITE DIVERS AFTER A ONE-WEEK DIET AND OVERNIGHT FASTING

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**Introduction.** It is well known that the nutritional status may affect performance. In competitive apnoea it is important to limit metabolism to minimise oxygen consumption and improve apnoea duration. Hence, many elite divers fast before performing apnoea. Lipid metabolism exerts two different effects during apnoea: by one hand it may increase oxygen consumption, on the other hand it may improve performance because it reduces splanchnic filling and the relative amount of carbon dioxide (CO<sub>2</sub>) produced. Therefore, fasting can delay respiratory contractions and prolong the total duration of the breath hold (Lindholm P et al., 2007). Thus, in our opinion, an overnight fasting after a short dietary period could reduce splanchnic filling without inducing an excessive increment in metabolism, thereby improving the diving response. **Methods.** We studied 8 healthy elite divers on two separate trials: (A) three dived to 10-20-30 meters deep, three hours after the normal breakfast, and (B) three dived at the same depth, but after following a specific diet and overnight fasting. Measurements have been performed through an impedance cardiograph contained inside an underwater torch, to assess hemodynamic parameters such trans-thoracic fluid index (TFI), stroke volume (SV), heart rate (HR) and cardiac output (CO), during static and dynamic apnoea (Tocco F et al., 2013). Before and at end of each test we collected blood pressure (MBP), arterial O<sub>2</sub> saturation (SaO<sub>2</sub>), blood glucose (Glu) and blood lactate (Bla) data. **Results.** Preliminary results show that overnight fasting causes an improvement in time of static apnoea at 10-20-30 meters with respect to the same trials after breakfast, probably because of an ameliorated cardiovascular response. In detail, a significant increment in static apnoea duration at 10 meters was found (mean time was  $57.7 \pm 22.8$  sec after fasting and  $40.0 \pm 25$  sec after breakfast,  $p < 0.05$ ). Besides, during dives at 30 meters, mean SV values after fasting were higher than after breakfast ( $+64.6 \pm 61\%$  and  $-1.1 \pm 21.7\%$  respectively,  $p < 0.05$ ). **Conclusion.** Data seem to indicate that diet followed by overnight fasting improves the diving response, and that dietary manoeuvres may have an important application in improving diving response via SV and CO changes during static and dynamic apnoea. **References** Lindholm P, Conniff M, Gennser M, Pendergast, D, Lundgren C. (2007). *Eur J Appl Physiol*, 100(4), 417-425. Tocco F, Marongiu E, Pinna M, Roberto S, Pusceddu M, Angius L, Migliaccio G, Milia R, Concu A, Crisafulli A. (2013). *Acta Physiol (Oxf)*. 207 (2), 290-298.

### CARDIORESPIRATORY RESPONSES IN EXHAUSTIVE TANDEM-BICYCLE ERGOMETER EXERCISE

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**Purpose:** We developed a tandem-bicycle ergometer. Two subjects can share for one load with one braking pist type using the tandem-bicycle ergometer. We have reported that the tandem-bicycle ergometer is suitable to give an equal load to two subjects during sub-maximal exercise (Onodera S. et al., ECSS 2012). Thus time, we performed a maximal incremental test, and we tested whether the tandem-bicycle ergometer can give equal load to two subjects to exhaustion. **Methods:** The subjects were sixteen males. Their age, height and body mass were  $25 \pm 7$  years,  $173 \pm 7$  cm, and  $71 \pm 10$  kg (mean  $\pm$  SD). All subjects signed the informed consent forms prior to participation in this study. First, the subjects performed incremental exercise until exhaustion using a single-bicycle ergometer (SIN). Cardiorespiratory variables (peak oxygen uptake (VO<sub>2</sub> peak) and peak heart rate (HR peak)) were recorded during exercise. Next, the incremental exercise using a tandem-bicycle ergometer was carried out in two different conditions: former saddle (FOR) and rear saddle (REA). The subjects, who have almost the same peak oxygen uptake (VO<sub>2</sub> peak), were selected for the exercise using a tandem ergometer. The coefficient of variations (CV) for each variable at exhaustion was calculated between trials, e.g., SIN vs. FOR and SIN vs. REA. **Results:** VO<sub>2</sub> peak and HR peak in the SIN trial were  $43.8 \pm 8.7$  ml/kg/min and  $189 \pm 7$  bpm. In the FOR and REA trials, VO<sub>2</sub> peak and HR peak were  $44.7 \pm 7.4$  ml/kg/min and  $192 \pm 12$  bpm (FOR), and  $44.1 \pm 9.3$  ml/kg/min and  $191 \pm 8$  bpm (REA), respectively. There were no significant differences among the trials. The CV for VO<sub>2</sub> peak was  $6.1 \pm 4.6\%$  (SIN vs. FOR) and  $5.5 \pm 3.6\%$  (SIN vs. REA). The CV for HR peak was  $2.7 \pm 2.7\%$  (SIN vs. FOR) and  $2.5 \pm 1.8\%$  (SIN vs. REA). **Discussion:** It was reported that circadian change in VO<sub>2</sub> peak is 3-10%, and that changes in intra-individual difference are 5.5%. These data in the previous studies are quite comparable for the results in the present study. In con-

clusion, it is suggested that the tandem-bicycle ergometer is suitable to give an equal load to exhaustion from the viewpoint of cardiorespiratory responses of two subjects. [The Ministry of Education, Culture, Sports, Science and Technology, Grant-in-Aid for Scientific Research (24500686)]

### THE COMPARISON OF ACUTE RESPONSE OF LUNG FUNCTION INDICES TO AEROBIC AND ANAEROBIC EXERCISES IN AIR POLLUTION

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**Introduction** While aerobic activity is one of the keys to a healthy lifestyle, air pollution and exercise can be an unhealthy combination. This is especially true if you have asthma, diabetes, heart or lung conditions, or lower respiratory disease. Even when you're not exercising, exposure to air pollution can cause health problems. But with the combination of air pollution and exercise, the potential health problems are increased. This thesis project aims at studying the effect of aerobic and anaerobic exercises on lung function in polluted weather. **Methods** In this study 20 healthy men with the age range of 22.4 , 4 were randomly divided into the experiment group (10 participants) and the control group. Initially, the experiment group had one session of aerobic exercised (lasing for 20 minutes with the intensity of 50 revolves in a minute and power of 100 watt). Then after a three- week break ,in polluted air, these participants did the anaerobic exercise (lasting for 21 minutes with the intensity of 70 revolves in a minute and with the power of 285 watt for one minute and a two- minute break for 7 times) on the ergometer bicycle. The same kind of exercise was done by the control group but in healthy clean air. The experimental and control groups were successively exposed to healthy (PSI=60) and unhealthy (PSI=150) weather. Lung function tests were run before the exercises, right after the exercises (the first post-test) and 24 hours after the exercises (the second post-test). Results The findings of this study showed that aerobic exercise in unhealthy polluted air resulted in the reduction of FEV1, FVC and FEF25-75% indexes in the first and second post-tests significantly ( $P<0.05$ ). Following anaerobic exercises in polluted air, a significant decrease was observed in FVC and FEF25-75% indexes in both the first and second post-tests ( $P<0.05$ ). Yet, in comparison to anaerobic exercises, FEV1 and FEF25-75% indexes in the first and second post-tests and FEV1 and FVC indexes in the second post-tests underwent a greater reduction ( $P<0.05$ ). **Discussion** While physical exercise in polluted weather caused a reduction in the lung function indicators (FEV1, FVC and FEF25-75%) in the first and second post-tests, it seemed that anaerobic exercises in polluted weather reduced (FEV1 and FEF25-75% in the first and second post tests and FEV1/FVC in the second post test to a far lesser extent. **References** 1. Abedi A,Sezavar S H,Mohamadi naghde M (2005). ' The comparison of test lung function in melderers aged 70 27 years with non melderers in Ardebil province. Medical science magazine of Tabriz. 36 (46). 61 57 . 2. A Carlisle and N Sharp (2001). ' Exercise and outdoor ambient air pollution'. Br J Sports Med. August; 35, 214-222. 3. Ashish R. shah, david gozal, and thomas G. keens (1998). "Determinants of Aerobic and Anaerobic Exercise Performance in Cystic Fibrosis". Am J Respir Crit Care Med 157, 1145-1150. 4. Bascom R, Bromberg PA (1996). 'Health effect of outdoor air pollution'. Am J Respir Crit Care Med. 50 153:3 .

### HIGHER CARDIORESPIRATORY FITNESS ATTENUATES ARTERIAL STIFFENING ASSOCIATED WITH THE ESTROGEN RECEPTOR-BETA POLYMORPHISM IN HEALTHY WOMEN

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**Introduction:** Epidemiological and animal studies have suggested that the reduction of estrogen secretion after menopause results in acceleration of arterial stiffening and cardiovascular diseases (Meyer et al., 2009). Action of estrogen via estrogen receptor-beta (ESR2) has an anti-atherosclerotic effect in vessels (Villablanca et al., 2009). Additionally, gene polymorphisms of ESR2 are associated with cardiovascular disease risks. Habitual exercise brings higher cardiorespiratory fitness and results in the improvement of arterial stiffening and cardiovascular disease risks. However, the effect of cardiorespiratory fitness on the relationship between genetic variation of ESR2 and arterial stiffness remains unclear. **Purpose:** The aim of present study was to clarify the effects of cardiorespiratory fitness on the relationship between ESR2 gene polymorphism and arterial stiffness in Japanese women. **Methods:** Five hundred eighty-eight healthy women (18-84 yr old) participated in a cross-sectional study. ESR2 (rs1271572, G>T; transposition in the promoter region) polymorphism was determined by real-time PCR with Taqman probe. Arterial stiffness was measured by brachial-ankle pulse wave velocity (baPWV), and cardiorespiratory fitness was evaluated by peak oxygen uptake. Subjects were divided into high-cardiorespiratory fitness (High-fit) and low-cardiorespiratory fitness (Low-fit) groups based on the median value of peak oxygen uptake in each gender and decade. **Results:** High-fit subjects had lower baPWV value than in Low-fit subjects (High-fit;  $1225\pm 224$ , Low-fit;  $1292\pm 284$  cm/sec, mean $\pm$ SD,  $p<0.05$ ). The baPWV value of individuals with the TT genotype of ESR2 was significantly higher than those with the TG and GG genotypes (GG;  $1244\pm 267$ , GT;  $1273\pm 264$ , TT;  $1328\pm 305$  cm/sec). In the Low-fit subjects, baPWV value was significantly higher in individual with TT genotype ( $1387\pm 364$  cm/sec) than in individuals with the GT ( $1293\pm 280$  cm/sec) and GG ( $1255\pm 246$  cm/sec) genotypes. However, there were no such differences in High-fit subjects (GG;  $1234\pm 285$ , GT;  $1252\pm 247$ , TT;  $1256\pm 235$  cm/sec). **Conclusion:** These results revealed that the higher cardiorespiratory fitness may attenuate the change in arterial stiffness that is associated with ESR2 gene polymorphism (rs1271572) in the healthy Japanese women. **References:** Meyer MR, et al., (2009) Cardiovascular research, 83, 605-610. Villablanca AC, et al. (2009) J Cardiovasc Transl Res, 2, 289-99. **Grants:** Supported by KAKENHI of the Japan Ministry of Education, Culture, Sports, Science and Technology (MI, MM).

### ASSESSMENT OF HEART RATE, PULMONARY AND MUSCULAR V'O<sub>2</sub>-KINETICS OF UPPER AND LOWER BODY EXERCISE DURING DYNAMIC MODERATE WORK RATE CHANGES

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**Introduction** During dynamic work rate changes the kinetics of heart rate and pulmonary V'O<sub>2</sub> can be measured by ECG and gas exchange easily. Muscular V'O<sub>2</sub> kinetics can be non-invasively estimated by using time-series analysis in combination with a physiological model, comprising the time delay and the distortive effects of the cardio-dynamic phases between muscular and pulmonary level (Hoffmann et. al., in press). Using the mentioned non-invasive approach, we compared the kinetics of upper (Up: arms/torso) and lower body (Lo: legs) exercise for heart rate (HR), pulmonary (V'O<sub>2</sub>pulm) and in particular for calculated muscular oxygen uptake (V'O<sub>2</sub>muscl). **Methods** 11 male volunteers (age:  $24 \pm 2$  years; height:  $184 \pm 8$  cm; weight:  $79 \pm 7$  kg;  $relV'O_{2peak}(Up)$ :  $37.8 \pm 5.0$  ml $\cdot$ min $^{-1}$  $\cdot$ kg $^{-1}$ ;  $relV'O_{2peak}(Lo)$ :

$56.1 \pm 7.4 \text{ ml}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$ ) were subjected to pseudo random binary work rate (WR) changes on a leg cycle ergometer (30 W, 80 W) and an arm cranking exercise device (20 W, 50 W). HR was measured beat-to-beat by ECG,  $\dot{V}O_{2\text{pulm}}$  was determined breath-by-breath, and  $\dot{V}O_{2\text{musc}}$  was estimated by the method of Hoffmann et al. (in press) for Up and Lo. Given a linear, time-invariant, first order system the peak of the cross correlation function (CCF) of WR and a second parameter (e. g. HR,  $\dot{V}O_{2\text{pulm}}$ ,  $\dot{V}O_{2\text{musc}}$ ) indicates the kinetic responses of this parameter (Hpeak, Ppeak, Mpeak). Higher peaks denote faster system responses. Accordingly, for Up and Lo the kinetic responses for HR (Up\_Hpeak, Lo\_Hpeak),  $\dot{V}O_{2\text{pulm}}$  (Up\_Ppeak, Lo\_Ppeak) and  $\dot{V}O_{2\text{musc}}$  (Up\_Mpeak, Lo\_Mpeak) were calculated. Differences between the kinetic responses were statistically analyzed applying a two-way ANOVA (parameter x exercise model) for repeated measurements. Results Significant differences were found between Up\_Mpeak ( $0.341 \pm 0.062$ ) and Lo\_Mpeak ( $0.414 \pm 0.046$ ;  $p=0.018$ ;  $n=11$ ). In addition, there were no significant differences between Up\_Hpeak ( $0.465 \pm 0.183$ ) and Lo\_Hpeak ( $0.457 \pm 0.075$ ;  $p=0.895$ ;  $n=11$ ), as well as between Up\_Ppeak ( $0.312 \pm 0.090$ ) and Lo\_Ppeak ( $0.351 \pm 0.072$ ;  $p=0.316$ ;  $n=11$ ). Discussion It can be speculated that there could be differences between upper and lower muscular  $\dot{V}O_2$  kinetics due to different characteristics of the specific upper and lower body musculature from daily activities. Furthermore, the influence of the individual training status, muscle fiber composition, and enzyme activity, remain to be clarified. The study was funded by the DLR (Deutsches Zentrum für Luft- und Raumfahrt), Germany (FKZ 50WB0726). References Hoffmann U, Drescher U, Benson AP, Rossiter HB, Essfeld D (in press).

### SYMMETRIC CARDIOVASCULAR DYNAMICS GENERATE ASYMMETRIC RESPIRATORY $\dot{V}O_2$ RESPONSES TO ON- AND OFF-STEP CHANGES IN WORKLOAD

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**Introduction** Muscular  $\dot{V}O_2$  kinetics ( $\dot{V}O_{2\text{musc}}$ ) are frequently estimated on the basis of respiratory  $\dot{V}O_2$  ( $\dot{V}O_{2\text{resp}}$ ) responses to step changes in workload. A typical approach to account for the distorting effects of cardiac output (CO) dynamics and venous return is to discard the initial response of about 20 s ("cardiogenic phase") before data fitting. **Methods** In this study we investigated, by means of a mathematical model, the influence of CO dynamics, muscle perfusion, venous volume and venous volume distribution on respiratory  $\dot{V}O_2$  as well as the effect of discarding the first 20 s of  $\dot{V}O_{2\text{resp}}$  on the quality of  $\dot{V}O_{2\text{musc}}$  estimation. **Results** The results show marked asymmetries between on- and off  $\dot{V}O_{2\text{resp}}$  kinetics and substantial errors in  $\dot{V}O_{2\text{musc}}$  estimates in particular for the off-kinetics. Discarding cardiogenic phases only partly compensates for the distortion of muscular  $\dot{V}O_2$  generated by the transport through the venous system. Within the parameter settings chosen, errors in the estimate of  $\dot{V}O_{2\text{musc}}$  time constants were up to 90% for off-kinetics and up to 40% for on-kinetics. **Discussion** The simulations suggest, that major improvements in estimated muscular  $\dot{V}O_2$  kinetics can only be obtained if the values of the relevant distorting parameters (muscle perfusion, venous volume and venous volume) are known. These values would allow a backward computation of muscular  $\dot{V}O_2$  dynamics from respiratory  $\dot{V}O_2$  data. **References** Barstow TJ and Mole PA. (1987). *J Appl Physiol*, 63, 2253-2261. Bearden SE and Moffatt RJ. (2001). *J Appl Physiol*, 90, 2081-2087. Grassi B, Pogliaghi S, Rampichini S, Quaresima V, Ferrari M, Marconi C, and Cerretelli P. (2003). *J Appl Physiol*, 95, 149-158. Murias JM, Kowalchuk JM, and Paterson DH. (2010). *J Appl Physiol*, 108, 913-922. Rossiter HB, Ward SA, Kowalchuk JM, Howe FA, Griffiths JR, and Whipp BJ. (2002). *J Physiol*, 541, 991-1002.

### GROUND'S SLOPE AFFECTS THE VENTILATORY EFFICIENCY IN SKYRUNNERS DURING A RACE SIMULATION AT ALTITUDE

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**Introduction** Skyrunning is the discipline of running in the mountains above 2000 m where the slope can exceeds 30%. During races at altitude the ventilatory request increases due to the combined effect of exercise and hypoxia. It is well known that a deeper and lower ventilation (VE) is more efficient in terms of gas exchanges. We aimed to analyse the ventilation, the thoraco-abdominal coordination and the oxygen saturation (SpO<sub>2</sub>) in skyrunners during a race simulation. **Methods** 14 athletes (12M; age 34-60) run from 2030m to 2804m wearing an inductive plethysmography system (Lifeshirt) equipped with a pulse-oximeter and GPS (Garmin). We evaluated ventilation (VE), tidal volume (VT), ventilatory pattern (VE/VT) and phase angle (PhA), index of thoraco-abdominal coordination. **Results** Subjects run 6.2 kilometers, mean speed 1.6m/s. Values at rest and during the ascent are respectively: SpO<sub>2</sub> (%) ( $94.8 \pm 1.2$ ;  $85.2 \pm 3.2$ ) VE (L/min) ( $20.3 \pm 4.3$ ;  $128.6 \pm 29.3$ ), VE/VT ( $22.4 \pm 3.9$ ;  $52.3 \pm 8.4$ ). The relationship between the slope (S) and PhA is represented by a quadratic curve. As S increases >30% a significant increase in PhA is observed ( $p < 0.01$ ), index of worsening thoraco-abdominal coordination. The increase in PhA is significantly related to an increase in VE/VT ( $r = 0.4^*$ ) which in turn affects SpO<sub>2</sub>. In fact the correlation between VE/VT and SpO<sub>2</sub> is highly significant ( $r = -0.69$ ). The low SpO<sub>2</sub> is associated to a lower race speed ( $r = 0.33^*$ ).  $*p < 0.01$  **Discussion** Our data evidence that in skyrunners the slope of ground negatively influences the thoraco-abdominal coordination, mostly when slope is >30%. The increase in slope is also related to a decrease in SpO<sub>2</sub> through a change in ventilatory pattern toward a less efficient breath. These factors negatively influence the speed performance. **References** Casaburi R, Porszasz J, Burns MR, Carithers ER, Chang RS, Cooper CB. (1997). *Am J Respir Crit Care Med*, 155, 1541-1551. Bernardi L, Spadacini G, Bellwon J, Hajric R, Roskamm H, Frey AW. (1998). *Lancet*, 351, 1308-1311. Do not insert authors here

### EFFECTS OF VARYING RAMP PROTOCOLS ON PEAK POWER AND MAXIMAL OXYGEN CONSUMPTION: A VALIDATION OF MORTON'S MODEL

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**Introduction** In ramp protocols, the peak power attained at the end of the test ( $w'_{\text{peak}}$ ) does not correspond to the  $w'_{\text{max}}$  of a classical Astrand-type test. On this basis, Morton (2011) proposed a model of  $w'_{\text{peak}}$  that included critical power (CP) and anaerobic capacity as constants, and the mean ramp slope as variable. He validated his model using experimental data from a previous study (Morton et al., 1997), with continuous linear ramp increments. Yet most ramp tests foresee discrete step ramp increments, in which power is increased by a given amount at a given fixed time which may vary from 15 to 300 s. The aim of this study was to test Morton's model of  $w'_{\text{peak}}$  in ramp tests, with invariant step increment and increasing step duration. **Methods** 16 men performed six ramp tests with 25 W increments up to exhaustion. Step duration was: 15, 30, 60, 90, 120 and 180 s.  $\dot{V}O_{2\text{max}}$  and  $w'_{\text{peak}}$  were identified as the highest values reached during each test. An Astrand-type test with 50 W increments, 5-min duration steps, 6-min recovery between steps, was also performed,

in which  $\dot{V}O_2\max$  and  $w\max$  were established from plateau in the  $\dot{V}O_2$  versus power relationship.  $\dot{V}O_2$  and ventilatory variables were measured by metabolic cart. Lactate and heart rate (HR) were also measured. The results were fitted into Morton's model. Results  $\dot{V}O_2\max$  was the same in all tests. In contrast,  $w\text{peak}$  was lower the longer the step duration, with differences being significant among all step durations. All  $w\text{peak}$  obtained in the various ramp tests were significantly different from the  $w\max$  of the Astrand-type test. At the end of the test, no differences were observed for HR, except for the two shortest protocols (15 and 30s ramps), during which a significantly lower HR was reached compared with the longest ramp test. No differences were found for the peak  $[La]_b$  values among the various ramp tests. When  $w\text{peak}$  was analysed within Morton's model, an excellent fitting was found, yielding mean CP equal to  $198.08 \pm 37.46$  W and anaerobic capacity equal to  $16.82 \pm 5.69$  kJ. Further developments of Morton's model provided a univocal relation between CP and  $w\max$ . Discussion Present validation of Morton's model authorizes estimating CP and  $w\max$  from any type of ramp test, provided  $w\text{peak}$  and ramp slope are known. Thus, there is no further need of establishing lactate threshold or performing long protocols like the Astrand-type when training powers are to be set. References Morton RH. (2011). *J Sport Sci* 29: 307-9. Morton RH, Green S, Bishop D, Jenkins DG (1997). *Med Sci Sports Exerc* 29: 833-6.

## A COMPARISON OF THE PHYSIOLOGICAL RESPONSES TO MAXIMAL OXYGEN UPTAKE TESTS ON MOTORISED AND NON-MOTORISED TREADMILLS

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**Introduction** Maximal oxygen uptake ( $\dot{V}O_2\max$ ) is considered to be the criterion measure of cardiorespiratory fitness (ACSM, 2010). A non-motorised treadmill (NMT) may better simulate the physical stress of the training environment and/or be better suited for testing team sport players. However it is unknown if the NMT allows the exerciser to reach  $\dot{V}O_2\max$ . The aim of the study was to examine the physiological responses to  $\dot{V}O_2\max$  test protocols on motorised and non-motorised treadmills. **Method** Sixteen males completed one continuous incremental test to exhaustion on a motorised treadmill (Cosmos) and two incremental tests on an NMT (Woodway Force 3) in a randomised order. Participants completed the motorised treadmill test using a step protocol that increased by  $1 \text{ km}\cdot\text{h}^{-1}\cdot\text{min}^{-1}$  at a gradient of 1% (MOT-CONT). The first NMT trial mirrored the motorised treadmill protocol (NMT-CONT) with the second NMT trial using an intermittent step protocol also increasing by  $1 \text{ km}\cdot\text{h}^{-1}\cdot\text{min}^{-1}$ , but alternating between higher and lower speeds ( $2 \times 15 \text{ s}$  blocks per minute - NMT-15). Heart rate was measured in the final 15 s of each stage. Expired air was measured by a breath-by-breath system (Oxycon). Data were analysed using the effect size statistic and 90% confidence intervals (Hopkins, 2009). **Results** The mean (SD)  $\dot{V}O_2\max$  ( $\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) were MOT-CONT 46 (7), NMT-CONT 46 (7), NMT-15 45 (7). The mean difference as an effect size for MOT-CONT vs. NMT-CONT (ES = -0.03; 90%CI -0.12 to 0.09) and MOT-CONT vs. NMT-15 (ES = -0.16; 90%CI -0.37 to 0.05) were both trivial. The mean (SD) peak speeds ( $\text{km}\cdot\text{h}^{-1}$ ) were MOT-CONT 15.1 (1.5), NMT-CONT 10.3 (0.9), NMT-15 13.8 (1.0). The mean difference in peak speed as an effect size for MOT-CONT vs. NMT-CONT was very large (ES = -3.71; 90%CI -4.13 to -3.29). The mean difference in peak speed as an effect size for MOT-CONT vs. NMT-15 was moderate (ES = -0.87; 90%CI -1.35 to -0.38). The mean (SD) HR<sub>peak</sub> ( $\text{beats}\cdot\text{min}^{-1}$ ) were MOT-CONT 186 (7), NMT-CONT 178 (9), NMT-15 183 (7). The mean difference as an effect size for MOT-CONT vs. NMT-CONT was large (ES = -0.84; 90%CI -1.10 to -0.59) and for MOT-CONT vs. NMT-15 was small (ES = -0.38; 90%CI -0.63 to -0.13). **Discussion**  $\dot{V}O_2\max$  can be successfully achieved on an NMT when using the same protocol as used on a motorised treadmill. However, the peak speed achieved is reduced by approximately one third and with a large reduction in HR<sub>peak</sub>. When an incremental protocol is performed intermittently on the NMT the same  $\dot{V}O_2\max$  can be achieved together with smaller reductions in peak speed and HR<sub>peak</sub> compared to a motorised treadmill protocol. **References** Thompson (2010). ACSM's Guidelines for Exercise Testing and Prescription (9th Edn). Hopkins (2009). *MSSE*, 41(1), 3-13.

## AN INNOVATIVE PROCEDURE FOR THE ANALYSIS OF $\dot{V}O_2$ KINETICS WITHOUT DATA PRE-TREATMENT

Bringard, A.

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**Introduction** The study of pulmonary gas exchange dynamics at the onset of exercise is constrained by the low time resolution due to breathing frequency and the low signal-to-noise ratio. Off-line interpolation was proposed to artificially increase the time resolution, but it may induce data distortion. The aim of this study was to propose and evaluate a new approach to the problem of poor time resolution in the analysis of breath-by-breath  $\dot{V}O_2$  kinetics. **Methods** A set of noiseless bi-exponential  $\dot{V}O_2$  kinetics (Barstow and Molé, 1987), mimicking transitions from rest to moderate exercise, were simulated by Monte-Carlo method. This provided a set of exact data, which we used as reference data. The parameters were randomly selected from intervals that cover the range of physiological values for this intensity domain. Then, each of these kinetics was sampled 10 times with non-uniform sampling time, mimicking breathing patterns during rest-exercise transition, and was subjected to 3 different pre-treatment procedures. The linear (Hughson et al, 1993) and step (Lamarra et al, 1987) pre-treatment methods consisted, respectively, of linear and step 1-s interpolations of each repetition. Then the average value was calculated for each second, resulting in an "averaged transition", to which bi-exponential fitting was applied. Our method (called none) needed no interpolation: the data of the 10 repetitions were pooled together as if they were from the same transition. Bi-exponential fitting was applied to the pooled data. For all methods, data were compared with the exact values. The confidence intervals were estimated by bootstrap using the bias corrected and accelerated percentile method. **Results** Phase I time constant ( $\tau_1$ ) data lying exactly on the identity line were more numerous with the none than with the linear and the step methods. With the none method, the identity line stayed within the confidence intervals for  $\tau_1$  but was below the lower confidence interval curve for the step and the linear methods, indicating that both overestimated  $\tau_1$ . **Discussion** The better performance of the none method is due to the fact that the linear and step methods introduce a "filter-like" effect (interpolation followed by data averaging) that affect the data. This kind of pre-treatment is not present in the none method. By definition, a filter affects the time constants of an exponential response. We conclude that the none method should be used instead of the linear and step methods, when the rapid phase of  $\dot{V}O_2$  kinetics is to be analysed. **References** Barstow TJ, Molé PA. (1987). *J Appl Physiol*, 63, 2253-2261. Hughson RL, Cochrane JE, Butler GC. (1993). *J Appl Physiol*, 75, 1962-1967. Lamarra N, Whipp BJ, Ward SA, Wasserman K. (1987). *J Appl Physiol*, 62, 2003-2012.

14:00 - 15:00

## Mini-Orals

## PP-PM47 Physiology [PH] 14

**PHYSIOLOGICAL ADAPTATIONS OF AN 8-WEEK RECREATIONAL SOCCER PRACTICE AND RUNNING TRAINING IN UNTRAINED WOMEN**

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**PHYSIOLOGICAL ADAPTATIONS OF AN 8-WEEK RECREATIONAL SOCCER PRACTICE AND RUNNING TRAINING IN UNTRAINED WOMEN** Introduction Soccer is a potential element to induce physiological adaptations and improved performance for all types of people (Randers et al., 2010). Physiological indices are references to identify the effects of training in many sports (Impellizzeri et al., 2006). Thus, the purpose of the present study was to compare physiological adaptations of an 8-week recreational soccer practice and running training in untrained women. Methods Twenty-six untrained women were separated in two groups: soccer (SG) and running group (RG). Participants performed three times per week training during eight weeks. The soccer sessions consisted of ordinary eight-a-side matches on a 50 x 30 m artificial grass field. The aerobic training sessions consisted of continuous and interval training at low intensity and high intensity running on a motorized treadmill. Maximal incremental running test to determine maximum oxygen uptake (VO<sub>2</sub>max), lactate threshold (LT) and onset of blood lactate accumulation (OBLA) was performed before and after the intervention period. Data were evaluated by two-way analysis of variance on repeated measurement ( $p < 0.05$ ). Effect size (ES) was calculated, in which values of 0.2, 0.5 and  $> 0.8$  were considered small, moderate and large, respectively. Results After eight weeks of training VO<sub>2</sub>max increased from  $37.0 \pm 6.4$  to  $41.4 \pm 6.0$  ml.kg<sup>-1</sup>.min<sup>-1</sup> in SG ( $p < 0.05$ ; ES:0.7) and from  $36.5 \pm 6.2$  to  $42.2 \pm 5.5$  ml.kg<sup>-1</sup>.min<sup>-1</sup> in RG ( $p < 0.05$ ; ES: 1.0); speed at LT increased from  $6.1 \pm 0.7$  to  $6.7 \pm 0.9$  km.h<sup>-1</sup> in SG ( $p < 0.01$ ; ES:0.8) and  $6.0 \pm 0.8$  to  $7.0 \pm 1.2$  km.h<sup>-1</sup> in RG ( $p < 0.01$ ; ES:0.8); speed at OBLA increased from  $7.2 \pm 1.1$  to  $8.1 \pm 1.5$  in SG ( $p < 0.01$ ; ES:0.6) and  $7.1 \pm 1.1$  to  $8.4 \pm 1.1$  km.h<sup>-1</sup> in RG ( $p < 0.01$ ; ES:1.2). Discussion The main novel finding of the present study is that soccer training lead similar improvements to aerobic training performed at LT and OBLA intensities, generating significant changes in the metabolic and aerobic capacity. These results are in agreement with previous studies that investigated both indices (McMillan et al. 2005; Impellizzeri et al. 2006). Moreover, the improvement in VO<sub>2</sub>max (11 and 14% in SG and RG, respectively) is in agreement with a similar study, in which improved 15 and 10% in SG and RG, respectively (Bangsbo et al., 2010). Thus, the intensity of training conducted during physical exercise is key aspect for improvement of physiological indices. References Bangsbo J, Nielsen J, Mohr M, et al. (2010). Scand J Med Sci Sports, 20, 24-30. Impellizzeri FM, Marcora SM, Castagna C, et al. (2006). Int J Sports Med, 27, 483-492. McMillan K, Helgerud J, Grant SJ, et al. (2005). Br J Sports Med 39, 432-436. Randers MB, Nybo L, Petersen J, et al. (2010). Scand J Med Sci Sports, 20, 14-23.

**LACTATE TURN POINTS, CRITICAL LACTATE CLEARANCE AND CONSTANT LOAD CYCLE ERGOMETER EXERCISE**

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**LACTATE TURN POINTS, CRITICAL LACTATE CLEARANCE AND CONSTANT LOAD CYCLE ERGOMETER EXERCISE** Introduction According to the lactate shuttle theory (Brooks 2002), two turn points (LTPs) and three phases of lactate metabolism may be detected during incremental (Hofmann and Tschakert 2011) and constant load exercise. Aim of our study was to validate LTPs by constant load ergometer exercise (CE) below and above the pre-determined LTPs in a heterogenous group of subjects. Methods 23 healthy male and female subjects (age:  $36.0 \pm 13.2$  yrs; body mass:  $67.4 \pm 9.0$  kg; VO<sub>2</sub>max:  $49.5 \pm 9.7$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) performed maximal cycle ergometer exercise (IE) (20/40W start; 15/20W.min<sup>-1</sup> increments). The first (LTP1) and the second (LTP2) lactate turn points were determined by linear regression break point analysis. CE tests (30 min) were performed at 5% (or 10%) Pmax below and above LTP1 and LTP2 in all subjects. Heart rate (HR) and gas exchange variables were determined and blood lactate concentration (La) was determined at rest, at the end of every workload step (IE), every 5 min in CE as well as during 3 and 6 min of active and passive recovery. Results: Power output in IE was  $261.0 \pm 59.8$  W at Pmax,  $179.9 \pm 46.1$  W at LTP2 ( $68.9 \pm 3.2$  % Pmax) and  $89.7 \pm 32.0$  W at LTP1 ( $34.4 \pm 6.8$  %Pmax). Subjects worked at  $76.8 \pm 29.4$  W (LTP1-),  $102.9 \pm 34.6$  W (LTP1+),  $162.6 \pm 41.1$  W (LTP2-) and  $184.0 \pm 44.8$  W (LTP2+) which were  $28.7 \pm 6.6$  %Pmax (LTP1-),  $38.7 \pm 6.6$  %Pmax (LTP1+),  $62.1 \pm 3.5$  %Pmax (LTP2-) and  $70.5 \pm 5.0$  %Pmax (LTP2+) as well as  $39.9 \pm 7.9$  %VO<sub>2</sub>max (LTP1-),  $49.3 \pm 7.0$  % VO<sub>2</sub>max (LTP1+),  $76.4 \pm 5.6$  % VO<sub>2</sub>max (LTP2-) and  $88.0 \pm 6.9$  % VO<sub>2</sub>max (LTP2+), respectively. La was  $12.44 \pm 2.25$  mmol.l<sup>-1</sup> (max),  $3.58 \pm 0.71$  mmol.l<sup>-1</sup> (LTP2) and  $1.21 \pm 0.41$  mmol.l<sup>-1</sup> (LTP1). Subjects completed 30 min of CE up to LTP2- and stopped earlier with increasing work load (LTP2+:  $22.0 \pm 7.8$  min). Mean La values were sign. Different during CE at  $0.83 \pm 0.02$  (LTP1-),  $1.21 \pm 0.04$  (LTP1+),  $4.96 \pm 0.09$  (LTP2-), and  $7.54 \pm 0.07$  (LTP2+). 16 of 23 subjects presented a lactate steady state at 5% below LTP2 and 7 subjects showed a steady state at 10% below LTP2. Discussion According to the lactate shuttle theory (Brooks 2002), two distinct turn points and three phases of lactate metabolism, detected during IE (Hofmann and Tschakert 2011) were also found for CE. LTPs distinguished the lactate curve into different metabolic domains, were significantly related to the CE lactate response and define and discriminate the main metabolic trainings zones "low", "moderate" and "vigorous" for constant load exercise training. References Brooks GA (2002). Biochemical Society Transactions (2002) 30, 2: 258-264. Hofmann P, Tschakert G (2011). Cardiology Research and Practice, ID 209302, 10 pages, doi:10.4061/2011/209302. The project was funded by the Austrian Research Promotion Agency, project n. 827572.

**IS THERE A RELATION BETWEEN CHANGES IN TRAINING PERFORMANCE AND AEROBIC OR ANAEROBIC CAPACITY DURING TWO-WEEK HIGH-INTENSITY INTERVAL TRAINING?**

Koivumäki, M.1, Hannukainen, J.1, Eskelinen, J.J.1, Savolainen, A.1, Heinonen, I.1, Virtanen, K.1, Kempainen, J.1, Kapanen, J.2, Knuuti, J.1, Kalliokoski, K.K.1

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**IS THERE A RELATION BETWEEN CHANGES IN TRAINING PERFORMANCE AND AEROBIC OR ANAEROBIC CAPACITY DURING TWO-WEEK HIGH-INTENSITY INTERVAL TRAINING?** Introduction High-intensity interval training is a time-efficient strategy for promotion of health by physical exercise (Gibala et al. 2012). We investigated whether the changes in training intensity between the six training sessions over the period of two weeks of high-intensity interval training (HIT, Wingate protocol) are related into the changes in aerobic fitness (VO<sub>2</sub>max) and anaerobic capacity (blood lactate).

Methods 13 healthy sedentary middle-aged men (age  $48 \pm 5$  years and BMI  $25.8 \pm 2.9$ ) trained six HIT sessions within two weeks using Monark 894 E ergometer. A session consisted of 4  $\times$  6  $\times$  30 s maximal sprints (Wingate protocol) with 4 min rest between the sprints. The amount of training was increased after every second session (4 $\rightarrow$ 5 $\rightarrow$ 6 sprints). The Monark anaerobic test software 3.0.1 with the ergometer provided detailed information of the different parameters related to training intensity during the sprints and we selected peak (PEAK) and average (AVG) power and power drop (DROP) to be the most representative parameters of the training load. As the amount of sprints differed, we took only the first four sprints from every session for the analysis. The subjects did also VO<sub>2</sub>max test (cycle ergometry, start intensity 50 W, increased 30 W every two minutes until to the volitional fatigue) before and after the training. One subject abandoned the study due to personal reasons. Results VO<sub>2</sub>max improved by 6.2 % (from  $34.0 \pm 3.7$  to  $36.2 \pm 4.5$  ml/kg/min  $p=0.005$ ) and blood lactate 28.6% (from  $10.8 \pm 1.7$  to  $13.8 \pm 2.7$  mmol/l  $p<0.001$ ) after the training. Average power in the sprints increased during the training period and this was especially due to increase in power in the third and fourth sprint (about 10%). Power drop in the sprints decreased during the training intervention (from about 58 at the first training session to 51 % at the last training session,  $p<0.05$ ). Peak power remained unchanged. We found no correlation between the changes in the training data with VO<sub>2</sub>max or blood lactate improvements. Discussion Both aerobic fitness and anaerobic capacity were improved by HIT training, but these changes cannot be predicted by the changes in the training performance. References Gibala MJ, Little JP, Macdonald MJ, Hawley JA. (2012). *J Physiol*, 590(Pt 5):1077-1084

### EXHAUSTIVE CYCLING EXERCISE TERMINATES EARLIER FOLLOWING PRIOR UPPER BODY EXERCISE DESPITE LESS QUADRICEPS MUSCLE FATIGUE

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Changes in the metabolic milieu of locomotor muscles during heavy exercise may elicit inhibitory feedback to the central nervous system, thereby influencing the magnitude of central motor drive to prevent the degree of peripheral muscle fatigue and/or sensory perception exceeding a "critical" individual level [1]. Whether exhaustive exercise terminates due to reaching a critical level of peripheral fatigue per se or an intolerable level of sensory perception remains unknown. Therefore, we aimed to differentiate these influences by examining the effects of a pre-existing metabolite accumulation, achieved using prior upper body exercise, on cycling exercise capacity, effort perception, and locomotor muscle fatigue. Eight males performed 3 constant power cycling tests at 85% Wmax (mean (SD): 272 (26) W). Cycling was performed to exhaustion without (C) or with (AC) prior arm-cranking exercise (8  $\times$  1 min bouts, interspersed by 30 s rest intervals, at an intensity of 1.0-1.5W/kg body mass), or without prior exercise and for an equal duration to that achieved during AC (ISO). Arm-cranking was followed by a 6 min rest period prior to cycling. Blood lactate concentration ([La]) was measured before (PRE-CYC) and after (POST-CYC) cycling. Rating of perceived exertion (RPE) for leg discomfort was measured following 3 min of cycling and POST-CYC. Peripheral muscle fatigue was assessed via changes in potentiated (using maximal voluntary contractions) quadriceps twitch force (QTF) obtained via electrical stimulation of the femoral nerve. Cycling time to exhaustion during AC and ISO (4.33 (1.10) min) was 38% shorter than during C (7.46 (2.79) min) ( $P<0.01$ ). PRE-CYC [La] was higher during AC (9.3 (1.9) mmol/L) compared to C and ISO (pooled mean: 0.7 (0.3) mmol/L) ( $P<0.01$ ), whereas POST-CYC [La] differed between all trials (C: 11.5 (3.0) mmol/L; AC: 13.9 (2.4) mmol/L; ISO: 9.2 (2.6) mmol/L) ( $P<0.05$ ). Following 3 min of cycling RPE during C (3.6 (1.3)) and ISO (3.7 (1.4)) were similar, whereas both were lower compared to AC (6.0 (1.5)) ( $P<0.05$ ). POST-CYC RPE during C (7.9 (2.0)) and AC (8.6 (1.7)) were similar, whereas both were higher compared to ISO (4.6 (1.8)) ( $P<0.01$ ). QTF was unchanged after arm-cranking. The decrease in QTF following C (-38%) was greater than the similar decreases observed after AC (-26%) ( $P<0.01$ ) and ISO (-24%) ( $P<0.05$ ). In summary, compared to C the voluntary termination of exhaustive cycling during AC was associated with less quadriceps muscle fatigue but the same level of RPE. We thus attribute the reduced exercise capacity during AC to the attainment of a critical level of sensory perception resulting from metabolite accumulation, rather than a critical level of quadriceps muscle fatigue per se. [1] Amann M (2011). *Med Sci Sports Exerc*, 43, 2039-45

### EFFECTS OF TWO CYCLING LEG EXERCISES ON MAXIMAL POWER: COMPARISON BETWEEN THE WINGATE AND THE FORCE-VELOCITY TESTS

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Introduction Maximal power output on cycle ergometer depends on both pedaling velocity and braking force. It can be estimated from the force-velocity relationship (Pmax, Vandewalle et al., 1987) or by measuring the highest mechanical power (Ppeak) produced during an all-out Wingate test (Bar-Or, 1987). However, in order to be valid indicator of anaerobic fitness, the testing protocol must consider the resistance at which force is produced to achieve a maximal power output. Thus, the aim of this study was to compare maximal power measured by the force-velocity test (FVT) and by the Wingate test (WT) performed with two different loads among two groups with different anaerobic fitness. Methods Two groups of healthy males according to their individual training histories and physical fitness participated in this study. They consisted of ten active subjects (AS,  $22.7 \pm 1.4$  years,  $78.9 \pm 6.6$  kg and  $1.85 \pm 0.05$  m) and ten recreational subjects (RS,  $22.9 \pm 1.7$  years,  $73.3 \pm 10.4$  kg and  $1.81 \pm 0.06$  m). After a familiarization session, they performed randomly on three separate occasions a FVT according to the protocol proposed by Vandewalle et al. (1987) and two WTs with different loads, 8.7% (WT8.7%) according to the table optimization of Bar-Or (1987) and 11% (WT11%) of body mass (BM) on Monark cycle ergometer. Data were analyzed by ANOVA (group  $\times$  test) with repeated measures. Results Pmax values (W.BM-1) obtained from FVT were  $15.60 \pm 1.45$  and  $12.05 \pm 0.55$  W.kg<sup>-1</sup>, respectively for AS and RS. Ppeak values (W.BM-1) measured during the WT11% were  $14.95 \pm 1.09$  and  $11.98 \pm 0.72$  W.kg<sup>-1</sup>, respectively for AS and RS, and during the WT8.7% were  $13.58 \pm 0.96$  and  $11.40 \pm 0.70$ , respectively for AS and RS. Significant main effects of group, test and group by test interaction were found ( $p < 0.001$ ). Discussion In both groups, Ppeak measured during WT8.7% was significantly lower than Ppeak WT11% and Pmax. Consequently, a braking force 8.7% of BM underestimates maximal power and is not an optimal load, even in subjects with a low anaerobic level. In RS, Ppeak WT11% and Pmax were almost equal due to the similarity of the force and velocity values corresponding to maximal power in the FVT and WT. However, Pmax in AS was significantly higher than Ppeak WT11%, which corresponded to an underestimation of maximal power in WT using 11% of BM. Indeed, maximal power is occurred at optimal velocity and braking force (Hintzy et al., 1999; Vandewalle et al., 1985). Consequently, the load optimization should take into account not only age, individual body build, and composition, but anaerobic fitness as well. Our study suggested that FVT results in more sensible and individualized test for assessment of maximal mechanical power. References Bar-Or O (1987). *Sports Med*, 4(6), 381-394. Hintzy F, Belli A, Grappe F, Rouillon JD (1999). *Eur J Appl Physiol*, 79(5), 426-432. Vandewalle H, Pérès G, Heller J, Monod H (1985). *Eur J Appl Physiol*, 54(2), 222-229. Vandewalle H, Peres G, Heller J, Panel J, Monod H (1987). *Eur J Appl Physiol*, 56, 650-656.

## DOES MAXIMAL POWER OUTPUT ON A CYCLE ERGOMETRE DEPEND ON RATE OF FORCE DEVELOPMENT AND MUSCULO-TENDINOUS STIFFNESS OF THE PLANTAR ANKLE FLEXOR MUSCLES?

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**Introduction** The rate of force development depends on muscle fibre type. Furthermore, several studies suggested differences in the elastic behaviour of fast and slow muscles and were in favour of a negative relationship between stiffness and the percentage of fast fibres. Some results in single fibres or isolated muscles and in humans suggest that stiffness could be higher in the subjects with high percentage of slow fibres, i.e. the less powerful subjects. In this case, Pmax would be negatively correlated with musculo-tendinous stiffness while being positively correlated with MRTD. The aim of the present study was to verify if high MRTD and high indices of stiffness of the series elastic component of the plantar flexors were obtained in the most powerful subjects. **Methods** Twenty-one male physical education students ( $79.8 \pm 9.7$  kg,  $1.83 \pm 0.08$  m) participated in this study. Maximal power on a cycle ergometre (Pmax BM-1) was computed from the results of the force-velocity tests according to the protocol proposed by Vandewalle et al. (1985). The torque during a maximal voluntary contraction (TMVC) and musculo-tendinous stiffness (MTS) of the plantar flexors were studied by means of an ankle ergometre and quick release method (Lambertz et al. 2001). During the same session, maximal rate of torque development (MRTD) was measured according to the protocol of Sahaly et al. (2001). MTS was determined at 20, 40, 60 and 80% TMVC (S0.2, S0.4, S0.6 and S0.8). MTS was also predicted at 30% TMVC (S0.3) and 50% TMVC (S0.5) by interpolations of S0.2, S0.4 and S0.6. The relationship between Pmax, MRTD, TMVC and MTS has been tested by Pearson product-moment correlation (r), and linear regression analysis. The coefficient of determination ( $r^2$ ) was used to predict the proportion of the variance (fluctuation) of Pmax that is predictable from other variables (MRTD and MTS). **Results** Pmax BM-1 was significantly and positively correlated with MRTD related to body mass ( $r = 0.460$ ;  $P_{\text{max BM-1}} = 11.2 + 0.62 \text{ MRTD BM-1}$ ,  $P < 0.05$ ) but the positive correlation between Pmax BM-1 and TMVC did not reach the significance level ( $P > 0.05$ ). Pmax BM-1 was significantly and positively correlated with the stiffness at S0.4 ( $P_{\text{max BM-1}} = 10.7 + 0.94 \text{ S0.4 BM-1}$ ) and S0.5 ( $0.44 \leq r \leq 0.45$ ,  $P < 0.05$ ) but not with stiffness at S0.2, S0.6 and S0.8 ( $P > 0.05$ ). **Discussion** The results of the present study suggested that maximal power output during cycling is significantly correlated with the level of musculo-tendinous stiffness which corresponds to torque range around peak torque at optimal pedal rate. However, the low coefficient of determination ( $r^2 = 0.203$ ) between Pmax BM-1 and S0.4 BM-1 or S0.5 BM-1 suggested that Pmax BM-1 largely depended on other factors than the musculo-tendinous stiffness of the only plantar flexors. **References** Lambertz D, Pérot C, Kaspranski R, Goubel F (2001). *J Appl Physiol*, 90(1), 179-88. Sahaly R, Vandewalle H, Driss T, Monod H (2001). *Eur J Appl Physiol*, 85(3-4), 345-50. Vandewalle H, Pérès G, Heller J, Monod H (1985). *Eur J Appl Physiol*, 54(2), 222-9.

## SPECIFICS OF MUSCLE ELECTRIC ACTIVITY DURING ARCHERY SHOOTING

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**Introduction:** The research goal was to study specifics of muscle electric activity when shooting arch. **Methods:** Eight highly-qualified archers underwent the study, each doing 10 shooting sessions of 3 shoots. Registering and analysis of shoot kinematic parameters was done with the help of the "Qualisys Track Manager" 3D video-analysing system (Sweden), electromyography - with the help of the 16-channel ME6000 myograph and MEGAWIN software. **Results:** 12 "leading" muscles were determined out of 32 ones under study, the former had a high electromyographic amplitude and significant activity changes at various shoot stages. It became clear that on the group average (1st session, 46 %) the first to activate were the upper left dorsal fascicles of the trapezius muscle, those were also the first to stop contracting in the course of the shooting exercise. By the end of the exercise (10th session) the upper left dorsal fascicles of the trapezius muscle were the first to activate only in 31 % together with the upper right dorsal fascicles (31%), which attests to the fatigue process at the end of the shooting session. Electrical activity of the right extensor carpi ulnaris muscle and the left flexor carpi radialis muscle were at highest at the moment of the arrow release, which attests to a programmed control of the muscles at this particular stage. The EMG of the upper right dorsal and lower left dorsal fascicles of the trapezius muscle at the stage of "post-strengthen" showed sporadic high amplitude rises combining with low amplitude action potential, the latter fact speaks of the corrective-mechanism principle. It was found out that out of all the shoots the "successful" ones amounted to 63% and, respectively, 37 % to the "unsuccessful". A statistically valid direct dependence of the success was determined, based on the increase of average group amplitude values of the EMG of the following muscles - lower right dorsal fascicles of the trapezius muscle, posterior fascicles of the right deltoideus muscle, flexor carpi radialis muscle of the right hand, extensor carpi ulnaris muscle of the left hand. On the whole, the total electric activity of the mentioned muscles would increase by 28,6% compared with "unsuccessful" results. The latter fact attests to the dependence of the success on a higher electrical amplitude of the muscles under study.

## BLOOD LACTATE AFTER COMPETITIVE FREE DIVING AND SYNCHRONIZED SWIMMING EVENTS

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**Introduction** Analysis of sports involving apnea is essential for the understanding of how dives with different levels of exertion and apneic durations lead to changes in the net lactate accumulation (NLA). The aim was to describe lactate accumulation during competition performances in different free-diving and synchronized swimming (SS) disciplines. **Methods** Volunteers were 43 free apnea divers and 34 synchronized swimmers competing at an elite level. Disciplines investigated were static apnea (STA), dynamic apnea with-(DYN) and without fins (DNF), deep diving disciplines constant weight with-(CWT) and without fins (CNF), and free immersion using upper body work (FIM). Competitive SS events included solo, duet and team routines. The blood lactate concentration (La) was measured at rest before (rLa), and 3 minutes after (La3post) dives and routines executed in competition. **Results** For the entire group of athletes the average rLa was  $1.8 \pm 0.7$  mmol/L and La3post was  $6.0 \pm 2.1$  mmol/L ( $p < 0.001$ ). La3post was lower after STA ( $2.5 \pm 0.9$  mmol/L) than in all other disciplines ( $p < 0.05$ ). It was also higher after CNF ( $7.6 \pm 1.8$  mmol/L) than after DYN ( $6.2 \pm 2.1$ ), DNF ( $6.2 \pm 2.2$ ), and all SS events (solo  $6.3 \pm 2.0$  mmol/L, duet  $5.8 \pm 1.4$  mmol/L and team  $5.8 \pm 1.7$  mmol/L),  $p < 0.05$  in all cases. CWT ( $7.6 \pm 1.7$  mmol/L) showed higher La3post values than SS duets ( $5.8 \pm 1.4$  mmol/L,  $p < 0.05$ ) and teams ( $5.8 \pm 1.7$  mmol/L,  $p < 0.01$ ). **Discussion** The lowest La3post observed in STA is explained by the lack of work. CNF seems to represent the greatest hypoxic stress due to the whole body being at work and likely the full development of the diving response during the free-fall phase of the deep dive to keep O<sub>2</sub> conservation at its maximum (Schagatay, 2011). Relatively moderate La3post in SS events despite intense exertion suggests that lactate is used as an energy source due to intermittent breathing pattern

in accord with the "lactate shuttle" hypothesis (Brooks, 1991), but apnea-related peripheral vasoconstriction may play a role as well in limiting lactate clearance in the active muscles and subsequent lactate oxidation during recovery (Rodríguez-Zamora et al., 2012). Our results suggest that NLA is influenced by 1) the type, intensity, and duration of work, 2) the magnitude of the diving response developed, and 3) by the apneas' duration. References Schagatay E (2011). *Diving Hyperb Med* 41(4), 216-228. Brooks GA (1991). *Med Sci Sports Exerc* 23(8), 895-906. Rodríguez-Zamora L, Iglesias X, Barrero A, Chaverri D, Erola P, Rodriguez, FA. (2012). *PLoS One* 7(11), e49098.

### SHORT-TERM EFFECTS OF DIFFERENT HIGH-INTENSITY INTERVAL EXERCISE PROTOCOLS IN ADULTS

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**Introduction** Over the last years, a huge number of different high-intensity training (HIT) protocols were published with the aim of improving aerobic and anaerobic capacity. Most of them have been shown to be superior in improving athlete's performance comparing to traditional endurance training. However, the prescription of different HIT protocols with regard to intensity, number of intervals, work-to-rest-ratio and movement pattern has yet to be evaluated. Therefore the aim of this study was to compare the acute effects of five different HIT protocols on the physiological, neuromuscular and psychological parameters of adults. **Methods** Nine trained male subjects participated in five different training protocols (P1: 4x4 min; P2: 7x2 min; P3: 2x10x30 s; P4: 3x9x15 s; P5: 4x6x5 s) with similar total work output (~26 min) but different work-to-rest-ratio (from 2:1 to 1:6). Measurements included blood lactate (La), blood pH, creatin kinase (CK), perceived exertion (RPE and Session-RPE), total quality recovery (TQR), delayed onset muscle soreness (DOMS), heart rate (HR) and counter movement jump (CMJ), which were taken pre, during and post-training. **Results** Significant differences ( $p < 0.05$ ) were found in mean La between P4 and P2 (5.37 vs. 10.01 mmol•L<sup>-1</sup>) as well as between P4 and P5 (5.37 vs. 10.19 mmol•L<sup>-1</sup>). Blood pH was significantly different ( $p < 0.05$ ) between P4 and P5 (7.38 vs. 7.27). Rate of perceived exertion (RPE and Session-RPE) differed significantly between P4 and P1 (2.9 and 3.1 vs. 5.7 and 6.1) and also between P4 and P2 (2.9 and 3.1 vs. 5.7 and 6.1). Significant differences for mean HR were found between P3 and P5 (168 vs. 149 beats•min<sup>-1</sup>). No differences between protocols or pre and post-training were found for CK and CMJ. Moreover, there were no differences between protocols in TQR and DOMS. **Discussion** Although the present results show differences between HIT protocols, all induced relatively high physiological and perceptual demands. The magnitude of the physiological and perceptual responses in all protocols is similar to previously research conducting HIT interventions, which is associated with physical performance improvements. Overall, the results show no great differences between HIT protocols even though intensity, number of intervals, work-to-rest-ratio and movement pattern differed significantly between protocols. Furthermore, the evaluation of different HIT interventions (e.g., mid and long-term) and their effects on the physiological and performance characteristics of team sport athletes warrants future studies. **References** Burgomaster, K. A., Howarth, K. R., Phillips, S. M., Rakobowchuk, M., Macdonald, M. J., McGee, S. L., & Gibala, M. J. (2008). *J Physiol*, 586, 151-160. Gibala M. J., Little J. P., van Essen M., Wilkin G. P., Burgomaster K. A., Gosselin, L. E., Kozłowski, K. F., Devinney-Boymel, L., & Hambridge, C. (2012). *J Strength Cond Res*, 26, 2866-2871. Iaia, F. M., Rampinini, E., & Bangsbo, J. (2009). *Int J Sports Physiol Perform*, 4, 291-306.

### MENSTRUAL CYCLE PHASES EFFECTS ON ANAEROBIC POWER AND REACTION TIMES

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**MENSTRUAL CYCLE PHASES EFFECTS ON ANAEROBIC POWER and REACTION TIMES AU-SCH P EDUC SPORT (Ankara, Turkey)** **Introduction** Although menstruation is a universal phenomenon experienced by almost all women it has been assumed that, women's mental performance capacity and physical work capacity is impaired prior and during menstruation (Gamberale, 1975). It is still poorly understood and has been discussing effects of menstrual cycle (MC) on athletic performance (Dawson and Reilly, 2009). The purpose of this study determine effects of menstrual cycle phase on anaerobic power and reaction time of college athlete. **Methods** Nine female students from the School of Physical Education have voluntarily participated in this study. Mean age 22.22 year ( $\pm 1.39$ ), mean body height 165.20 cm ( $\pm 6.09$ ), mean body weight 57.28 kg ( $\pm 9.41$ ) and mean body fat 26.47 % ( $\pm 3.66$ ) has been found for the participant. Body compositions were measured by Avis 333 plus (Korea) and parameters about anaerobic power as; Peak Power (PP), Average Power (AP), Minimum Power (MP) and Power Drop (PD), were determined by Wingate Test (WanT) with Monark Peak Bike ergometer. Visual (VRT) and auditory (ART) reaction times were determined by Newtest (Finland) for both left and right hand. Resting heart rates (RHR) were recorded after ten min rest with lying position by Polar F 11 (FINLAND). All measurements were repeated for each participant at follicular, ovulation and luteal phases of menstruation. For statistical significance alpha value set as 0.05. After the test of normality, mean differences of normally distributed parameters were compared with Repeated Measures ANOVA and abnormally distributed parameters were compared by Friedman tests. **Results** Results obtained from participants during three phases of MC is as follows; RHR 71.22 ( $\pm 11.53$ ), 71.00 ( $\pm 10.86$ ), 79.87 ( $\pm 7.01$ ), VRT for right hand.186 ( $\pm .031$ ), .182 ( $\pm .021$ ), .184 ( $\pm .021$ );for left hand 193 ( $\pm .055$ ), .183 ( $\pm .021$ ), .183 ( $\pm .020$ ); ART for right hand.161 ( $\pm .017$ ), .169 ( $\pm .018$ ), .166 ( $\pm .023$ ) and for left hand.169 ( $\pm .019$ ), .175 ( $\pm .021$ ), .166 ( $\pm .014$ ) msec. Anaerobic powers test results was recorded as follows; for PP i 7.78 ( $\pm 1.35$ ), 8.32 ( $\pm 1.08$ ), 8.23 ( $\pm 1.14$ ); for AP 5.48 ( $\pm .57$ ), 5.72 ( $\pm .50$ ), 5.62 ( $\pm .69$ ) and for MP i3.38 ( $\pm .91$ ), 3.00 ( $\pm .95$ ), 2.67 ( $\pm 1.31$ ) and PD is 56.61 ( $\pm 13.02$ ), 64.08 ( $\pm 10.22$ ), 68.22 ( $\pm 14.44$ ) w/kg. The only difference has recorded between on luteal and follicular phases auditory left hand reaction time results. **Discussion:** The results of this study indicated that menstrual cycle has no effect on anaerobic power and visual and auditory reaction time. Despite significant differences on auditory reaction time of left hand, this result can interpreted as coincidence. **References** Gamberale F, Strindberg L, Wahlberg I. (1975). *Scand J Work Env Hea*, 1(2):120-127. Dawson E, Reilly T. (2009). *Biol Rhythm Res*, Vol. 40, No. 1, 99-119.

### BETA-ALANINE SUPPLEMENTATION AFFECTS SUPRAMAXIMAL EXERCISE METABOLISM BUT NOT INTERVAL TRAINING EFFECTIVENESS

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**Introduction:** Sporting events lasting 1 to 4 minutes require intensities that exceed the limits of the aerobic capacity; fatigue is partly due to metabolite accumulation caused by substrate-level phosphorylation and insufficient aerobic energy supply. Thus, enhancing performance capacity is possible by improving the response time and maximal rate of aerobic energy production or by counteracting metabolite accumulation. Thus, we hypothesized that 1) high-intensity interval training (HIT), by enhancing aerobic energy contribution, and  $\beta$ -alanine supplementation, by increasing acid buffering capacity via muscle carnosine, would discretely and positively affect physiological

mechanisms important for supramaximal exercise, and 2) that HIT would have greater benefits when performed directly after supplementation. Methods: Seventeen active men performed an incremental cycling test for aerobic capacity and a 90-second supramaximal (110 % VO<sub>2</sub>max) cycling test at three time points: before and after oral supplementation with 3.2 g/d β-alanine (n=7) or placebo (n=9), and after an 11-d HIT block (9 sessions, 4 × 4 min maximal cycling), which followed supplementation directly. Aerobic energy contribution was estimated from the ratio of O<sub>2</sub> consumption to the O<sub>2</sub> deficit, while biopsies from m. vastus lateralis were taken before and immediately after the supramaximal cycling test to address metabolic mechanisms. Subjects also completed stress-recovery questionnaires weekly and logged all training throughout the study. Results: Supplementation with β-alanine improved subjective state and stress-recovery balance, especially during HIT, and slightly increased aerobic energy contribution during 90 s cycling at 110% VO<sub>2</sub>max (1.4 ± 1.3 %, effect size 0.53), concurrent with reduced oxygen deficit and muscle lactate accumulation (-23 ± 30 %, e.s. 0.87), but had no effect on pH disturbance during exercise, buffering capacity or incremental cycling parameters. The HIT block improved buffering capacity (8 ± 11 %, e.s. 0.57), glycogen storage (30 ± 47%, e.s. 0.56) and peak cycling power output slightly (4 ± 4 %, e.s. 0.29), but did not affect VO<sub>2</sub>max or supramaximal exercise mechanisms. Moreover, there were no differential training effects of HIT when performed following β-alanine supplementation. Conclusions: Contrary to our hypothesis, β-alanine had only minor effects on supramaximal exercise mechanisms whereas HIT had none. However, β-alanine may benefit subjective parameters and perceived stress-recovery balance during intense training phases, while HIT blocks are probably useful in sports involving repeated sprints, where glycogen depletion and acidosis limit performance.

### MAXIMAL MEAN POWER OF TRACK AND ROAD SPRINT CYCLISTS DURING WORLD CLASS RACES

Menaspà, P., Martin, D.T., Flyger, N., Quod, M., Beltemacchi, M., Abbiss, C.R.

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Introduction. Sprint cyclists have the ability to produce very high power outputs for relatively short durations (i.e. 1-30 s). Within track cycling, sprinters are required to produce these high power outputs over short durations (20-60 s), whereas, road race sprint specialists will produce high power outputs at the end of a long ride (up to ~7 hours). As a result, the physiological demands of track and road races are extremely different. However, the peak power (PP) and maximal mean power (MMP) of track and road sprinters has not been extensively reported. Thus, the aim of this study is to describe PP and MMP achieved by these specialists during world class races. Methods. Four world class track sprinters (TRACK) and three successful professional road sprinters (ROAD) participated in this study. Data were collected from flying events at track World Cup or Championship, and during World Tour road races. Anthropometric characteristics, cadence at PP and absolute (W) and relative (W/kg) PP and MMP for 10, 20 and 30 s were determined and compared between TRACK and ROAD using independent sample T-test. Significance was established at P<0.05. Results are presented as means ± SD. Results. Age and stature were not statistically different between TRACK (age, 23±3 y; height, 183±9 cm) and ROAD (age, 26±3 y; height, 176±3 cm). TRACK was heavier than ROAD (89.0±3.8 vs. 72.0±1.7 kg). Absolute PP and MMP for 10, 20 and 30 s were higher in TRACK (2027±136, 1592±102, 1336±75 and 1129±86 W, respectively), compared with ROAD (1358±168, 1174±149, 944±80 and 843±63 W). Relative PP and MMP for 10, 20 or 30 s were not different between TRACK (22.8±0.8, 17.9±0.9, 15.0±0.6 and 12.7±0.5 W/kg) and ROAD (18.8±2.1, 16.3±1.8, 13.1±1.1 and 11.7±0.6 W/kg). Cadence at PP was higher in TRACK, compared with ROAD (128±6 vs. 109±6 rpm). Discussion. Despite a similar age and height, TRACK was considerably heavier than ROAD. As expected, the absolute power output of TRACK was significantly higher than ROAD. Although the physiological demands of track and road sprinting is extremely different, PP and MMP relative to body weight were not different. Further research should compare power relative to coefficient of drag (CdA), which could explain typically observed differences in sprint speed (~72 vs. ~65 km/h, for TRACK and ROAD, respectively). This study presents novel data which will assist sport scientists and coaches in the preparation of athletes by providing a better understanding the demands of world class track and/or road sprint performances.

14:00 - 15:00

## Mini-Orals

### PP-PM55 Rehabilitation [RE] 2

#### RELATIONSHIP BETWEEN ILLNESS-SPECIFIC SELF-EFFICACY, DEPRESSION AND THE LEVEL OF PHYSICAL ACTIVITY OF COPD- PATIENTS

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Introduction Among Patients with Chronic Obstructive Pulmonary Disease (COPD), physical activity (PA) is the strongest predictor for mortality (Waschki et al., 2011). Consequently, the maintenance of PA on a long-term basis does play an essential role in COPD-disease management. However, there is a lack of instruments to assess illness-specific self-efficacy. Together with a validation of a German version of Wigal's et al. (1991) "COPD-Self-Efficacy Scale", the purpose of the present study is to investigate the correlation between the illness-specific self-efficacy and the patient's level of activity as well as their psychological health. Methods For the present cross sectional study data giving evidence about the physical activity level (FFkA) of in- and out- patients with COPD (N=160; male: 68,6%; Age: M=67.3, SD=10.3) have been generated. Next to socio-demographic data, we also collected the illness-specific self-efficacy with the help of the first German version of the "COPD-Self-Efficacy Scale" (Müller et al., 2013; α = .984) as well as the level of depression using the HADS-D. Results The results indicate a total time of physical activity of 9.8 hours per week (SD= 8.8), however 30.6% of the patients show too little physical activity. Physically active participants reach higher values regarding the illness-specific self-efficacy (F(2,153)=8.21, p<.001). There is a low correlation between the total physical activity and the level of depression (r=-0.261, p<.01). Additionally, calculations indicate a middle correlation between levels of depression and illness-specific self-efficacy (r=-0.453; p<.001). For further interpretations, multivariate analysis will follow. Discussion Depending on the factors illness-specific self-efficacy and symptoms of depression, COPD- patients show different levels of physical activity. Interventions aiming on changing these factors can increase the level of physical activity and therefore essentially contribute to a successful disease management on a long-term basis. References Müller, K, Brammer, N, Wagner, W, Kotschy-Lang, N. (2013). Erfassung der Selbstwirksamkeitserwartungen bei pneumologischen Berufskrankheiten mit der deutschen

Version der „COPD Self-Efficacy Scale“ – Zusammenhänge zur körperlichen Aktivität und Depressivität. Kongressbeitrag DGAUM. Waschki, B, Kirsten, A, Holz, O, Müller, KC, Meyer, T, Watz, H, Magnussen, H. (2011). Physical activity is the strongest predictor of all-cause mortality in patients with chronic obstructive pulmonary disease: a prospective cohort Study. *Chest*, 140 (2), 331-342. Wigal, JK, Creer, TL, Kotses, H. (1991). The COPD Self-Efficacy Scale. *Chest*, 99, 1193-1196.

## BENEFITS OF EXERCISE IN SELF IMPROVEMENT IN ELDERLY PATIENTS WITH CARDIOVASCULAR DISEASES

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**Introduction** Physical Exercise (PE) seems positively influence the functional autonomy. The aim of this study was to investigate the benefits of a program to improve the EF functional autonomy in elderly patients with cardiovascular diseases. **Methodology** A total of 39 seniors, including 28 women and 11 men, mean age 77 years, were subjected to a 90-day EF program. The program consisted of sessions fine and gross motor control, individual counseling, gait training and sensory stimulation. These sessions were held for 5 days a week with a duration of 55 minutes each. This study consisted of two phases: the first, before running the program, and the other end after application. At such times, various measures were taken kinanthropometric (resting HR, maximal HR, systolic blood pressure, diastolic blood pressure, BMI, weight, test March 6 minutes Rikli & Jones) and performed a functional assessment of activities of daily living (IADL's) with scale application Lawton (1969). The comparison between the behavior of variables kinanthropometric autonomy and total 'score' in IADL assessed'S (Scale Lawton, 1969) at the beginning and at the end was done by t test for related samples. **Results** When comparing the 'score' of Autonomy at the beginning and end found a statistically significant increase of the values of autonomy, having seen an average increase of 7 (95% CI: 5.4 to 7.7). We also found statistically significant differences between the measures kinanthropometric the initial and final moments, when there was an average decrease in the following variables: 4.8 bpm in resting HR (95% CI: 1.2 - 8.3) and 1.1 HMG in systolic BP (95% CI: 1.5 - 2). It was also observed an average increase of 81.5 m in Test 6 Mins Walking (95% CI: 61.9 to 101.1). **Discussion of Results** The results of the study suggest that the comparison of the initial and final time kinanthropometric measures, an average decrease of 4.8 bpm (95% CI: 1.2 - 8.3) and resting HR in systolic BP of 1.1 HMG (95% CI: 1.5 - 2). Second, Michel (1) (2001) the EF has a positive impact on hypertension. It was also observed an average increase of 81.5 m in Test 6 Mins Walking (95% CI: 61.9 to 101.1). In the study by Sousa (2) et al. (2010) sought to compare the level of functional ability and practice of EF in adults and the elderly with chronic diseases were statistically significant differences in the re-test Test March 6 min, where there was an increase in the number of meters traveled. The results obtained in the 'Score' of autonomy through the Lawton Scale (1969), we observed a statistically significant increase in the values of autonomy, having been an average increase of 7 (95% CI: 5.4 to 7.7). In the study by Correia (3) et al. (2010) found statistically significant improvement in functional capacity in elderly patients with diabetic disease practitioners EF. In this context, it appears that this program EF was effective for the improvement of autonomy in IADL'S in locomotor capacity and cardiovascular endurance.

## THE IMPORTANCE OF VO2MAX, WORK EFFICIENCY & ANAEROBIC ENERGY TURNOVER IN TRAINING-INDUCED INCREASE IN EXERCISE CAPACITY AMONG CARDIO PATIENTS

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**Introduction** Based on a pilot study showing that the increase in exercise capacity with training in cardio patients often is larger than what can be explained by increased VO2max, our aim was to analyse the relative contributions of the VO2max, work efficiency and anaerobic energy turnover to the training-induced increase in exercise capacity. **Methods** In 93 patients, VO2 and power output was measured during an incremental ramp-test (8-12 min) performed on a bicycle ergometer to exhaustion before (1) and after (2) an 8-w exercise rehabilitation program. Maximal power output (MPO) was taking as an estimate of exercise capacity, and VO2peak as VO2max. Work efficiency (WE) in W/mL O2 was determined as the slope between power output and VO2 in the interval between 25 % of MPO and power output at RER 1 using regression analysis. The anaerobic energy turnover (AET) was calculated as MPO - (WE x VO2peak). The contribution of increased VO2peak to the increased MPO after the 8-w exercise program was calculated as [VO2peak(2) - VO2peak(1)] x WE(1), contribution from work efficiency as [WE(2)-WE(1)] x VO2peak(1), and contribution from anaerobic energy turnover as AET(2)-AET(1). **Results** Preliminary results from 14 subjects showed that before the rehabilitation program, MPO and VO2peak were 123 ± 22 W and 1520 ± 340 mL O2/min, and increased by 12 ± 7 and 13 ± 10 % (P < 0.0003), respectively, when tested after the rehabilitation program. Determinations of VO2peak, WE and AET indicate that both improved VO2peak and improved WE contributed to the increase in MPO (P < 0.01 and P < 0.06, respectively). There were, however, large inter-subject variations in their relative contributions. Thus, the increased VO2peak and increased WE accounted for 44 ± 53 and 56 ± 102 %, respectively, of the increase in MPO. The rehabilitation program had no effect on AET. **Discussion** The results suggest that increased VO2max and increased WE are equally important for the improved MPO after training in cardio patients. Other studies show that a significant part of the increase in WE with endurance training is related to mechanisms that are independent on the specific exercise task, including decreased motor discharge rate in submaximal contractions (Vila-Chã et al., 2009) and more economical fibre Ca2+ handling (Majerczak et al. 2008). Since this indicate that increased WE transfers to exercise tasks outside the test laboratory, our study point to MPO as a better predictor for improvements of physical function after cardiac rehabilitation than VO2max. **References** Majerczak J., Karasinski J., Zoladz J.A. (2008). *J. Physiol. Pharmacol.*, 59, 589-602 Vila-Chã C., Falla D., Farina D. (2010) *J. Appl. Physiol.* 109, 1455-1466

## THE EFFECT OF ENDURANCE TRAINING IN A GROUP OF CARDIAC PATIENTS ALSO PERFORMING STRENGTH TRAINING.

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**Abstract** ECSS, Barcelona 2013 The effect of endurance training in a group of cardiac patients also performing strength training. **Introduction** In cardiac rehabilitation the main focus has been on endurance training. Combination of strength training has recently been suggested. So far, the effect of training with combined endurance and strength training on maximal oxygen uptake has not been studied extensively in overweight cardiac patients. **Aim:** The aim of this study was to investigate whether intensified training consisting of two strength training session with heavy loads and two high intensity interval spinning weekly increased maximal oxygen uptake more than a moderate training consisting of two endurance training sessions with moderate intensity and one circuit training session weekly. **Methods** Thirty coronary patients (aged: 50-72 years; 23 males and 6 females) were recruited from Fredrikstad Cardio-Club (Club for cardiac

patients after hospital treatment) and stratified and randomly assigned to intensified training or continuation of normal training. During 10 weeks of intervention, the control group (CON) exercised 45 minutes aerobic training two days a week and one day of strength circle training. The endurance training sessions had three high intensity periods where heart rates should reach 95 % of maximal heart rate. The group performing intensified training (INT) exercised four days a week: two aerobic exercises (spinning) of 60 minutes and two days of strength training. Endurance training was performed as interval of 2-3-4-5-4-3-2- min with 2 min rest between intervals (Pyramid training) with intention to obtain heart rates higher than 90 of maximal heart rate. Strength training was performed twice a week with 8 RM to 12 RM. Results The group continuing with 3 weekly training sessions (CON) increased maximal oxygen uptake from  $29.7 \pm 1.3$  and  $30.9 \pm 1.2$  ml/kg/min ( $p < 0.05$ ) during the 10 week intervention. The group performing intensified training increased maximal oxygen uptake from  $30.9 \pm 1.0$  to  $32.4 \pm 1.2$  ml/kg/min ( $p < 0.05$ ). There was no difference in the increase in maximal oxygen uptake between groups. The increase in peak watt during maximal oxygen uptake similar in both groups. Discussion: Intensified training improved maximal oxygen uptake significantly similarly to the group performing moderate intensity endurance training. However, the group with intensified training performed two strength training sessions weekly and showed a large increase in strength. Importantly, cardiac patients are able perform high intensity strength and endurance training with improvement in both parameters. Conclusion: Inclusion of strength training to a group of cardiac patients does not impair the improvement in maximal oxygen uptake when two sessions of high intensity interval training sessions are performed weekly for 10 weeks.

### THE EFFECT OF STRENGTH TRAINING IN A GROUP OF CARDIAC PATIENTS ALSO PERFORMING ENDURANCE TRAINING.

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**Introduction** In cardiac rehabilitation the main focus has been on endurance training. However, combination of strength training has recently been suggested to be superior to endurance training alone to improve health in middle-aged subjects. **Aim:** The aim of this study was to investigate whether intensified training consisting of two strength training session with heavy loads and two high intensity interval spinning weekly increased strength more than a moderate training consisting of two endurance training sessions with moderate intensity and one circuit training session weekly. **Methods** Thirty coronary patients (aged: 50-72 years; 23males and 6 females) were recruited from Fredrikstad Cardio-Club (Club for cardiac patients after hospital treatment) and stratified and randomly assigned to intensified training or continuation of normal training. During 10 weeks of intervention, the control group (CON) exercised 45 minutes aerobic training twice a week and one day of circuit training. The intensified training group (INT) exercised four days a week: two sessions with high intensity spinning and two sessions with strength training. Strength training was performed as three sets of eight exercises (leg press, leg curl, leg extension, chest press, pull down, curl, crunches, back; performed in machines). Load was in the first 2 weeks 12 RM; 10 RM in week 3-6, and 8 RM in week 7-10. **Results** Maximal strength in chest press increased from  $23.3 \pm 3.0$  kg to  $27.9 \pm 3.4$  kg (19.7 %;  $p < 0.05$ ) in CON and from  $26.7 \pm 2.0$  kg to  $32.9 \pm 2.2$  kg (23.2 %;  $p < 0.05$ ) in INT. Maximal strength in leg press increased from  $110.8 \pm 8.9$  kg to  $125.4 \pm 9.5$  kg (13.2 %;  $p < 0.05$ ) in CON and from  $107.9 \pm 8.1$  kg to  $162.0 \pm 8.4$  kg (50.1 %;  $p < 0.05$ ) in INT. Intensified training increased muscles strength more than CON ( $p < 0.05$ ). Maximal oxygen uptake increased similarly and significantly in both groups (~ 4 %). **Discussion/Conclusion** Discussion: Strength training in machines improved strength in both arms and legs. Circuit training also increased muscles strength in arm and legs, but was less effective than training in machines to improve strength in leg muscles. The fact that strength in leg muscles increased by more than 50 % highlights the importance of heavy strength training to induce muscle hypertrophy. It is also noteworthy that the large increase in strength was possible although two weekly spinning sessions were performed to maintain endurance capacity. **Conclusion:** Strength training with weights increased leg strength much more than circuit training whereas the increase in arm strength was similar. Importantly, it is possible to increase muscle strength in leg muscles even though two sessions of high intensity endurance training is performed.

### EFFECT OF WATER IMMERSION IN PATIENTS WITH STABLE CARDIAC DISEASE

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*1: Graduate school, Kawasaki University of Medical Welfare, 2: The Sakakibara Heart Institute of Okayama, 3: Hyogo University of Health Sciences, 4: Kawasaki University of Medical Welfare*

**Background** Water exercise would be one of the most effective techniques for adopted persons. However the influence of water immersion on cardiac function has been controversial. The purpose of this study was to clarify the physiological effect of patients with cardiac disease in water. **Methods** Six male patients (age :  $72.2 \pm 2.9$  years, BMI :  $22.5 \pm 1.5$  kg/m<sup>2</sup>) with stable cardiac disease were involved in this study (3 patients with non-ischemic cardiomyopathy, 2 patients with history of previous coronary artery bypass grafting, 1 patients with ischemic cardiomyopathy, mean left ventricular ejection fraction (LVEF) :  $48.5 \pm 11.6\%$ ). Beta-blockers and diuretics were used in all patients. Evaluation out of water was during a stable ambient temperature of thirty degree Celsius. Evaluation in water immersion to the level of axilla was during water temperature of thirty-one degree Celsius. In both conditions, patients were evaluated while sitting the chair after five minutes of rest. Blood pressure, heart rate and thermal sensation were monitored. Transthoracic echocardiography was performed to evaluate E and A wave velocity, left ventricular stroke volume (LVSV). **Results** In five patients, water immersion significantly increased E wave velocity (from  $0.69 \pm 0.35$  m/sec to  $0.85 \pm 0.30$  m/sec,  $p = 0.021$ ), and LVSV (from  $37.4 \pm 29.2$  ml to  $42.2 \pm 32.3$  ml,  $p = 0.043$ ), except one patient with non-ischemic cardiomyopathy (LVEF=38%) who showed decrease in those values. There were no significant changes in blood pressure, heart rate or thermal sensation. **Discussion** Water immersion has beneficial hemodynamic effects in patients with stable cardiac disease in terms of enhanced diastolic filling leading to an increase in LVSV. However, patients with severe heart failure could show negative hemodynamic responses and those hemodynamic variations might be masked in patients using antihypertensive medication. **Conclusions** Although careful consideration is required for patients with severe heart failure, water exercise is a useful therapy in patients with stable cardiac disease.

## BLOOD FLOW RESTRICTED TRAINING IMPROVES MUSCLE POWER AND GAIT SPEED IN A 74 YEAR-OLD MALE WITH SPORADIC INCLUSION BODY MYOSITIS: A CASE REPORT

Jørgensen, A.N.1, Nielsen, J.L.1, Frandsen, U.1, Aagaard, P.1, Diederichsen, L.2  
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**Introduction** Sporadic inclusion body myositis (sIBM) is an idiopathic inflammatory myopathy, which is a systemic disease that result in substantial muscle weakness and skeletal muscle inflammation. sIBM is mostly observed in patients of +50 years of age, and it is characterized by a progressive loss in skeletal muscle mass and a resulting reduction in muscle strength of 5-15% per year in both distal and proximal muscles, particularly affecting hands and thighs (1–3). In comparison, healthy adults typically experience a loss of muscle strength of 0.5-1.5% per year from the age of 60-65 years (5). Currently no effective treatment of sIBM is known. The purpose of this study was to investigate how a patient with sIBM would tolerate and respond to low-load resistance exercise with concurrent partial restricted blood supply to the working muscles (BFRE). **Methods** Twelve weeks of BFRE training (2 sessions per week). Training consisted of unilateral- leg press, knee extension and seated calf rise, with a load equalling 25RM. The patient was tested before (Pre), at 6 wks (Mid), and after 12 wks of training (Post). Testing consisted of a series of functional tests and maximal unilateral knee extension power (Nottingham Power rig). Results Calf raise training loads increased by 75% and total training volume increased by 146%/163% (left/right leg). Leg press training loads increased 33% and 40% with gains in total training volume of 47%/70% (right/left leg). No pre-to-post changes in self-chosen 10m walking speed and Timed Up & Go (3m) were observed. In contrast, 10m maximal walking speed increased by 19% (7.9s to 6.4s). At Pre, leg extension power was 40% lower in the left compared to right leg (0.49W/kg vs. 0.82W/kg). Post training, knee extension power for the right leg remained unaltered, but increased in the left leg by 47% (0.72W/kg) and was only 12% lower than the right leg. **Conclusion** BFRE was well tolerated by the present sIBM patient, and led to substantial improvements in mechanical muscle function and maximal gait speed. Further, a reduced limb-asymmetry in maximal muscle power was observed, which is known to reduce the risk for falls (4). **References** 1. Cox F & Reijnen M. *Rheumatology* : 1153–1161, 2011. 2. Dalakas MC et al. *Brain* 132: 1536–44, 2009. 3. Rose MR et al. *Neurology* 57: 548–50, 2001. 4. Skelton D et al. *Age and Ageing* 31: 119–25, 2002. 5. Young A & Skelton D. *International Journal of Sports Medicine* 15: 1993–1995, 1994.

## ACTUAL TEMPERATURE DURING AND THERMAL RESPONSE AFTER WHOLE-BODY CRYOTHERAPY IN CRYO-CABIN

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**Introduction** Whole-body cryotherapy involves exposing minimally dressed participants to very cold air (injecting liquid nitrogen with temperature -195 °C), either in a specially designed chamber (cryo-chamber) or cabin (cryo-cabin), for a short period of time. It has been widely used in sport to improve athletes' recovery (Banfi et al., 2010). The aim of this study was to examine the actual temperature of the air in the cryo-cabin at different locations throughout the cabin next to the subject's body. Additionally, we monitored skin temperature before and for 60 minutes after the cryo-cabin session. **Methods** Twelve subjects completed one 3-minute cryo-cabin session. Air temperature measured next to the skin was assessed during the session. Temperature sensors were placed on the middle of the tibia, middle of the thigh, lateral to the belly button and over the sternum. Skin temperature was monitored before, 3 min after and every 10 min for 60 minutes after the session with thermal imaging of the whole body from front and back. **Results** There was a statistically significant interaction (time x position) for temperature among the different body parts during the WBC ( $p = 0.000$ ), and for skin temperature among different body parts after the cryo-cabin session ( $p = 0.000$ ). Statistically significant time effects during and following cryo-cabin session were present for all body parts. **Discussion** We showed that atmospheric temperature in the cryo-cabin is substantially different from the one reported by the manufacturer. Manufacturers should pay attention on temperature sensors placement for displaying the temperature inside the cabin. This would be particularly important for clinical use when adjusting the temperature for specific therapeutic purposes such as recovery after strenuous exercise. Thermal response after cryo-cabin session is similar to the response observed after the cryo-chamber session reported in previously published studies (Westerlund et al., 2003). This could be of practical value as cryo-cabins are less expensive and easier to use compared to cryo-chambers. **References** Banfi, G., Lombardi, G., Colombini, A. & Melegati, G., 2010. *Sports Medicine*, 40, 509-517. Westerlund, T., Oksa, J., Smolander, J. & Mikkelsson, M., 2003. *Journal of Thermal Biology*, 28, 601-608.

## HIGH INTENSITY INTERVAL TRAINING IN CARDIOVASCULAR REHABILITATION

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**Purpose:** Interval training has a century long history in sports training, in the last decade High Intensity Interval Training (HIIT) as a special form of polarized training has come into the focus of scientific research. The effects on cardiovascular, respiratory and peripheral (muscle) systems have led physicians to consider its application in patients in cardiac rehabilitation (CR). A number of different protocols is currently used by different study-groups. The objective of this review is to report the effects and safety of HIIT in patients with cardiovascular diseases as coronary artery disease (CAD), metabolic syndrome (MBS), Diabetes mellitus type 2 (DM2), chronic heart failure (CHF) and with chronic obstructive lung diseases (COLD). **Methods:** We performed a non-systematic PubMed review using the keywords 'high-intensity interval training', 'exercise', 'interval training', 'coronary artery disease', 'coronary heart disease', 'metabolic syndrome', 'diabetes mellitus type 2', 'chronic heart failure', 'chronic obstructive pulmonary disease' and 'chronic obstructive lung disease'. Randomized and non-randomized interventional clinical trials, articles concerning basic science research, physiological research published in English were included. **Results:** HIIT protocols in general appear safe and often better tolerated by patients in CR than low- to moderate-intensity high-volume training (HVT) protocols. A large amount of recent studies gives detailed knowledge about the underlying specific physiological central and peripheral responses and adaptations to HIIT. Avoiding 'all-out' protocols like the Wingate-Test, in stable and selected patients it is a time-efficient (and therefore most motivating) strategy inducing substantial clinical improvements - often superior to those achieved by HVT - including beneficial effects on important prognostic factors like exercise capacity, peak oxygen uptake, left ventricular function, skeletal muscle and endothelial function, as well as improving quality of life. **Conclusions:** HIIT as a form of polarized exercise appears to be a safe and effective alternative for the rehabilitation of patients with CAD, DM2, MBS, CHF and also COLD. Due to its time-efficiency and variety of feasible protocols adjusted to a patient's individual fitness (in or after CR) it may also assist in improving adherence and maintenance to regular physical exercise. Still, randomized and larger interventional studies including clinical end-points are necessary to improve safety, indications and contraindications for this therapy in different populations.

## EVALUATION OF THE EFFECTS OF AN AEROBIC EXERCISE PROGRAM ON QUALITY OF LIFE AND CREATINE KINASE IN PATIENT WITH MCARDLE'S DISEASE: A CASE REPORT

Crege, D., Ferreira, R.C.M., Quaggio, M.C.

*Universitary Center Padre Anchieta*

**Introduction** McArdle disease (MAD) is a rare autosomal recessive metabolic myopathy that leads to myophosphorylase deficiency. Normally, the disease symptoms appear in the second or third decades of life. Subjects with this syndrome presents myoglobinuria, muscle pain, early fatigue, leg cramps and exercise intolerance that directly reflects on quality of life (Moustafa, et al., 2013). The aim of this study was to analyze the effects of an aerobic exercise program on quality of life and creatine kinase (CK) serum concentrations in a patient with MAD. **Methods** A 21 years old man with MAD diagnostic participated of an aerobic exercise program. The exercises were performed in treadmill, 2 times a week, for 40 minutes per session, during 8 weeks. The initial exercise intensity was determined calculating 60% of heart rate reserve. VO<sub>2</sub> was evaluated by indirect measurement, before and after the 8 weeks of the program. Every exercise session, 2 blood samples, before and after exercise, were collected to analyze CK. This procedure was performed before starting the program and every 15 days. To evaluate quality of life, Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) was applied 2 times. Results Initial VO<sub>2</sub> - mL x kg (-1) x min (-1) - was 12.6 and after the eight weeks increased to 16.0. Before initiating the exercise program, the CK serum concentrations was 846 U/L. As described before, in four days, blood samples were collected before (BS) and after every exercise session (AS). 15 days (after initiating exercise): BS – 714; AS – 785 U/L; 30 days: BS – 654; AS – 706 U/L; 45 days: BS – 586; AS – 598 U/L; 60 days: BS – 863; AS – 868 U/L. The SF-36 results showed increases in 5 of the 8 domains analyzed, demonstrating that quality of life was improved at the end of the program. **Discussion** Our results showed that moderated aerobic exercise can improve VO<sub>2</sub> values in patients with MAD, after 8 weeks, as occurs with individuals that practice regular exercise activity. CK is useful as an indirect marker of muscle damage. During the eight weeks, the CK serum concentrations, before initiating exercise sessions, reduced compared to first analysis performed, except for the last analysis. We believe that the reason for this increase, is due before the last exercise session, according to patient report, he did not sleep during the night and went straight to the gym. These results corroborates with literature, that showed reduction in CK in patients with MAD that performed different exercises programs, suggesting reduction in muscle damages, which collaborates to the management of other symptoms of MAD, resulting in better quality of life for the patient. **References** Moustafa S., Patton DJ., Connelly MS. (2013). *Heart Lung Circ*, 18.

**14:00 - 15:00**

### Mini-Orals

#### PP-PM59 Sports Medicine [SM] 3

##### SOMATOTYPING OF THE SWISS JUNIOR AND ELITE NATIONAL JUDO TEAM - A DESCRIPTIVE STUDY

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**Objective** To establish the anthropometrical characteristics and the hand grip strength of the Swiss junior and elite judo national team. **Methods** 24 members, 19 males (23.01 ± 4.91 years) and five females (19.95 ± 2.02 years), were measured. The following anthropometric measurements were carried out: body size, body weight, skinfolds (subscapular, biceps, triceps, supraspinal, abdominal, calf) bicondylar humerus and femur breadths, upper arm and calf circumferences, body fat % (Tanita scale). Based on these measurements BMI and determination of somatotypes were calculated. In addition, the handgrip strength was measured. The anthropometric measurements were carried out in accordance with ISAK guidelines. **Results** There were anthropometric differences between the Swiss male juniors and elite male judokas in muscular components and between the Swiss athletes and the athletes of the reference studies. The mean somatotype of the male judokas was 2.2 ± 0.8 for the endomorphy, 6.0 ± 0.9 for the mesomorphy and 2.0 ± 0.7 for the ectomorphy. The mean somatotype was balanced mesomorph. The mean handgrip strength of male judokas was 47.4 ± 6.7kg. The mean somatotype of female judoka was 3.7 ± 1.2 for the endomorphy, 4.9 ± 0.7 for the mesomorphy and 1.5 ± 0.3 for the ectomorphy. The mean somatotype was mesomorphic endomorph. The mean hand grip strength of the female judoka was 27.0 ± 3.1kg. **Conclusion** Somatotyping and handgrip strength values indicate the importance of muscularity in judo performance. All results are in agreement with the literature. **References** Degotte F, Jouanel P, Bègue RJ, Colombier M, Lac G, Peguinot J M, Filaire E. Food Restriction, Performance, Biochemical, Psychological, and Endocrine Changes in Judo Athletes. *Int J Sports Med* 27; 2006: 9–18 Clarys P, Ramon K, Hagman F, Deriemaeker P, Zinzen E. Influence of weight reduction on physical performance capacity in judokas. *Journal of Combat Sports and Martial Arts* 2010; 1: 71–76 not insert authors here

##### SPORT SPECIFIC ADAPTATIONS IN THE SHOULDER IN ADOLESCENT ELITE HANDBALL PLAYERS. A RANDOMIZED CONTROLLED TRIAL

Asker, M.1, Skillgate, E.1,2

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**INTRODUCTION:** Handball includes repetitive overhead motions in the shoulder girdle (1). Sports related adaptations in the shoulder girdle in adolescent elite tennis and baseball players are associated with shoulder injuries (2-3). Knowledge is missing regarding prevalence of such adaptations and about possible treatment strategies in adolescent elite handball players. The aim of this study was to 1. Investigate whether adolescent elite handball player have a shorter pectoralis minor muscle (PM) and decreased internal rotation (IR) in the glenohumeral joint on their dominant side compared with the non-dominant side, and 2. To evaluate the effect of soft tissue manipulation (STM) combined with self-stretching (SS) on such adaptations. **METHODS:** Two-hundred and fifty-one adolescent Swedish elite handball players, 160 boys, aged 15.5 (± 0.9) and 92 girls aged 15.3 (± 0.9), were screened for PM length, shoulder posture and glenohumeral joint rotation mobility using a digital caliper and a goniometer. Sixty five shoulders from 33 adolescent elite handball players, 16 boys aged 15.4 (± 0.9) and 17 girls aged 15.4 (± 0.9), were randomized to either STM and SS of the PM or placebo treatment in form of SS of the

upper part of the pectoralis major muscle. PM length and SP was measured right before and after treatment. Perceived mobility in the shoulders was measured direct after treatment and after 14 days. RESULTS: The players showed a significantly shorter PM (0,9 cm 95% CI 0,5-1,1), a gleno-humeral internal rotation deficit (11,2 degree 95% CI 9,0 - 13,0) and a more rounded SP on the dominant side (0,8 cm 95% CI 0,7-1,1). The index group showed a significantly greater increase in PM length than the control group (0,5 cm 95% CI 0,2 to 0,7) after treatment, but there were no significant differences in SP. DISCUSSION: Adolescent elite handball players have shoulder adaptations in form of shorter PM and poorer internal rotation in their dominant side compared with the non-dominant. SMT and SS may increase the length of PM, especially on the dominant side. To evaluate long lasting effects and the clinically relevance, further studies is needed. 1. Gorostiaga, EM, Granados, C et al Effects of an entire season on physical fitness changes in elite male handball players. *Med Sci Sports Exerc* 38: 357–366, 2006. 2. Kibler WB, Sciascia A et al. Glenohumeral internal rotation deficit: pathogenesis and response to acute throwing. *Sports Med Arthrosc.* 2012 Mar; 20(1): 34-8. 3. Cools AM, Johansson FR et al.. Descriptive profile of scapulothoracic position, strength and flexibility variables in adolescent elite tennis players. *Br J Sports Med.* 2010; 44(9): 678-84.

### AWARENESS OF GENITAL EXAMINATION IN MALE ELITE SOCCER PLAYERS

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INTRODUCTION: The consensus regarding the medical exam prior to sports participation recommends performing examination of the genitals. The literature references about this topic are scarce. In sports there is no awareness about the importance of genital exploration at Pre-Participation Physical Examination (PPE). It may be due to abnormal findings at genital examination do not affect sport performance, and they are not usually life threatening diseases for athletes. The incidence of genitourinary abnormalities is low. The genital examination in young patients is a simple, fast, and routine procedure. It is important for diagnosis of testicular diseases like varicocele, testicular hydrocele, cryptorchidism, etc. Therefore, early detection and treatment are important for prognosis and fertility in adulthood. Varicocele and cryptorchidism are the most common disorders in this age group. The subclinical varicocele in young athletes seems to progress faster, compared to non-athletes, which may lead to changes in the quality of semen and therefore problems with fertility. These findings highlight the importance of performing a genital examination, at least until the patient has completed puberty. OBJECTIVE: To describe the incidence of genital abnormalities in adolescent athletes METHODS: During PPE protocol we examined 280 elite football players between the 2010-2011 and 2011-2012 seasons, boys ages 7-17. Evaluated by the same physician, who palp and measured: both testicles and spermatic cord before and after the Valsalva maneuver. RESULTS: No athlete refused to be examined. Of 280 players evaluated, ages 7 to 17 years old, fifteen genital anomalies were detected, representing 5.36 cases /100 subjects (confidence interval 95% (2,70-8,01), and nine of them (3.2%) had clinical varicocele (VC) representing 3.21 cases / 100 subjects (confidence interval 95% (1,14-5,29). Only two (13%) of the 15 athletes affected had prior knowledge of their pathology, and 13 (87%) were unaware of their abnormality. All patients were referred to their pediatricians to confirm the diagnosis and one of them required early surgery. CONCLUSION: The preventive health exam at pediatric age is the time to detect abnormalities to prevent adulthood consequences. In Spain, there is no regular medical control during late puberal or post-puberal time, and it's unusual the genital examination at PPE. Although this study shows a low incidence of genital abnormality in our population, only 13% were aware of it prior to our assessment, 87% were unaware of their abnormality. These findings demonstrate that the genital examination of the pediatric population is practical, simple and effective to identify genital abnormalities undetected by pediatric health checks or to appear afterwards. Further research is required to determine whether sport predisposes to genital abnormalities and emphasize the genital examination at PPE as comprehensive health strategy

### WAIST CIRCUMFERENCE IS A BETTER PREDICTOR OF MOTOR ABILITY IN KINDERGARTNERS THAN BMI

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Introduction Recent data indicate that prevalence of childhood overweight especially increases around the age of school entry (Hoffmann et al., 2012). Parallel to an increase in childhood obesity, motor abilities (MAs) have deteriorated by an average of 10% (Bös, 2003). Little is known about the relationship between anthropometric measurements and MA at pre-school age (De Toia et al., 2009), and published data were only related to BMI. Therefore, the aim of the present study was to analyse whether waist circumference (WC) predicts significantly to MA in kindergartners. Methods Data of 764 subjects aged 3-6 years were obtained from a cross-sectional health study conducted in Mainz, Germany. BMI and WC-SDS were calculated relative to international proposed values (Cole et al., 1992). MA was collected with multiple test items to determine the MAs of coordination, speed strength, muscular endurance, and speed (Bös et al., 2004; De Toia et al., 2009). Adjusted for covariates (SES, parental BMI, media time), correlation analysis and logistic regression were conducted to estimate the effect of WC on MA. Results Below-average motor abilities (BAMA) were found in 46.0%. No relationship to BMI has been observed ( $p=0.247$ ). Children with BAMA had significantly higher WC compared to the reference group (OR: 1.56, 95% CI: 1.16-2.11;  $p=0.004$ ). The risk decreases with age (0.54, 0.42-0.71;  $p<0.001$ ) and higher physical activity levels (0.58, 0.42-0.78;  $p<0.001$ ). Discussion Overall, WC is a more specific predictor to determine abdominal obesity in children than BMI (Savva et al., 2000). Furthermore, our findings suggest that altered WC appeared to be linked to measurements of MA already in kindergartners. We therefore propose that WC is a better predictor of MA than BMI. References Bös K. Motorische Leistungsfähigkeit von Kindern und Jugendlichen. In: Schmidt W, Hartmann-Tews I, Bretschneider WD (eds): Erster Deutscher Kinder- und Jugendsportbericht. Schorndorf, Hofmann, 2003, 85-107. Bös K et al. Karlsruher Motorik-Screening für Kindergartenkinder (KMS 3-6). *Sportunterricht* 2004;53:79-87. Cole TJ, Green PJ. Smoothing reference centile curves: the LMS method and penalized likelihood. *Stat Med* 1992;11:1305–1319. De Toia D et al. Relationship between anthropometry and motor abilities at pre-school age. *Obes Facts* 2009;2:221-225. Hoffman S, Ulrich R, Simon P. Refined analysis of the critical age ranges of childhood overweight: Implications for primary prevention. *Obesity* 2012;20:2151-2154. Savva SC et al. Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. *Int J Obes Relat Metab Disord* 2000;24:1453-1458.

## BASKETBALL TRAINING EFFECTS ON GROWTH AND DEVELOPMENT OF YOUNG GIRLS

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**Introduction** Growth and development are influenced by a variety of genetic and external factors. Only favorable environmental conditions will lead to the full expression of genetic potential without jeopardizing maturation. Considering the obvious impact of physical activity on children's health status the objective of this study was to assess the influence of basketball training on growth and development of young girls in the period of 18 months. **Methods** Girls were divided into two groups: research group (RG) consisted of 25 girls who played basketball 5-8 hours per week at beginner level (age  $13,86 \pm 0,89$ ) and control group (CG) of 25 girls who were not involved in any sports (age  $13,90 \pm 0,74$ ). Anthropometric and body composition measurements, together with functional and motor tests were performed. Somatic growth was assessed by height, weight, body mass index, arm span and body fat percentage (FAT%). Functional capacity tests included the evaluation of aerobic endurance (AE)-VO<sub>2</sub> max obtained by maximal test on a treadmill and anaerobic endurance (ANE)-300 yards test. Following motor skills were tested: static power (SP)-dynamometry, repetitive power (RP)-push-ups, sit-ups, explosive power (EP)-vertical jump, flexibility (F) and agility (A)-T test. The questionnaire regarding the menstrual status was filled out by both groups. All measurements were performed at the beginning of the study and after 18 months. Student T test was used for statistical analysis. **Results** Initial measurements: There was no statistically significant difference between two groups in terms of anthropometry (APM), FAT%, SP, EP and F ( $p > 0.05$ ). On the other hand, statistically significant difference was found regarding AE and ANE, as well as RP and A ( $p < 0.01$ ). Menarche was reported at average age of  $12.04 \pm 1.06$  for RG, and  $12.3 \pm 1.26$  for CG. The average period between two menstrual cycles was  $29.0 \pm 2.9$  days for RG and  $30.9 \pm 5.26$  days for CG. Measurements after 18 months period: No statistically significant difference between RG and CG was obtained regarding APM, FAT% and F ( $p > 0.05$ ). Statistically significant difference between two groups existed in terms of AE and ANE, SP, RP, EP and A ( $p < 0.01$ ). No changes in menstrual status were observed. Within RG there was significant increase in AE, SP and EP compared to the initial tests ( $p < 0.01$ ). All measurements in the CG showed an insignificant increase after 18 months ( $p > 0.05$ ). **Conclusion** Moderate level of basketball training has no negative effects on somatic growth and menstrual status of young girls. Moreover, this type of physical activity has beneficial influence on growth and development in general, as it is associated with cardiovascular benefits and favorable changes and improvements in motor skills which are important for adequate maturation of young girls.

## IMPACT OF CERTAIN MUSCLE GROUPS FUNCTIONAL STATE ON THE YOUNG BASKETBALL PLAYERS EFFECTIVENESS

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**Introduction** The HUBER® MOTION LAB (LPG Systems, France) is a multifunctional device for musculoskeletal system functional state evaluation and neuromotor rehabilitation, and it has "real-life situation" advantages for sports training application (Couillandre A. et al., 2008). The aim of this study was to determine possible correlation between functional state of specified muscle groups obtained with the HUBER use and the game effectiveness of young basketball players. **Methods** Eleven basketball players of the URFU Student Basketball team (MSBL) underwent the examination of musculoskeletal functional state with the HUBER use during training period before the MSBL game. All players signed the consent for study participation. The following parameters of musculoskeletal system functional state were determined: maximum pushing and pulling force right (MFRpush and MFRpull) and left (MFLpush and MFLpull), coordination, pushing and pulling muscle endurance (Epush and Epull), reaction rate. Furthermore, the indices of cardiorespiratory system during stress test with treadmill (Schiller AG, Switzerland) use were determined as well. Evaluation of effectiveness was based on game statistic indices monitoring. As a result, the number of effective actions (EFF) and points per game (PPG) were calculated. The statistic software package IBM SPSS was used for statistical analysis. **Results** On average, the players had  $21.8 \pm 0.6$  years,  $198.5 \pm 7.4$  cm height and  $93.4 \pm 11.3$  kg body weight. We found close correlations between EFF and MFRpull ( $r=0.61$ ,  $n=11$ ,  $p < 0.05$ ); EFF and MFLpull ( $r=0.63$ ,  $p < 0.05$ ); EFF and Epush ( $r=0.62$ ,  $p < 0.05$ ); PPG and MFRpull ( $r=0.61$ ,  $p < 0.05$ ); PPG and MFLpull ( $r=0.62$ ,  $p < 0.05$ ); PPG and Epush ( $r=0.66$ ,  $p < 0.05$ ). No significant correlations between EFF or PPG and any parameter of cardiorespiratory system function were found. **Discussion** The research has mainly an assessed value because of limited number of sportsmen examination. Perhaps, the lack of correlation between the cardiorespiratory system parameters and game effectiveness ones is the reason of little number of observations. Meanwhile, we found out that the player effectiveness depended on the indices, characterizing pulling, e.g. involving mainly posterior surface muscles, flexors of upper limbs, hips and shins. On the contrary, the pushing force indices didn't impact significantly on EFF and/or PPG. At the same time, the increase of Epush resulted in the increase of EFF and/or PPG. We concluded that the pushing muscle endurance is the most important determinant of young basketball player effectiveness than the pushing muscle maximum force. **References** Couillandre A., Duque Ribeiro M.-J., Thoumie P., Portero P. (2008), *Annales de readaptation et de médecine physique* 51, 67-73.

## OSTEOGENIC EFFECT IN PRE-PUBERTAL ATHLETES PRACTICING DIFFERENT IMPACT-LOADING SPORTS

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**Introduction** Physical activity involving weight bearing or jumping is beneficial per se to bone mineral accrual in children. However, there is large evidence that sports involving high-impact loading (i.e., generated ground reaction forces greater than or equal to 3 times body weight) tend to produce a better overall osteogenic response than sports without impact loading (i.e., generated ground reaction forces = 0 times bodyweight). The aim of this study was to compare the effect of different impact loading sports on bone quality and body composition of pre-menarcheal athletes. **Methods** Thirty pre-menarcheal girls (aged  $11.1 \pm 1.33$ (SD)) participating in volleyball (VOLLEY,  $n=10$ ) and artistic gymnastics at high (HGYM,  $n=10$ ) and low (LGYM,  $n=10$ ) intensity training underwent total body DXA analysis. Body composition (bone mineral content (BMC), fat-free soft tissue mass (FFST), fat mass (FM), and %FM) was assessed by dual-energy X-ray absorptiometry (DXA) at the total body and regional (arms, legs, trunk) level as well as specific axial skeleton sites (thoracic and lumbar spine, pelvis). Normality of data was assessed with the Kolmogorov-Smirnov test. Comparison of the three groups of pre-menarcheal athletes was performed with univariate ANOVA taking "group" as the within-subjects factor. Post-hoc analysis used Bonferroni's correction for multiple comparisons. Statistical analysis was performed with SPSS v.16. Differences were considered significant when  $P \leq 0.05$ . **Results** After adjusting for body size, total body composition measurements were all significantly ( $p < 0.01$ ) different in the three groups of pre-menarcheal athletes. VOLLEY had lower BMC and FFST, and greater FM and %FM vs. both HGYM and LGYM. The main difference between LGYM and HGYM was greater %FM in the former.

Similar results were found at the regional level (but for similar BMC in the legs) and at lumbar spine and pelvis. Linear regression analysis showed that a model using FFST mass as the independent variable is able to explain more than 90% of variance in total body less head BMC in the whole group of impact loading athletes, whereas introducing %FM in the model did not improve its predictive power. Discussion The findings of this study provide evidence that greater bone mineral accrual takes place in pre-menarcheal impact loading athletes participating in artistic gymnastics vs. volleyball and the dose of impact loading activity mainly affect %FM; moreover, results suggest that BMC in the weight-bearing skeleton is strongly.

### VARIABLE PARAMETERS OF BODY COMPOSITION OF YOUNG HOCKEY PLAYERS

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**Introduction** Body composition is the result of long-term adaptation to the effects of specific training loads, and it reflects different priorities of energy mechanisms (aerobic, mixed, anaerobic). Accordingly, the level of labile body components, and their ratio may be considered as markers of different types of training. In the case of individual analysis it allows to evaluate indirectly the level of general physical fitness, adequate balance between physical work and recovery, and to focus on the priority of physical effects (Portal et al. 2010). The aim of the study was to evaluate the level of body fat and muscle mass in young male hockey players. **Methods** We examined nine young hockey players (1 group, main). Various anthropometric measurements were evaluated (weight, height, circumferences and skinfold thicknesses). The following anthropometric indices were derived from the obtained data: fat mass (FM, kg), relative FM (%), muscle mass (MM, kg), relative MM (%). For this we used modified by Lutovina et al. (1970) anthropometric equations of Mateika. The results were then compared with the literature data (young male hockey players, 2 comparison group; Abramova 2010). Groups of young athletes were matched by the following parameters: body weight ( $31.37 \pm 4.5$  kg and  $28.4 \pm 4.5$  kg, respectively), height ( $134.3 \pm 5.75$  cm and  $131.4 \pm 5.7$  cm) and duration of sports experience ( $3.25 \pm 1.16$  years and  $2.7 \pm 1.5$  years, respectively), age (all of young athletes were 8 years old). **Results** The two groups of young athletes showed similar measurements of the following anthropometric characteristics: relative FM ( $17.13 \pm 7.17\%$  vs.  $13.8 \pm 8.6\%$ ,  $P > 0.05$ ), MM ( $12.07 \pm 3.96$  kg vs.  $12.7 \pm 2.1$  kg,  $P > 0.05$ ). Moreover, first group of athletes had higher fat mass ( $5.53 \pm 2.79$  kg and  $3.5 \pm 1.9$  kg,  $P < 0.03$ ), and lower percentage of muscle mass ( $38.35 \pm 11.48\%$  vs.  $44.8 \pm 1.8\%$ ,  $P < 0.02$ ) in comparison with the second group. **Discussion** Low levels of muscle mass and medium level of fat mass corresponded to the age of young hockey players, and pointed to the low exercise tolerance of children, especially to high intensity work. So, planning of training process should be in accordance with the age and the level of physical fitness of children. **References** Portal S. Body fat measurement in elite adolescent volleyball players: correlation between skinfold thickness, bioelectrical impedance analysis, air-displacement plethysmography, and body mass index percentiles / S. Portal, J. Rabinowitz, D. Adler-Portal et. al. / *J Pediatr Endocrinol Metab.* - 2010. - 23 (4). - pp.395-400. Abramova T.F. Morphological criteria: metod. recommendation. - Moscow, 2010. - p.81

### ANTHROPOMETRY, MATURITY AND PERFORMANCE IN YOUNG SOCCER PLAYERS DIVIDED IN AGE-QUARTILES

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**1**Department of Physical Education and Sport, University of the Basque Country, UPV/EHU. **2**Department of Nursing, UPV/EHU. **3**Athletic Club de Bilbao **Acknowledgements** This study was partially supported by a grant from the Basque Government (UE09+/07) **Introduction** The presence of the Relative Age Effect (RAE) has been widely reported; however, its underlying causes have not yet been clearly determined. The aim of this study was to analyze if anthropometry, maturity and performance were different amongst older and younger soccer players born in the same year. **Methods** Eighty-eight young soccer players, all born in 2001, participated in the study (age  $9.75 \pm 0.30$ , range: 9.16-10.37). Anthropometric measurements, performance tests (30m sprint, 30m agility, Yo-yo IT test, CMJ, hand dynamometry) and the estimation of the maturity status were carried out (Mirwald et al., 2002). Also, to estimate an overall performance, a SCORE was calculated summing up the results (z-scores) of the performance tests. The 75th, 50th and 25th percentiles (Pc) of the chronological age were calculated. According to these Pc, four groups (quartiles) of players were obtained: Q1= players whose age was above Pc 75th (they were the eldest), Q2 (Pc50-75), Q3 (Pc25-50) and Q4= age below Pc 25th (the youngest). Measurements were compared amongst the groups of players of the four age-quartiles. Mean  $\pm$  standard deviations are shown and the differences were assessed using a Student t-test or a U-Mann-Whitney test and also Cohen's d. **Results** Most players (65.9%) had been born in the first half of the year. Older players were taller (Q1:  $140.85 \pm 5.58$  vs. Q4:  $137.13 \pm 4.51$  cm,  $p < 0.05$ ), had longer legs (Q1:  $66.10 \pm 2.81$  vs. Q4:  $64.11 \pm 2.99$  cm,  $p < 0.01$ ) and a larger fat-free mass (Q1:  $29.54 \pm 3.32$  vs. Q4:  $27.37 \pm 2.78$  kg,  $p < 0.05$ ). Maturity offset was closer in the older boys (Q1:  $-3.50 \pm 0.36$  vs. Q4:  $-3.93 \pm 0.23$  kg,  $p < 0.05$ ); however age at peak height velocity was similar. Older boys performed better ( $p < 0.05$ ) in velocity (Q1:  $5.07 \pm 0.27$  vs. Q4:  $5.37 \pm 0.42$  s) and agility (Q1:  $5.89 \pm 0.38$  vs. Q4:  $6.24 \pm 0.42$ ) and particularly in the overall SCORE of performance (Q1:  $2.03 \pm 3.55$  vs. Q4:  $-1.66 \pm 3.41$ ,  $p < 0.01$ ). Older players also performed better in the Yo-yo IR1 (Q1:  $626.66 \pm 285.49$  vs. Q4:  $470.47 \pm 216.85$  m) and the CMJ (Q1:  $29.56 \pm 3.13$  vs. Q4:  $27.10 \pm 3.25$  cm) but the differences were not statistically significant; however, the effect size was medium to large ( $d = 0.616$  and  $0.771$ , respectively). **Conclusion** Older players were taller and displayed a better performance which may underlie the RAE through a selection of soccer players towards the outstanding players. **References** Mirwald RL, Baxter-Jones AD, Bailey DA, Beunen GP. An assessment of maturity from anthropometric measurements. *Med Sci Sports Exerc.* 2002, 34, 689-94

### FLUID INTAKE AND SWEAT RATE OF YOUNG ELITE BASKETBALL PLAYERS

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**Introduction** FIBA Europe, as active International Federation in fields of sports medicine, supplementation and anti-doping, has decided to monitor hydration of basketball players on the one major European competition. The aim of this study was to determine sweat rate and fluid intake of young elite basketball players. Sweat rates depend principally on factors such as the environmental conditions, choice of clothing or exercise intensity and they also vary greatly between individuals. Exercise can elicit high sweat rates and substantial water and electrolyte losses during sustained exercise, particularly in warm-hot weather. **Method** Ninety-six basketball players of eight national teams were assessed during the official FIBA Europe U20 Championship Division B. In order to determine sweat rate and fluid intake we measured body mass of all players before and after one game, the quantity of consumed fluid and urine output during the game, as well

as temperature and humidity in the sports hall. Results Players age was  $19\pm 0.79$  years. After the game body mass loss was  $0.9\pm 0.7$  kg, percentage of dehydration  $0.99\pm 0.7\%$ , total fluid intake  $1868\pm 816$  ml (range 435 – 3987) and sweat rate  $2.7\pm 0.9$  L/h (range 5.54 - 1.16). Urine output during the game was  $55\pm 61$  ml. Ambient temperature was  $30\pm 2^\circ\text{C}$  and humidity  $55\pm 4\%$  on average. We found statistically significant correlation between sweat rate and: Usg ( $p<0.05$ ), Uosmol ( $p<0.01$ ), body mass loss ( $p<0.01$ ), FI ( $p<0.01$ ), BSA ( $p<0.01$ ) and percentage of dehydration ( $p<0.01$ ). Discussion Most of the athletes failed to match sweat losses during the game and they were significantly dehydrated. Recommendations for fluid and electrolyte replacement must be carefully considered and monitored in basketball players to promote safe hydration. Players, as well as coaches and team doctors, should receive encouragement and educational information about suitable hydration strategies.

### **BENEFICIAL EFFECTS OF EXERCISE TRAINING IN CHILDHOOD-ONSET SYSTEMIC LUPUS ERYTHEMATOSUS**

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**Introduction** Exercise training has emerged as a promising therapeutic strategy to counteract physical dysfunction in adult systemic lupus erythematosus. However, no longitudinal studies have evaluated the effects of an exercise training program in childhood-onset systemic lupus erythematosus (C-SLE) patients. **Objective** To evaluate the safety and the efficacy of a supervised aerobic training program in improving the cardiorespiratory capacity in childhood-onset systemic lupus erythematosus (C-SLE) patients. **Methods** Nineteen physically inactive C-SLE patients were randomly assigned into two groups: trained (TR,  $n=10$ , supervised moderate-intensity aerobic exercise program) and non-trained (NT,  $n=9$ ). Gender-, BMI- and age-matched healthy children were recruited as controls (C,  $n=10$ ) for baseline (PRE) measurements only. C-SLE patients were assessed at PRE and after 12 weeks of training (POST). Main measurements included exercise tolerance and cardiorespiratory measurements in response to a maximal exercise (i.e.: peak  $\text{VO}_2$ , chronotropic reserve [CR], and the heart rate recovery [ $\Delta\text{HRR}$ ] (i.e. the difference between HR at peak exercise and at both the first [ $\Delta\text{HRR1}$ ] and second [ $\Delta\text{HRR2}$ ] minutes of recovery after exercise). **Results** The C-SLE NT patients did not present changes in any of the cardiorespiratory parameters at POST ( $p>0.05$ ). In contrast, the exercise training program was effective in promoting significant increases in time-to-exhaustion ( $p=0.01$ ;  $\text{ES}=1.07$ ), peak speed ( $p=0.01$ ;  $\text{ES}=1.08$ ), peak  $\text{VO}_2$  ( $p=0.04$ ;  $\text{ES}=0.86$ ), CR ( $p=0.06$ ;  $\text{ES}=0.83$ ), and in  $\Delta\text{HRR1}$  and  $\Delta\text{HRR2}$  ( $p=0.003$ ;  $\text{ES}=1.29$  and  $p=0.0008$ ;  $\text{ES}=1.36$ , respectively) in the C-SLE TR when compared with the NT group. Moreover, cardiorespiratory parameters were comparable between C-SLE TR patients and C subjects after the exercise training intervention, as evidenced by the ANOVA analysis ( $p>0.05$ , TR vs. C). SLEDAI-2K scores remained stable throughout the study. **Conclusion** In conclusion, this study demonstrated for the first time that a three-month supervised moderate-intensity aerobic exercise training program can be safe and effective in ameliorating the cardiorespiratory capacity and the autonomic function in C-SLE patients. These findings stress the potential role of exercise training in the management of C-SLE, strengthening previous evidence of the beneficial effects of exercise in other pediatric rheumatic diseases.

### **ACL INJURY RISK IN FEMALE BASKETBALL PLAYERS DURING MATURATION**

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**Introduction** Anterior cruciate ligament (ACL) injuries are frequently seen in basketball players, especially in girls during maturation. Biomechanical factors such as knee valgus motion have been associated with ACL injuries. Understanding when young female athletes increase biomechanical ACL injury risk factors may help identify the optimal timing to implement injury prevention program. Therefore, the purpose of this study was to evaluate ACL injury risk in female basketball players during puberty. **Methods** Ninety-two female basketball players between 9 and 17 years old participated in the study. They were classified based on maturation stages: early pubertal, middle pubertal, late pubertal, and post pubertal. ACL injury risk was evaluated using a newly developed ACL injury risk prediction algorithm (Myer et al., 2010), which consists of measurements of tibia length, weight, quadriceps/hamstring ratio, two-dimensional knee valgus motion and knee flexion range of motion during a drop vertical jump. ACL injury risk (probability of high knee abduction moment), knee valgus motion and knee flexion range of motion were compared among four subject groups. **Results** Early pubertal stage demonstrated smaller knee valgus motion than middle and post pubertal stages ( $p<0.05$ ). Similarly, knee flexion range of motion was greater in early pubertal stage when compared with late and post pubertal stages ( $p<0.01$ ). ACL injury risk was significantly lower in early pubertal stage compared with other stages ( $p<0.01$ ). **Discussion** In this study, height and weight were significantly increased between early and middle pubertal stages. Following this rapid growth, knee valgus motion was significantly increased. This finding supported previous studies that reported increased knee valgus angle in late and post pubertal females (Hewett et al. 2004). This study also found that knee flexion angle was decreased following the growth spurt. Decreased knee flexion angle during landing is commonly observed during actual ACL injuries (Koga et al., 2010) and might be a risk factor of ACL injury. These biomechanical factors, as well as a rapid increase in height and weight, contributed to increased ACL injury risk. The results of this study suggested that early pubertal stage might be the important time period. Implementation of injury prevention program during this period might be needed. **References** Myer G, Ford K, Khoury J, Succop P, Hewett T. (2010). *Clinic Biomech*, 25, 693-699. Hewett T, Myer G, Ford K. (2004). *J Bone Joint Surg Am* 86-A (8), 1601-1608. Koga H, Nakamae A, Shima Y, Iwasa J, Myklebust G, Engebretsen L, Bahr R, Krosshaug T. (2010). *Am J Sports Med* 38 (11), 2218-2225.

### **EFFECTS OF ROPE JUMPING ON PHYSICAL FITNESS IN CHILDREN WITH ADHD**

Lin, W.S.1, Su, C.T.2, Yang, A.L.1

*1:Taipei Physical Education College; 2:Fu Jen Catholic University*

**Introduction** As one of the most prevalent pediatric disorders, attention deficit hyperactivity disorder (ADHD) is characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity. Recently, the concerns of problems of physical performance in children with ADHD have been raising. However, studies that explored the physical performance, such as physical fitness, and the effects of exercise intervention in this population (Hopkins et al., 2009; Verret et al., 2012) remained insufficient. Thus, the purposes of this study were to (1) compare the physical fitness between typically developing children and children with ADHD; (2) evaluate the influences of the long-term rope jumping intervention on physical fitness in children with ADHD. **Methods** We recruited 30 children, including 20 children with ADHD and 10 matched typically developing children (normal group), to participate in this study. The recruited children with ADHD were randomly assigned into control (ADHD-CON) and exercise (ADHD-EX) groups. Participants in the ADHD-EX group performed an eight-weeks exercise intervention, i.e. rope jumping, for 30 minutes per day, 3 days per week. Physical fitness assessment included height, weight, body

mass index, waist-hip ratio, body fat, sit and reach test (flexibility), sit-up test for 1 minute (muscle endurance), standing long jump (instantaneous power), and 3-min step test (cardiorespiratory endurance). The assessment was conducted for 3 groups at the baseline and for 2 ADHD groups at the end of the intervention. Results Our results indicated poorer physical fitness in the ADHD groups compared with the normal group, including sit and reach test, sit-up test for 1 minute, and standing long jump. After eight weeks of exercise intervention, height and weight were increased and waist-hip ratio was reduced in the ADHD-EX group in comparison with the ADHD-CON group. Also, body fat increased significantly in the ADHD-CON group, but remained the same for the ADHD-EX group. The performance for tests of sit and reach, standing long jump, and sit-up for 1 minute in the ADHD-EX group were significantly greater than the ADHD-CON group. Discussion This study confirmed the problems of physical fitness for children with ADHD. Our findings suggested that eight-weeks rope jumping could improve parts of physical fitness for children with ADHD, including height, weight, waist-hip ratio, body fat, flexibility, muscle endurance, and instantaneous power. References Verret C, Guay MC, Berthiaume C, Gardiner P, Béliveau L. (2012). *J Atten Disord*, 16(1), 71-80. Hopkins M, Sharma M, Evans G, Bucci D. (2009). *Behav Neurosci*, 123(3), 599-606.

**14:00 - 15:00**

## Mini-Orals

### PP-PM65 Sports Medicine [SM] 9

#### DIPLOMA IN MOUNTAIN MEDICINE PROGRAM IN JAPAN

Natsui, H., Masuyama, S., Kamikomaki, N.

*Japan Women's College of Physical Education*

Introduction Diploma in Mountain Medicine (DiMM) program in Japan started in May/2010. This diploma is based on Union Internationale Des Associations D'alpinisme Medical Commission (UIAA-MedCom), International Commission for Alpine Rescue (ICAR), and International Society of Mountain Medicine (ISMM). This program is operated by Japanese Society of Mountain Medicine (JSMM), in co-operation with Japan Mountaineering Association and National Mountaineering Training Center Japan. Methods This program includes 6 clusters, 1 ; Utsunomiya cluster (various medical problems in Japanese mountains), 2 ; Tateyama cluster (mountaineering techniques in summer), 3 ; Matsumoto cluster (pre-hospital evaluation and care), 4 ; Tokyo cluster (basic theory), 5 ; Yatsugadake cluster (mountaineering techniques in winter), and 6 ; Sapporo cluster (rescue technic in mountain and snow activity in Japan). In order to complete the courses, it needs 3 steps; pre-examination paper before each cluster, participation in each cluster, and terminal examination after each cluster. All clusters must be completed within 5 years. Results In May 2010, opening of DiMM program in Japan started 35 registered doctors, and it grew up to 102 doctors (23 female, 79 male) at the end of 2012. Doctors come from various specialties, such as sports medicine, cardiology, neurology, psychology, orthopedics, brain surgery, gynecology, plastic surgery, anesthesiology, emergency medicine, and dentist. Only 9 doctors have been authorized as International Diploma in Mountain Medicine on November 2012. Discussion This DiMM program started in Europe (Austria, France, Germany, Italy, Spain, Switzerland, and UK) from 1998, 3500 doctors registered this program. On the other hand, JSMM joined DiMM program from 2010, 102 doctors registered and only 9 doctors were authorized. It is expected to create more DiMM doctor in Japan.

#### ESTABLISHING SPORT PSYCHOLOGY TRAINING WITHIN ATHLETIC TRAINING CURRICULA

Schoen, C., DiCredico, L., Murphy, J.

*Salem State University*

Context: Despite the requirement that accredited university AT clinical curriculum in the United States includes psychosocial strategies and referral techniques, many AT programs do not schedule sport psychology courses in their curriculum. The purpose of this study was to demonstrate a demand for a course designed specifically to offer coursework covering currently accepted theory-based practices from sport psychology in the area of injury rehabilitation. Design: A three day workshop for 30 athletes training students (ATS) currently placed in clinical internships at area high school and university sites was developed to cover sport psychology principles, psychology of the injured athlete and counseling techniques. The workshop was conducted by the university's sport psychology professor and a licensed social work counselor. At the start of the workshop we asked with open-ended questions what ATS' current perception of sport psychology was and how it can be used in rehabilitation situations. Additionally, we obtained baseline data measuring how often they had used sport psychology techniques in the past, and how often they had ever worked with a sport psychology consultant (SPC) or referred an athlete to one before. This data will be used at a later time to demonstrate competency and proficiency of psychosocial intervention and referral techniques. Results: Using content analysis of the open-ended responses concerning importance of using sport psychology techniques during rehabilitation, our results confirmed what has been reported in similar studies. ATS mostly admitted that they did not know enough sport psychology to use them adequately in rehabilitation while at the same time overwhelmingly reporting that sport psychology techniques are important or very important for the success of rehabilitation. Conclusions: Our findings support studies published in athletic training journals calling for instituting curriculum covering sport psychology principles. Specific content areas that need to be included in these curricula include motivation techniques, establishment of social supports systems and most importantly training ATS to treat athletes holistically with emotional awareness and regulation strategies.

#### RISK FACTORS FOR SPORTS CONCUSSION: A SYSTEMATIC REVIEW

Mc Fie, S.1, Abrahams, S.1, Patricios, J.2, Posthumus, M.1, September, A.V.1

*1. University of Cape Town, 2. Morningside Sports Medicine and Sports Concussion, Johannesburg*

Introduction Concussion is a common sports injury with approximately 1.6-3.8 million sport-related concussions reported in the US annually. Identifying risk factors may assist in preventing these injuries. This systematic review aims to identify such risk factors. Methods Three electronic databases; ScienceDirect, PubMed and Springerlink, were searched using the keywords "RISK FACTORS" or "PREDISPOSITION" in conjunction with "SPORT" and "CONCUSSION" (including truncated forms). The database search was limited to articles published be-

tween 1980 and 2012. Inclusion and exclusion criteria were independently evaluated by two of the authors. Reference lists of relevant studies were screened for additional articles using the same selection method. Only articles with a level of evidence of I, II and III were included (Obremskey et al., 2005). The level of certainty, as previously defined (Sawaya et al., 2007), for each risk factor was determined. Briefly, a high level of certainty was given if the research provided a good risk estimate and produced consistent findings. Moderate certainty was assigned when available evidence was sufficient to determine that there is risk, but confidence estimate was constrained by study quality. Low certainty was given when there was insufficient evidence of risk. Results Sixty nine articles were selected for appraisal. A history of concussion was the only risk factor with a high level of certainty. All 14 studies, including 8 prospective studies, showed that athletes sustaining more than 1 previous concussion had an increased risk of a subsequent concussion. Risk factors with a moderate level of certainty included playing position, sex and match play. Defensive players and forwards were high risk playing positions in American football and ice hockey, respectively. Generally a higher concussion risk was observed for males, across ages and sports, except for soccer in which females often had a higher risk. Concussion proportion was greater in games compared to training in 6 of the 7 studies. The use of protective equipment, age, genetics and playing environment had a low level of certainty. Conclusion Although several risk factors were identified in the appraised studies, poor study methodology limited estimation of concussion risk. Prospective cohort design and consistent measures of risk should be employed in future research.

### **EFFECT OF 1-YEAR RUGBY TRAINING AND PARTICIPATION IN MATCHES ON THE SCORES OF THE CONCUSSION ASSESSMENT TOOL**

Otomo, M.1, Torii, S.2, Otuka, S.1, Iwanuma, S.2, Saho, Y.2, Fukubayashi, T.1

1: *Graduated School of Sport Sciences, Waseda University*, 2: *Faculty of Sport Sciences, Waseda University*

**Introduction** Sport-related concussion attracted attention of sports medical personnel in recent years. Therefore, Japan rugby association has recommended the measurement of baseline testing using the assessment tool of concussion at the start of the season. Purpose of this study was to research the effect of 1-year rugby training and participation in matches on the scores of the concussion assessment tools (SCA). **Methods** Subjects are adult male rugby players in Japan. To examine differences in SCAs at baseline testing between 2011 and 2012 season, concussion assessment used included the Standardized Assessment of Concussion (SAC), Balance Error Scoring System (BESS), Trail Making Test form A and B (TMT) and Symbol Digit Modalities test (SDM) (Tamerah and Michael, 2009; P McCrory et al., 2009). In addition, we counted the number of matches, playing time, the number of impact and tackle in each player of 2011 season matches, investigating the relationship of SCAs and these match data. **Results** There was no significant difference between SCAs in 2011 and 2012, except for TMT improved. Also, there were no significant correlations between SCAs and each parameter of match data. **Discussion** Improvement of TMT scores was considered to be learning effect. However, it is considered that it is more effective to use objective neuropsychological tests (eg: SAC, BESS) than using pencil and paper tests (eg: TMT) for concussed athletes (Tamerah and Michael, 2009). In addition, no significant difference was found on comparison between 2011 and 2012 season on the scores of SCAs. One of the reasons was that the player who injured concussion was only one. Another reason was that players of this team engaged to the prevention training of concussion by wrestling. Moreover, it means that training and matches of rugby has no effect on SCAs in 1 season. But there is a style of play in each team. Therefore this result may be special result of this team. As the playing style is different between teams, these results may limited to this team. **Conclusion** During 2011 season, only one player had concussion. Very low incidence of concussion and practice of prevention training for concussion recommended would decrease the effects of rugby participation on SCAs. **References** Tamerah N, Michael S. (2009). *Journal of Athletic Training*, 44(4), 405-409. P McCrory, W Meeuwisse, K Johnston, J Dvorak, M Audry, M Molloy, R Cantu. (2009). *British Journal of Sports Medicine*, 43(suppl 1), i76-i84.

### **DIURNAL PROFILES OF Pedometer-DETERMINED PHYSICAL ACTIVITY IN OLDER PRIMARY HEALTH CARE PATIENTS**

Bloch, A., Hinrichs, T., Platen, P., Moschny, A.

*University of Bochum*

**Purpose** Although the benefits of regular physical activity (PA) are widely known, many older adults are insufficiently physically active. In order to design appropriate PA programs for older people, it is important to better understand their PA behaviour. Therefore, the aim of this study was to analyse the diurnal profiles of PA in a sample of adults aged 70 years and over. **Methods** 213 older (70+), chronically ill and mobility restricted primary health care patients were recruited via their general practitioner. Participants wore a pedometer (Omron Walking Style Pro HJ-720IT-E2) on six consecutive days and documented whether or not they had worn the device for the whole day. Only participants who wore the pedometer on at least 2 workdays (Monday-Saturday) and on a Sunday with a minimum of 300 steps per day were included in the analysis. Mean steps per day (d) and per hour (hr) were analysed descriptively for all participants as well as stratified by gender and age group (<80/80+ years). **Results** A total of 149 primary health care patients (74.5% women) with a median age of 80 (range 70-94) years were included in the analysis. The overall PA averaged 3267±1901 steps/d (men: 3037±1688 steps/d, women: 3346±1969 steps/d; <80 years: 3721±2017 steps/d, 80+ years: 2819±1675 steps/d). Participants walked 3340±1879 steps on workdays and 2890±2687 steps on Sundays. Analyses by gender and age group showed the same trend. Looking at diurnal profiles, there were two peaks at 10-11 am (373±318 steps) and at 15-16 pm (316±336 steps) interrupted by a period of lower PA with a low point at 13-14 pm (230±241 steps). The same profile was observed in male (10-11 am: 385±297 steps; 13-14 pm: 254±257; 15-16 pm: 281±365 steps) and in female participants (10-11 am: 368±326; 13-14 pm: 161±170; 15-16 pm: 328±326 steps) as well as in younger adults (10-11 am: 425±364 steps; 13-14 pm: 246±218; 15-16 pm: 382±378 steps). For adults aged 80+ years peaks were less prominent and the PA level was more evenly distributed throughout the day. **Conclusion** This study is the first to analyse diurnal profiles of pedometer-determined PA in older adults. The overall PA level was rather low, with distinct gender- and age group-related differences. Considering diurnal profiles, PA was highest late in the morning, followed by a second peak in the afternoon. A better understanding of PA in the course of the day helps to adjust offers of PA/exercise programmes to preferred PA phases of older adults in order to more successfully increase their PA.

### **TIME OF DAY, ENVIRONMENT LUMINOSITY AND PHYSICAL EXERCISE ON INFLAMMATORY PARAMETERS OF SWIMMING RATS**

Beck, W., Scariot, P.P.M., Dos Reis, I.G.M., Gobatto, C.A.

*University of Campinas*

**Introduction** Forced swimming for rats has been extensively used in sport sciences investigations, however, the chronobiological control is usually neglected. Since the circadian rhythm is mainly controlled by light/dark cycle, the environmental luminosity and time of day

should be investigated in order to avoid additional stress. So, we aimed to analyze inflammatory parameters in animals submitted to a time to exhaustion swimming trial (TE) at lactate minimum intensity under two environmental luminosities during sleep and wakefulness period. Methods At 45 days-old, 84 rats were housed under 12/12 h light-dark cycle in standard (SI) or experimental (EI) illumination. The daylight was equal for both (560-595nm; <60lux), however, from 18:00h to 06:00h SI was maintained in total darkness while EI under constant red light (>600nm; <15lux). These groups were further subdivided according time of day, being assessed at 12:00h or 20:00h. After two weeks of water and swimming adaptation, the animals were submitted to lactate minimum test (90 days-old) and to TE 48h after. Were collected blood samples immediately after TE in order to determine the C-reactive protein (CRP), lymphocytes (Lymp), neutrophils (Neutr) and monocytes (Mono). Analysis of variance were used with  $p < 0.05$  to luminosity, time of day and exercise effects. Results At 12:00 h, Lymp (7550.14/mm<sup>3</sup>), Mono (861.86/mm<sup>3</sup>) and Neutr (2872.61/mm<sup>3</sup>) were higher ( $p < 0.01$ ) in relation to 20:00 h (5347.67/mm<sup>3</sup>, 498.81/mm<sup>3</sup> and 1992.62/mm<sup>3</sup>, respectively), remained only CRP unaltered by time of day (3.11µg/mL for 12:00 h and 3.21µg/mL for 20:00 h;  $p = 0.23$ ). EI increases Lymp (SI = 5984.63/mm<sup>3</sup>; EI = 6913.19/mm<sup>3</sup>;  $p = 0.01$ ), Mono (SI = 523.40/mm<sup>3</sup>; EI = 837.29/mm<sup>3</sup>;  $p < 0.01$ ) and decreases Neutr (SI = 2678.70/mm<sup>3</sup>; EI = 2186.53/mm<sup>3</sup>;  $p < 0.01$ ), while CRP do not suffer alteration in function of this main effect (3.21µg/mL for SI and 3.11µg/mL for EI;  $p = 0.22$ ). Solely the exercise increases CRP concentration (3.05µg/mL for control and 3.26µg/mL for exercise;  $p = 0.01$ ), also leading to high count on Lymp (5269.47/mm<sup>3</sup> and 7628.34/mm<sup>3</sup>;  $p < 0.01$ ), Neutr (2084.25/mm<sup>3</sup> and 2780.97/mm<sup>3</sup>;  $p < 0.01$ ) and Mono (621.27/mm<sup>3</sup> for control and 739.41/mm<sup>3</sup> for exercise, respectively;  $p = 0.04$ ). Discussion While SI and 20:00 h groups had normal Lymp, Mono and Neutr counts, EI and 12:00 h groups showed increased counts, expressing worse experimental conditions. Our results confirm the acute characteristic of CRP, being modulated only by exercise effect. We postulate that luminosity and time of day should be controlled for all animal models investigations to avoid mistaken interpretations on experimental results, once the studied white blood cells counts could be associated to modulations on physiological parameters. Supported by FAPESP-Proc. 2011/13226-1

### EFFECTS OF LOW-INTENSITY PULSED ULTRASOUND EXPOSURE ON SKELETAL MUSCLE REGENERATION AFTER CARDIOTOXIN-INDUCED DAMAGE IN THE MOUSE MODEL.

Sakamoto, M., Horiuchi, T., Hiraguchi, T., Tadano, C., Takahira, N.

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Effects of low-intensity pulsed ultrasound exposure on skeletal muscle regeneration after cardiotoxin-induced damage in the mouse model. Sakamoto, M.1, Horiuchi, T. 1, Hiraguchi, T.1, Tadano, C.2 Takahira, N.1. 1: Kitasato University (Sagamihara, Japan), 2: Toho University School of Medicine(Tokyo, Japan) Introduction Low-intensity pulsed ultrasound (LIPUS) has non-thermal effects and it has been shown to induce biological activities related to tissue repair. Although there are several studies on the effect of therapeutic ultrasound on bone, tendon and ligament injuries (Khanna A, et al), information on the therapeutic application of LIPUS for muscle injuries is insufficient( Rantanen J, et al, Shu B, et al). The purpose of this study was to examine the effects of LIPUS exposure on the regenerative process of injured muscle using immunohistochemistry in a mouse model. Methods Female ICR mice were used in this study. These mice were divided into the control group (N=5), muscle injury (injury) group (N=25) and LIPUS exposure after muscle injury (LIPUS) group (N=25). To induce muscle injury, cardiotoxin was injected into the left tibialis anterior (TA) muscle. LIPUS was initiated 3 hours after injury to the left TA muscle and it was applied once daily in the day that followed until sacrifice. LIPUS was performed under the following conditions: 10 min/day, frequency of 3 MHz, intensity of 0.5W/cm<sup>2</sup>, 20 % duty cycle. TA muscles were excised after 2, 3, 5, 7 and 10 days after injury. Frozen cross sections were reacted with anti-desmin antibody (a marker of myogenic cell). Nuclei were stained with DAPI. Sections were observed to identify the expression of desmin-positive mononuclear cells. And, fiber cross sectional area (FCSA) was measured in injured part at 10 days after injury. The results were analyzed using 1-way analysis of variance. If statistical significance was achieved ( $p < 0.05$ ), multiple comparisons were performed using Tukey's method. Results Desmin-positive mononuclear cells were detected at 3 days after injury in both the injury group and the LIPUS group. The mean FCSA was no significant difference between the injured group and the LIPUS group. Regarding the size distribution of FCSA, it tended to differ between injured group and LIPUS group. In LIPUS group, the number of myofibers with FCSA > 2800 µm<sup>2</sup> was larger compared with the injured group. Discussion In this experiment, mean FCSA was similar in both the injured group and the LIPUS group at 10 days after muscle injury. However, the number of larger myofibers tended to increase in the LIPUS group compared with the injury group. Thus, it seems likely that exposure with LIPUS had a beneficial effect on the injured muscle. Reference Khanna A, et al. (2008) Br Med Bull. 89: 169-182 Rantanen J, et al (1999) Am J Sports Med. 27: 54-59. Shu B, et al. (2012) Cell Biochem Biophys. 62: 329-336.

### DIFFERENTIAL SENSORI-MOTOR MODULATIONS ON THE LOAD COMPLIANCE DURING MAINTAINING CONSTANT FINGER FORCE OR POSITION

Kirimoto, H., Tamaki, H., Onishi, H., Suzuki, M., Matsumoto, T., Yotani, K.

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Introduction When an individual performs a submaximal static contraction, there are two different load types either to produce a constant force by pulling against a noncompliant restraint (force task) or to maintain a constant limb angle while supporting an equivalent isoinertial load (position task). Despite each subject exerting a similar net muscle torque during the two tasks, referring to the Newtonian mechanics (the force outputs are the same and the joints are still), previous work has reported that time to failure, which occurs when the participant is no longer able to match the task criterions, is briefer for the position task than for the force task. The aim of this study was to determine whether sensorimotor modulations on the load compliance during maintaining constant finger force or position are different Methods Ten healthy subjects contracted the right first dorsal interosseus muscle by abducting their index finger 90 seconds either to produce a constant force against a rigid restraint by 10 degree (force task) or to maintain a constant position against a constant load of 20% of maximum contraction (position task). Visual feedback was provided during both tasks. Somatosensory evoked potentials (SEPs) were recorded from the C3' (2 cm posterior to C3) by stimulating either right ulnar or median nerve at the wrist while subjects kept contraction. In addition, the motor evoked potentials (MEPs) and the silent period (cSP) to the transcranial magnetic stimulation were recorded. Results The amplitudes of P45 reduced significantly during isometric contraction of both force and position tasks. The reduction of amplitude of P45 was significantly larger during position task than force task only when ulnar nerve but not median nerve was stimulated. The duration of the cSP in force task was significantly longer than position task. However, the amplitude of MEPs did not differ between tasks. Discussion These results suggest that the position task causes more inhibitory effect on somatosensory cortex compared with the force task. Larger gating effect in the position task could imply that the task to maintain the position of the index finger while supporting a constant load requires more proprioceptive information from the group Ia afferents with which the enhanced gating of

centripetal mechanism occurs. Shorter duration of the cSP in position may be attributable to lower levels of presynaptic inhibition of Ia afferents. These results suggest that there is a more rapid recruitment of the motor unit pool and a briefer time to task failure when supporting a compliant load. References Enoka RM, Baudry S, Rudroff T, Farina D, Klass M, Duchateau J. Unraveling the neurophysiology of muscle fatigue. *J Electromyogr Kinesiol* 2011;21:208-19.

### STATIC AND DYNAMIC POSTURAL CONTROL IN ANKLE SPRAIN COPERS

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**Introduction** Approximately every third person suffering an ankle sprain develops long term functional impairments (Hiller et al., 2011). Studying those who successfully return to preinjury levels of sports activity while having no injury recurrences or feelings of instability (ankle sprain copers) may help to gain a better understanding of underlying mechanisms (Hertel and Kaminsky, 2005). The aim of this study was a) to compare static and dynamic postural control abilities between copers and noninjured controls and b) to evaluate correlations between measures of static and dynamic postural control. **Methods** 32 athletes with a long-term history of ankle sprain (coper, age:  $23.8 \pm 3.2$  years; time since injury:  $21.3 \pm 13.2$  months) but no residual symptoms or subjective instability were compared with 30 athletes without a history of lower extremity injury (control group; age:  $24.4 \pm 3.3$  years). They completed two measures of postural control: (static) centre of pressure sway velocity (vCOP) in single-leg-stance and (dynamic) the 'star excursion balance test' (SEBT) in four reach directions (anterior, medial, lateral, posterior). Differences between groups were determined with independent t-tests. Effect sizes were calculated as Hedge's g. The relationship between both dependent variables was measured by using the Pearson product-moment correlation coefficient. Results Sway velocity in single-leg-stance did not differ significantly between groups (control group =  $2.39 \pm 0.60$  cm/s; coper =  $2.65 \pm 0.65$  cm/s;  $p = .128$ ). Significant group differences existed for mean SEBT in anterior (ES =  $-0.64$ ;  $p = .016$ ) and lateral (ES =  $-0.52$ ;  $p = .046$ ) direction. No significant correlation was found between vCOP and mean SEBT ( $r = -.005$ ;  $p = .966$ ) among all participants. **Discussion** Although seemingly recovered, postural control deficits appear to exist in ankle sprain copers. The lack of correlation between static and dynamic measures indicates that they rely on different aspects of sensorimotor control. Dynamic measures of postural control seem to be more sensitive in detecting long term deficits. References Hertel J, Kaminsky TW. (2005) *J Orthop Sports Phys Ther*, 35(5), A2-6. Hiller CE, Nightingale EJ, Lin C-C, Coughlan GF, Caulfield B, Delahunt E (2011). *Br J Sports Med*, 45(8), 660-672.

### EFFECTS OF NORDIC HAMSTRING EXERCISE ON THE HAMSTRING MUSCLE ATROPHY AND WEAKNESS AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Nomura, Y., Kuramochi, R., Fukubayashi, T.

Waseda University

**Effects of Nordic Hamstring Exercise on the Hamstring Muscle Atrophy and Weakness after Anterior Cruciate Ligament Reconstruction** Nomura, Y. 1, Kuramochi, R. 2, Fukubayashi, T. 3 1: Graduate School of Sport Sciences, Waseda University, 2: Chukyo University School of Health and Sport Science, 3: Faculty of Sport Sciences, Waseda University **Introduction** Atrophy of the semitendinosus (ST) muscle after harvesting the ST tendon for anterior cruciate ligament reconstruction (ACLR) has been reported (Makihara et al.2006). This morphological change could be reasonably a factor causing torque deficits in deep knee-flexion. However, the way to prevent this problem remains controversial. Moreover, previous study showed that the ST peculiarly responded to knee-eccentric flexion tasks among hamstring muscles (Kubota et al., 2007). This study aimed to evaluate the effects of Nordic Hamstring exercise (NH), a partner exercise focusing the eccentric phase - on atrophy of the ST and strength deficit after ACLR. **Methods** Twelve athletes (7 males and 5 females, age:  $19.1 \pm 1.4$ yr) who underwent unilateral ACLR ( $19.0 \pm 15.8$  months postoperation) were divided into either a control group or an NH group. The exercises were conducted 22 sessions during a period of eight weeks. Two sessions were conducted each week for the first two weeks, then three sessions per week for the remaining six weeks. Before and after the training period, hamstring muscle strength was measured as isometric maximal torque on a Biodex dynamometer. And hamstring muscle volume was evaluated using MRI for biceps femoris long head, biceps femoris short head, ST, semimembranosus, gracilis. Then we compared pre and post measurements in each two groups. **Results** Before the training period, deep knee-flexion torque and the ST muscle volume of the ACLR limb were smaller compared with these of the normal limb in both groups. In the post NH group, isometric knee-flexion torque and muscle volume of the ST, biceps femoris short head and gracilis were observed to have increased significantly. In the control group, there was no statistical difference between pre and post measurements. **Discussion** The results suggest that Nordic Hamstring exercise is an effective method to improve muscle atrophy and weakness induced by ACLR in the knee-flexor muscles, especially the fusiform muscle. Moreover, it is obvious that ST muscle can function and be enhanced even after harvesting its tendon. Nevertheless, since the control subjects were not demanded any training program, we do not know the difference between eccentric exercise and concentric exercise such as hamstring curl. References Makihara Y, Nishino A, Fukubayashi T, Kanamori A. (2006). *Knee Surg Sports Traumatol Aethrosc*, 14, 310-317. Mjølshes R, Arnason A, Østhaugen T, Raastad T, Bahr R. (2004). *Scand J Med Sci Sports* 14, 311-317. Kubota J, Ono T, Araki M, Torii S, Okuwaki T, Fukubayashi T. (2007). *Eur J Appl Physiol*, 101, 713-720.

### EFFECTS OF DIFFERENT TRAINING PROGRAMMES ON ANTHROPOMETRIC OUTCOMES AND BLOOD LIPIDS IN OVERWEIGHT/OBESE SUBJECTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

Schwingshackl, L.1, Strasser, B.2, Hoffmann, G.1

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**Introduction:** Physical exercise is an integral part of obesity management. However, it still remains a matter of debate which kind of training programme (aerobic (AET), resistance (RT) or combined training (CT)) is the most efficacious. The aim of this study was to compare the efficacy of AET, RT and CT on anthropometric as well as blood lipid outcome parameters. **Methods:** Electronic searches for randomized controlled trials (RCTs) were performed in MEDLINE, EMBASE and the Cochrane Central Register of controlled trials with no restrictions to language and calendar date. Inclusion criteria were: Body Mass Index (BMI)  $\geq 25$  kg/m<sup>2</sup>, supervised exercise training and a minimum intervention period of 8 weeks. Outcomes of interest included: weight, waist circumference, waist-to-hip ratio, fat mass and blood lipids. Pooled effects were calculated using an inverse-variance random effect meta-analysis, following the guidelines of the Cochrane Collaboration (1). Begg's and Egger regression tests were performed to detect publication bias (2,3). **Results:** Overall, 27 studies enrolling 1381 participants met the inclusion criteria and were considered for meta-analysis. As compared with RT, AET resulted in a significantly more pronounced reduction of body weight [weighted mean differences (WMD):  $-0.99$  kg (95% CI  $-1.85$  to  $-0.13$ ),  $p = 0.02$ ], and waist circumfer-

ence [WMD: -0.82 cm (95% CI -1.51 to -0.13),  $p=0.02$ ], respectively. Moreover, HDL-cholesterol increase turned out to be more prominent following AET [WMD: 1.71 mg/dl (95% CI 0.34 to 3.07),  $p=0.01$ ]. When comparing CT with RT, WMD in change of body weight [-1.67 kg (95% CI -2.32 to -1.01),  $p<0.00001$ ], waist circumference [-1.51 cm (95% CI -2.31 to -0.71),  $p=0.0002$ ], and fat mass [-1.59 mg/dl (95% CI -2.51 to -0.67),  $p=0.0007$ ] was in favour of combined training, respectively. Results of Begg's and Egger test indicated no hint for publication bias. Discussion: The present systematic review and meta-analysis indicate that some of the anthropometrical as well as blood lipid data seem to be more affected by AET and CT as compared to RT. However, further studies are necessary to estimate the effectuality of the different training programs in the setting of obesity management. References 1. Higgins JPT, Green S (2008). General methods for Cochrane Reviews, Wiley. 2. Begg CB, Mazumdar M (1994). *Biometrics* 50. 3. Egger M, Davey Smith G, Schneider M, Minder C (1997). *BMJ* 315.

### **INTERMITTENT HYPOBARIC HYPOXIA AND ELECTRICAL MUSCLE STIMULATION INFLUENCE IN CIRCULATING PROGENITOR CELLS LIBERATION IN PATIENTS WHO SUFFERED A TRAUMATIC BRAIN INJURY**

Conde, L., Guillamó, E., Blasi, J., Juncadella, M., Gaitán-Peñas, H., Corral, L., Javierre, C., Ventura, J.L., Viscor, G.  
*Barcelona University*

Introduction: severe traumatic brain injured (TBI) patients may have long term physical and psychological sequelae. A previous study showed an increase of circulating progenitor cells (CPC) after Intermittent hypobaric hypoxia (IHH) and electrical muscle stimulation. Increase of CPC may contribute to neurogenesis and TBI patients recovery. The objective of this study is to improve physical or psychical sequelae of patients who suffered a TBI with a program of IHH sessions and electrical muscle stimulation and measure CPC in peripheral blood. Methods: a program of IHH and electrical muscle stimulation 3 days (3 hours/day) per week during 12 weeks were carried out in the intervention group (IG),  $n=6$ , and a day of cognitive activities 1 day (1 hour/day) per week during 12 weeks were done in the control group (CG),  $n=5$ . Physical stress test, neuropsychological tests and circulating progenitor cells (CPC) were measured before and after the program. IHH were applied in the hypobaric chamber of Barcelona University simulating an altitude of 4.500m during 2 hours and at the same time two sessions of 20 minutes of electrical muscle stimulation were applied with the Compex Vitality® vascular capillarization program, in quadriceps and abdominal muscles. CPC were measured nine times before, during and after the program. Results: in the IG there was an increase in workload of the physical stress tests, but there were no changes in psychological tests and CPC. There were no changes in physical stress tests, psychological tests and CPC in CG. Discussion: the IHH and electrical muscle stimulation, under the conditions of the current study, did not increase CPC in peripheral blood in TBI patients, nor any changes in psychological tests. Only the workload increased in physical stress tests compared to CG. This may be because it was an insufficient intensity stimulus or perhaps a different inter-individual answer in CPC liberation. References: Viscor et al. *J Transl Med* 2009;9:91. Elder et al. *Mt Sinai J Med* 2006;73:931-940

**14:00 - 15:00**

## Mini-Orals

### **PP-PM18 Health and Fitness [HF] 12**

#### **EFFECTS OF WEIGHT LOSS ON THE DYNAMICAL MARKS OF CENTRE OF GRAVITY IN DIFFERENT BMI, BODY FAT PERCENTAGE AND WAIST HIP RATIO CATEGORIES**

Szablics, P.1, Szabó, S.1, Dvorák, M.1, Orbán, K.1, Balogh, L.1, Molnár, A.H.1, Béres, S.3, Pintér, Z.2, Pósa, A.2, Kupai, K.2, László, F.1,2, Varga, Cs.2  
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Introduction: It is known that the quality and dynamical marks of movement deteriorate due to obesity and overweight. The movement dynamics is also improved by recreational training (Katzmarzyk and Lear, 2012). We investigated the recreational training-induced changes in body composition and dynamical marks of centre of gravity (CG) in case of simple movements like crouch and jump. Methods: 50 participants (age: 20-70 years) took part in our study. They did 60 minute long recreation trainings two times a week for 3 months on 60 percent of maximal heart rate. The movement analysis (APAS 3D system) was performed in the beginning and at the end of training program. Participants crouched and jumped in front of a camera. We analysed the position, velocity and acceleration of CG. Changes of body weight, fat and muscle mass were determined by InBody230. Participants were divided into normal (N), overweight (OW) and obese (O) groups based on their initial BMI, BF % and WHR (Gallagher et al., 2000). Statistical analysis: simple 't' test. Results: We detected significant decrease of body weight in the OW and the O groups at the BMI and WHR categories. This change was significant in all groups at the BF% categories. The decrease of fat mass was significant in the N and the OW groups at every three categories. We observed significant increase in lifting of CG in case of jump in every three groups at the WHR categories, in the OW and the O groups at the BMI categories, and in the N and the OW groups at the BF% categories. The increase of CG velocity was significant in the N body type group at the BMI categories, in the OW group at the BF% and WHR categories. In case of crouch the sinking of the CG was significantly enhanced in the OW group at the BF% and WHR categories, and the sinking velocity of the CG was increased in the O group at the BMI, BF% and WHR categories. Discussion: Our results suggest that low intensity recreational training optimizes the body composition and the dynamics of movement. The most effective among was detected in the OW people based on the different categories. Comparing the BMI, BF% and WHR categories, the detected changes were similar at the body composition, but the detected changes at the dynamic of the movement were different, because the BF% and WHR categories distinguish between the fat mass and the muscle mass. References: Katzmarzyk PT and Lear SA. (2012). *Obesity Reviews*, 13(2), 95-105. Gallagher et al. (2000). *Am J Clin Nut*; 72:694-701. Support: SROP 4.2.2-08/1-2008-0006; SROP 4.2.1./B-09-1/KNOV-210-0005

## EFFECT OF 24-WEEKS OF BIODENSITY TRAINING ON BONE MINERAL DENSITY AND LEAN MUSCLE QUANTITY AND STRENGTH IN HEALTHY AND OSTEO-PENIC/-POROTIC ADULTS

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(1) University of Wyoming (2) Indiana University (3) JMC Associates

**Introduction** The age-related decline in skeletal muscle mass and strength, collectively known as sarcopenia, are well-documented (Doherty, 2001; Roubenoff, 2001). Sarcopenia is associated with a higher likelihood of less than optimal bone mineral density and osteoporosis (Verschuere et al. 2013). bioDensity is a novel resistance training (RT) approach that employs a one session per week high-intensity (maximal-voluntary contraction) routine using four limited-range static exercises to achieve a near total body RT program - Chest Press (CP), Leg Press (LP), Core Pull (Core), and Vertical Lift (VL). Methods Healthy and osteopenic/porotic adults (N=116; 21-80 years) were recruited and assigned to complete 36-weeks of bioDensity RT. At baseline, 12-, 24-, and 36-weeks the following assessments will be made: 1) bone mineral density, lean body mass, fat mass (DEXA); 2) change in bioDensity-quantified force production; 3) upper (push-up) and lower (vertical jump) body bilateral ground reaction forces (dual force plates); and 4) 5-component fitness assessment. Changes between baseline and follow-up assessments were determined (RMANOVA) for the entire sample and across tertiles of age and bone health (normal, osteopenic, and osteoporotic). Results Presently, 116 participants are actively training and 12-week follow-up testing has been completed in 2 participants (due to the start date of the intervention November 2012). Ninety-eight participants will have completed 24-week follow-up testing by June 10, 2013. Body composition, ground reaction force, and 5 component fitness assessment data are not yet available. However, for bioDensity force production at 8-weeks in 73% of the sample: CP increased 6.3%; LP increased 7.1%; Core was stable (0.5% change); and VL 6.8%. Discussion With exception of the Core exercise, these increases in maximal-voluntary force production resulting from 8-weeks of bioDensity RT are encouraging and may be associated with improvements in functional upper and lower body power and health promoting adaptations to bone mineral density and lean muscle mass. 12- and 24-week findings will elucidate whether the time-sparing and low-volume approach of bioDensity RT elicits significant and meaningful body composition and functional changes important to the prevention or attenuation of osteoporosis and sarcopenia (Sundell, 2011). References Doherty TJ. The influence of aging and sex on skeletal muscle mass and strength. *Curr Opin Clin Nutr Metab Care* 4: 503-508, 2001. Roubenoff R. Origins and clinical relevance of sarcopenia. *Can J Appl Physiol* 26: 78-89, 2001. Verschuere S, Gielen E, O'Neill TW, Pye SR, Adams JE, Ward KA, Wu FC, Szulc P, Laurent M, Claessens F, Vanderschueren D, Boonen S. Sarcopenia and its relationship with bone mineral density in middle-aged and elderly European men. *Osteoporos Int.* 24(1):87-98, 2013. Sundell J. Resistance Training Is an Effective Tool against Metabolic and Frailty Syndromes. *Adv Prev Med.* 2011:984683. doi: 10.4061/2011/984683, 2011.

## EFFECTS OF A 3-MONTHS VIGOROUS PHYSICAL ACTIVITY INTERVENTION ON EATING BEHAVIOR AND BODY COMPOSITION IN OBESE ADOLESCENTS

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1GENUD Toledo Research Group, Univ. of Castilla-La Mancha, Spain; 2Division of Psychology, Univ. of Bradford, UK; 3Department of Pediatrics, Hospital Severo Ochoa, Spain. **Introduction** The Three Factor Eating Questionnaire (TFEQ) is associated with weight loss and less successful weight maintenance following weight loss intervention in adults (Bryant et al., 2012): the relationship in children is unclear. Previous evidence has shown that, despite having a lower % body fat, those children who perform more vigorous physical activity (VPA) have a higher energy intake (Gutin, 2008). Thus, the aim of this study was to analyze the effects of a short-term VPA intervention on eating behavior and whether those effects are related to the body composition changes. **Methods** Twenty three obese adolescents (Tanner 3-4) participated in this study. Thirteen were ascribed to the active group (13.6±0.3 yr, 30.1±0.8 kg/m<sup>2</sup>) and 10 to the control group (13.2±0.4 yr, 30.4±0.6 kg/m<sup>2</sup>). Body composition was assessed in all participants pre and post the VPA intervention / control condition, using dual energy X-ray absorptiometry (DXA). Adolescents' eating behavior was determined with a shortened 21-item version of the TFEQ (TFEQ-R21) that includes 3 main factors: uncontrolled eating (UE), cognitive restraint (CR) and emotional eating (EE) (Cappelleri et al., 2009). The intervention included 3 hours of VPA per week of recreational games for 3 months. **Results** Although no significant changes were found, TFEQ-UE and TFEQ-EE scores decreased 8% and 6% respectively in the active group, while no changes in the control group were found. In the active group, whole body fat mass decreased by 6% (36.1±1.3 kg vs. 34.1±1.6 kg, pre and post respectively, p>0.05), and total lean mass increased by 3% (41.6±2.2 kg vs. 42.7±2.2 kg, p>0.05). No significant correlations between the 3 factors of TFEQ-R21 and changes in body composition were found. **Discussion** Despite the changes in body composition (decrease in fat mass and increase in lean mass) found in the active group after a short-term VPA intervention, TFEQ scores were similar after the intervention and no correlation between eating behavior and body composition changes were found. Eating behaviors and body composition changes after a longer VPA intervention need further investigation. References Bryant EJ, Caudwell P, Hopkins ME, King NA, Blundell JE. (2012). *Appetite*, 58, 234-241. Gutin B. (2008). *Obesity*, 16, 2193-2196. Cappelleri JC, Bushmakin AG, Gerber RA, Leidy NK, Sexton CC, Lowe MR, Karlsson J. (2009). *International Journal of Obesity*, 33, 611-620.

## BODY COMPOSITION IN TENNIS PLAYERS AND MAXIMAL OXYGEN INTAKE: A LONGITUDINAL STUDY WITH CHILDREN.

Rey López, J.P., Berdejo del Fresno, D., Santiin Medeiros, F., Moraes, A.C., Barbosa de Carvalho, H.

University of Sao Paulo

**Introduction** Tennis is an anaerobic predominant activity requiring high levels of aerobic conditioning to avoid fatigue and aid in recovery between points. Body composition is often measured in young tennis players but it is unclear if it is a useful predictor of a better cardiorespiratory fitness. The aim of this study is to examine the association between: I) Anthropometric measures and maximal oxygen intake (VO<sub>2</sub>max); II) Dual x-ray absorptiometry (DXA) and VO<sub>2</sub>max. **Methods** 7 children (3 boys and 4 girls, age = 10.83 ± 0.39) from the high-performance tennis center from the Aragon Tennis Federation (Spain) were measured twice during a whole season (baseline-10 months later) (Berdejo del Fresno et al. 2010). Body composition (whole lean, bone and fat mass) by DXA (Explorer, Hologic Corp.) and by anthropometry (height, weight, waist circumference). VO<sub>2</sub>max was estimated by Leger et al. (1984) using the 20 meter shuttle run test. A linear regression analysis was performed (adjusting by age) between baseline body composition and VO<sub>2</sub>max at the end of the season. A significance level was considered when p values were <0.05. Statistical analyses were performed using STATA 12.1. **Results** No significant mean differences in VO<sub>2</sub>max (ml/kg/min) were found during the season (baseline: 54±3, 10months: 55±3). In the regression model,

body composition at baseline by DXA was not statistically associated with VO<sub>2</sub>max values at the end of the season: Standardized  $\beta$  (95% CI): 0.56 (-0.28-1.19); -0.55 (-1.02-0.24); 0.46 (-1.60-9.24) for lean mass, fat mass and bone mass respectively. Similarly, anthropometric measurements were not associated with VO<sub>2</sub>max values.  $\beta$  (95% CI): -0.27 (-0.67-0.28); -0.34 (-63.4-25.7); -0.05 (-0.60-0.57) for weight, height and waist circumference respectively. Discussion Our results show that in children who regularly train for competitive reasons (our sample around 12 hours per week) body composition is not a predictor of VO<sub>2</sub>max changes during a whole season. Therefore, we suggest that in pubescent tennis players changes in VO<sub>2</sub>max are more likely due to hematological variables (Hemoglobin, Hematocrit changes) as has been found in soccer players (Hansen et al. 2004). In summary, in competitive tennis children players' body composition analyses are not justified as a way to predict aerobic performance. Nonetheless, the study of body composition in athletes by DXA should be promoted to monitor changes in bone mass during growing years. References Berdejo del Fresno D, Vicente-Rodríguez G, González-Ravé JM, Moreno LA, Rey-López JP. (2010). *J Hum Sport Exerc*, 5, 250-264. Leger L, Lambert J, Goulet A, Rowan C, Dinelle Y. (1984) *Can J Appl Sport Sci*, 9, 64-69. Hansen L, Klausen K. (2004) *J Sports Med Phys Fitness*. 44:219-223.

### **BODY COMPOSITION CHANGES AFTER 4 MONTHS OF HIGH-INTENSITY AEROBIC INTERVAL TRAINING IN METABOLIC SYNDROME PATIENTS.**

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*Universidad de Castilla-La Mancha*

Introduction and purpose: Sedentary lifestyle in obese individuals can develop into many health conditions, particularly cardiovascular diseases. Four months of a 3-week intense pedaling program (70% VO<sub>2</sub>max; 40 min) lowers trunk fat and tends to reduce leg fat in obese, type II diabetic patients [1]. The purpose of our study is to determine if high-intensity aerobic interval training could also reduce trunk fat in a larger sample of obese subjects with metabolic syndrome. Subjects: Forty-eight obese men and women aged between 31 and 68 years volunteered to participate in this study. Participants were defined as having MetS according to the criteria of the International Diabetes Federation [2]. Methods: Nude body weight was obtained using a  $\pm$  0.05 kg sensitive scale (WildCat; Mettler, Toledo, USA). Waist circumference was measured to the nearest 0.1 cm using a plastic tape (Figure Finder Tape Measurement, LaCrosse, WI, USA) 2 cm below the lower rib while subjects rested their arms along their bodies. Whole body percent body fat, trunk and leg fat and fat-free mass was determined using DEXA scanning, using a total body scan mode; Lunar iDXA (GE Medical Systems Lunar, Madison, WI 53718 USA). The analyses were performed using encore TM 2008 software version 12.30.008. Results: Body weight decreased by 1.2 $\pm$ 0.4 kg after 4 months of training (P=0.003). Waist circumference was also reduced by 4.1 $\pm$ 0.45 cm (3.9% reduction; P=0.000). Fat-free mass was maintained during the exercise program (51.5 $\pm$ 1.4 vs. 51.2 $\pm$ 1.4 kg, P=0.12). Fat mass decreased by 0.9 $\pm$ 0.3 kg after 4 months of training (P=0.006). However, due to the concomitant loss of body weight, percent body fat was reduced only by 0.5% (38.7 $\pm$ 0.01 to 38.2 $\pm$ 0.01; P=0.033). Most of the 0.9 kg of fat loss, belonged to trunk fat that declined from 18.5 to 17.7 (i.e., 0.77 $\pm$ 0.25; P=0.03). Leg fat mass was reduced by only 89 $\pm$ 0.05 gr which was not significant (P=0.06). Conclusions: An intense aerobic exercise program with a frequency of 3 sessions per week during 4 months, results in measurable losses of waist circumference and body weight. Approximately, 75% of the reduction in body weight could be accounted by losses of body fat. Most of the fat loss in this exercise program belonged to abdominal fat (86%). Thus, high-intensity aerobic interval training meets the objective of reducing abdominal fat which is associated with a risk reduction of developing cardiovascular diseases. References: 1. Shaw, C.S., et al., Prolonged exercise training increases intramuscular lipid content and perilipin 2 expression in type I muscle fibers of patients with type 2 diabetes. *Am J Physiol Endocrinol Metab*, 2012, 303(9): p. E1158-65. 2. Alberti, K.G., P. Zimmet, and J. Shaw, Metabolic syndrome--a new world-wide definition. A Consensus Statement from the International Diabetes Federation. *Diabet Med*, 2006, 23(5): p. 469-80.

### **VALIDITY OF SELF-REPORTED ANTHROPOMETRIC VALUES USED TO ASSESS BODY MASS INDEX IN PHYSICALLY ACTIVE ADULTS**

Theodoropoulou, E., Karteroliotis, K.

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Introduction Large scale studies frequently used self-reported weight and height to assess Body Mass Index (BMI). However, self-reported anthropometric values were subject to measurement errors (Spencer et al., 2002; Stommel & Schoenborn, 2009). Specifically, men and women underreported their weight, overestimated their height and consequently, underestimated their BMI. Thus, the purpose of the current study was to examine the differences between self-reported and measured anthropometric values in a sample of Greek physically active adults. Methods The participants were 684 volunteers, 206 men and 478 women, ranging in age from 18 to 65 years (39.2 $\pm$ 13.5 yrs), who regularly participated in various exercise programs in the Sport Facilities of the Municipality of Athens. First, the participants completed questions about their body weight and height. Second, the anthropometric measurements were carried out by trained personnel in accordance with Heyward and Stolarczyk recommendations (1996). Weight was measured to the nearest 100 gr by a calibrated scale and height in bare feet to the nearest cm by a stadiometer. BMI was calculated as weight (kg) divided by height (m) squared. A series of paired t tests were conducted to explore the differences between self-reported and measured anthropometric values. Results The results showed that according to self-reported BMI, 69.3% of the participants were normal weight, 23.6% were overweight and 4.6% were obese. Based on measured BMI, 58.6% of the participants were normal weight, 31.6% were overweight and 8.3% were obese. Men underestimated their weight (t(203)=-11.2, p<0.01) and overestimated their height (t(202)=18.5, p<0.01). Women underreported their weight (t(476)=-18.6, p<0.01) and BMI (t(475)=-7.8, p<0.01) and overestimated their height (t(475)=30.2, p<0.01). Additionally, the overweight subgroup underestimated weight (t(212)=-11.7, p<0.01) and BMI (t(213)=-12.7, p<0.01) and overestimated height (t(212)=20.0, p<0.01). Similarly, the obese subgroup underreported weight (t(50)=-6.5, p<0.01) and BMI (t(50)=-10.9, p<0.01) and overestimated height (t(50)=10.2, p<0.01). Discussion The results of this study demonstrated significant differences between self-reported and measured anthropometric values, showing that self-reported data were subject to measurement errors. Large scale studies should use more valid procedures for overweight and obesity assessment. References Heyward VH, Stolarczyk LM. (1996). Applied body composition assessment. Human Kinetics, USA. Spencer et al. (2002). *Public Health Nutr*, 5(4), 561-565. Stommel M, Schoenborn CA. (2009). *BMC Public Health*, 9, 421.

### ASSOCIATION OF FEMORAL NECK BONE MINERAL DENSITY WITH BODY COMPOSITION AND GRIP STRENGTH

Tachiki, T.1, Kitagawa, J.1, Takahira, N.1, Iki, M.2, Tamaki, J.2, Kajita, E.3, Sato, Y.4, Kagamimori, S.5, Kagawa, Y.6, Yoneshima, H.7

1: Kitasato Univ. Graduate School of Medical Science, 2: Kinki Univ., 3: Nagoya Univ. Graduate School of Medicine, 4: Jin-ai Univ., 5: Univ. of Toyama, 6: Kagawa Nutrition Univ., 7: Shuwa General Hospital

**Introduction** Osteoporosis reduces quality of life in the elderly because of bone fracture (Copland, 1999). Femoral neck fracture is critical in elderly women, as they will require primary nursing care or, at worst, become bedridden. Therefore, it is very important to study the factors associated with femoral neck bone mineral density (FNBMD). Optimum body mass, good muscle strength, and physical activity have beneficial effects on FNBMD. Because body mass can be divided into fat mass and lean tissue mass, the factors associated with FNBMD need to be determined by analyzing fat mass and muscle mass separately. In this cross-sectional study, we investigated the associations among grip strength (GS) as an indicator of whole-body strength, FNBMD, and body composition in postmenopausal Japanese women. **Methods** This research was part of the Japan Population-based Osteoporosis (JPOS) study. The subjects were 304 women aged 54 to 91 years (mean  $70.8 \pm 7.7$  years). All subjects had undergone natural menopause more than 10 years previously, and none had abnormalities in bone metabolism. FNBMD, fat mass, and appendicular lean soft tissue mass were measured by dual-energy X-ray absorptiometry. Total-body skeletal muscle mass (TBSM: Kim, 2002) and fat mass index (FMI: fat/height<sup>2</sup>) were then calculated. GS was measured with a digital hand dynamometer. **Results** FNBMD was significantly correlated with age ( $r = -0.34$ ,  $P < 0.01$ ), TBSM ( $r = 0.42$ ,  $P < 0.01$ ), FMI ( $r = 0.31$ ,  $P < 0.01$ ), and GS ( $r = 0.34$ ,  $P < 0.01$ ). GS was not significantly correlated with FMI ( $r = 0.06$ ,  $P = 0.30$ ), but it was significantly correlated with TBSM ( $r = 0.55$ ,  $P < 0.01$ ). Multiple linear regression analysis showed that FNBMD was significantly associated with age ( $\beta = -0.27$ ,  $P = 0.01$ ), TBSM ( $\beta = 0.16$ ,  $P = 0.01$ ), FMI ( $\beta = 0.22$ ,  $P = 0.01$ ), and GS ( $\beta = 0.12$ ,  $P = 0.04$ ). **Discussion** This research suggests that FMI and TBSM have the same degree of influence on FNBMD. The association of FMI with FNBMD could be affected by the presence of aromatase in fat (Riancho, 2007). Because GS as well as TBSM were associated with FNBMD, both muscle strength and muscle mass must be maintained and improved. We intend next to perform a longitudinal study of the effects of GS and TBSM on FNBMD. **References** Copland CA et al. (1999) *Int J Epidemiol*, 28, 241-246. Kim K et al. (2002) *Am J Clin Nutr*, 76(2), 378-383. Riancho JA et al. (2007) *J Clin Endocrinol Metab*, 92(2), 660-665.

### RELATIONSHIPS AMONG BODY MASS INDEX, BODY IMAGE AND PHYSICAL PERFORMANCE IN ITALIAN ADOLESCENTS

Spiga, F., Di Michele, R., Merni, F., Ceciliani, A., Semprini, G., Brasili, P., Toselli, S.

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**Introduction** The prevalence of weight status disorders and body dissatisfaction is continually increasing in adolescents from European countries (Sanchez Cruz et al, 2013) (Eisenberg, Neumark-Sztainer, & Paxton, 2006). Physical capacities are related to body size. In particular, the weight status affects some motor and strength performances (Graf et al, 2004). Little is known, however, on how one's physical fitness affects the perception of his/her own body image. The objective of the present study was to determine the interrelationships among body mass index, body image perception and motor performance in Italian second grade school students. **Methods** The sample included 61 adolescents (35 boys and 26 girls) from Bologna, Emilia-Romagna, Italy, aged 16-17 years. Height and weight were measured and BMI was calculated. Body image perception was assessed using Body Silhouette Charts (Collins, 1991). Physical assessments included a standing broad jump, hand grip dynamometer test, sit and reach flexibility test, gross motor skill test, and shuttle run endurance test. **Results** The BMI was similar in girls (21.4 kg/m<sup>2</sup>, SD: 2.0) and boys (22.4, kg/m<sup>2</sup>; SD: 2.9). However, girls overestimated their actual figure, and showed a higher body dissatisfaction, as revealed by a larger difference between their desired and perceived body image. Boys performed better than girls in the standing broad jump, dynamometer, and shuttle run tests, while girls had a higher flexibility. When controlling for gender, BMI was negatively related to performance in the standing broad jump and gross motor skill tests. When controlling for both gender and BMI, performing better in the standing broad jump and shuttle run involved a thinner body perception. **Discussion** Self-perception of body image is affected, apart from the actual body size, even by one's aerobic and explosive strength capacity. Therefore, improving physical fitness may contribute to reduce body dissatisfaction in adolescents, by means of both loss of weight and change of perceived body image. **References** Sanchez Cruz et al. (2013). *Rev Esp Cardiol*. Doi: 10.1016/j.recesp.2012.10.016. Eisenberg, M. E., Neumark-Sztainer, D., & Paxton, S. J. (2006). *J Psychosomatic Res*, 61, 521-527. Graf et al. (2004). *Int J Obes Relat Metab Disord*, 28, 22-6. Collins M.E. (1991). *International Journal of Eating Disorders*, 10, 199-208.

### SECULAR TREND IN ANTHROPOMETRIC MEASUREMENTS OF ATHLETES SPECIALIZING IN SPEED SKATING

Godina, E., Bobarykin, N.

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**Introduction** Studies of secular changes in different populations remain one of the most important research topics in human biology. Manifestations of a secular trend include changes in morphological characteristics for children and adults. While a lot of data is known for general populations, not many studies deal with the same subject for professional sportsmen. In our previous publications secular changes in the free wrestlers have been studied (Godina and Kolomeichuk, 2012). The aim of the present paper is to follow secular changes in speed skaters for the last 40 years. **Methods** In 2011/12, 74 athletes specializing in speed skating were investigated in Moscow according to the standard anthropometric protocol. All were of high sports qualification (Master of Sports or Master Candidate), 18-24 years old. The results were compared with archive data on speed skaters from the previous generation (Gladysheva et al., 1979). Anthropometric program included about 30 measurements; body mass index (BMI) and body mass components were calculated. Statistical analysis was performed with STATISTICA 6.0, 8.0 packages. **Results** There are noticeable changes in main body dimensions in modern speed skaters as compared with their counterparts from the previous years. While stature remained practically the same, as well as biacromial and pelvic diameters, body weight and BMI significantly decreased (weight: 73.5 kg in 1979 vs 70.5 in 2012; BMI: 23.8 vs 22.9 correspondingly), leg length increased, chest and some other body circumferences decreased. There is a significant increase in bone component, measured as elbow and knee breadth (e.g., knee breadth: 91 mm in 1979 vs 100 mm in 2012). The hand grip strength in 2012 athletes showed significant decrease. **Discussion** In our previous study it was shown that secular changes in free style wrestlers could be connected with their typical morphological structure and adaptation to specific sports activity (Godina, Kolomeichuk, 2012). The comparison of body dimensions in high qualification speed skaters examined in 1979 and in 2012, revealed that modern athletes express the tendency towards leg length increase, elbow and ankle breadth, as well as decrease in all circumferences of the body. The increase in leg length is part of the general secular trend (Bogin and Varela-Silva). The changes in bone mass shown in this study could

be associated with the cardinal change of skates' model in the middle of the 1990's and with the techniques of run. The decrease in BMI, some body circumferences and hand grip might demonstrate the trend to asthenic body build, which was found in some modern populations (Godina, 2011). References Bogin B., Varela-Silva I. (2010). *Int. J. Res. Publ. Health*, 7 (3), 1047-1054 Gladysheva A, Podar G, Pushkin A, Danilov V. (1979). *Skating Sports*, 1, 45-46. In Russian Godina E. (2011). *Anthropol. Anzeiger*, 68 (4), 367-377 Godina E., Kolomeichuk A. (2012). *ICSEMIS 2012, Abstracts*, 434-435

### **DOES BODY MASS INDEX AFFECT ARREST TECHNIQUE PERFORMANCE ON NORWEGIAN POLICE UNIVERSITY COLLEGE STUDENTS?**

Jenssen, O., Dillern, T.

*The Norwegian Police University College*

**INTRODUCTION** Police officers tend to increase their body mass during their occupational career. (Boyce, Jones, Schendt, Lloyd, & Boone, 2009; Sørensen, Smolander, Louhevaara, Korhonen, & Oja, 2000). This can cause health issues but it can also affect police officers ability to perform occupational tasks such physical confrontation and arresting struggling suspects. Our aim with this study is therefore to investigate if body mass index (BMI) affects results in arrest amongst Norwegian Police Students. **METHODS** 19 males and 10 females participated in the study. BMI was calculated as kg/m<sup>2</sup>. The World Health Organization (WHO) categories are used to categorize BMI. Arrest technique (AT) results are gathered as physically performed tests, evaluated and given points from experienced instructors. The test performed was seizing technique, teamwork 2 against 1, release techniques and self defence techniques. Descriptive statistics as mean, SD is used. T-test is used to compare gender and BMI classifications. Significance level was set to P<0.05. **RESULTS** Mean BMI for the subjects was 24.1(±1.9) Males: BMI 25.0 (±1.5). Females: BMI 22.4 (±1.2), results presented as means (±SD). 57.9% of the males was classified normal weight and 42.1% classified overweight. All females classified as normal weight. The normal weight group performed better in all AT test, and also the final AT score summarized from all tests. A significant better performance was found for the self-defence technique (P<0.042). P-levels for the seizing technique (P<0.066) and the total AT score (P<0.067) **DISCUSSION** The tendencies that higher BMI levels has a negative effect on performance in arrest technique raise a concern regarding the police officers capability to safely perform occupational tasks as arresting suspects and self-defence. Especially if these students development in BMI follow the trend with increasing BMI during the occupational career. **REFERENCES** Boyce, R. W., Jones, G. R., Schendt, K. E., Lloyd, C. L., & Boone, E. L. (2009). Longitudinal changes in strength of police officers with gender comparisons. *Journal of Strength and Conditioning Research*, 23(8), 2411-2418. Sørensen, L., Smolander, J., Louhevaara, V., Korhonen, O., & Oja, P. (2000). Physical activity, fitness and body composition of Finnish police officers: A 15-year follow-up study. *Occupational Medicine*, 50(1), 3-10.

### **RELATIONSHIP BETWEEN PRACTICE, BODY COMPOSITION AND PERFORMANCE IN MALE UNDERGRADUATE TRIATHLETES**

Elvira, L., Drehmer, E., Blasco, E., Moratal, C., Vera, F., Salvador, T.

*Facultad de CC. de la Actividad Física y del Deporte Universidad Católica de Valencia*

**INTRODUCTION** Triathlon practice has increased during the last decade. According to the CSD, since 2000 the number of associated triathletes has quadrupled in Spain. As a consequence of this development, the number of scientific studies has increased in this field. There are studies which analyze body composition in triathletes (Martínez, Cejuela, Urdampilleta, Gallar, & Soriano, 2011); some show a relationship between the percentage (%) of body fat mass and the total performance time (Knechtle, Knechtle, & Rosemann, 2011; Knechtle, Wirth, Rüst, & Rosemann, 2011). Moreover, other studies analyze the relationships between the volume of training and performance (Knechtle, Wirth, Baumann, Knechtle, Rosemann, & Oliver, 2010). The main goal of this study was to analyze the relationship between practice, different body composition variables and final performance in male undergraduate triathletes. **METHODS** 41 male triathletes participating in the University Championship of Spain in 2012 were analyzed by 4 composition variables (BMI, %fat, %bone, %muscle mass), 2 practice variables (years of practice, practice index) and 1 performance variable (final line time). The instruments used for anthropometric data collection were a Skinfold caliper, a paquimeter and a height meter Holtain, and a Tanita BC-418 balance. To obtain practical data, subjects completed a Health Behavior Inventory designed by our research group and ChampionChip system was used to record the time. Data processing was conducted by descriptive analysis, normality was analyzed by Shapiro-Wilk test, and a correlative analysis was performed. **RESULTS** Significant correlation was observed between the final line time and (%) body fat (p=.003), BMI (p=.030), index of practice (p=.019) and years of practice (p=.045), these last were negative **DISCUSSION** The results show that the best times in finish line are related to highest index of practice, replicating the data obtained with women in the Knechtle et al., (2010) study, and with more years practicing triathlon. The best final line times also were related to %fat and BMI lower than the others, coinciding with results obtained by Knechtle, Knechtle, et al. (2011) and Knechtle, Wirth, et al. (2011). **REFERENCES** Knechtle, B., Wirth, A., Baumann, B., Knechtle, P., Rosemann, T., & Oliver, S. (2010). *Journal of strength and conditioning research/National Strength & Conditioning Association*, 24(10), 2785-2793. Knechtle, B., Knechtle, P., & Rosemann, T. (2011) *International journal of sports medicine*, 32(1), 20-27. Knechtle, B., Wirth, A., Rüst, C. A., & Rosemann, T. (2011) *Asian Journal of Sports Medicine*, 2(1), 23-30. Martínez, J. M., Cejuela, R., Urdampilleta, A., Gallar, M., & Soriano, J. M. (2011) *I World Conference of Science in Triathlon* (pp. 133-139) Universidad de Alicante

### **PHYSICAL PERFORMANCE IN YOUNG MEN AT SWISS ARMY RECRUITMENT 2006 TO 2012**

Wyss, T., Jimmy, G., Mäder, U.

*Swiss Federal Institute of Sport Magglingen SFISM*

Several studies have demonstrated decreases in aerobic fitness levels in young Scandinavian and Swiss men between 1980 and 2000 [1-3]. The aim of the present study is to describe the development of physical fitness in young Swiss men in the new millennium. Therefore, data of the compulsory Swiss Army recruitment were analysed. In 2006 a new physical fitness test was implemented at the recruitment and physical performances of 218'939 male conscripts (19.9 ±1.0 y) have been measured in the past seven years. The fitness test battery contained a progressive endurance run (PER) to measure aerobic endurance capacity, a trunk muscle strength test (TMS) to assess trunk muscle fitness, a standing long jump (SLJ) and a seated shot put (SSP) to determine the muscle power of the lower and upper extremities, respectively, and a one-leg standing test (OLS) to quantify balance [4]. In addition, body height and mass were measured and a self-report physical activity questionnaire (adapted ipaq short) was administered. ANOVA with Bonferroni post-hoc tests was applied to compare results between calendar years. Only SLJ decreased constantly from 2.33m in 2006 to 2.30m in 2012 (p<.001). Results for all other performance tests did not change over time (mean values and SD between years: 6.47 ± 0.01m in SSP, 123.34 ± 1.37s in TMS, 45.81

$\pm 0.64s$  in OLS and  $14.10 \pm 0.07\text{km/h}$  in PER). Body mass index increased about 1.5% from 23.07 in 2006 to 23.41 in 2012 ( $p < .001$ ). The physical activity questionnaire showed, that the ratio of conscripts classified as trained increased constantly from 41.5% in 2006 to 47.0% in 2012. The trend of decreasing aerobic fitness, investigated in young European men between 1980 and 2000 was not confirmed between 2006 and 2012 in young Swiss men. No relevant changes in physical fitness were seen in that time period. The decreasing SLJ performances are most likely explained by an increase in body mass of about 1kg in seven years. 1. Dyrstad SM, Aandstad A, Hallen J. Aerobic fitness in young Norwegian men: a comparison between 1980 and 2002. *Scand J Med Sci Sports*. 2005;15:298-303. 2. Santilla M, Kyrolainen H, Vasankari T, Tiainen S, Palvalin K, Hakkinen A, et al. Physical fitness profiles in young Finnish men during the years 1975-2004. *Med Sci Sports Exerc*. 2006;38:1990-4. 3. Wyss T, Beuchat C, Zehr S, Mäder U. Physical performance in young men at Swiss Army recruitment 1982 to 2005. *Swiss J Sportmed Sporttraumat*. 2009;57:75-7. 4. Wyss T, Marti B, Rossi S, Kohler U, Mäder U. Assembling and verification of a fitness test battery for the recruitment of the Swiss Army and nation-wide use. *Swiss J Sportmed Sporttraumat*. 2007;55:126-31.

## 14:00 - 15:00

### Mini-Orals

#### PP-PM09 Health and Fitness [HF] 3

##### EFFECTS OF SOCIAL OCCUPATIONS IN EXERCISE REHABILITATION RESPONSES OF FRENCH ELDERLY

Leprêtre, P.M., Bréchat, P.H., Lebreton, C., Bellanger, M., Rivière, D., Regnard, J., Lonsdorfer, J., Vogel, T.

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Introduction Controversial results on exercise training on senior health status may be explained by fitness, gender, exercise modalities (Mian et al. 2007). It has been also shown that environmental variables could also explain a part of difference in physical and mental health between rural and urban senior (Philipps et al. 2012). Objective To examine the links between geographical areas, social classification of occupations (SPC), aerobic and health related quality of life (HRQoL) responses to exercise training in middle-aged and aged population, 148 on 232 mixed subjects (ranged from 50 to 85 years) engaged in 9 weeks of twice-a-week interval training (IWEP). HRQoL was assessed with a French version of SF-36 questionnaire. The independent variables were gender, age, socio-economic status and size of town. Ordinal regression models were fitted to assess the association of physical training benefits (i.e aerobic capacity) with sociodemographic factors. Results A significant training-induced difference was observed in aerobic capacity ( $+ 43.6 \pm 29.9 \%$ ) and all components of HRQoL in whole population: physical, functioning and role, bodily pain, general and mental health, vitality, emotional role and social functioning dimensions. Lower was endurance before training, greater was the increase in aerobic capacity with training. Our results also showed significant relationship between changes in aerobic capacity with exercise training, SPC and disease status. Only living in an urban area of Northeast of France was related with aerobic changes due to physical activity; there were no difference among genders. Conclusion Based on the present data, IWEP may have potential to promote aerobic capacity and the all HRQoL dimensions in middle-aged and aged subjects whatever their geographical areas and social classification of occupation. Reference Phillips SM, Wójcicki TR, McAuley E. (2007). *Sport Med*, 29, 233-247. Mian OS, Balizopoulos V, Minetti AE, Narici MV. (2012). *Qual Life Res*, 37, 683-70.

##### WAIST CIRCUMFERENCE AND GRIP STRENGTH ARE MORE STABLE AT 6, 8 AND 10 YEARS OF OBSERVATION

Matsudo, S.M.M., Araujo, T., Raso, V.2,3

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PURPOSE: To examine the stability of body composition and functional capacity in physically active older women at 6, 8 and 10 years of observation. METHODS: We measured body composition (body mass index, total body adiposity and waist circumference), physical function (body balance, flexibility, grip strength, and usual walking) in 157 physically active older women at three different moments apart 6 (age:  $64.9 \pm 1.1$  vs  $70.7 \pm 1.1$  years-old; BMI:  $27.4 \pm 0.5$  vs  $27.7 \pm 0.5 \text{ kg}\cdot\text{m}^2$ ), 8 (age:  $66.7 \pm 0.9$  vs  $74.6 \pm 0.9$  years-old; BMI:  $27.3 \pm 0.5$  vs  $26.9 \pm 0.7 \text{ kg}\cdot\text{m}^2$ ) and 10 YEARS (age:  $65.3 \pm 0.7$  vs  $75.2 \pm 0.7$  years-old; BMI:  $27.2 \pm 0.5$  vs  $27.2 \pm 0.5 \text{ kg}\cdot\text{m}^2$ ) from baseline. RESULTS: Our multiple regression analyses demonstrated that total adiposity (6 YEARS: adjusted  $R^2 = .49$ ,  $P = .001$ ; 8 YEARS: adjusted  $R^2 = .52$ ,  $P = .001$ ; 10 YEARS: adjusted  $R^2 = .37$ ,  $P = .001$ ), waist circumference (6 YEARS: adjusted  $R^2 = .37$ ,  $P = .001$ ; 8 YEARS: adjusted  $R^2 = .67$ ,  $P = .001$ ; 10 YEARS: adjusted  $R^2 = .58$ ,  $P = .001$ ), grip strength (6 YEARS: adjusted  $R^2 = .35$ ,  $P = .001$ ; 8 YEARS: adjusted  $R^2 = .59$ ,  $P = .001$ ; 10 YEARS: adjusted  $R^2 = .64$ ,  $P = .001$ ), flexibility (6 YEARS: adjusted  $R^2 = .63$ ,  $P = .001$ ; 8 YEARS: adjusted  $R^2 = .45$ ,  $P = .001$ ; 10 YEARS: adjusted  $R^2 = .44$ ,  $P = .001$ ), body balance (6 YEARS: adjusted  $R^2 = .29$ ,  $P = .001$ ; 8 YEARS: adjusted  $R^2 = .26$ ,  $P = .003$ ; 10 YEARS: adjusted  $R^2 = .25$ ,  $P = .001$ ), usual walking (6 YEARS: adjusted  $R^2 = .15$ ,  $P = .022$  mediated by age and body mass index; 8 YEARS: adjusted  $R^2 = .14$ ,  $P = .036$  mediated by age; 10 YEARS: adjusted  $R^2 = .09$ ,  $P = .037$ ) were significantly predicted by respective variables at baseline regardless of age (unless for usual walking at 6 and 8 YEARS) and body mass index (unless for usual walking at 6 YEARS). CONCLUSION: Our data permit to conclude that the stability of waist circumference and grip strength appears to be proportionally direct to the years of observation. Nevertheless, the explained variance of body balance and usual walking seems to be more dependent of external variables rather than physical activity regardless of observation period.

##### WALKING TIME AS A KEY FACTOR FOR THE MAINTENANCE OF PHYSICAL FITNESS IN NON-INSTITUTIONALIZED ELDERLY PEOPLE

Gómez-Cabello, A., Vicente-Rodríguez, G., Pedrero-Chamizo, R., Rodríguez-Marroyo, J.A., Olivares, P.R., Luzardo, L., Aznar, S., Villa, J.G., Gusi, N., Espino, L., Gonzalez-Gross, M., Casajús, J.A.

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Introduction: the aging process is accompanied by several changes, such as a decrease in physical fitness. Low levels of physical fitness are associated with increased risk of several diseases, disabilities and also higher risk of mortality [1]. Aims: to examine whether an active

behavior (walk more than 1 hour per day [1 h•d-1]) is associated with lower risk of having low levels of physical fitness in a representative sample of non-institutionalized Spanish elderly people. Methods: a total of 3136 people  $\geq 65$  years of age, members of the cohort of the multi-center EXERNET Study [2], were included in this report. Balance, lower- and upper-body strength and flexibility, agility, walking speed and aerobic endurance were assessed with specific tests (adapted from the Senior Fitness Test Battery and Eurofit Testing Battery for adults). Self-reported hours walking per day were recorded by questionnaire. Binary logistic regression analysis was used to study the association of walking time with low levels of physical fitness by sex, using as reference for each test the 20th percentile of the normative values in Spain [3]. Results: in both, men and women, walking more than 1 h•d-1 was associated with lower odds of having low levels of physical fitness in most of the tests compared with those walking less than 1 h•d-1 (all  $p < 0.01$ , except for strength of left arm and walking speed in men and upper-body flexibility in both genders). Specifically, the risk of having low physical fitness levels in the tests mentioned above was reduced up to 60.4% in men and 51.5% in women. Moreover, the highest prevalence of low physical fitness were found in those who spent walking less than 1 h•d-1 compared with those who spent walking more than 1 h•d-1 (all  $p < 0.05$ ). Conclusion: time spent walking has a positive influence on physical fitness in elderly people. An active lifestyle should be encouraged in the older population in order to contribute to a good health during the aging process. References: 1. Erikssen G. Sports Med 2001. 2. Gomez-Cabello A et al. Obes Rev 2011. 3. Pedrero-Chamizo R et al. Arch Gerontol Geriatr 2012.

### **RELATIONSHIP BETWEEN PHYSICAL FITNESS AND PARTICIPATION IN SOCIAL ACTIVITIES IN JAPANESE COMMUNITY-DWELLING OLDER PEOPLE.**

Haeuchi, Y., Honda, T., Matsuo, E., Nofuji, Y., Kumagai, S.

*kyushu university*

Introduction Participation in social activities (SA) has been indicated as one of the important factors for successful aging 1). Similarly, regular exercise has been suggested as an enhancing factor of physical and mental health through the maintenance or improvement of physical fitness (PF) in older adults. However, older people don't always engage in regular exercise 2). Furthermore, although both factors are important in older people, little is known about the relationship between PF and participation in SA. Therefore, we aimed to investigate the relationship between PF and SA in Japanese community-dwelling older people. Methods A total of 1746 Japanese community-dwelling older people aged 65 years or older were involved in this study. We assessed the following types of PF: grip strength, knee extension strength, five-times-sit-to-stand, one foot balance with eyes open, and 5 meter gait speed. Also, participation in the following SA was asked by questionnaire with a binary manner (yes/no): local event or festival, senior citizen's club, paid work, community activity, independent group activity, volunteer activity, religious activity, cultural lesson, and association of commerce and industry. We also asked participants if they engage in regular exercise. In order to exclude the effect of regular exercise to PF, participants were divided into two groups: exercise and non-exercise group. SA were categorized into 4 category based on the number of participation: (1)none, (2)one or two, (3)three or four, and (4)five or more. We examined the trend of each PF score according to SA category in both exercise and non-exercise group. Adjusting factors for the trend analyses were gender, age, body mass index (BMI), and instrumental activity of daily living (IADL). Results In exercise group, participants categorized into groups with greater number of SA tend to have higher scores in all of the five PF indexes ( $p$  for trend  $< 0.05$ ). Similarly, in non-exercise group, participants categorized into groups with greater number of SA tend to have higher scores in all of the five PF indexes ( $p$  for trend  $< 0.05$ ). Discussion This study showed that older people participating in greater number of SA showed higher PF. Furthermore, this result was indicated in both exercise and non-exercise groups. Since the categories of SA in this study may include various types of physical activity with different intensities, future study should investigate them. References 1) Robert B.T, Leedine L et al. Definition of successful aging by elderly Canadian males:The Manitoba follow-up study. Gerontologist (2003).43,735-744. 2) Iain KC, Linda I et al. Why older people do not participate in leisure time physical activity:a survey of activity levels, beliefs and deterrents. Age and aging (2004).33,287-292

### **LET'S DANCE:A PROGRAM FOR OLDER ADULTS USING LIVE MUSIC TO ENHANCE MOBILITY AND PHYSICAL ACTIVITY**

Le Navenec, C., Rosling, L., Hirst, S.

*University of Calgary*

The purpose of this presentation is two-fold: (1) to disseminate the research findings of a scooping study about the contribution of various type of music (e.g., dance, marches, other) for enhancing /maintaining mobility and physical activity among older adults in a residential centre; and (2) to compare those findings to a short descriptive case study of the Let's Dance program at Langara Residential Centre in Vancouver, Canada. This interdisciplinary program (involving nursing, physiotherapy, rehab assistants, and volunteers) is designed to improve/maintain walking, gait, and physical activity through use of live music (piano playing by the music therapist) What is unique about this program is that the music used is based on the participant's taste, and is structured to support, match, and encourage each person's walking style and ability. When not walking, the other participants are offered percussion instruments so that they may accompany rhythmically the resident who is walking Based on the staff's observations of so many smiles on everyone's faces, and sounds of laughter, this is indeed a "moving experience" that enhances not only mobility but also personhood well-being for all the participants, including the staff. If time permits, a concluding discussion will address how 'frontline' line residential staff are indeed engaging in knowledge translation (KT) ; i.e., informing their clinical practice with research findings about a creative way to promote mobility and mood enhancement of older people in residential settings.

### **PROMOTING FUNCTIONAL FITNESS PROGRAMS FOR THE ELDERLY FOR AN ACTIVE AGEING**

Honório, S.1, Batista, M.1, Martins, J.2, Cardoso, J.2, Dias, M.1, Honório, G.3

*Higher School of Education, Torres NOvas-Portugal*

Introduction In order to improve the quality of life for seniors and their remaining physical capacities, we intend to establish differences in physical fitness among older adults with physical activity programs and systematic non-active elderly evaluated by Fullerton Battery Tests. Methods The sample consisted of 62 elderly aged between 58 and 90 years old, with 37 males and 25 females, from the district of Santarém - Portugal. This Battery Tests were applied, contains 10 exercises that assess the fitness of these individuals. They were also evaluated according to their Gender, Age Group, Programs / Practices for Physical Activity and BMI. It was applied for statistical comparison techniques and non-parametric correlation. Results We found that on the gender variable, this was not determinative of the results obtained in Battery Fullerton because men showed better results in just two variables; Individuals from younger age are the ones with the best performing tests; Older people who practice physical activity, fulfilling a regular schedule, the best-performing activities assessed by

the battery, and individuals with higher BMI perform in a more effective activities. Discussion We inferred this way that regular physical activity and systematic programs reveal a positive and functional factor, and a greater ability to perform daily tasks, as assessed by tests that promote and maintain active aging.

### THE STRENGTH IN MIDDLE-AGED ADULT WOMEN PRACTITIONERS OF DIFFERENT PHYSICAL EXERCISE PROGRAMS

Araujo, P., Filippetto, M.C., Peirau, X.

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**Introduction** The physical exercise is an important agent in the improvement and maintenance of the health and of the physical condition (American College of Sports Medicine, 7th ed., 2006). It acts in the reduction of the chronic illnesses risk factors and in the decrease of the effects of the osteoporosis, common in middle-aged adult women. Within the developed physical abilities, strength stands by its prophylactic in the risk of falls and fractures, frequent in this population. The aim of the study was to evaluate the strength in women practitioners of two different programs of physical exercise. **Methods** Initially was applied the IPAQ questionnaire (International Physical Activity Questionnaire) for the amount of physical activity performed by the sample  $N = 43$  women aged between 44 and 57 years, divided into aquatic fitness practitioners, practitioners of neuromuscular stimulation mechanic and non-practitioners systematic physical exercise. Exercise programs had the duration of 12 weeks and we evaluate the strength before and after (pre and post test). We measured the peak of isometric force of the lower body coupling the Muscledab® system to a machine of Leg Press. The system consists of a load cell and a computer-readable recording the variation of force versus time with unsurpassed resistance and absence of motion. **Results** The strength of women practitioners aquatic fitness, neuromuscular stimulation mechanic and non-practitioners physical exercise ( $n = 17, 13, 13$ ) has not presented significant variation ( $p = 0.92, 0.71, 0.58$ ). **Discussion** The programs of physical exercise have been geared towards a maintenance perspective and health promotion, so the not decreased strength is considered a positive factor. Emphasize the importance of maintaining the strength for this population as a factor favouring overall fitness, improving functionality in activities of daily living (Caspersen, Powell & Christenson, 1985) and contributing to the prevention of falls (Matsudo, 2002). **References** American College of Sports Medicine (7th ed) (2006). ACSM's Guidelines for Exercise Testing and Prescription. Baltimore: Lippincott Williams & Wilkins. Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise and physical fitness: definitions and distinctions for health-related research. *Public Health Nutr*, 100, 126-131. Matsudo, S. M. (2002). Envelhecimento, atividade Física e saúde. *R. Min. Educ. Fis*, 10(1), 195-209.

### EFFECTS OF A PHYSICAL EXERCISE PROGRAM IN THE FUNCTIONAL FITNESS AND BODY COMPOSITION OF AN ELDERLY POPULATION

Martins, A.1, Raimundo, A.1,2, Pereira, C.1,2

*1: UE (Évora, Portugal), 2: CIDESD (Portugal)*

**Introduction** Exercise is a key mean for the maintenance of health, functional capacity, quality of life and independence in the elderly, being recommended the performance at least 3 sessions/week(1). Although many elderly adhere to these recommendations, the absenteeism can be an impediment to exercise benefits. This study aimed analyze the effects of a 3 months exercise program (3 sessions/week; 50-60'; 50-60%HRmax.), accounting for absenteeism, in elderly women. **Methods** Participants were 44 women, equal or >60 yrs, clustered into 3 groups: Experimental 1 (E1: 20-59% sessions;  $n:13$ ; age:  $69,3 \pm 6,9$  yrs); Experimental 2 (E2: equal or >60% sessions;  $n:15$ ; age:  $70,9 \pm 5,6$  yrs); Control (C: 0% sessions;  $n:16$ ; age:  $68,7 \pm 9,2$  yrs). Anthropometry and DXA assessed body composition. Clinical analysis determined the lipid profile. Functional Fitness Test assessed physical fitness. POMS-SF questionnaire assessed the Mood States. The variation between pre post intervention (post-pre values) were computed for all variables. Comparisons between groups were performed by ANOVA and Bonferroni post hoc test or by Kruskal-Wallis and Pair Wise Wilcoxon tests. The level of significance was set at  $p < 0.05$ . **Results** There were significant differences between groups concerning variation in upper ( $p = .001$ ;  $E2 > C$ ) and lower strength ( $p = .009$ ;  $E2 > C = E1$ ), lower flexibility ( $p = .020$ ;  $E2 > C$ ), aerobic endurance ( $p < .001$ ;  $E2 = E1 > C$ ) and speed/agility/balance ( $p < .001$ ;  $E2 = E1 > C$ ) and confusion ( $p = .027$ ;  $E2$  60%HRmax to improve these parameters. This study highlights the usefulness of programs adopting an active lifestyle through exercise because proved that exercise have benefices in physical fitness and mood state even with a high absenteeism. **References** 1 ACSM (2009). *Med Sci Sports Exerc*, 1510-1530. 2 Barata T (2003). Lisboa: Publicações D. Quixote. 3 Spidurso W, Francis K. & MacRae P (2005). Champaign, Human Kinetics. 4 Tran Z, Welman A, Glass G & Mood D (1983). *Med Sci Sports Exerc*, 15, 393-402.

### INBODY 720 COMPARED TO DEXA FOR THE ASSESSMENT OF BONE MINERAL CONTENT, FAT%, FAT MASS, FAT FREE MASS, AND LEAN BODY MASS IN ELDERLY MEN

Lohne-Seiler, H.1, Bjørnsen, T.1, Hetlelid, K.1, Salvesen, S.1, Stea, T.H.1, Paulsen, G.2, Berntsen, S.1

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**Do not insert authors here** **Introduction** Aging is characterized by a progressive atrophy of muscle tissue, increased fat mass and loss of bone mass. Bioelectrical impedance analysis (BIA) is a non-invasive, transportable and relatively inexpensive method for measuring body composition and hence extensively used by health professionals. However, few studies have examined the validity of the BIA based instrument Inbody 720 in the elderly. We aimed to compare InBody 720 to DEXA (Dual Energy X-ray absorptiometry) for the assessment of bone mineral content (BMC), fat%, fat mass (FM), fat free mass (FFM), and lean body mass (LBM) in elderly men (60-80 years). **Methods** The present study is a part of the SARA-study, a double-blinded randomized placebo-controlled study evaluating the effect of whether large dosages of antioxidants can affect adaptation to resistance training in elderly men. Forty five men ( $68.6 \pm 6.2$  yrs) were included in the present study. Analysis were based on the tests performed at baseline which were completed within a week. Data were analyzed as follows: paired-samples t-test, Bland-Altman plots with limits of agreements, and intra-class correlations (ICCs), two-way mixed model, with 95% confidence intervals (CIs). **Results** Mean differences and limits of agreements from the Bland-Altman plots were: BMC:  $0.21 \pm 0.38$  kg ( $p = 0.001$ ), fat%:  $-3.0 \pm 2.7\%$  ( $p < 0.001$ ), FM:  $-1.7 \pm 2.4$  kg ( $p < 0.001$ ), FFM:  $1.5 \pm 2.7$  kg ( $p = 0.001$ ), and LBM:  $1.2 \pm 2.7$  kg ( $p = 0.003$ ), percentage changes were 6.0, -11.0, -8.1, 2.3, and 2.1%, respectively. The ICCs were: BMC: 0.54 [95% CI: 0.29-0.72] ( $p < 0.001$ ), fat%: 0.92 [95% CI: 0.85-0.95] ( $p < 0.001$ ), FM: 0.96 [95% CI: 0.92-0.98] ( $p < 0.001$ ), FFM: 0.92 [95% CI: 0.85-0.95] ( $p < 0.001$ ), and LBM: 0.91 [95% CI: 0.84-0.95] ( $p < 0.001$ ). **Discussion** These results indicate that InBody 720 seems to overestimate BMC, FFM and LBM compared to DEXA and underestimate fat% and FM. Fat%, FM, FFM, and LBM assessed with InBody 720 explained more than 90% of the variance in fat%, FM, FFM, and LBM assessed with DEXA. On the other hand BMC assessed with InBody 720 explained only 54% of the variance in BMC assessed with DEXA. Our results are in agreement with other studies (Völgyi et al., 2008; Holteberg 2010) however these studies are includ-

ing younger individuals. In conclusion it seems that InBody 720 is a valid method for the determination of fat%, fat mass, fat free-, and lean body mass in elderly men. References Holteberg, K. (2010). Master thesis, NSSC. Völgyi E, Taylavsky FA, Lyttikäinen A, Suomien H, Alén M, Cheng S. (2008). *Obesity*, 16(3), 700-5.

### DOES FITNESS LEVEL INFLUENCE URINARY INCONTINENCE AND SLEEP QUALITY IN AGED WOMEN?

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1: GENUD "Growth, Exercise, Nutrition and Development" TOLEDO Research Group, University of Castilla-La Mancha, Toledo, Spain; Introduction Urinary incontinence (UI) and poor sleep quality (SQ) are highly prevalent in women after menopause (1). In addition, fitness level is dramatically reduced with advanced age (2). Very few studies have been conducted in order to investigate the interactions between fitness levels, UI and SQ. Thus, the aim of this study was to analyze the relationships between the mentioned factors in aged women. Methods A total of 174 women (age:  $74.3 \pm 5.5$  yr, body mass index:  $30.1 \pm 3.8$  kg/m<sup>2</sup>) completed a battery of physical fitness tests including static balance, lower body strength, agility/dynamic balance, walking velocity and aerobic endurance (2). The ICIQ-SF questionnaire and Cervantes Scale (for UI) (3, 4) and Jenkins Scale (5) (for SQ) were used. Participants' physical fitness tests were graded according to normalized percentile values for Spanish elderly (2) to correct the effect of age. Additionally, a fitness index (FI) was calculated splitting subjects into low fitness (LF) and high fitness (HF) level groups for those corresponding to the 1st and 4th quartile respectively. Results UI variables (i.e. frequency and amount of urine leaks, never leaks urine, urge UI, stress UI and number of times that urinates during the night) showed significant worse values in the LF compared to the HF group (all  $p < 0.05$ ). Significant correlations between frequency of urine leaks, amount of urine leaks, number of times that urinates during the night and FI were found (range:  $-0.18$  to  $-0.26$ ,  $p < 0.05$ ), whereas no correlation between SQ variables and fitness level was present. Discussion An inverse association between moderate physical activity and UI exist (6), maybe due to maintaining body weight, reducing intra-abdominal fat and/or other potential mechanisms such as the strengthening of the pelvic floor muscles (7). Furthermore, our findings support that lower physical fitness is strongly associated with higher UI values in aged women. Therefore, physical fitness seems to play an important role in quality of life in aged women further than the typical associations with a better performance in movement tasks. References 1. Monterrosa-Castro A et al. (2012). *Menopause*. 19:924–30 2. Pedredo-Chamizo R et al. (2012). *Arch Gerontol Geriatr*. 55:406–416. 3. Palacios S et al. (2002). *Climacteric*, 5(supplement 1)159. 4. Pérez-López FR et al. (2012). *Maturitas* 73(4):369–72 5. Klerman EB et al. (2008). *Curr Biol*. 5; 18(15): 1118–1123. 6. Qiu J et al. *Eur J Obstet Gynecol Reprod Biol*. (2011). 159(1): 224–229. 7. Townsend MK et al. (2008). *J Urol*, 179:1012–6.

### MAXIMAL FAT OXIDATION IN TRAINED YOUNG AND MIDDLE-AGED MALE TRIATHLETES DURING RUNNING AND CYCLING

Beck, T.N.1, Dela, F.1, Helge, J.W.1

*Copenhagen University*

Objective: This cross-sectional study investigated the effect of exercise mode and aging on the maximal fat oxidation capacity in well trained young and middle aged male triathletes. Methods: Two groups of well trained male subjects (8 young triathletes [ $28 \pm 1.6$  y,  $VO_{2\max}$ :  $69.7 \pm 2.5$  ml/min/kg] and 10 middle aged triathletes [ $53.2 \pm 2$  y,  $VO_{2\max}$ :  $58.7 \pm 2$  ml/min/kg]) performed two graded exercise tests to exhaustion; one test on cycle ergometer and the other on a treadmill. The stage duration in both trials was 3 minutes and gas exchange measurements (Oxycon Pro, Jaeger) and venous blood was sampled at the end of each stage. Plasma lactate and free fatty acid (FFA) concentrations were determined using commercially available assays. Fat oxidation rates were calculated using stoichiometric equations. Results: Maximal fat oxidation was significantly higher in running compared with cycling in well trained middle aged men ( $0.62 \pm 0.04$  vs.  $0.46 \pm 0.03$  g \* min<sup>-1</sup>;  $P = 0.002$ ), but not in young men ( $0.84 \pm 0.09$  vs.  $0.720 \pm 0.02$  g \* min<sup>-1</sup>;  $P = 0.1$ ), respectively. The relative work intensity which elicits Fatmax, was different between cycling and running in trained middle aged men ( $46.4 \pm 2.7$  vs.  $60.7 \pm 2.4$  %  $VO_{2\max}$ ;  $P < 0.001$ ), but not in trained young men ( $57.4 \pm 2.6$  vs.  $63.3 \pm 3.8$ ;  $P = 0.215$ ). The relative work intensity which elicits Fatmax was different between groups in cycling but not in running (24 %;  $P < 0.001$  and 5.7 %  $P = 0.274$ ). In both trained middle aged ( $P = 0.073$ ) and trained young men ( $P = 0.011$ ) lactate concentrations were higher in cycling than running. During both cycling and running in trained young men there was an (83 and 29 %) reduction plasma FFA concentrations from baseline values at ( $685 \pm 85$  and  $537 \pm 117$  μmol L<sup>-1</sup>, respectively) and in trained middle aged an (12 and 3 %) reduction in plasma FFA concentrations from baseline values at ( $347 \pm 44$  and  $406 \pm 48$  μmol L<sup>-1</sup>, respectively) until exhaustion. Conclusions: In both middle aged and young male trained triathletes maximal fat oxidation was 35 % and 17 % higher doing treadmill compared with cycle exercise, respectively, whereas the intensity which elicits maximal fat oxidation in the two exercise modes was only different in the middle aged and not the young triathletes. The higher venous plasma lactate concentrations during cycling compared to running implies a higher muscle glycogen turnover and supports the observed lower maximal fat oxidation during cycling. Interestingly the plasma FFA was reduced and not increased though the graded exercise protocol.

**14:00 - 15:00**

### Mini-Orals

#### PP-PM02 Adapted Physical Activity [AP] 2

### EFFECTS OF MOTOR PLAY INTERVENTION ON PHYSICAL ACTIVITY IN JAPANESE PRESCHOOL-AGED CHILDREN AND THE RELATIONSHIP BETWEEN THE EFFECTS AND MOTOR ABILITY

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Introduction Recently, children's physical activity (PA) has tended to decrease in many countries (Dollman et al., 2005). This study aimed to estimate the effects of intervention on the amount of PA for Japanese young children by supporting their motor play and evaluate the

durability of these effects. Furthermore, this study clarified the relationships among the amount of PA, the effects of intervention, and children's motor ability (MA). **Methods** Subjects were 31 preschoolers (14 boys, 17 girls) at two preschools. PA was measured using a 3-axis accelerometer (Power-Walker EX-300) worn between 9 a.m. and 2 p.m. As a control (T1), children wore the accelerometer for three days in a week (Mon., Wed. and Fri.). For the intervention (T2), children were supported in motor play with university students for 60 minutes in the morning, during which they wore the accelerometer. For the post intervention period (T3), the accelerometer was also worn for three days (same days of the week). MA was evaluated using the following items: potato-race, grip strength, sits-and-reach, long distance throwing, standing broad jump and side jump. Principle component analysis was used to calculate a general MA score. To compare the mean PA (T1-T3), two-way layout and repeated measures ANOVA and the Bonferroni test were used. Results The mean PA of each time differed significantly according to ANOVA ( $F(2, 60)=9.82, p<.001$ ), and there was no interaction of gender or each time ( $F(1, 30)=.47, p=.449$ ). PA for boys was larger than PA for girls ( $F(1, 30)=7.05, p<.05$ ). A multiple comparison test revealed a significant difference in PA between T1 and T2 (T1=5971.5 steps

### COMPARISON OF SUMMER AND WINTER PHYSICAL ACTIVITY OF SENIOR CITIZENS IN THE REYKJAVIK CAPITAL AREA

Oskarsdottir, N.1, Arnardottir, N.1, Koster, A.2, VanDomelen, D.3, Brychta, R.4, Eiriksdottir, G.5, Sverrisdottir, E.5, Gudnason, V.5, Johannsson, E.1, Harris, T.3, Chen, K.4, Sveinsson, T.1

1: UI (Iceland), 2: MU (The Netherlands), 3: NIA (USA), 4: NIDDK (USA), 5: IHA (Iceland).

1: UI (Reykjavik, Iceland), 2: IHA (Kopavogur, Iceland), 3: NIA (Bethesda, Maryland, USA); 4: MU (Maastricht, The Netherlands), 5: NIDDK (Bethesda, Maryland, USA), 6: UI (Laugarvatn, Iceland), 7: USD (Odense, Denmark). **Introduction** Regular physical activity (PA) has various health benefits both physically and mentally. Seasonality may play a role in PA patterns, and Iceland has a unique dark-light cycle difference between winter and summer. The objective of this study was to examine the difference between summer and winter in PA of older Icelanders living in the capital area. **Methods** The research was conducted in cooperation with the Icelandic Heart Association (Harris et al., 2007, Arnardottir et al., 2012). Among participants who had one week of free-living measurements by a hip-worn accelerometer during the summer months, 219 volunteered to repeat another session during the opposite dark-light cycle (winter). Overall, 142 people (87 women and 55 men) finished at least four valid days of PA measurements during both sessions. The levels of PA was categorized as sedentary < 100 counts/min, low-light 100-759 counts/min, light-moderate 760-2019 counts/min, and moderate-vigorous >2020 counts/min. Results Significantly more time was spent in summers at the low-light PA level (178 vs 161 min,  $p<0.001$ ), and the light-moderate level (30 vs 22 min,  $p<0.001$ ). However, subjects recorded significantly more sedentary time in the winter as compare to summer (10.4 vs 10.2 h,  $p=0.02$ ) and less wear-time (13.5 vs 13.8 h,  $p=0.002$ ). Very limited time was spent in moderate-to-vigorous PA in either seasons (7 vs 6 min,  $p=0.19$ ) with women spending less time than men on average (5 min vs 9 min,  $p=0.01$ ). The differences in seasonal wear-time and low-moderate PA were significantly higher for men than women ( $p=0.03$  and  $p=0.02$ ). The difference in PA between seasons was not related to age or body weight. **Discussion** The seasonal difference in PA patterns in this unique population showed the environmental influences on habitual PA in older populations and underscores the necessity of taking season into account in analysis. Future studies should examine the feasibility and effectiveness of different interventions to increase of PA all year long. **References** Harris TB, Launer LJ, Eiriksdottir G, et al. (2007) *Am J Epidemiol* 165:1076-87. Arnardottir NY, A Koster, DR Van Domelen, et al. (2013). *Age Ageing* (in press).

### ANALYSIS OF VARIATIONS IN CENTRE OF PRESSURE IN STANDING POSITION IN YOUNG SUBJECTS WITH DOWN SYNDROME AFTER A DANCE TRAINING PROGRAMME

Massó, N., Gutiérrez, L., Rey, F., Costa, L., Casals, S.

*Universitat Ramon Lull*

**Introduction:** People with Down Syndrome (DS) show slow motor performance, long reaction times and anomalies in COP (centre of pressure) control (Galli M. et al. 2008; Cabeza-Ruiz R. et al. 2011; Rigoldi et al. 2011). Nevertheless, they can improve with training (Debū, 2004). Thus, our purpose is to analyze COP control differences between groups and possible changes before and after a dance training programme during 18 weeks. **Methods:** 11 young people with DS aged  $20.5 \pm 1.3$  and 11 non-DS aged  $20.2 \pm 2.0$  were analyzed. We registered bipedal standing position in closed eyes and open eyes conditions during 30 seconds. The following parameters relative to COP were taken from platform (AMTI- SGA6-4): sway area, A-P (anteroposterior) and M-L (mediolateral) displacement, and also maximum displacement excursion. Differences were compared between both groups using Mann-Whitney U test. Wilcoxon Test was applied to compare differences between open and closed eyes in both groups. All of them were registered before and after training programme, and changes pre-post training were analyzed using Anova Test. **Results:** In open eyes condition we found significant pre-training differences between groups in COP sway area ( $p<.000$ ), A-P ( $p<.000$ ) and M-L displacement ( $p<.005$ ) and maximal displacement excursion ( $p<.001$ ). In contrast, post-training results did not show significant differences between groups in A-P and maximal displacement excursion. In closed eyes condition differences were found in pre-training sway area and M-L values. And, post-training results were different in all parameters. Intragroup pre-post changes did not show any variation except sway area in closed eyes condition of control group. Nevertheless, DS group showed a better reduction in A-P displacement in open eyes condition in comparison with control group ( $p<.018$ ). **Discussion:** According to previous literature, we found that people with DS show worse COP control than non-DS in open and closed eyes conditions. Also, we can conclude that a dance-based training programme can improve some parameters relative to COP control in open eyes condition. **References:** Cabeza-Ruiz R. et al. (2011). *Gait & Posture* 33, 23-28. Debū B. et al. (2004). *Eur. B. of Adap. Phy. Act.* 2004, 3, 3. Galli M. et al. (2008). *Gait & Posture* 28, 502-506. Rigoldi C. et al. (2011). *Res. in Dev. Dis.* 32, 170-175. " This work is partially supported by Ministerio de Economía y Competitividad (Dirección General de Investigación y Gestión Plan Nacional I+D+i. Grant DEP2012-38984 "

### EFFECT OF TWO ENDURANCE TRAINING METHODS ON PHOSPHOCREATINE KINETICS IN CHILDREN

Slopianka, M.1, Kappenstein, J.1, Ferrauti, A.1, Müller, K.2, Zange, J.2,3

1: RUB (Bochum, Germany), 2: DLR (Cologne, Germany), 3: University of Cologne (Cologne, Germany)

**Introduction** Several studies showed similar positive adaptations on the oxidative capacity comparing high-intensity intermittent (HIT) with continuous endurance training (CT) in children (Williams et al., 2000; McManus et al. 2005; Baquet et al., 2010). However, studies measuring the effects of endurance training on phosphocreatine (PCr) kinetics are only available in adults, suggesting a faster PCr recovery after a training intervention (Jones et al., 2007; Forbes et al., 2008). The aim of the present study was to compare the effects of HIT and moder-

ate-intensity continuous training (CT) on PCr kinetics in children. Methods 36 children (9.5±1.1 yrs, 141±8 cm, 35±8 kg, muscle mass 48±6%, VO<sub>2</sub>max 54±9 ml/kg/min) participated in the study. A 3-group experimental design was applied comparing the PCr kinetics after 10 weeks (2 training sessions per week) of HIT with CT, by means of <sup>31</sup>P-magnetic resonance spectroscopy (31P-MRS). Both training modalities were compared with a non-exercising control group (CG). The exercise test consisted of a dynamic plantar flexion protocol (8 bouts of 30-s exercise interspersed by 20-s recovery) followed by 5 min of passive recovery, measuring the energy-rich phosphates during and post-exercise. Results Results were calculated using a multi factor ANOVA (main factors were group [HIT, CT, CG] and training [pre-post]). No significant differences for the main factors group and training as well as no interactions were found for average PCr at the end of exercise contractions and post-exercise PCr recovery time constant (τ) (P > 0.5). Conclusion The results obtained in the present study suggest that ten weeks of two different endurance training modalities (HIT and CT) don't affect the PCr kinetics during and after a high-intensity intermittent exercise protocol in children. Therefore, it seems that in order to specifically train endurance in children, coaches and physical trainers should wait until the age at peak height velocity. For practical reasons both training methods seem to be suitable, although children show clear preferences for high intensity intermittent bouts of exercise under natural conditions (i.e., short runs with changes of direction). References Baquet, G., Gamelin, F.X., Mucci, P., Thevenet, D., Van Praagh, E. & Berthoin, S. (2010). *J Strength Cond Res*, 24, 1381-1388. Forbes S. C., Slade J. M., Meyer R. A. (2008). *Appl Physiol Nutr Metab*, 33, 1124-1131. Jones, A.M., Wilkerson, D.P., Berger, N.J. & Fulford, J. (2007). *AJP: Reg Integr Comp Physiol*, 293, R392. McManus, A.M., Cheng, C.H., Leung, M.P., Yung, T.C. & Macfarlane, D.J. (2005). *Int J Sports Med*, 26, 781-786. Williams, C.A., Armstrong, N. & Powell, J. (2000). *Br J Sports Med*, 34, 168-173.

### INDIRECT ASSESSMENT OF AEROBIC CAPACITY OF OBESE ADOLESCENTS: INTEREST OF A SHORT INTERMITTENT, PROGRESSIVE AND MAXIMAL RUNNING TEST.

Rey, O.1,2,3, Nicol, C.1, Rossi, D.4, Mercier, C.S.5, Vallier, J.M.2,3, Maïano, C.6

1 - ISM (Marseille, France), 2 - LAMHES (Nice, France), 3 - LAMHES (Toulon, France), 4 - Lycée Raynouard (Brignoles, France), 5 - AJO@ (Sanary, France), 6 - Lab. Cyberpsychologie (Gatineau, Canada)

Introduction This study examined the validity of a progressive intermittent running test (15-15; entitled Spartacus) to indirectly assess the aerobic capacity of obese adolescents in comparison with the Shuttle run test. Methods The participants were 43 obese adolescents (33 girls and 10 boys) aged 13.7 ± 1.4 years old, with a mean IMC of 31 ± 5. Both tests were performed at the 3.8th ± 1.5 month of their stay for combined diet and exercise training in a health care centre. The two tests were performed at a three week interval. Differences according to the « test », « sex » and the interaction « test X sex » have been assessed for maximum heart rate (HRmax), final running speed, total and net running durations, and perceived exertion (Borg's scale RPE 6-20). Results MANOVA analysis did not reveal any significant inter-test differences for HRmax (193 vs. 196 ± 9 bpm) and RPE (16 ± 2). As compared to the Shuttle test, however, the Spartacus resulted in a 20% increased final running speed (11.5 vs. 9.4 km.h<sup>-1</sup>) and a 3.3 times longer total running duration (17.3 vs. 5.3 min) for a 1.7 times longer net exercise duration (8.7 vs. 5.3 min) (p<0.001). The results were neither influenced by the « sex » nor by the "test X sex" interaction. Discussion The Shuttle test includes repeated braking and accelerating actions from lower limb extensor muscles, which are known to affect runners, and in particular obese ones (Bovet et al. 2007). As expected, the aerobic capacity indirectly assessed by the Shuttle run test was significantly lower than when using the Spartacus test. The mean values of HRmax give support to the maximal involvement of the adolescents in both tests. This is not attenuated by the observed HRmax-REP uncoupling, which is commonly reported for this age group (Gros Lambert and Mahon 2006). Conclusion The Spartacus test allowed obese adolescents to reach a similar psycho-physiological state effort while producing an increased aerobic performance in both speed and duration. Although requiring additional validation, the Spartacus test might contribute to the individual planning of short intermittent exercises, and thus to the prevention of cardiovascular risks associated with obesity. References. Bovet P, Auguste R, Burdette H (2007) *Int J Behav Nutr Phys Act* (5): 4-24. Gros Lambert A and Mahon AD (2006) *Sports Med* 36(11): 911-928.

### THE EFFECT OF WII FIT® BALANCE GAME ON THE BALANCE ABILITY OF CHILDREN WITH HEARING IMPAIRMENT

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National Taichung University of Education

Introduction As a result of the impairment of their inner ears or premature growth, the capability of balance for children who are hard of hearing is malfunctional. However, the capability of balance is essential for the human body to maintain its own stability in our daily life. A poor ability of balance will affect our everyday life as well as the quality of learning. Therefore, this study aimed to explore the effect of a six-week Wii Fit game of balance training on the static and dynamic ability of balance for hearing-impaired children. Methods The subjects of this study were 14 hearing-impaired children and 7 normal, unimpaired children. The hearing-impaired ones were further divided into 7 experimental-group children and 7 regular-activity children, whereas the normal-hearing ones were divided into 7 control-group children. With the experimental group, the Wii Fit game of balance training was conducted 3 times per week, 45 minutes per session for 6 weeks. The regular-activity group and the control group ones just live their lives the way they normally do with their regular routines. This experiment utilizes a force plate and thin sensor strip to measure the SLECLL(Single-leg Eyes Closed Left Leg) and the SLECRL(Single-leg Eyes Closed Right Leg) balance abilities of these two groups' subjects, as well as to time the test of "timed up-and-go" Afterwards, the BTS Bioengineering-Sway software was used to gather the parameters of the subjects' characteristics of balance control. After the data were analyzed and processed, the Wilcoxon signed ranks test of nonparametric statistics and the Kruskal-Wallis one-way analysis of variance ranks(H-test) of nonparametric statistics were undergone to compare the result of the pre-test and the post-test, as well as to compare the variations among the groups. Results The collected data indicate that, with the comparison of the pretest and the posttest between the experimental group and the control group, the timing of the SLECLL and of the SLECRL, as well as the time of the "timed up-and-go", have both reached a remarkable variation of p< .05. Of all the collected data, a significant progress has shown. Discussion The Wii Fit game of balance training can effectively enhance the ability of body balance for the hearing-impaired children. During the process of the training, it's not only fun-filled but also safe, so this is a highly recommended exercise. References An, M. H., Yi, C. H., Jeon, H. S., Park, S. Y. (2009). Age-related changes of single-limb standing balance in children with and without deafness. *International Journal of Pediatric Otorhinolaryngology*, 73(11), 1539-1544. Verhagen, E., Bobbert, M., Inklaar, M., Kalken, M. V., Beek, A.V. D., Bouter, L. & Mechelen, W. V. (2005). The effect of a balance training programme on centre of pressure excursion in one-leg stance. *Clinical Biomechanics*, 20, 1094-1100.

## EFFECTS OF A SPECIFIC FLEXIBILITY TRAINING PROGRAM ON SPINAL RANGE OF MOTION IN OLDER WOMEN

Battaglia, G.1,2, Bellafiore, M.1,2, Guglielmo, T.1, Caramazza, G.2, Paoli, A.3, Bianco, A.1,2, Palma, A.1,2

1: University of Palermo, Italy; 2: Regional Sports School of CONI Sicilia, Italy. 3: University of Padova, Italy.

**Introduction** Aging-related reduced spinal mobility can interfere with the execution of important functional skills and activities in elderly women. However there is a lack of studies about the effects of range of motion exercises on flexibility outcomes in older populations and a lack of consensus regarding the prescription of stretching exercises for older adults (ACSM, 2009). For these reasons the purpose of this study was to examine the extent to which spinal extension and flexion could be improved in a population of older women participating in a 8-week flexibility training program. **Methods** Thirty female volunteers were cluster randomized into either a control group [CG] (n: 13; age: 69.69±7.94 years; height: 1.57±0.06 m; weight: 68.42±8.18 kg, BMI: 27.88±2.81) and a trained group [TG] (n: 17; age: 68.35±6.04 years; height: 1.54±0.06 m; weight: 64.78±10.16, kg, BMI: 27.28±3.08). TG was trained for 8 weeks by two sessions/week. In particular, every trained session included: a warm up period (~15 min), a training period (~60 min) including specific exercises to train spinal flexibility, cool down period (~15 min). CG did not perform any structured physical activity during the experimental phase. All data were acquired before and after the experimental period. Spinal ranges of motion (ROM) were measured using SpinalMouse® (Ildiag, Volkerswill, Switzerland), which is an electronic computer-aided device that measures sagittal spinal ROM and inter-segmental angles non-invasively using the so-called surface technique. Each angle was measured three times in a neutral standing (nS) position, maximum bending (maxB) position, and maximum extension (maxE) position, and average data were used. **Results** Results indicated a significant improvement in spinal mobility in the trained group compared to the control one, and virtually no measurable change in the control group. In particular, we found a significant increase of thoracic ROM from nS position to maxB one ( $p < 0.05$ ) in TG than CG after the training period compared to baseline. Instead we did not show any significant difference of sagittal spinal ROM from nS position to maxE one ( $p > 0.05$ ). **Discussion** This study shows that used training program can improve the spinal flexibility in female older adults. We suggested, in agreement with Miyakoshi et al. (2007), that an increase in spinal ROM had positive effects on quality of life and that deterioration of back muscle strength could be the most important factor decreasing spinal ROM in elderly people. **References** Miyakoshi N, Hongo M, Maekawa S, Ishikawa Y, Shimada Y, Itoi E. (2007). Osteoporosis Int 18:1397–1403.

## MAY BE ASSESSED THE INDEPENDENCE IN SENIORS WITH HELP OF BODY COMPOSITION?

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**Introduction** The importance of physical activity as an element of healthy living for older adults is important mainly for their independence and self-serving. Physically active older adults can reduce or prevent functional declines linked to aging through improved cardiovascular functioning, reduced risk of osteoporosis, reduced risk of falling, and reduced loss of muscle mass and strength. Surveys such as the Behavioral Risk Factor Surveillance System, however, show that only one third of people age 65 years and older participate in regular sustained physical activity. Therefore, ways older adults can modify their behaviors or leisure lifestyles to be more active are critical to promoting their muscle state. An effect of physical exercise in humans may be assessed by body composition (BC). Like a decisive parameter for independency assessment may be used the relationship between extracellular (ECM) and body cell mass (BCM). The aim of this study was to verify BC assessment in female seniors by whole body BIA analysis and verify if the BC parameters may be used like a predictor of their independency. **Methods** In a group of healthy non-active senior women (n=23, age=70.1±4.8 years, BM=70.3±5.9 kg, height=161.9±2.0 cm, percentage of body fat (%BF)=37.5±5.1%) were determined by DEXA method. These data were used for the prediction equation calculation that was used by BIA analysis. The measurement itself was performed in a tetrapolar configuration of electrodes. The BIA was used in a group of healthy senior women (n=79, age=70.7±4.3 years, BM=69.9±7.9 kg, height=161.0±2.8 cm, %BF=37.9±4.8%, TBW=46.0±2.3% of BM, ECM/BCM=0.98±0.03). **Results** The exercise time in active seniors spent per week ranged between 90-250 min (mean 156.8±48.9 min). According to data from non active group the influence of the resting activities should be neglected. The mean energy output was 3970±960 kJ. A highly significant dependence of peak oxygen uptake on ECM/BCM was found:  $VO_{2peak}.kg^{-1} (ml.kg^{-1}.min^{-1}) = -43.165 * ECM/BCM + 67.765$ ;  $r = 0.911$ ,  $p < 0.005$ ,  $SEE = 1.68 ml.kg^{-1}.min^{-1}$ ,  $TEE = 1.93 ml.kg^{-1}.min^{-1}$ . The relationship ECM/BCM increased significantly with the age. The following linear dependence was established:  $ECM/BCM = 0.021 * age (years) + 0.412$ ;  $r = 0.898$ ,  $p < 0.005$ ,  $SEE = 0.04$ ,  $TEE = 0.05$ . **Discussion** If we evaluate their daily regime it may be determine that the  $ECM/BCM < 1$  may be use like a morphological criterion of senior's independence. We may conclude that for the BC assessment and thus for evaluation of an actual state of seniors and predispositions of their independence may be use the BIA analysis if the senior's prediction equation was used with the reproducibility about 2% of absolute values of measured variables. The study was supported by the grant Czech Ministry of Education MSM 0021620864

## TWO WEEKS OF ONE LEG IMMOBILISATION DECREASES HDL CHOLESTEROL IN YOUNG AND ELDERLY HEALTHY MEN

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**Background:** Previous studies have shown that bed rest significantly reduces high-density lipoprotein cholesterol (HDL-c). However, the impact of inactivity and possibly of age on the HDL-c concentration where only a limited muscle mass is affected, is not well established. **Objective:** To investigate and compare the lipid profile in young (Y) and elderly (E) healthy males after two weeks of one-leg immobilisation and six weeks of aerobic retraining. **Methods:** 17 Y (23±1 yr; 48±1 ml O<sub>2</sub>/min/kg) and 15 E (68±1 yr; 33±2 ml O<sub>2</sub>/min/kg) male subjects had one leg immobilised using a Don Joy cast for two weeks. This was followed by six weeks (20 sessions) of supervised aerobic cycle training (86±1% of maximal heart rate). The plasma lipid profile was measured overnight fasted at baseline, after immobilization and after retraining. The daily activity level was monitored with a three-axial accelerometer during the intervention. On the three days prior to each blood sampling, subjects were asked to eat a high carbohydrate diet. Data are Mean ± SEM. **Results:** Immobilisation decreased the daily activity level ( $P < 0.001$ ) for both Y (by 31±9 %) and E (by 37±9%) compared to baseline and during training it was not different from baseline. At baseline E had higher plasma concentrations of total cholesterol (TC) (5.2±0.2 vs. 3.8 ±0.1 mM,  $P < 0.001$ ), low-density lipoprotein cholesterol (LDL-c) (3.5±0.2 vs. 2.3±0.1 mM,  $P < 0.001$ ) and triglyceride (TG) (1.2±0.1 vs. 0.8±0.1 mM,  $P < 0.05$ ) compared to Y. Immobilisation caused a significant decrease in the plasma concentration of TC (4.0±0.1 to 3.8±0.1 mM and 6.0±0.1 to 4.9±0.1 mM), HDL-c (1.4±0.1 to 1.2±0.1 mM and 1.6±0.1 to 1.4±0.1 mM), TG (0.9±0.1 to 0.8±0.1 mM and 1.3±0.1 to 1.0±0.1 mM) and LDL-c (2.2±0.1 to 2.1±0.1 mM and 3.7±0.1 to 3.4±0.1 mM) in Y and E, respectively. Training increased ( $P < 0.05$ ) plasma HDL-c concentration back to baseline (1.2±0.1 to 1.3±0.1 mM and 1.4±0.1 to 1.6±0.1 mM) in Y and E, respectively. After training plasma TC concentrations remained ( $p < 0.05$ ) below baseline (3.7±0.1 vs. 4.0±0.1 mM and 5.3±0.1 vs. 5.5±0.1 mM) in Y and E, respectively. Plasma LDL-c and TG concentrations were not affected

by training. The Y and E subjects responded similarly to the intervention. Conclusion: Despite the possibility to ambulate freely and encouragement to stay habitually active the immobilisation of one leg was sufficient to decrease the HDL-c concentration. This reduction occurred irrespective of age. Our findings emphasise the marked effects of physical inactivity in both young and elderly and highlights the prolonged recovery period needed to recover the HDL-c to baseline levels.

### ASSOCIATION OF BRAIN ANATOMY WITH PHYSICAL ACTIVITY IN OLDER ICELANDERS

Arnardottir, N., Koster, A., Van Domelen, D., Brychta, R., Caserotti, P., Eiriksdottir, G., Sverrisdottir, J., Sigurdsson, S., Johannsson, E., Chen, K., Gudnason, V., Harris, T., Launer, L.

1: UJ (Reykjavik), 2: IHA (Kopavogur), 3: NIA (Bethesda, Maryland), 4: MU (Maastricht), 5: NIDDK (Bethesda, Maryland), 6: SDU (Odense), 7: UJ (Laugarvatn)

**Introduction** The brain atrophies with age, which is reflected in reduction in white (WM) and gray matter (GM) and in increased white matter lesions (WML). This change in the brain has been associated with reduced cognitive ability. The aim of this study is to examine how MRI-derived brain atrophy measurements in a 5-year period, is associated with physical activity (PA) in an older population. **Methods** PA was measured in the second phase of the Age, Gene/Environment Susceptibility (AGES II- Reykjavik study) (Harris et al., 2007) from April 2009 to June 2010. Among many other measurements, all participants had a second MRI as a follow-up to their first MRI 5 years prior (AGES-Reykjavik study). We examined the relative volume of WM, GM and WML and their changes over 5 years. The participants wore an accelerometer (Actigraph GT3X) at the right hip for one complete week in a free-living setting (Arnardottir et al., 2013). PA is expressed as total counts of activity/day and average minutes/day >760 counts/min (HLH-PA), and sedentary time is expressed as <100 counts/min. In total, 361 participants had complete PA measured in AGESII and both MRI measurements in AGES and AGESII. Results The mean age of the participants was 79.2 (SD=4.5 years) (at AGES III). After adjusting for age, sex and brain infarctions, both 5-year change in GM (beta=0.17, p=0.001) and baseline GM (beta=0.17, p=0.002) predicted time spent in both PA categories. Baseline WM predicted PA (beta=0.14, p=0.014) but not the 5-year change in WM. However, the 5-year change in WML predicted only HLH-PA (beta=-0.12, p=0.017) but not baseline WML. Conversely, the 5-year change in GM (beta=-0.13, p=0.015) and baseline WM (beta=-0.13, p=0.029) predicted sedentary time. Adjustments for baseline PA according to questionnaire did not change the above relationships. **Discussion** The results suggest that brain atrophies negatively affects PA in older adults. However, the causality is unclear as PA has positive effects on cognitive functions (Smith et al., 2010) and the older adults with more PA may slow the changes in the brain anatomy. **References** 1. Harris TB, Launer LJ, Eiriksdottir G, et al. (2007) *Am J Epidemiol.* 165(9):1076-87. 2. Arnardottir NY, Koster A, Van Domelen DR, et al. (2013) *Age Ageing* (in press) 3. Smith PJ, Blumenthal JA, Hoffman BM, et al. (2010) *Psychosom Med.* 72(3):239-52.

14:00 - 15:00

### Mini-Orals

#### PP-PM24 Neuromuscular Physiology [PH] 2

### ELECTROENCEPHALOGRAPHIC CHARACTERISTICS OF DIFFERENT MOVEMENT PARAMETERS DURING A COMPLEX SENSORIMOTOR TASK

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**Introduction** Movement quality is a key determinant for success in many different sports. However, until now only little is known about the central mechanisms of movement control. The currently available literature on cortical processes associated with movement is limited to simple movements with small muscular activity. Considering the motor requirements of many daily life tasks as well as in sports, these movements are not representative and control processes may differ significantly in more complex movements which usually involve a larger muscle mass and are more dynamic. **Methods** Twelve male subjects were asked to perform 30 counter-movement jumps, respectively. EEG was recorded over sensorimotor areas of the cortex and spectral power was analyzed using band-pass-Filter. Alpha, beta and gamma frequency bands were defined based on individual frequency characteristics. The entire period of movement was further subdivided into different segments based on the ground reaction force. For statistical analysis log-transformed electrical power values were calculated for the electrodes overlying the functional leg/foot region of the primary motor cortex. Results We found a desynchronization (ERD) in the alpha and beta frequency bands before movement onset while the gamma frequency band remained unchanged. During movement execution beta and gamma power increased significantly with maximum values within the segment prior to toe off. After landing, beta power decreased to baseline level within one second while gamma power remained elevated for about two seconds. These effects revealed broad band characteristics rather than narrow reactive frequencies. **Discussion** The present study provides first insights into the electrocortical characteristics of a complex whole-body movement task. Our results suggest common processes in the primary sensorimotor cortex preceding simple and complex movements that are reflected by the alpha and beta ERD. However, during actual movement execution significant differences were present when compared to the literature on simple isolated limb movements reflected by the beta ERS during movement and the absence of a beta ERS after movement offset. The combined beta and gamma changes during jumping were interpreted to reflect different feedback processing and binding of information based on the 'binding by synchronization' hypothesis.

### COMPARISON OF LOWER LIMBS TORQUE PRODUCTION IN PARKINSON DISEASE

Vieira, A., Fischer, B.L., Homem, R.C.P.P., Akira, V., Resende, L.C., Tavares, D.P., Paulista, H.R., Bottaro, M., Lima, R.M., Oliveira, R.J.

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One of the earliest manifestations of Parkinson's Disease (PD) is the clinical condition characterized by more pronounced unilateral impairment, which cause a decrease in functional capacity and disability. By the way, few studies have examined the effects between this

characteristic and lower limbs torque production in this population. **PURPOSE:** To evaluate the differences in torque production between the more involved lower limb (MILL) and less involved lower limb (LILL) in PD subjects. **METHODS:** 41 PD subjects ( $67 \pm 13.79$  years,  $161 \text{ cm} \pm 0.64 \text{ cm}$ ,  $70.7 \pm 13.97 \text{ kg}$ ), evaluated by the UPDRS (section 3), stages 1 to 3 of Hoehn and Yahr scale, were submitted to a concentric isokinetic knee extension (Biodex System 3 Isokinetic Dynamometer) using a protocol composed of one warm up set (10 repetitions at  $120.\text{s}^{-1}$ ) and two evaluation sets (4 repetitions at  $60.\text{s}^{-1}$ ) with one minute interval after each set. **RESULTS:** One-way ANOVA did not demonstrated significant differences between MILL and LILL for absolute peak torque ( $\Delta = 14 \text{ N/m}$ ;  $\Delta\% = 8.68\%$ ;  $p = 0.5864$ ), average torque ( $\Delta = 9.9 \text{ N/m}$ ;  $\Delta\% = 9.3\%$ ;  $p = 0.5139$ ) and relative peak torque ( $\Delta = 4.5\%$  of bodyweight;  $\Delta\% = 2.41\%$ ;  $p = 0.5864$ ). **CONCLUSION:** Our results demonstrated that despite subjects with PD have more pronounced unilateral impairment, the torque production between MILL and LILL are equal.

### EFFECT OF A 103-KM MOUNTAIN TRAIL-RUNNING RACE ON CORTICOSPINAL VOLUNTARY ACTIVATION AND EXCITABILITY

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**Introduction** The well-established central deficit in ultra-endurance running races (Millet et al. 2011) is poorly understood. The use of transcranial magnetic stimulation (TMS) in parallel with peripheral nerve stimulation provides greater insight into the source of these central changes. The aims of this study were to determine the presence and magnitude of corticospinal and peripheral voluntary activation deficits after completion of a mountain trail-running race and whether there are simultaneous changes in corticospinal excitability and intracortical inhibition. **Methods** Neuromuscular function was evaluated before and after a 103-km mountain trail-running race ( $20:25:30 \pm 3:28:55$ ) in 27 experienced endurance trail runners (15 men, 12 women;  $43 \pm 9$  years;  $66 \pm 11 \text{ kg}$ ;  $\text{VO}_2\text{max}: 56 \pm 6 \text{ ml}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$ ). Subjects performed maximal voluntary isometric contractions (MVC) of the knee extensors with electrical stimulation of the femoral nerve (single and paired 100-Hz stimuli) delivered at rest and during MVC to evaluate peripheral voluntary activation (VAp) and maximal vastus lateralis (VL) M-wave. TMS was also delivered during sets of voluntary isometric contractions at 100, 75 and 50% MVC to calculate estimated resting twitch, cortical voluntary activation (VAc), motor-evoked potential (MEP) amplitude and cortical silent period (CSP) duration in VL. MEPs were normalized to maximal VL M-wave. Variables were analyzed by paired t-test with significance at 0.05. **Results** There was a 37% decrease in MVC post-race ( $P < 0.001$ ), coinciding with decreased VAc (92 to 78%) and VAp (91 to 67%) (both  $P < 0.001$ ). There was a significant correlation between  $\Delta\text{VAp}$  and  $\Delta\text{VAc}$  ( $r = 0.83$ ;  $P < 0.001$ ). VL MEP amplitude at 100% MVC was increased post-race ( $P < 0.05$ ). There were no differences in MEP amplitude at 50 or 75% MVC nor in CSP duration at any contraction intensity pre- to post-race ( $P > 0.05$ ). **Discussion** The changes in cortical and peripheral VA indicate a serious inability of the corticospinal pathway to maximally drive the muscles after an endurance mountain trail-running race. This was not explained by changes in intracortical inhibition. Increased corticospinal excitability was observed post-race during maximal contractions but not during submaximal effort at the same relative intensity as pre-race, suggesting a hypothetical link between increased corticospinal excitability and decreased VA at maximal effort. **References** Millet GY, Tomazin K, Verges S, Vincent C, Bonnefoy R, Boisson RC, Gergele L, Feasson L, Martin V. (2011) PLoS One, 6, e17059.

### ACTION DIRECTION OF MUSCLES DURING MULTI-DIRECTIONAL ACTIVITIES IN 3-DIMENSIONAL FORCE SPACE

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**Introduction** The central nervous system is expected to activate the relevant muscles based on their mechanical actions to produce the desired endpoint force (Kuo, 1994). The torques, however, are generated on complicated interaction among neighboring muscles, so it is required to examine the net contributions of muscles to endpoint forces (referred to as 'action direction [AD]') in various configurations. In this study, we estimated the ADs of muscles during multi-directional voluntary isometric force-generating tasks in 3-dimensional force space. **Methods** Each subject lay on their left side on a bed with the right leg supported horizontally by a sling. The knee and hip joint were applied with the angles of  $90^\circ$  from full extension. Isometric endpoint forces surrounding the right ankle were produced for 10 s at two different intensities (20 N and 40 N) in each of 32 different directions in 3-dimensional space, which were composed of three force vectors referring to anatomical hip adduction-abduction, knee extension and hip flexion directions, respectively. The subjects viewed the desired force as a target on a visual display. Surface electromyograms (EMGs) were recorded from quadriceps muscles. The AD is based on a cross-correlation of each rectified EMG and force component. According to three correlation coefficients, which peak time lag was defined from 0 to 200 ms, the AD in the 3-dimensional space was determined across each trial. **Results** The ADs of vastus lateralis (VL), vastus medialis longus (VML) and vastus intermedius (VI) as mono-articular knee extensors, dominated not only knee extension but hip flexion torques and were furthermore not corresponding to each other despite functionally similar muscles. Additionally, the ADs of the knee extensors containing the rectus femoris (RF) as bi-articular muscle showed not only the directions on sagittal plane but either medial or lateral direction. Interestingly, variability of ADs for all muscles was also observed across each trial. **Discussions** The contribution of off-axis torques or misalignment of functionally similar muscles might come from the complex interaction between each muscle and bi-articular muscle, RF (Nozaki et al., 2005), or the neighboring muscle based on the different characteristics in their architecture (Akima et al., 2000). The variability of ADs was suggested to be involved with the change of the interaction among muscles depending on desired endpoint forces and make it possible to generate flexible forces in a high degree of freedom. **References** Akima H, Kubo K, Kanehisa H, Suzuki Y, Gunji A, Fukunaga T. (2000). Eur J Appl Physiol, 82: 30-38. Kuo AD. (1994). Hum Move Sci, 13: 635-663. Nozaki D, Nakazawa K, Akai M. (2005). J Neurophysiol, 93: 2614-2624.

### POTENTIATION OF ELECTROMYOGRAPHIC ACTIVITIES OF THE PLANTAR FLEXOR BY ANTAGONIST CONDITIONING CONTRACTION AND JUMP

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**Introduction** Preceding antagonist conditioning contraction (ACC) has been shown to potentiate agonist contraction force, electromyography (EMG) activity, and other agonist outputs (Sale, 1986). Previously, we showed that the rate of rise of EMG activity was increased by isometric ACC (Kamimura et al, 2009). However, the neural influence on muscle activities of plantar flexors in dynamic ACC has not been

clarified. In addition, whether plantar flexor activities in loaded conditions were affected by ACC was not clear. The purpose of this study was to examine whether plantar flexor activities were potentiated by the dynamic ACC in a standing position and to clarify the involvement of neural factors. Methods Twelve male subjects performed three experimental trials five times for each: plantar flexion in a standing position (control), plantar flexion immediately after dorsi flexion in a standing position (ACC), and continuous jump at toe. The plantar flexion in control and ACC trials was done maximally. In the ACC trials, the plantar flexion was done immediately after maximal dorsi flexion of less than one second. Surface EMG signals were recorded from the gastrocnemius medialis, and integrated EMG (iEMG) and median power frequency (MdPF) of the EMG signals during the plantar flexion phase were calculated. To calculate the rate of the EMG amplitude development (RED), the absolute values of EMG amplitude signal were numerically filtered and differentiated. The statistical analysis was done using Kruskal-Wallis and Steel-Dwass tests. Results The magnitude of iEMG during plantar flexion phase in jump trial was significantly larger than that of control, whereas that in ACC trial was not. In contrast, the value of MdPF in ACC trial, but not in jump trial, was significantly larger than that of control. Both the values of RED in ACC and jump trials were significantly larger than that of control. No significant difference was observed between the RED of jump and ACC trials. Discussion Among the three EMG activities of the plantar flexor tested in this study, RED was potentiated in both ACC and jump trials, suggesting involvement of neural factors in the potentiation. However, iEMG was potentiated only in jump trial, whereas MdPF was potentiated only in ACC trial. It was suggested that the proprioceptive stretch reflex might primarily contribute to the potentiation in jump trial, whereas other neural factors such as Golgi tendon organ reflex originated from antagonist muscles might be involved in the potentiation observed in ACC trial. Reference Sale DG. (1986). Human Muscle Power. 289–307. Champaign, IL: Human Kinetics. Kamimura T, Yoshioka K, Ito S, Kusakabe T. (2009). Human Movement Science. 28, 407–414.

### PREFRONTAL CORTEX OXYGENATION AND ELECTROCORTICAL ACTIVITY DURING INCREMENTAL BICYCLE EXERCISE

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Introduction Decreased prefrontal cortex (PFC) oxygenation was postulated to reflect impaired PFC function contributing to central mediated fatigue during high intensity exercise. In hypoxia, oxygenation saturation within the PFC is known to be reduced and assumed to go along with decreased brain activity playing a role in earlier occurring fatigue. Near-infrared spectroscopy (NIRS) has mainly been used for the examination of PFC oxygenation situation, which is supposed to reflect neural activity indirectly, however so far no exercise study exists investigating hemodynamic (NIRS) and electro cortical activity (EEG) synchronously to shed light on their correlation. Methods Eight sport students commenced an incremental bicycle exercise test at 50 Watts (W) increased by 50 W at any five minutes under normoxic and hypoxic (12.7 kPa PIO<sub>2</sub>) conditions respectively. Before, during and after exercise EEG and NIRS recordings of the left and right PFC Brodmann area (BA) 10 and 46 were performed synchronously. ANOVA for repeated measures was used to compare mean EEG and NIRS values of the last twelve minutes of exercise to pre and post exercise as well as between conditions and hemispheres. Results Under normoxic conditions, higher absolute workload (231.3± 37.2 W), and relative PFC oxygenation (oxygenated- (O<sub>2</sub>Hb): 8.82± 9.57; deoxygenated- (HHb): 3.04± 3.19) were observed, whereas hypoxic conditions resulted in earlier exhaustion (200± 26.7 W) and reduced PFC oxygenation (O<sub>2</sub>Hb: -1.49± 3.02; HHb: 6.56± 3.05). Hemodynamic parameters increased remarkably with exercise intensity (p< .001) and differed between conditions (O<sub>2</sub>Hb: p< .001; HHb: p=.021) and hemispheres (O<sub>2</sub>Hb: p=.047). For EEG cortical source density within PFC BA10 and BA46, higher values during compared to pre and post exercise (p< .001) and an interaction between hemisphere and condition (BA10 p=.007; BA46 p=.017) indicating a shift of electro cortical activity from left towards right hemispheric activation from normoxia to hypoxia were revealed. No correlation between NIRS and EEG but between NIRS and heart rate were found. Discussion The results shed light on the correlation between two different methods for brain imaging during high-intensity exercise and emphasize that transferability of results between methods need to be done with caution. NIRS signal is supposed to be predominated by systemic hemodynamic changes during exercise overlaying changes attributable to neural activity. Reduced performance in hypoxia was accompanied by lower left-sided and higher right-sided PFC activity. Results are discussed in relation to the proposed frontal asymmetry model.

### SPECIFIC FEATURES OF EXCITABILITY OF CENTRAL AND PERIPHERIC PARTS OF NEUROMUSCULAR SYSTEMS OF ATHLETES IN THE TRAINING CYCLE

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Introduction Investigation of the mechanisms of neuronal adaptation of central and peripheral sections of neuromuscular systems of athletes under the influence of training and competitive loads is of great importance for practical sports. Methods and subjects 8 (males) middle - distance runners (ages 18 -21) took part in the research. Motor-evoked potentials (MEP) of leg muscles by transcranial magnetic stimulation (TMS), posterior root-muscle reflexes (PRM-reflex) of these muscles by electrical stimulation of the spinal cord at T11-T12 and M-wave were registered at rest. Single stimulus (1ms long) were used for the stimulation. Thresholds and amplitudes MEP m. soleus, m. tibialis anterior, m. gastrocnemius were analysed. Results Thresholds and maximum amplitude MEP have been changed during the training cycle. The most significant changes occurred in the competitive period. Thresholds of MEP under TMS were raised before the competitions and were decreased after them, thresholds of PRM-reflex had opposite changes. The amplitude of MEP under stimulation of motor cortex and amplitude of PRM-reflex increased before the competitions and reduced after them. The amplitude of M-wave varied insignificantly. Conclusion. There are the processes of the specific neuronal adaptation, under the influence of a focused training, which were more pronounced at the supraspinal and spinal levels. The results of the study can be used in practice of sports to control the efficiency of the training, and to evaluate degree of adaptation to muscle work. References Minassian K., Persy F., Rattay F., Dimitrijevic M.R., Hofer C., Kern H. Posterior root-muscle reflexes elicited by transcutaneous stimulation of the human lumbosacral cord// Muscle Nerve.2007 Mar;35 (3): 327-36. Leukel C, Taube W, Beck S, Schubert M. Pathway-specific plasticity in the human spinal cord// Eur J Neurosci. 2012 May;35(10):1622-9.

### ESTABLISHING CRITICAL TORQUE DURING AN INCREMENTAL TEST OF INTERMITTENT ISOMETRIC KNEE EXTENSIONS

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For every exercise there is a critical intensity above which output can not be maintained for a long time (30-60 min) without progressive fatigue. Establishing this critical exercise intensity is time consuming and difficult to perform as it involves a series of exhausting exercise

tests performed at different intensities and days (e.g. Burnley, 2009). However, during muscle function testing, strenuous exercise may be problematic for fragile subjects and patients. Moreover, also in healthy individuals the occurrence of central fatigue may affect estimated critical torque. Recently de Ruiter et al. (2012) showed that during 5 min bouts of sub maximal isometric knee extensor contractions (3s with 2s rest in between), the highest torque level during which EMG and muscle oxygenation remained stable (fatigue threshold, FT) was related to aerobic training status (VO<sub>2</sub>-max). In that study bouts of different intensities were applied in random order, with the risk of inducing early fatigue that may affect the test outcome. We hypothesize that the FT can also be established during an incremental test and that this FT signifies a critical exercise intensity that can be sustained for at least 30 min with ratings of perceived exertion (RPE)<8. Starting at 25% MVC (3s with 2s rest in between, 90 deg knee angle), for 10 subjects (~25yr, 6 male) torque was increased in steps of 5 % MVC every 5 minutes until failure. In each subject, the ratio of rectified surface EMG (mean values of the 3 superficial knee extensor muscle heads) over Torque Time Integral (TTI) was averaged over 6 consecutive contractions and values were subsequently expressed as a percentage of the first value at 25% MVC. The highest intensity for which EMG/TTI did not increase more than 10% during the 5 min (linear regression) was defined the fatigue threshold. FT (mean±sd) was reached at 39.0 ± 6.1% MVC (RPE: 5.8±1.8), which was 15.5 ± 5.0 % MVC below torque failure. With two additional measurements on different days and in a double blinded set up, for 5 subjects sustainable torque (ST; 30min completed with RPE<8) was subsequently found to be the same as FT, while for the others ST was 5% MVC higher than FT. We conclude that during repetitive isometric contractions a critical intensity, at which torque can be sustained for 30 minutes with limited signs of fatigue, can objectively be established using a sub maximal incremental test that does not require participants to go all out. M Burnley (2009) Estimation of critical torque using intermittent isometric maximal voluntary contractions of the quadriceps in humans. *J Appl Physiol* 106:975-983. CJ de Ruiter et al. (2012) Knee extensor fatigue threshold is related to whole body VO<sub>2</sub>max. *Med Sci Sports Exerc* 44(7): 1366-74.

### INTERACTION OF CENTRAL AND PERIPHERAL FACTORS DURING REPEATED SPRINTS AT DIFFERENT LEVELS OF ARTERIAL SATURATION

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**Introduction** We investigated the effects of arterial hypoxemia on muscle recruitment, functional performance and the development of peripheral locomotor muscle fatigue during repeated-sprint exercise (RSE). **Methods** In a single-blind, randomised and cross-over design, ten team-sport male athletes performed two RSE (fifteen 5-s cycling sprints with 25 s of rest; power self-selected) in normoxia and in acute moderate hypoxia (FIO<sub>2</sub> 0.138). Mechanical work, total electromyographic intensity (summed quadriceps electromyograms, RMSsum) and muscle (vastus lateralis) and pre-frontal cortex near-infrared spectroscopy (NIRS) parameters were calculated for every sprint. Blood lactate concentration ([Lac-]) was measured throughout the protocol. Peripheral quadriceps fatigue was assessed within 45 s post-exercise via changes in potentiated quadriceps twitch force ( $\Delta Q_{tw,pot}$ ) pre- versus post-exercise in response to supra-maximal magnetic femoral nerve stimulation. The central activation ratio (QCAR) was used to quantify completeness of quadriceps activation. **Results** Compared with normoxia, hypoxia reduced arterial oxygen saturation (-13.7%, P=0.001), quadriceps RMSsum (-13.7%, P=0.022), QCAR (-3.3%, P=0.041), and total mechanical work (-8.3%, P=0.019). However, the magnitude of quadriceps fatigue induced by RSE was similar in the two conditions ( $\Delta Q_{tw,pot}$ : -53.5% and -55.1%, P=0.71). Performance reduction in hypoxia occurred despite similar metabolic (muscle NIRS parameters and [Lac-]) and functional (twitch and M-wave) muscle states. **Conclusion** These results suggest that quadriceps muscle recruitment and cycling performance during intermittent, short sprints may be regulated to limit the development of quadriceps muscle fatigue. This finding supports the role of the interaction between muscular perturbations and neural adjustments in the regulation of high-intensity, whole-body exercise.

### EFFECTS OF FINGERTIP LIGHT TOUCH ON HUMAN WALKING ON THE GROUND

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**Introduction** Previous studies have shown that fingertip light touch to a fixed surface substantially reduces postural sway during quiet standing (Jeka and Lackner, 1994), due to an enhanced somatosensory feedback (Kouzaki and Masani, 2008; Kimura et al., 2012). To further shed light on this additional feedback, we examined the effects of the fingertip light touch on the posture of walking on the ground. **Methods** Twelve young subjects (20-26 yrs) volunteered for two experiments. In Exp 1, they walked straight for 16 m at their comfortable velocity, in a measurement room. In the light touch trial, the subject lightly (less than 2.0 N) touched a handrail, with his/her index finger of the right hand. A force transducer attached on the fingertip measured the touch force online. The experimental conditions with and without light touch (LT and CON) were conducted. Also, in each experimental condition, the eyes-open (EO) and eyes-closed (EC) trials were performed. The four trials were, respectively, repeated three times, in pseudo-random order. A triaxial-accelerometer was attached on the subject's back. The height of the accelerometer was adjusted to the third lumbar vertebra. A pair of foot switches was attached on the soles of the feet. As the Exp 1 eliminated the effect of fingertip tactile sensation, the additional experiment was performed (Exp 2). The handrail in the Exp 1 was replaced by a water way, positioned at about the same height as the handrail. The subject dipped the index finger into the water during walking, in a manner similar to that employed in the Exp 1, while the force transducer on the fingertip had been removed. **Results and Discussion** In the Exp 1, the average number of footsteps in the 16 m was not different between LT and CON trials. On the other hand, it was found that, in each of the EO and EC conditions, the LT significantly reduced the average amplitude of the acceleration of the third lumbar vertebra in the mediolateral direction (P<0.05). Also, in the Exp 2, the light touch to the water significantly reduced the average amplitude of the mediolateral acceleration (P<0.05). In the Exp 1, the additional feedback of the body orientation may be accounted for mainly by the proprioception of upper limb. And, in the Exp 2, the effect of the finger tactile sense was also confirmed. These results suggest that the somatosensation, including the proprioception and the tactile sense, can enhance the postural stability during normal walking on the ground, as well as the quiet standing. **References** Jeka JJ, Lackner JR. (1994). *Exp Brain Res*, 100, 495-502. Kimura T, Kouzaki M, Masani K, Moritani T. (2012). *Neurosci Lett*, 506, 100-103. Kouzaki M, Masani K. (2008). *Exp Brain Res*, 188, 153-158.

**UNILATERAL LEG PRESS FATIGUE INFLUENCES INTRACORTICAL EXCITABILITY IN NONEXERCISED HAND MUSCLES**

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Objective It has recently been demonstrated that exhaustive unilateral fatiguing exercises not only affects the motor area innervating exercising muscles but also the ipsilateral motor area innervating nonexercised muscles. The aim of this study was to examine whether exhaustive unilateral leg press exercise affects intracortical excitability of the motor cortex representation of nonexercised hand muscles. Methods Two experiments were performed. In the first experiment, 8 subjects performed an intermittent right leg press exercise composed of 3 bouts of 5-min leg presses at 50% maximal voluntary contraction, each separated by a 2-min period of rest and followed by a 30-min period of recovery. Single- and paired-pulse transcranial magnetic stimulation (TMS) were applied to evoke responses in the non-exercised right first dorsal interosseous (FDI) muscle before and immediately after each bout of exercise; TMS was also applied during recovery. Inhibitory (3 ms) and facilitatory (10 ms) interstimulus intervals were randomly intermixed with the test stimulus. In the second experiment, 6 subjects underwent TMS to the left FDI muscle by using the same experiment design as experiment 1. Results Short-interval intracortical inhibition (SICI) of the right and left FDI muscle gradually decreased with the exercise time, and was maximal 5 min into the recovery period. Intracortical facilitation (ICF) also gradually decreased with the exercise time; however, it was unchanged during the recovery period. The rate of change of both SICI and ICF in the right FDI muscle was larger than that in the left FDI muscle. Conclusions Exhaustive unilateral leg press exercise influences the intracortical excitability of the motor area innervating the right and left FDI muscles. Furthermore, our findings suggest that it induces more significant change in the ipsilateral hand muscle than the contralateral hand muscle.

**EFFECT OF PRESSURE INTENSITY OF GRADUATED ELASTIC COMPRESSION TIGHT ON MUSCLE FATIGUE DURING RUNNING**

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*Waseda University*

Elastic compression garments such as tights and stockings are widely used for the improvement of sports performance. Although previous studies have examined the effect of wearing compression garments during submaximal running exercise on oxygen consumption, blood lactate level and time to exhaustion, the findings are not consistent. One of the possible reasons for the inconsistent findings is the pressure intensity exerted by the compression garments. It has been shown that the elastic compression garment with adequate pressure can relieve a decline in muscle force generating capacity (i.e., muscle fatigue) during repetitive muscle contractions (Miyamoto et al. 2011). They suggested the smaller accumulation of metabolites such as inorganic phosphate and proton as possible mechanisms for the reduced muscle fatigue. However, it remains unclear. The purpose of the present study was to examine the effect of pressure intensity of elastic compression tight on the extent of muscle fatigue of the thigh muscles during running, by using magnetic resonance (MR) T2-weighted imaging which is sensitive to accumulation of lactate, inorganic phosphate, and proton. Methods Eleven subjects performed three treadmill tests consisting of 4.5-min warm-up and 30-min running at 12 km/h on separate days; two kinds of elastic compression tights (one (LOW) with  $1.08 \pm 0.20$  kPa at 50% regions of the thigh length and the other (HIGH) with  $1.94 \pm 0.44$  kPa at the same regions, respectively) and non-elastic compression tight as a control (CON). Before and after the exercise, MR-T2 images of the thigh were recorded without the tights (TE: 25, 50, 75, 100 ms; TR: 2000 ms; Matrix:  $256 \times 256$ ; FOV:  $240 \times 240$  mm; Slice thickness: 10 mm; Gap: 20mm). From each image, the T2 values of four knee extensors (vastus lateralis, vastus medialis, vastus intermedius, rectus femoris), three knee flexors (short and long heads of the biceps femoris, semitendinosus, semimembranosus), two hip adductors (adductor magnus and longus) were computed. For T2 values of each muscle, separate 2-way ANOVAs with repeated measures (time (before, after)  $\times$  condition (CON, LOW, HIGH)) and post-hoc tests were performed. Results and Discussion In almost all knee flexors and hip adductors, the T2 values were significantly increased after the 30-min running at 12 km/h. For the biceps femoris, semimembranosus, adductor magnus, and adductor longus, 2-way ANOVAs revealed significant condition  $\times$  time interaction, and post-hoc tests showed that the T2 values after running in HIGH condition were significantly smaller than those in CON conditions. These results indicate that wearing an elastic compression tight with adequate pressure intensity during running can relieve the accumulation of metabolites. References Miyamoto N, Hirata K, Mitsukawa N, Yanai T, Kawakami Y (2011). J Electromyogr Kinesiol 21(2):249-254.

**14:00 - 15:00****Mini-Orals****PP-PM69 Training and Testing [TT] 4****TRAINING RECOMMENDATIONS FOR THE DEVELOPMENT OF TORQUE, POWER AND ACCELERATION IN MEN AND WOMEN BASED ON MULTIVARIATE STRUCTURAL EQUATION MODELS**

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Do not insert authors here Introduction Structural equation modeling (SEM) is analogous to multiple regression but is a more powerful statistical method as it can evaluate the modeling of more complex interactions, nonlinearities, correlated independent variables, measurement error, correlated and uncorrelated error terms and multiple latent independents or factors, each measured by multiple indicators (Hair et al., 2010; Arbuckle, 2009; Heazlewood & Boutagy, 2010). Research aim was to evaluate using structural equation modelling more complex relationships between strength-torque, power and sprint acceleration in both genders. Methods The sample was physically fit males (n=32) and females (n=28). The exogenous variables in the model were isokinetic peak torque (N.m) at isokinetic speeds of 60os-1, 180os-1 and 300os-1 using leg extension/flexion. The endogenous variables were vertical jump (flight time (s)), peak vertical height (m) and jump contact time (s) and 10m (s) acceleration sprint. Isokinetic torque, power, work and fatigue index were measured using a HUMAC NORM - CYBEX 340. Statistical analysis was AMOS 18 software (Arbuckle, 2009) to solve the structural equations and path mod-

els. Results It was observed the relationship for jump height to sprint time is significantly more important for males (coefficient = -.82) than for females (coefficient = -.47). The path coefficients from peak torque are more significant for males at 600s-1, however peak torque at 1800s-1 and 3000s-1 were similar for gender. The significant indirect effect is the peak torque leg extension for 600s-1 on 10m sprint performance mediated via the vertical jump for males, whereas in females this effect was not significant. Analysis assessing the congruence between the two path models indicated significant difference between genders. This was attributed to the significant direct effect between vertical jump height and 10m sprint in males and the gender difference for the indirect effect of peak torque leg extension for 600s-1 on 10m sprint. Discussion Different interactions between strength-torque, power and acceleration ability were evident between genders. The significant indirect path of isokinetic peak torque for leg extension for 600s-1 influencing 10m acceleration ability via power ability in males when contrasted with this non-significant path in females has implications for training. Males should gain improvement from both high resisted strength training coupled with specific jump power training to enhance acceleration whereas females would gain more by training with power and sprint acceleration activities. References Arbuckle J (2009). AMOS 18 Users Guide. SPSS Inc, Chi

### **THE ISAF AEROBIC FITNESS TEST. A TRIAL INTO THE VALIDATION OF A CARDIO-RESPIRATORY ENDURANCE TEST FOR FOOTBALL PLAYERS**

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*University of Greenwich*

Introduction & Objective The intermittence and the random nature of football games make any specific physiological assessment quite harder comparing to any "cyclic" sports. This study is part of a series of investigations within the process of a new aerobic fitness test validation: the "ISAF aerobic fitness test" (International Science And Football Association). It aims to compare the cardio-respiratory and metabolic variables between two gradually increasing maximal tests: a random and a standardised one that contain specific football skills Method 22 male football players took part in this stage [23.3 (4.4) yrs, 80.1 (9.2) kg, 180 (1) cm]. Each subject performed two trials based on the YoYo test: a standardised test and a randomised one. Running speed increased every 2 min. Footballers performed selected skills signalled by audio stimulus while running, either in standard order or randomised during two different occasions (running forward & backward, jumping, changing directions, ball work). Gas exchange (VO<sub>2</sub>; VCO<sub>2</sub>) and heart rate (HR) were continuously measured using portable gas analyser (MetaMax). Blood lactate (BL) before and after the test was also measured using Analox Lactate analyser. Data were compared using a one-way ANOVA for repeated measures followed by a post hoc Fisher for cell-to-cell comparison. Results and discussion Sharp linear increase of the HR and VCO<sub>2</sub> have been noticed at the start of both tests. HR continued to slightly increase until exhaustion reaching maximal values around 190 bpm with no significant difference between the trials. VO<sub>2</sub> showed a more obvious linear increase during the randomised test compared to the standard one, reaching significantly different values around 45 and 35 ml/kg/min respectively (p<.05). The rate of the expiratory ratio (RER) was significantly higher during the randomised test compared to the standardised one (p<.05), reaching 1.47 and 1.19 respectively. Maximal BL was average around 4 mmol/l, with no difference between the trials. Conclusion Both trials have led to the footballers' maximal cardiovascular abilities. They have however affected them differently from the respiratory system point of view, with a clear difference between the VO<sub>2</sub> maxs achieved. The metabolic response seems nevertheless quite reduced within both tests. Note: the results above are the very early stage of data collection; we are currently continuing the investigations and more footballers are being tested. More work will be done within the validation process including variation and reliability assessment within each trial and reproducibility. References Kemi, O. J., Hoff, J., Engen, L. C., Helgerud, J., & Wisløff, U. (2003). Soccer specific testing of maximal oxygen uptake. *J Sports Med Phys Fitness*, 43(2), 139-144. Vahedi A, Jemni M. (2011) Developing a cardio respiratory endurance fitness test for football players. In: Jemni M, Bianco A, Palma A, Eds; 1st International Week of Football. 15-17 April 2011, Palermo, Italy. CONI publications ISBN 978 - 88 - 905268-2-4

### **STAR EXCURSION BALANCE TEST AND SINGLE-LEG DROP JUMP TEST FOR THE ANALYSIS OF DYNAMIC STABILITY: WHAT IS THE RELATIONSHIP BETWEEN THEM?**

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Introduction Several analysis tools have been described to evaluate balance in humans. Among these tools, we highlighted two dynamic tests widely used in sport injury prevention: the Star Excursion Balance Test (SEBT) and a single-leg drop jump (SLDJ) test on a force platform. We have hypothesized that there could be a relationship between both tests. In this study, we evaluated the relationship between the SEBT and the force platform in terms of dynamic balance. Methods Fifteen male subjects were evaluated (age 14.9±0.915, height 181.025±8.97, weight 67.34±11.83). Six attempts were recorded in the posterior-medial (PM) and posterior (P) directions for the SEBT, and 3 attempts for the drop jump test from a 20cm high landing on a portable extensometric force platform (MuscleLab 4000TM), sampled at 100Hz. Different variables related to the centre of pressure (COP) were assessed: anterior/posterior COP displacement, middle/lateral COP acceleration and anterior/posterior COP acceleration. One-minute rest was given between every test. During the landing test, subjects were instructed to let themselves drop (without jumping) with their hands on their waist. Kendall's tau and Spearman's rho were used to analyse the correlation. Results Measurements for PM direction correlated with the anterior/posterior COP displacement, the acceleration of the COP middle/lateral and anterior/posterior were significant (p=0.029/p=0.047/p=0.029) (p=0.039/p=0.023/p=0.039) and for P direction correlated with the anterior/posterior COP displacement, the acceleration of the COP middle/lateral and anterior/posterior were significant (p=0.015/p=0.042/p=0.015) (p=0.046/p=0.046) except for P direction correlated with the acceleration of the COP middle/lateral (p=0.064) Discussion We used the SEBT PL and P directions as they seem to have more impact on the dynamic balance (Olmsted et al., 2002), and we compared the results to the test platform (Ross, Guskiewicz and Yu, 2005). According to our results, we can suggest that the longer the measurement the participants got on the SEBT, the better dynamic stability was observed on the platform test for the anterior/posterior displacement of COP and the anterior/posterior acceleration of the COP. Despite the relative small sample size, we can suggest the possibility of evaluating balance using the SEBT, which is an easy, economic and reliable tool instead of other expensive items, especially when the institution cannot afford it. References Olmsted LC, Garcia C, Hertel J, Shultz S (2002). *J Athl Train*, 37(4), 501-6. Ross SE, Guskiewicz KM, Yu B (2005) *J Athl Train*, 40(4), 298-304.

## VO<sub>2</sub> PEAK MEASURED DURING 200 M IS NOT DIFFERENT FROM THAT CALCULATED WITH A NEW MODEL AFTER A 200-M MAXIMAL SWIM

Chaverri, D.1, Iglesias, X.1, Barrero, A.1, Schuller, T.2, Štrumbel, B.3, Hoffmann, U.2, Rodríguez, F.A.1

1: GRCE, INEFC-Barcelona, Universitat de Barcelona (Spain), 2: Institut für Physiologie und Anatomie, Deutsche Sporthochschule Köln (Germany), 3: University of Ljubljana (Slovenia)

**Introduction** Measuring V<sub>O</sub>2 during swimming is a complex and cumbersome procedure. Backward extrapolation (BE) is often used for estimating V<sub>O</sub>2 during exercise, but error can derive from a delay at the onset of the V<sub>O</sub>2 recovery curve. We aimed to compare direct peak V<sub>O</sub>2 during an incremental test with estimated values after a free 200-m maximal swim using a new modelling procedure. **Methods** 12 elite swimmers performed an incremental test (IT) composed by 3x200 m at increasing submaximal speeds, followed by an all-out 200-m swim. V<sub>O</sub>2 was measured bxb using a portable gas analyser (K4 b2, Cosmed, Italy) connected by a respiratory snorkel. HR was measured from RR intervals (CardioSwim, Freelap, Switzerland). Peak V<sub>O</sub>2(IT) was the average of the last 20 s during the 200-m maximal swim. On a separate session, all swimmers performed a free all-out front crawl 200 m swim and gases were collected during 30 s using a Hans-Rudolph 7400 oro-nasal mask immediately afterwards. Peak vV<sub>O</sub>2(200) was the post-exercise 20-s average calculated using a mathematical model (Schuller et al., 2013). In short, virtual V<sub>O</sub>2 at time (t) of recovery [vV<sub>O</sub>2(t)] is calculated using the peak HR during the last 10 s of the swim [HR(t)] and the 1-s interpolated value at (t) [IHR(t)], multiplied by the 1-s interpolated V<sub>O</sub>2 at (t) [V<sub>O</sub>2(t)], according to:  $vV_{O2}(t) = HR(t) / HR(t) \cdot V_{O2}(t)$ . Differences between direct and estimated peak V<sub>O</sub>2 were assessed using a paired t-test and Pearson's coefficient (r) was used to examine correlation. **Results** Peak V<sub>O</sub>2(IT) (mean 3296 ±SD 629 ml•min<sup>-1</sup>) was not different from vV<sub>O</sub>2(200) (3313±651) (mean diff.=17 ml•min<sup>-1</sup>, p=0.74). Both parameters were highly correlated (r2=0.97) and the standard error of the estimate was low (SEE=170 ml•min<sup>-1</sup>). **Discussion** Montpetit et al. (1981) showed that peak V<sub>O</sub>2 estimated by BE method was not different from V<sub>O</sub>2 peak during an incremental swimming test using Douglas bags. Frequently, a delay of the V<sub>O</sub>2 recovery curve occurs and BE overestimates peak V<sub>O</sub>2 (Rodríguez, 1996). In our study no significant differences were found between directly measured peak V<sub>O</sub>2 during an incremental test and that calculated using the new model based on post-exercise V<sub>O</sub>2 measures and HR kinetics. **References** Montpetit RR, Léger LA, Lavoie JM, Cazorla G. (1981). *Eur J Appl Physiol Occup Physiol*, 47(4), 385-391. Rodríguez FA. (1999). *Biomechanics and Medicine in Swimming VIII*. Jyväskylä, Gummerus. Schuller T, Rodríguez FA, Iglesias X, Barrero A, Chaverri D, Hoffmann U. (2013) 18th ECSS Annual Congress, Barcelona.

## VALIDITY OF PEAK V<sub>O</sub>2 AFTER A MAXIMAL 400-M FREE SWIMMING TEST USING A NEW MODEL BASED ON POST-EXERCISE MEASUREMENTS AND HEART RATE KINETICS

Chaverri, D.1, Iglesias, X.1, Schuller, T.2, Barrero, A.1, Štrumbel, B.3, Hoffmann, U.2, Rodríguez, F.A.1

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**Introduction** A mathematical model based on heart rate (HR) and post-exercise V<sub>O</sub>2 measurements for estimating peak V<sub>O</sub>2 at the end of a swimming exercise has been recently implemented (Schuller et al., 2013). We aimed to ascertain the validity of direct V<sub>O</sub>2 measurements during an incremental 200-m test with modelled peak V<sub>O</sub>2 after a free 400-m maximal swimming test. **Methods** 17 elite swimmers performed 3x200 m at increasing submaximal speeds, followed by a maximal 200-m front crawl swim. V<sub>O</sub>2 was measured bxb using a portable gas analyser (K4 b2, Cosmed, Italy) connected by a respiratory snorkel. HR was measured from RR intervals (CardioSwim, Freelap, Switzerland). Peak V<sub>O</sub>2(200) was the average of the last 20 s during the 200-m swim. On a separate session, all swimmers performed an all-out front crawl 400 m swim and respiratory gases were collected during 30 s at the immediate recovery with a Hans-Rudolph 7400 oro-nasal mask. Peak vV<sub>O</sub>2(400) was the immediate post-exercise 20-s average calculated using the mathematical model proposed by Schuller et al. (2013). In short, virtual V<sub>O</sub>2 at time (t) of recovery [vV<sub>O</sub>2(t)] is calculated using the peak HR during the last 10 s of the swim [HR(t)] and the 1-s interpolated value at (t) [IHR(t)], multiplied by the 1-s interpolated V<sub>O</sub>2 at (t) [V<sub>O</sub>2(t)], according to:  $vV_{O2}(t) = HR(t) / HR(t) \cdot V_{O2}(t)$ . Differences between peak V<sub>O</sub>2(200) and vV<sub>O</sub>2(400) were assessed using a 2-tailed paired t-test, and correlation was examined using the Pearson's coefficient (R). **Results** V<sub>O</sub>2(200) (mean 3551±SD 657 ml•min<sup>-1</sup>) was not different from vV<sub>O</sub>2(400) (3535±631) (mean diff.=17ml•min<sup>-1</sup>, p=0.70). Correlation was very high (R2=0.93) and the standard error of the estimate was low (SEE=180 ml•min<sup>-1</sup>). **Discussion** Peak V<sub>O</sub>2 during an incremental test can be estimated from HR kinetics and recovery V<sub>O</sub>2 measured after a maximal 400-m test using the modelling procedure by Schuller et al. (2013). It has been shown that V<sub>O</sub>2 attained after a maximal 400-m swim does not differ from V<sub>O</sub>2max measured at maximal incremental tests on the treadmill or the cycle ergometer in competitive swimmers (Rodríguez, 2000). Therefore, we propose the testing and modelling procedure, using a maximal 200-m test with continuous HR and post-exercise V<sub>O</sub>2 measures, as a valid method for estimating V<sub>O</sub>2max in competitive swimmers. **References** Rodríguez FA. (2000). *J Sports Med Phys Fitness* 40(2), 87-95. Schuller T, Rodríguez FA, Iglesias X, Barrero A, Chaverri D, Hoffmann U. (2013) 18th ECSS Annual Congress, Barcelona.

## THE EFFECTS OF A SINGLE INTAKE OF POLYPHENOLS EXTRACTS® ON EXERCISE ENDURANCE AND RECOVERY IN HEALTHY SUBJECTS: A CONTROLLED, RANDOMIZED, CROSS-OVER, DOUBLE-BLIND STUDY VERSUS PLACEBO

Deley, G., Babault, N., Guillemet, D., Allaert, F.A.

Faculty of Sport Sciences

**Introduction** Exercising involves adaptations of all the systems of the body (pulmonary, cardiac, muscular and vascular) and this requires an increase in peripheral blood flow and a vasodilation. Among the various mediator of this vasodilation, nitric oxide (NO) is one of the most important.1 Supplements such as polyphenols are, therefore, thought to be an interesting ergogenic aid.2 To date, most of the studies regarding the effects of polyphenols investigated several weeks supplementation and vascular or blood parameters.3 The present work therefore aimed to study the effects of an acute intake of polyphenol (Vinitrox®) on physical performances. **Methods** 48 physically active men (31±6 yrs) were included in this study, composed of 3 experimental sessions interspersed with at least 7 days. During the first experimental session, subjects performed a maximal test on an ergocycle to determine their maximal aerobic power. During the 2 other testing sessions, subjects realized an endurance test at 70% of their maximal power and time to exhaustion was measured. The preceding evening and 1 hour before the endurance test, volunteers had to absorb either 2 capsules with 250mg Vinitrox® each or 2 placebo capsules according to randomization. **Results** In comparison with the placebo, there was a significant 2.5 min increase of the maximal duration of the endurance with Vinitrox® (P<0.05) corresponding to a 9.7±6.0% increase. Moreover, the maximal perceived exertion was reached 2.7 min later (+12.8±6.8%, P<0.05) with Vinitrox® than with placebo. **Discussion** As a conclusion, the results of the

present study showed beneficial effects with Vinitrox® for athletes looking for performance. Indeed, Vinitrox® appears to enhance endurance (i.e., capacity to maintain an intense effort) and delay maximal effort perceived exertion. Several mechanisms could account for these effects, and this, through its action on NO production. NO might increase muscle perfusion thanks to a direct vasodilation on vessels smooth muscle cells and to an inhibition of the adrenergic vasoconstriction.<sup>4,5</sup> This hyperemia would result in an increased oxygen availability to muscle cells allowing a greater and longer aerobic utilisation of glycogen. References 1. Bescós R, Sureda A, Tur JA, et al. *Sports Med* (2012) 42:99-117. 2. Petroczi A, Naughton DP. *J Int Soc Sports Nutr* (2010) 7:25. 3. Lafay S, Jan C, Nardon K, et al. *J Sports Sci Med* (2009) 8:468-480. 4. Maxwell AJ, Schauble E, Bernstein D, et al. *Circulation* (1998) 98:369-374. 5. Vassilakopoulos T, Deckman G, Kebbewar M, et al. *Am J Physiol Lung Cell Mol Physiol* (2003) 284:L452-457.

### HANDBALL GOALKEEPER TRAINING FOR COMPETITION AND FOR SHOOTING ANTICIPATION

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**Introduction** The importance of knowledge held by experts has been increasingly valued. Researchers can benefit if they focus on athletes who represent successful models, because these athletes have a complex knowledge inherent to the performance of their activity (Gomes & Cruz, 2006). The objectives of this study are to understand how goalkeeper's experts prepare the competition and what 'tools' they use to more accurately and earlier anticipate the shots. **Methods** Eight male international level goalkeeper experts participated in this research. All participants were submitted to tape-recorded semi-structured interviews, and the software QSR 6 was used to help the categorizing data. At the time of the interviews, all participants were competing at the highest level, they were from five different nationalities and they were also considered as one of the best in the world in their position. **Results** During preparation for competition, one of the most relevant tools used was observing opponents playing videos. This observation allowed athletes to understand opponent's actions, and therefore they could later anticipate their movements during competition. It was evident that goalkeepers use as shooting anticipation references: shooter corporal references; defenders actions; the impulse, trajectory and shooter laterality; along with their knowledge of opponent's actions. **Discussion** It becomes necessary and relevant that goalkeeper's preparation has its starting point on the characteristics of the competitive activity (Pascual, 2008). Games preparation is crucial and goalkeeper's main sources of information are: observing opponents' previous games and gaming experience between the same opponents. Shooter study and analysis, more specifically their finishing location predilections and their athletic qualities should lead the goalkeeper to capture information in order to anticipate the ball trajectory. It seems that pre-indicators information analysis can be a good basis on how to found a possible change in handball goalkeeper training methodology. If the goalkeeper is able, through training, to understand and to interiorize significant signs that the involvement of the shot gives, it will facilitate a spatiotemporal anticipation, while ensuring a high percentage of success in its anticipation. References Gomes, A. & Cruz, J. (2006). *Relação treinador-atleta e exercício da liderança no desporto: A percepção de treinadores de alta competição*. Estudos de Psicologia, 11(1), 5-15. Pascual, X. (2008). *La actividad competitiva del portero de balonmano en el alto rendimiento* (Unpublished Tese de Doutoramento). Faculdade de Ciencias da Educación e do Deporte. Universidade de Vigo.

### RELATIONSHIP BETWEEN BALANCE MEASURES AND PERFORMANCE OUTCOMES IN YOUTH AND ADULT TEAM ATHLETES

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**Introduction** Lower extremity injuries in team sports occur most frequently in the youth population aged 10 to 16. This has been explained with the lower skill level and physical performance in the less experienced, younger players (Peterson et al 2000). The objective of this study is to determine whether balance measures, that have been shown to be associated with an increased injury risk, differ between the youth and adult team athlete population. Furthermore, the relationship between balance and performance outcomes will be compared between both age groups. **Methods** Twenty-seven youth (14±1 years) and twenty-one adult (27±1 years) team athletes (soccer, hockey) without previous lower extremity injuries volunteered for participation. They performed the star excursion balance test (SEBT) and the balance error scoring system (BESS) in order to assess balance. Physical performance was measured by using the 30m sprint, standing long jump and agility (T-Test) tests. Differences between both age groups were analyzed by using ANOVA. Pearson product-moment correlation coefficients were calculated between maximum reach distances of the SEBT and BESS error scores as well as sprint time, jump distance and T-test time. **Results** Performance and balance outcomes differed significantly between both age groups. Young athletes demonstrated shorter jump distances ( $p=0.021$ ) and longer T-Test times ( $p=0.046$ ), as well as smaller SEBT reach distances ( $p<0.001$ ) and higher BESS error scores ( $p<0.001$ ). In both age groups, significant correlations ( $p<0.001$ ) were found among all performance outcomes (between  $r=-0.66$  and  $r=-0.83$ ). Performance and balance outcomes showed no significant correlation in adult athletes. In youth athletes, the BESS error score correlated negatively with jump distance ( $r=-0.50$ ;  $p=0.011$ ). **Conclusions** Youth athletes demonstrated lower scores in the balance and performance measures compared to adult athletes. This finding indicates that postural control is not fully developed in the age of 13 to 15 years which may contribute to the enhanced injury risk. The lack of correlations between most performance and balance variables in both groups also questions the hypothesis that the skill level and physical performance may contribute to postural or sensorimotor control impairments and thus, an increased injury risk. Peterson L, Junge A, Chomiak J, Graf-Baumann T, Dvorak J. Incidence of football injuries and complaints in different age groups and skill-level groups. *Am J Sports Med*. 2000;28(5 Suppl):S51-7.

### DEVICE-BASED CONTROL FOR ON-WATER TRAINING AND ROWING RACES

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**Introduction** Biomechanical diagnostics in rowing performance and technique has been conducted for many years in the German Rowing Association (DRV) using mobile measuring systems, capturing relevant data for a functional training structure (Mattes, 2012). The disadvantage in its routine daily use by coaches is the complexity of the systems which require professional installation. Accrow was developed in cooperation with movement scientists from the University of Hamburg, to provide an easy-to-use measuring-, testing and analyzing device to determine important factors of the boat motion (BM) in on-water training (WRT) and rowing races (RR), by providing sport specific design and device-requirements, and engineers from BeSB GmbH Berlin, producing the hard- and software. Accrow provides clear analysis of WRT and RR and facilitates the answering of numerous training questions. **Methods** Accrow measures and stores the boat's position and acceleration data during the rowing trip with 4-Hz-GPS (0.25% measuring error 2000m) and MEMS-acceleration

sensor 50Hz (1% accuracy,  $\pm 2g$ ) and transfers the data wireless (WLAN) in real time to an operation system (notebook or iOS device). Accrow-Live provides the coach an online data-visualization during the WRT. The evaluation software Regatta analyses the measured data and calculates different rowing-specific evaluation routines: intensity analysis for WRT, RR-profile (500-2000m) and rowing start (1.-15. rowing stroke). Rowing stroke (RS) detection proceeds on the basis of the boat acceleration (aB). For each RS, Regatta calculates the mean boat velocity (vB), stroke frequency (SF), propulsion per RS (sB), total distance traveled (sGPS) and the driving time per section (tsection). Results Accrows results are well suited for analyzing and optimizing WRT and 2000-m-RRs including its main phases (start, max. and pick-up aB, max. vB., transition phase and final-sprint) by specifying the main details of external training load (vB, SF, sB), volume (sGPS, number of strokes) and time duration (tsection). Data analysis refers to RS as well as to sB and the results were described on the basis of specialized experiences in biomechanical and physiological performance diagnostics in race rowing (tabular form and graphically) for the documentation of WRTs. Discussion Accrow analyses BM according to scientific criteria and provides a precise measuring for the performance diagnostic or for scientific studies by describing the external training intensity. In combination with results from the internal training load of physiological related performance studies (e.g. lactate-step-tests), the device facilitates the daily training routine of rowing coaches. It was validated with elite athletes from DRV and successfully implemented into the biomechanical diagnostic of the German National Rowing Team for the World Championships and Olympics. References Mattes, K. (2012). Rowing Technique. In Altenburg, D, Mattes, K. & Steinacker, J. (eds.) Manual of Rowing Training: Technique, High Performance and Planning. 2nd Ed. Limpert Verlag.

## RELATIONSHIP BETWEEN MAXIMAL ISOMETRIC STRENGTH IN UPPER AND LOWER LIMBS AND BALL VELOCITY IN THE TENNIS SERVE

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1: UVic (Vic, Spain), 2: INEFC-Lleida, UDL (Lleida, Spain), 3: UEx (Cáceres, Spain), 4: FCT (Barcelona, Spain); 5: Faculty of Sports Science, Ruhr-University Bochum (Germany).

**Introduction** The tennis serve is a highly complex stroke because of the reliance on multiple body segments to produce power through properly timed rotations and complex coordinated muscular activations, as well as the most important from a strategic standpoint (Girard et al., 2007; Elliot, 2003). Therefore, strength levels in muscles related to the serve performance seem to be an important issue. The aim of this study was to analyse the relationship between isometric strength levels in different upper and lower limb movements and serve velocity in competitive tennis players. **Methods** Twelve male competitive tennis players (mean  $\pm$  SD; age:  $17.2 \pm 1.0$  years; height:  $180.1 \pm 6.2$  cm; weight:  $71.9 \pm 5.6$  kg) participated in the study. Measurements were conducted using a strain gauge (500N) connected to a portable MuscleLab™ system, and included maximal isometric voluntary contraction (100 Hz) of the wrist flexion/extension, elbow flexion/extension, and shoulder internal/external rotation, in the dominant side, as well as leg and back extension. A radar gun (Stalker ATS 4.02, EJA) was used to measure serve velocity (i.e., best of twelve serves (six to each side)). The relationship between quantitative variables was established with a linear correlation analysis, by calculating the Pearson's linear correlation coefficient (r). A multivariate analysis was carried out using a multiple regression model (stepwise method). Results None of individual quantitative variables analysed was significantly correlated with serve velocity in any of the analysed movements. Individual correlations were found for wrist ( $p=0.076$ ) and elbow ( $p=0.08$ ) flexion/extension. Results obtained from the multivariate analysis showed that the highest relationship ( $R^2=0.484$ ) was established between serve velocity and wrist flexion/extension, shoulder flexion and internal rotation, and knee extension. Discussion The lack of relationship between strength variables analysed and serve velocity could be due to the complexity of the tennis serve motion. The serve requires a combination of limb and joint movements in order to summate and transfer forces from the ground up through the kinetic chain and out into the ball (Pugh et al., 2003). Multivariate correlation suggests that in order to be efficient in the tennis serve, isolated strength is not the only determinant factor, and the total body perspective is just as important as the individual segments alone (Kovacs & Ellenbecker, 2011). Effective servers maximally utilize their entire kinetic chain via the synchronous use of selective muscle groups, segmental rotations, and coordinated lower extremity muscle activation. References Elliot, B., Fleisig, G., Nicholls, R. & Escamilla, R. (2003). *J Sci Med Sport*, 6, 87. Girard, O., Micallef, J.P., & Millet, G.P. (2007). *J Strength Cond Res*, 21, 3. Kovacs, M. & Ellenbecker, T.S. (2011). *Sports Phys Ther*, 12:504-513. Pugh, S., Kovaleski, J., Heitman, R. & Gilley, W. (2003). *Percept Mot Skills*, 97, 867-72.

## RELATION BETWEEN METABOLIC AND PSYCHOLOGICAL RESPONSES AS A SIMPLE METHOD TO DETERMINE THE LEVEL OF EFFORT IN HIGH INTENSITY EXERCISES

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**Introduction** The intensity of the exercises along with the speed of execution are the key factors to estimate the mechanical power output generated. Several studies have attempted to measure the intensity of effort through metabolic responses such as blood lactate and ammonia concentrations. Given the complexity of the measure has been validated a scale of rating of perceived exertion (RPE) (Borg scale). This RPE scale has been used to measure the resistance exercise intensity (low intensity) hitherto only Lauren et al (2010) have used the RPE at submaximal sprint. Thus, we tried to correlate the RPE scale with acute effects in high intensity sprints. **Methods** Eighteen high level sprinters (age  $23.1 \pm 4.4$  yr, body mass  $73.7 \pm 4.6$  kg, height  $177.6 \pm 5.9$  cm; body fat  $9.6 \pm 2.9\%$ ) took part in this study. Three sessions for 40, 60 and 80m performed at highest possible speed up to lose 3% of speed with 4, 6 and 8 minutes rest between sets (same ratio work/recovery for different DT) separated by a week were performed. Psychological (i.e. RPE) and metabolic responses (i.e. blood lactate and ammonia concentrations) were measured pre-exercise, during exercise each repetition performed and post-exercise. Results RPE pre-post session were significant for all sprint workouts analyzed and highly correlated to metabolic responses (Lact-RPE40/60/80m  $r = 0.86, 0.8, 0.83$ ) (Amn-RPE40/60/80m  $r = 0.84, 0.79, 0.81$ ). The speed losses produced in the successive sprints presented a high relation between the distances and RPE responses. The fatigue, measured as RPE increment, is strongly correlated to lactate ( $r = 0.83$  average), and ammonia ( $r = 0.82$  average). Discussion Through different studies it has observed that exist a relation between RPE and strength trainings (Naclerio, F., Barriopedro, I., Rodríguez, G., 2009). In addition the high correlations found between psychological (RPE) and metabolic (lactate and ammonia) measures of fatigue support the validity of using RPE to objectively quantify metabolic fatigue during sprint training. The results of this study show that, indicating or using the values of RPE in different moments or at the end of each serie, it is possible to monitor the intensity of successive sprints. References •Laurent CM, Green JM, Bishop PA, Sjøkvist J, Richardson MT. (2010). *J Exerc Sci Fit* Vol 8; No 1: 1-10. •Randall E. Schumacker5, Matt Curtner-Smith3Naclerio, F., Barriopedro, I., Rodríguez, G.(2009). *Kronos VIII*: 14. 59-66

## EFFECTS OF SIX WEEKS OF MEDICINE BALL TRAINING ON THROWING VELOCITY, PRECISION AND SHOULDER ISOKINETIC STRENGTH IN FEMALE HANDBALL PLAYERS

Raeder, C., Fernandez-Fernandez, J., Ferrauti, A.

*Ruhr-University Bochum*

Introduction Handball is a high-intensity impact intermittent sport game which requires an optimal combination of maximum intensity efforts in a short period of time, where players jump, run, and throw the ball at a high velocity, followed by low intensity or rest moments. Throwing performance is an important key skill for success in competitive handball, with the effectiveness of a shot primarily affected by two aspects: throwing velocity and precision. To the best of our knowledge there is no information evaluating the impact of medicine ball training on throwing velocity in handball. Medicine ball training ensures the opportunity to closely mimic the powerful actions and specific movement patterns relevant for success. Therefore the aim of the study was to investigate the effects of medicine ball training on throwing velocity, precision and shoulder strength in female handball players. Methods Twenty-eight 4th division female handball players (18-26 years of age) were randomly allocated into a training group (TG; n=15) and a control group (CG; n=13). TG performed supervised shoulder injury prevention (i.e., elastic tubing) and medicine ball training programs (throws that all illustrate handball-specific movement patterns), finishing with a throwing protocol using a regular handball. CG performed the supervised shoulder injury prevention program and the throwing protocol with a regular handball. Players trained three times a week, for a total of six weeks. Pre and post-measurements included throwing velocity, throwing precision and isokinetic peak torques of shoulder internal (IR) and external rotation (ER) at 90°/s and 180°/s. Results There was found a significant group x time interaction in throwing velocity ( $p=0.000$ ) with a significant increase in throwing velocity ( $p=0.000$ ) of 14% and 3.7% for both TG and CG, respectively. Precision did not change ( $p=0.144$ ) from pre to post-training, both for TG and CG. There was a significant group x time interaction ( $p=0.023$ ) for concentric IR at 180°/s for the dominant arm with a significant increase in concentric IR of 15% in TG, whereas no changes occurred in CG. Discussion The study showed that six weeks of a combined strength training (i.e., shoulder injury prevention, medicine ball training and handball throwing) can elicit significant improvements in the performance variables analyzed (throwing velocity and shoulder strength) in female handball players, while throwing precision remained unaffected. Medicine ball exercise training seems to be a useful and inexpensive strength training strategy in enhancing functional performance by closely mimic sport-specific movement activities. References Hermassi et al., (2010). *J Strength Cond Res*, 24 (9), 2408-2418. Ignjatovic et al., (2011). *J Strength Cond Res*, 26(8), 2166-73. Van den Tillaar (2004). *J Strength Cond Res*, 18 (2), 388-396.

## ANALYSIS AND COMPARISON OF LACTATE AND ANAEROBIC THRESHOLDS OF PROFESSIONAL AND ELITE CYCLISTS IN A 20-WEEK PERIOD

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INTRODUCTION. Improving lactate and anaerobic thresholds (LT and IAT, respectively) is considered crucial to the performance in the road cycling (I). Cyclists with high values of LT and IAT have a high potential for success in this sport (I). The aim of the study was to compare the evolution of LT and IAT in elite and professional cyclists in a 20-week period. METHODS Thirty-two cyclists participated in this study, 19 elite level ( $20.5 \pm 1.9$  years) and 13 professional level ( $24.2 \pm 1.1$  years). During the period of study (20 weeks) the participants performed 3 tests; during the 1st (T1), 10th (T2) and 20th (T3) weeks, corresponding respectively to the preseason, beginning of the competitive period and the competitive period. During testing 3 variables were measured; heart rate, blood lactate and power. The exercise protocol for LT and IAT determination started at a workload of 100 W and 50 W increments every 3 minutes until exhaustion performed on a cycle ergometer. RESULTS The LT and IAT values increased during the 20-week period in both groups. These increments were observed in absolute power (T1: 140 + 31 W; T2: 155 + 33 W; T3: 166 + 35. W LT elite), percentage of Wmax (T1: 44 + 6 %Wmax; T2: 48 + 3 %Wmax; T3: 50 + 3 %Wmax LT professional) and power relative to body mass (T1: 2,0 + 0,3 W•kg<sup>-1</sup>; T2: 2,3 + 0,4 W•kg<sup>-1</sup>; T3: 2,5 + 0,4 W•kg<sup>-1</sup> in LT elite) (T1: 3,1 + 0,4 W•kg<sup>-1</sup>; T2: 3,5 + 0,5 W•kg<sup>-1</sup>; T3: 3,7 + 0,5 W•kg<sup>-1</sup> IAT elite) values for  $p<0,05$ . Professional cyclists showed significantly higher absolute (T1: 215 + 41 vs. 246 + 25 W; T2: 239 + 43 vs 268 + 27 W, 3°: 245 + 41 vs 277 + 27 W IAT) and relative (T1: 3,14 + 0,40 vs 3,56 + 0,51 W•kg<sup>-1</sup>; T2: 3,55 + 0,47 vs 4,10 + 0,26 W•kg<sup>-1</sup>; T3: 3,67 + 0,47 vs 4,24 + 0,34 W•kg<sup>-1</sup> IAT) values for  $p<0,05$  in both thresholds. No statistical differences using heart rate criteria were observed. DISCUSSION During the 20-week period absolute (W) and relative (%Wmax and W•kg<sup>-1</sup>) values of both thresholds increases, Lucia described the same in previous study (2). In the present study, LT and IAT values of professional cyclists are higher than the previously observed in elite cyclists (3). In addition, these differences were maintained during 20 weeks. It is proposed the need and the importance of analyzing the thresholds in relative values for body mass and maximum power, because the differences between the two groups suggested that at the same absolute intensity the biological status of each group could be different. REFERENCES. 1.Faria EW, Parker DL, Faria IE. The Science of Cycling Factors Affecting Performance. *IPart 2*. *Sports Medicine*. 2005 Apr. 15;35(4):313-337. 2.Lucía A, Hoyos J, Pérez M, Chicharro J. Hear rate and performance parameters in elite cyclists: a longitudinal study. *Medicine & Science in Sports & Exercise*. 2000 Oct. 6;32(10):1777-1782. 3.Lucía A, Pardo J, Durántez A, Hoyos J, Chicharro L. Physiological Differences Between Professional and Elite Road Cyclists. *International Journal of Sports Medicine*. 1998 Jun. 6;19(5):342-348.

## THE ACUTE EFFECT OF WHOLE BODY VIBRATION ON REPEATED SHUTTLE-RUNNING IN YOUNG SOCCER PLAYERS

Padulo, J.1,2, Ibba, G.1, Di Giminiani, R.3, Chamari, K.2, Attene, G.1, Bishop, D.4, Migliaccio, G.M.1

1: CONI -Italian Regional Olympic Committee, Sardinia (Italy), 2: National Centre of Medicine and Science in Sport, Tunis (Tunisia), 3: University of Aquila (Italy), 4: Victoria University (Australia).

Introduction In this study we hypothesized that whole body vibration (WBV) improves the repeated sprint ability (RSA) performance and reduces the fatigue. To test our hypothesis we studied the acute effect of WBV, which could represent a new field training method (ecological validity), on time performance variables and blood lactate concentration during the RSA. Therefore, the aim of this study was to investigate the acute effects of WBV on RSA (Impellizzeri et al., 2008). Methods Seventeen male soccer players ( $16.71 \pm 0.47$  yrs) performed three RSA tests in different days (Randomized crossover study). RSA (1,2,3) test was performed with 6 maximal 40m shuttle-sprints (20+20m) with a change of direction of 180° separated by 20-s of passive recovery. The second RSA (RSA2) test was done with WBV "Power Plate pro5" was applied during the recovery periods to evaluate the effect of WBV (45 Hz - 2.2 mm). The studied variables were: best time (BT), worst time (WT), total time (TT), blood lactate (BLa) and the fatigue index (FI). Result ANOVA with repeated measures showed no effect between RSA1 and RSA3, while there were significant differences in TT= (RSA2 <0.92% ( $p<0.05$ ) vs. RSA1; RSA2 <1.71% ( $p<0.005$ )).

vs. RSA3],  $Bl_a = [RSA2 > 20.39\%$  ( $p < 0.001$ ) vs. RSA1;  $RSA2 > 12.82\%$  ( $p < 0.001$ ) vs. RSA3],  $WT = [RSA2 < 2.35\%$  ( $p < 0.005$ ) vs. RSA1;  $RSA2 < 3.51\%$  ( $p < 0.0001$ ) vs. RSA3], and  $Fl = [RSA2 < 29.38\%$  ( $p < 0.0001$ ) vs. RSA1;  $RSA2 < 69.11\%$  ( $p < 0.0001$ ) vs. RSA3]. When compared individual sprints, WBV showed a significant effect at the 5° sprint:  $RSA2 < 2.29\%$  ( $p < 0.005$ ) vs. RSA1;  $RSA2 < 2.95\%$  ( $p < 0.0001$ ) vs. RSA3, and the 6° sprint:  $RSA2 < 2.75\%$  ( $p < 0.01$ ) vs. RSA1;  $RSA2 < 4.09\%$  ( $p < 0.0001$ ) vs. RSA3. Discussion In conclusion, by using WBV during the recovery periods of a RSA test, we demonstrated that most of the time performance variables were improved. Further studies are needed to explain the physiological mechanisms behind these improvements and also to see whether chronic use of WBV during training might improve the on-field RSA performance. References Impellizzeri FM, Rampinini E, Castagna C, Bishop D, Ferrari BD, Tibaudi A, Wisloff U. (2008). *Int J Sports Med*, 29, 899-905.

**14:00 - 15:00**

## Mini-Orals

### PP-PM75 Training and Testing [TT] 10

#### EFFECTS OF HEAVY STRENGTH TRAINING ON UPPER-BODY STRENGTH, POWER AND SPRINT PERFORMANCE IN ICE SLEDGE HOCKEY

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**INTRODUCTION:** Ice sledge hockey is a popular paralympic team sport where players rely entirely on their upper-body to propel themselves rapidly across the ice surface. These isolated and repetitive poling movements provide a good model for examining upper-body sprint ability, and the subsequent requirements for upper-body maximal strength and power. Therefore, the purpose of the present study was to investigate the relationship between upper-body maximal strength, power and sprint performance in ice sledge hockey, as well the effects of six weeks of maximal strength training on these variables. **METHODS:** Eight ice sledge-hockey players from the Norwegian national team performed 30-m maximal sprint on ice and 1 repetition maximal (1RM) strength and peak power in the bench pull (BP) and pull-down (PD) exercises before and after six weeks with heavy strength training. Strength training was standardized the last month before the intervention period started and a stable level in 1RM during this period was shown. In the intervention period, the athletes performed three weekly sessions of heavy strength training; each session included two warm-up sets and three sets with 6-8 RM for pull-down, pull-over and front-pull exercises. Each lift was performed with maximal effort. **RESULTS:** 30-m sprint time correlated with 1RM and peak power for BPu ( $r = 0.86$  and  $0.62$ , respectively) and PD ( $r = 0.97$  and  $0.78$ , respectively) at pre-test (both  $P < 0.05$ ). From pre- to post-test there was significant improvements for 30-m sprint time ( $6.63 \pm 0.54$  vs  $6.47 \pm 0.50$  s), 1RM in BPu ( $77.2 \pm 13.4$  vs  $79.4 \pm 13.7$  kg), and 1RM and peak power in PD (1RM:  $92.6 \pm 12.5$  vs  $101.3 \pm 9.7$  kg, peak power:  $556.6 \pm 104.8$  vs  $642.3 \pm 126.0$  W) (all  $P < 0.05$ ). Peak power for BPu did not change ( $515.6 \pm 81.4$  vs  $536.2 \pm 94.6$  W). When correlating the changes in sprint and strength performances from pre- to post-test, there were significant correlations between 30-m sprint time and 1RM for BPu ( $r = 0.59$ ) and PD ( $r = 0.60$ ) (both  $P < 0.05$ ). **CONCLUSIONS:** The strong associations between 1RM strength, peak power and sprint ability found in this study support the general view that maximal strength and power are key components for sprint performance. Here, we show this for highly upper-body trained athletes, and additionally reveal that short-time heavy strength training can improve maximal strength, power, and sprint performance significantly in such populations. The correlation between changes in 1RM strength and in sprint performance lead further support to our conclusion that upper-body maximal strength training is advantageous for improving sprint performance.

#### A NEW WAY TO QUANTIFY TRAINING LOAD IN SPORT: THE "Z-INDEX"

Zabala, M., Morente-Sánchez, J.

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**A NEW WAY TO QUANTIFY TRAINING LOAD IN SPORT: THE "Z-INDEX"** Zabala, M.1,2 & Morente-Sánchez, J.1 1 Faculty of Sport Sciences, University of Granada (Spain) 2 Spanish Cycling Federation, Madrid (Spain) Introduction Training load is an important issue related to adequately apply the optimum stimulus to get the best work-recovery relationship to improve performance. In some middle-long distance sports like cycling or running, some indexes in relation to the time spent working are used as Heart Rate (TRIMP) [1], RPE (Foster) [2], relative Power output in cycling (TSS -Training Stress Score-) [3], or Time/km in running (multiplying them by time in minutes or seconds). The aim of this study was to integrate those indexes that describe the same event from different but complementary perspectives (physiological, physical, and perceptual perspectives) to create a more complete index of training load. Methods Twelve under-23 elite road cyclists, and 14 recreational triathletes, (mean age:  $19.67 \pm 1.12$  years, and  $27.67 \pm 3.12$  years, respectively) participated in the study. Training was monitored during a total of  $20 \pm 2$  training sessions measuring TRIMP, Foster, and TSS or time/km x min. Then a new score was got weighting each value in a scale from 0-10 (Log10) and then getting the average of the indexes multiplied by 10 to get a final score in %: for cyclists, the so-called "Z-Index" =  $[(\log_{10} \text{ of TRIMP} + \log_{10} \text{ of Foster} + \log_{10} \text{ of TSS}) / 3 * 10]$ , and for runners, "Z-Index" =  $[(\log_{10} \text{ of TRIMP} + \log_{10} \text{ of Foster} + \log_{10} \text{ of (Time/km x min)}) / 3 * 10]$ . Descriptive and correlation statistics was carried out. Results Values in % of daily, weekly or monthly training loads were calculated in relation to the training plan and sessions. The relation of the subjective plan and the later training load showed that sometimes the proposed training load was less or more than the one measured after the workouts (10 to 20% difference, correlation of  $r = 0.80^{**}$ ). When relating the different conventional indexes to the Z-index, significant and high correlations were found in cycling ( $r = 0.75^{**}$  for TRIMP,  $r = 0.79^{**}$  for Foster,  $r = 0.81^{**}$  for TSS), and running ( $r = 0.80^{**}$  for TRIMP,  $r = 0.79^{**}$  for Foster,  $r = 0.80^{**}$  for km/time x min). All the athletes stated that the new index was "easy, useful, and practical". Discussion Z-index is a very easy to understand value calculated taking into account the most feasible indexes that can be got from training using specific variables for each sport - cycling or running- and that could be used in Swimming adapting the formula from running but using the specific units (e.g. time in seconds / 25-50-100m). This index can be somewhat elitist, but there are many athletes nowadays that can afford GPS devices, powermeters, or just a chronometer. More research is needed to validate and develop the original formula. References 1. Manzi V. et al. *Am J Physiol Heart Circ Physiol* 2009; 296, H1733-40. 2. Foster C. *Med Sci Sport Exerc* 1998 Jul 30(7): 1164-8. 3. Allen H & Coggan A. 2006 Velopress.

## EFFECTS OF RESISTED SLED TOWING ON ACCELERATION SPRINT KINEMATIC IN SOCCER PLAYERS. A PILOT STUDY

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1: UCAM (Murcia, Spain), 2: UCLM (Toledo, Spain)

**INTRODUCTION** Weighted sled towing is a popular resisted sprint training methods. Several researches have shown acute effects on sprint kinematics during a sled towing exercise, in athletes such as sprinters and rugby players (Cronin et al., 2008; Lockie et al., 2003, Alcaraz et al., 2008). However, to our knowledge no one has been carried out in soccer players. The purpose of this study was to analyze the effects that increasing loads have on running kinematics during a sled towing exercise with soccer players. **METHODS** Seven semi-professional soccer players ( $23.07 \pm 2.25$  years;  $1.77 \pm 0.07$  m;  $77.6 \pm 5.8$  kg) with previously sled-towing training experience performed 4 x 20-m sprints (unloaded, 15, 20 and 25% of their body mass) from a standing start. The order for the trials was randomized and a 3-min rest period was allocated. First five meters were recorded with a high speed video camera (Casio Exilim EXFH20, Casio Computer, Tokyo, Japan) operating at 210 fps. The camera was placed at 90° angle to the direction of the sprinting, a distance of 15 m from the middle of the athlete's lane and it was mounted on a rigid tripod at a height of 1.3 m. Open-source software (Kinovea-v0.8.15) was used to analyze the data. The kinematic variables taken into account for the analysis were: stride length (SL), stride frequency (SF), contact time (CT) and flight time (FT) performed in first five meters of sprint. Repeated-measures ANOVA were used to compare the four sprint conditions. **RESULTS** As expected, both velocity and SL decreased significantly for all loaded situations when comparing with unloaded sprint ( $p < 0.01$  for all trials). CT increased significantly only between unloaded and 25% Bm ( $p = 0.005$ ). No significant differences were found for nor FT either SF. **DISCUSSION** Data suggested that variables most affected by load were SL and CT. Particularly CT has only affected with high loads (25% Bm). In fact, one study (Alcaraz et al., 2012) reported that CT increased significantly after a 4-weeks sled towing training in sprinters. However, SF and FT were not affected significantly by the external load. These results are consistent with previous studies (Lockie et al., 2003, Cronin et al., 2008, Alcaraz et al., 2008). When we use sled towing training method in soccer players, must be considered that SL decreases when an external load is added, and CT may be modified by a load of 25% of Bm or above. **REFERENCES** Alcaraz PE, Palao JM, Elvira JL, Linthorne NP. (2008). *J Strength Cond Res.* 22(3), 890-7. Cronin J, Hansen K, Kawamori N, McNair P. (2008). *Sports Biomech.* 7(2), 160-72. Lockie RG, Murphy AJ, Spinks CD. (2003). *J Strength Cond Res.* 17(4), 760-7.

## RESULT OF AN INDIVIDUALIZED CYCLING TRAINING PROGRAM THROUGH POWER METERS

Fernández-Montilla, J.A., López-Grueso, R., Sarabia, J.M., Aracil, A., Guillén, S., Pastor, D., Moya, M.

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**Introduction** The theoretical framework for quantifying the training proposed by Dr. Coggan (Allen and Coggan, 2010) parts of the biparametric models theory applied to cycling and bike segment in triathlon. The aim of the study was to evaluate the influence that an individualized training program at different percentage of functional threshold power (FTP) Methods Fourteen triathletes (aged  $38.12 \pm 6.37$  years) were divided into two groups (Control -C- and Experimental, -E-) and developed six weeks of planned workouts, with a pre and post-test in both cycle ergometer (Monark ergomedic 839) and field tests (Powertap, CycleOps, Madison, USA). The program focuses on the critical pedaling power with normalized power (NP) and decreasing by 30% the intensity factor (IF), developing a working method based on the and training stress score (TSS) on the basis of an individualized FTP for each subject (E) versus usual training group (C). The variables evaluated were: maximal oxygen uptake (VO<sub>2</sub>max), time to exhaustion (tExh), power generated at the second ventilatory threshold (wVT<sub>2</sub>), lactate threshold (LT) on a cycle ergometer test, and volume in kilometers (Vkm), absolute and relative power generated in the FTP field test (wFTP and w/kgFTP). **Results** The average values show no significant differences between both groups in the different tests and variables assessed at the pre y post- tests. However, a beneficial trend (in favor of experimental group) is clearly marked in all of them: wFTP (C:  $256.6 \pm 22.4$  to  $260.0 \pm 16.9$  w vs E:  $236.0 \pm 19.3$  to  $248.0 \pm 25.0$  w), w/kgFTP (C:  $3.34 \pm 0.32$  to  $3.33 \pm 0.27$  w/kg vs E:  $3.53 \pm 0.21$  to  $3.67 \pm 0.20$  w/kg), tExh (C:  $14.71 \pm 1.08$  to  $14.89 \pm 1.43$  min vs E:  $12.29 \pm 1.89$  to  $13.50 \pm 1.86$  min), wVT<sub>2</sub> (C:  $267.9 \pm 12.2$  to  $271.4 \pm 17.3$  w vs E:  $239.3 \pm 19.3$  to  $260.7 \pm 24.4$  w), wLT (C:  $200.0 \pm 0.0$  to  $204.2 \pm 19.0$  w vs E:  $158.3 \pm 34.0$  to  $170.8 \pm 43.0$  w), w/kgLT (C:  $2.60 \pm 0.08$  to  $2.60 \pm 0.27$  w/kg vs E:  $2.42 \pm 0.53$  to  $2.63 \pm 0.73$  w/kg) and lactate production at LT kgLT (C:  $2.23 \pm 0.37$  to  $1.95 \pm 0.61$  mM vs E:  $2.12 \pm 0.60$  to  $2.32 \pm 0.73$  mM). The decline in VO<sub>2</sub>max had a negative trend less marked in the experimental group also (C:  $55.1 \pm 2.1$  to  $54.0 \pm 2.2$  ml/kg/min vs E:  $55.4 \pm 3.5$  to  $55.0 \pm 3.9$  ml/kg/min,  $p = 0.088$ ). **Discussion** For group C which was training a larger volume at different IF and not individualized %UPF (but the same NP) is not guaranteed performance improvement. This group even manifests a negative trend, while group E, with relatively lower but personalized volumes, shows a slight improving trend, although not significant. **References** Allen H, Coggan A. (2010). Training and racing with a power meter. Velopress, Colorado.

## THE EFFECT OF DIFFERENT WARM-UP PROTOCOLS ON PAP IN SPRINTERS – A PILOT STUDY

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**Introduction** It is known that different types of pre-conditioning activity (PCA) (squat, CMJ and sprint running), as well as different levels of intensity and volume, have a different effect on the function of the neuromuscular system. Therefore, it is likely that different content and, as a result, different intensity of warm-up will influence different mechanisms of the neuromuscular function after different warm-up protocols (WUP). The aim of this study was to examine Postactivation Potentiation (PAP) effects induced by different warm-up protocols based on 1) jump with extra loads from light to heavy and 2) squats from light to heavy weight. **Methods** Ten high level sprinters (age  $21.1 \pm 2.2$  yr, body mass  $70.3 \pm 3.2$  kg, height  $180.6 \pm 5.1$  cm; body fat  $7.9 \pm 3.3\%$ ) took part in this study. Two different PCA were designed and two different WUP was assigned to each one of these two PCA, and after that, athletes were separated by groups. Each group corresponded each one of the 2 different PCA designed. PCA were squat (SQ) with 80% 1RM and other with 40% 1RM, and CMJ with loads of 100% of body weight (BW) and 50% of BW. PAP effect was verified on CMJ and sprint performance in 0, 4, 6, 8 and 10 minutes after each WUP and group. **Results** The main result of this study was that CMJ height increased significantly 4 min after the PCT with 80% 1RM in SQ and 100% BW in CMJ. The percentage increase, based on the pre and post means, was 3.7% (significant) in CMJ performance with 80% 1RM vs 40% 1RM (an increase of 0.5%, ns), and, a reduction of 2.4% (significant) in sprint time performance with 80% 1RM vs 40% 1RM (a reduction of 0.1%, ns). In CMJ with loads, the percentage increase, based on the pre and post means, was 3.4% (significant) in CMJ performance with 100%-BW vs 50%-BW (an increase of 0.3%, ns), and, a reduction of 2.7% (significant) in sprint time performance with 100%-BW vs 50%-BW (a reduction of 0.4%, ns). **Discussion** According to Mitchell & Sale (2011), CMJ performance increased significantly 4 min after a similar load than they used in his study (80% 1RM vs 5RM). In addition to this, in our study, a load of 100% of BW in

CMJ increased CMJ performance 4 min after too. Likewise, in our study, sprint performance improved in these protocols. The mechanism of PAP increases rate of force development (RFD) (Baudry & Duchateau, 2007) and the shortening velocity attained under load (Baudry & Duchateau, 2007); therefore, PAP may have contributed to the increase in CMJ height in our study, as same than Mitchell & Sale (2011).  
References Baudry S, Duchateau J (2007). JAP 102:1394–1401 Mitchell C, Sale D (2011). EJAP 111:1957–1963

### ACUTE EFFECTS OF STATIC STRETCHING ON PLANTAR FLEXORS MUSCULAR AND TENDINOUS STIFFNESS

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*UFR STAPS Dijon*

**Introduction** Although widely used during warm-up, static stretching has been suggested to alter the muscle-tendon unit stiffness and consequently passive resistance (Behm et al. 2011). However, the effects on the tendon and muscles fascicles stiffness and their origins are still equivocal (Kay and Blazevich, 2009). The aim of the present study was therefore to examine the acute effects of static stretching in dorsiflexion on the gastrocnemius medialis and Achilles tendon passive stiffness. Since the "dose effect" has never been clearly determined, we also assessed the kinetics of all these parameters at several time points of the stretching protocol. **Methods** 11 male subjects underwent 10 repetitions of 30-s static, passive dorsiflexion stretching, on an isokinetic dynamometer. Passive torque, musculo-tendinous junction (MTJ) displacement, pennation angle and gastrocnemius medialis (GM) muscle fascicles length have been measured during the 1st, 5th and 10th stretching movement. Muscle and tendon stiffness indexes have been determined from the relation between passive torque variation and variations of the MTJ displacement and fascicles length. **Results** GM and Achilles tendon stiffness indexes were significantly decreased during the 5th ( $-25.9 \pm 10.1\%$ ;  $-22.3 \pm 16.9\%$ ,  $P < 0.05$ ) and 10th stretching movements ( $-32.4 \pm 8.4\%$ ;  $-29.4 \pm 14.4\%$ ,  $P < 0.05$ ). Although passive torque variation was significantly decreased for both the 5th and 10th stretch ( $-12.5 \pm 7.4\%$ ;  $-6.8 \pm 6.7\%$ ,  $P < 0.05$ ), the MTJ displacement, fascicles length and pennation angle variations were not modified. **Discussion** These results suggest that 5 x 30-s of static stretching could alter the muscle-tendon unit's mechanical properties and therefore significantly decrease muscle and tendon stiffness. Alterations of the elements responsible of force production and transmission such as actin-myosin bridges, titin, viscosity or muscle fibres recruitment, could be responsible of this decrease. Sports requiring strength, power or speed should therefore use very short duration of static stretching or even totally exclude them before competition. **References** Behm DG, Chaouachi A (2011) A review of the acute effects of static and dynamic stretching on performance. *Eur J Appl Physiol.* 111: 2633-51. Kay AD, and Blazevich AJ (2009) Moderate-duration static stretch reduces active and passive plantar flexor moment but not Achilles tendon stiffness or active muscle length. *J Appl Physiol.* 106:1249-1256.

### EFFECT OF SPEED TRAINING IN YOUTH SOCCER PLAYERS

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**Introduction** Sprint and agility performance is crucial in many sports like soccer. There are few studies about training effect in children and youth in sprint distances shorter than 30 m, and in agility performance. Earlier studies have shown conflicting results regarding the effects of sprint training programs in this age, but recent studies have found that appropriate training stimulus may lead to enhances sprint and agility performance. However, more research is needed to find out the effectiveness in methods of sprint and agility training in youth. Therefore, in the recent study we wanted to examine a high-intensity short-burst exercise program on 13-year-old male soccer players. **Method** A training group of 14 male soccer players, mean age ( $\pm$  SD) 13,5 years ( $\pm$  0,24) followed an 8 week intervention program, one hour per week, and a group of 12 male soccer players of corresponding age, mean age 13,5 years ( $\pm$  0,23) served as control group. The intervention consisted of short burst linear sprints, or mostly sprints with change of direction (agility) with maximal effort in 2-6 seconds, and interspersed with recovery periods lasting from 1-1,5 minutes. Each session consisted of 30-40 sprints. Pre- and post-tests assessed 10 m linear sprint, 20 m linear sprint and agility performance. The agility test course was a 20 m standardized course. Electronic timing gates were used to record split and completion times (Brower Timing System, USA). Differences between groups were tested with one way analyze of variance, and Pearson product moment correlation  $r$  were used to evaluate the relationship between linear sprint and agility performance test measures (SPSS 19.0). **Results** Results showed significant improvement in agility performance, pre 8,23 s ( $\pm$ 0,34) to post 7.69 s ( $\pm$  0,34) ( $p < 0.01$ ), and significant improvement in 0-20 m linear sprint, pre 3,54 s ( $\pm$  0,17) to post 3,42 s ( $\pm$  0,18) ( $p < 0,05$ ). In 0-10 m sprint the participants showed improvement, pre 2,02 s ( $\pm$  0,11) to post 1,96 s ( $\pm$  0,11) (n.s). Correlation between 10 m sprint and agility was  $r = 0.53$  ( $p < 0,01$ ), and between 20 m linear sprint and agility performance  $r = 0.67$  ( $p < 0,01$ ). **Discussion** The major finding in the study is the improvement in agility performance. The participants showed a smaller, but significant improvement in 0-20 m linear sprint, and also improvement in 0-10 m linear sprint, not significant. The control group showed no significant improvement. Another interesting finding is the correlation between linear sprint (10 m and 20 m) and agility performance, indicating a stronger relationship in sprint and agility at this age than have been found among adults. These findings suggest that organizing the training sessions with short burst high-intensity activities lasting 2-6 sec, interspersed with adequate recovery time, may result in improvements in both linear sprint and especially agility at this age among young soccer players. **References** Venturelli M, Bishop M, Pettene L. Sprint Training in Preadolescent Soccer Players. *Int J Sports Physiol* 2008; 3: 558-562

### TRAINING EFFECT ON ROS PRODUCTION PROFILE IN MASTER SWIMMERS DETERMINED BY ELECTRON PARAMAGNETIC RESONANCE

Mrakic-Spota, S.1, Porcelli, S.1, Bellistri, G.1, Montorsi, M.2,1, Gussoni, M.3, Vezzoli, A.1

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1: Istituto di Bioimmagini e di Fisiologia Molecolare, CNR, (Segrate, Italy), 2: Univ. Telematica S. Raffaele, (Rome, Italy), 3: Dipartimento di Fisiopatologia Medico Chirurgica e dei Trapianti, Unimi (Milan, Italy) **Introduction** Exercise induces an increase in free radicals production in human skeletal muscle. The amount of production depends on the intensity of exercise, with higher amount of free radicals and, consequently, oxidative cellular damage generated by strenuous exercise. Electronic Paramagnetic Resonance (EPR) is the only non-invasive technique available to detect and quantitate Reactive Oxygen Species (ROS) concentration. **Methods** Ten masters swimmers (males, mean age  $30 \pm 5$  ys; weight  $78.6 \pm 5.1$  kg; height  $1.82 \pm 0.47$  m) underwent to 6 weeks of low-volume high-intensity training. Peak oxygen consumption ( $VO_{2peak}$ ) was evaluated by an incremental arm-ergometer test until exhaustion. At rest and after incremental exercise, time course of ROS generation was determined in 50  $\mu$ l capillary blood by means of a recently developed EPR micro-invasive method (Mrakic Spota et al., 2012), both before (PRE) and after (POST) training period. **Results**  $VO_{2peak}$  significantly increased after

training ( $37.2 \pm 4.7$ ,  $40.8 \pm 5.5$  in PRE and POST respectively). At the end of exercise, a significant increase ( $p < 0.05$ ) of ROS production was observed both in PRE and POST. As for training effects: 1) ROS resting values recorded in POST were significantly ( $p < 0.001$ ) lower (-20%) than in PRE and, 2) the increase of ROS blood concentration at the end of exhaustive exercise was lower (+10 vs +16%) in POST than in PRE respectively. Discussion Strenuous aerobic exercise increases ROS resting production, as demonstrated in our previous study (Mrakic Sposta et al., 2012) and others studies with different athletes (Bailey et al., 2004, 2007). A good training scheduling, although characterized by high intensity regimen, reduces ROS production values at rest and after an exhaustive exercise. This results could be due to a more efficient mitochondrial respiratory chain or antioxidant capacity. Indeed a variance analysis indicate an inverse correlation ( $r^2$  value = 0.58,  $p < 0.05$ ) between ROS rate production and  $VO_{2peak}$ . References Mrakic-Sposta S, Gussoni M, Montorsi M, Porcelli S, Vezzoli A. (2012). Oxid Med Cell Longev, Article ID 973927 Bailey DM, Young IS, McEneny J, Lawrenson L, Kim J, Barden J, Richardson RS. (2004). Am J Physiol. 287, H1689-H1699. Bailey DM, Lawrenson L, McEneny J, Young IS. (2007). Free Rad Res, 41(2) 182-190.

## PHYSICAL PERFORMANCE AND MORPHOLOGICAL CHARACTERISTICS OF YOUNG ATHLETES IN THE STATE OF PARANÁ – BRAZIL.

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1:State of Paraná Secretariat of Sports, 2: Center-West of Paraná University (Paraná-Brazil), 3: State University of Londrina (Paraná-Brazil), 4: Federal University of Paraná (Paraná-Brazil)

Introduction The control of sports performance of young athletes by means of morphological, physiological, biomechanical and genetic evaluations is essential for following up their improved performance, long term training organization and sport life style, aiming at positive results in sports modalities and tests. Therefore, the objective of this study was to identify the characteristics of body composition, velocity, potency of lower limbs and aerobic potency of young athletes in the State of Paraná – Brazil. Method The data obtained in this study refer to 180 athletes (N=102 male and N=78 female), average age between 11 and 18 years old, under systematic training and from 19 sports modalities. For their physical performance and morphological characteristics, the following tests and items were used: body composition – plethysmographic (Bodpod); velocity in 30m – photoelectric sensors (Multisprint); potency of lower limbs – applied in 3 types of different jumps: Squat Jump/SJ – Countermovement Jump/CJ – Countermovement Jump with the aid of arms/CJF (thrust mat - Multisprint); aerobic potency – treadmill test with start speed of 8 km/h, and progressive increases of 1km/h at every 1 minute, and the subject being tested until showing signs of exhaustion, controlled by ergospirometer (K4b2). For the presentation of results, descriptive statistics with measures of central tendency was used (average and standard deviation and frequency). Results In both genders, the following values were found for the male athletes (102) and female athletes (78) respectively: height  $174.6\text{cm} \pm 0.109$  –  $162.0\text{cm} \pm 0.203$ ; weight  $69.81\text{kg} \pm 16.06$  –  $57.65\text{kg} \pm 17.45$ ; % slim mass  $81.04 \pm 26.06$  –  $68.27 \pm 29.72$ ; % fat mass  $11.13 \pm 11.20$  –  $21.93 \pm 20.25$ , speed 30meters  $3^{\circ}74\text{s} \pm 1.77$  –  $3^{\circ}76\text{s} \pm 2.27$ ; SJ  $31.67\text{cm} \pm 8.36$  –  $27.31\text{cm} \pm 27.19$ ; CJ  $34.68\text{cm} \pm 9.19$  –  $26.83\text{cm} \pm 7.23$ ; CJF  $40.50\text{cm} \pm 11.03$  –  $31.49\text{cm} \pm 8.59$ ; aerobic potency  $VO_{2max}$   $42.40\text{ml.kg.min} \pm 12.11$  –  $37.78\text{ml.kg.min} \pm 13.76$ , maximum cardiac rate  $187\text{bpm} \pm 41.16$  –  $188\text{bpm} \pm 39.85$ . Discussion In this present study, the values for morphological variables and physical performance of both genders were coherent and similar to the values found in other studies (Hoff, 2005; Bosco, 1993) There was also a predominance of more athletic results from male subjects, favoring their physical and sports performance despite the fact that all the young athletes had been grouped from 19 different sports modalities (Malina, 2001). HOFF, J. Journal of Sports Sciences, v 23, n 6, p. 573-582, 2005. Bosco, C.. *Atleticastudi*. Roma. Vol. 6. 1993. p. 361-371. Malina, R. M., 2001. Am. J. Hum. Biol. 13, 162–172.

## INDICATORS IN LENGTH OF THE LOWER LIMBS, BODY COMPOSITION AND RELATIONSHIP WITH NEUROMUSCULAR PERFORMANCE IN UNDER 15 SOCCER PLAYERS

Franciscon, C.A., Spigolon, L.M.P., Medeiros, E.M., Gongora, A., Borin, J.P.

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Introduction Currently the information obtained in the training of young players, especially in the category U15, seeks to identify aspects involved in sports performance, especially in detection and promotion of sporting talent, but dismiss the influence of relationships and various biological components, which can assist in understanding and targeting of sports preparation. Thus, this study aims to identify the relationship of the length of the lower limbs (CMMII) and indicators of body composition with neuromuscular performance indicators. Methodology 30 athletes participated in the U15 category ( $14.79 \pm 0.48$  years,  $176.88 \pm 6.01$  cm,  $64.06 \pm 6.41$  kg) with experience of two years of training. We measured the CMMII, the percentage of muscle mass (% MMusc) (Martin et al,1990) and body fat percentage (BF%) (Faulkner,1968). Neuromuscular performance was evaluated using a forward sprint, with distances of 10, 20 and 30m (T10M, T20M and T30M), (Svensson, Drust,2005) by means of photocells (SpeedTestFit-Cefise®) placed every 10m. The potent force lower limb was assessed by the countermovement jump (CMJ) (JumpTest-Cefise®). It is the normality of the data, of Shapiro-Wilk and then the Pearson correlation test, with significance level of  $p < 0.0001$ . Results There were no significant correlations between CMMII, indicators of body composition (%BF, CMMII and MMusc%) and neuromuscular performance (CMJ, T10M, T20M and T30m). Discussion Even with the non-significance of the data, one must consider that: i) the neuromuscular performance is related to maturational changes and morphofunctional (Mirwald et al,2002); ii) influence of organization of sessions and content of training, especially regarding the biomotors capacities (Gomes,2002); iii) the assessment of speed and potent force, intra and intermuscular coordination are influenced by the process of training and type of muscle fibers. This information shows the importance of following the young athlete facing the process of sports preparation, besides considering the various biological components associated with monitoring the response of sporting performance. References Bosco, C, Luhtanen, P, Komi, PV, (1983). Eur J Appl Physiol, v.50 n.2, p.273-282. Faulkner, JA.(1968). In: Falls, H, Exercise Physiology, Baltimore: Academic Press. Gomes, AC, (2002) *Treinamento Desportivo:estrutura e periodização*. 1ªed. Martin, AD, Spenst, LF, Drinkwater, DT, Clarys, JP, (1990) Med Sci Sports Exercise, v.22, n.5, p. 729-733. Mirwald, RL, Baxter-Jones, AD, Bailey, DA, Beunen, GP, (2002) Med Sci Sports Exercise, v.34, n.4, p.689-694. Svensson, M, Drust, B, (2005) J Sport Sci, n.23, p.601-618.

14:00 - 15:00

## Mini-Orals

## PP-PM81 Training and Testing [TT] 16

**EFFECTS OF MATURATION AND BODY MASS ON MATCH RUNNING PERFORMANCE IN HIGHLY-TRAINED UNDER 15 SOCCER PLAYERS**

Buchheit, M., Simpson, B.M., Di Salvo, V., Mendez-Villanueva, A.

*ASPIRE*

**Introduction** In youth soccer, players in the same age group often present variations in maturation (Malina 2000). More mature players are taller and heavier, and outperform less mature players in most of physical performance tests (Malina 2000). Whether this physical advantage translates into greater match running performance is however unknown. Recent data have shown that increases in physical capacities are not consistently followed by increases in game physical activities (Buchheit 2012). The aim of the present study was to examine match running performance in highly-trained U15 soccer players differing in either maturation or body mass. **Methods** Thirty six highly-trained U15 soccer players ( $14.4 \pm 0.4$  yr,  $0.2 \pm 0.7$  yr from peak height velocity [APHV]) from an elite academy were involved. Maximal sprinting (MSS) and aerobic (MAS) speeds were measured via field tests. Match running performance was analysed with GPS (GPSport, 1 Hz) during 19 international friendly games. Total distance covered (TD), distance  $>16$  km/h, peak game speed (GS) and the number of high-intensity actions ( $>19$  km/h, HIA) were collected. The 16 less mature players (the 4 less mature central-defenders, full-backs, midfielders and wingers) were compared with the 16 more mature players, both in terms of physical capacities and match running performance. Similar comparisons based on body mass were also performed. Between-group differences were analyzed for practical significance using magnitude-based inferences. **Results** Compared with the less mature players (APHV:  $-0.3 \pm 0.3$  yr), more mature players ( $+0.9 \pm 0.4$  yr) were almost certainly taller (Cohen's  $d=+1.56$ ) and heavier ( $+1.42$ ), have almost certainly faster MSS ( $+0.98$ ) and possibly faster MAS ( $+0.33$ ). During games, they covered likely greater distances  $>16$  km/h ( $+0.51$ ), reached likely faster GS ( $+0.52$ ) and performed almost certainly more HIA ( $+0.74$ ). In contrast, TD was possibly lower ( $-0.15$ ). All other differences were unclear. **Discussion** In accordance with previous findings (Malina 2000), soccer players advanced in maturity were physically advantaged compared with their less mature counterparts. We showed however, for the first time, that these advantages are also beneficial for match running performance. The magnitude of the between-group differences was however lower for match activities than for physical performance. This extends previous findings suggesting that technical and tactical demands likely regulate (at least partially) match running activities independently of physical capacities (Buchheit 2012) and maturation. These results have important implications for the identification and selection of young players. **References** Buchheit M et al. *Int J Sport Med* 2012, 34:40-8 Malina RM et al. *J Sports Sci* 2000, 18:685-93

**THE COMBINATION OF PLYOMETRIC AND BALANCE TRAINING IMPROVES SPRINT AND SHUTTLE RUN PERFORMANCES TO A GREATER DEGREE THAN PLYOMETRIC-ONLY TRAINING WITH CHILDREN**

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**Introduction** Since balance is not fully developed in children and studies have shown functional improvements with balance only training studies (Behm et al. 2010), a combination of plyometric and balance activities might enhance static, dynamic balance and power. It was the objective of this study to compare the effectiveness of plyometric only (PLYO) with combined balance and plyometric (COMBINED) training on balance and power measures in children. **Methods** Before and following an 8-week training period, testing assessed lower body strength (1 repetition maximum leg press), power (horizontal and vertical jumps, triple hop for distance, reactive strength, leg stiffness), running speed (10m and 30m sprint), static and dynamic balance (Standing Stork Test and Star Excursion Balance Test), and agility (shuttle run). Subjects were randomly divided into two training groups (plyometric,  $n=14$  and plyometrics and balance,  $n=14$ ) and a control group ( $n=12$ ). **Results** Results based on magnitude-based inferences and precision of estimation indicated that the balance and plyometric training group was considered likely to be superior to the plyometric group in leg stiffness (91% likely), 10-meter sprint (84% likely) and shuttle run (80% likely). The difference between the groups was unclear in eight of the 11 dependent variables. **Discussion** While plyometric only training provided beneficial effects for static balance, combined training enhanced to a greater degree activities such as 10m sprints and shuttle runs. Whereas PLYO training was as effective as COMBINED training for static balance tests, COMBINED training produced better results for 10m sprint and shuttle run times as well as leg stiffness. The inherent balance challenges associated with plyometric training are sufficient to adequately improve static balance measures, while the greater stability or balance challenges of high speed sprinting and change of direction running (shuttle) may be enhanced with the addition of balance training to plyometric exercises. The increased leg stiffness scores found with the combined training may also have contributed to the greater improvement in sprint and shuttle run performance. As balance is less well developed in youth, coaches and athletes should consider adding or replacing some of their jumping, hopping, bounding and other similar training activities with balance activities. Considering that the COMBINED training group performed half as many jumping actions as the PLYO group, such COMBINED training could also be an important consideration for reducing the volume of jump training. This reduction in jump training volume with the replacement of balance and landing exercises might help to alleviate the overtraining effects of excessive repetitive activity. **References** Behm DG, Drinkwater EJ, Willardson JM and Cowley PM. Canadian society for exercise physiology position stand: The use of instability to train the core in athletic and non-athletic conditioning. *Appl Physiol Nutr Metab* 35: 11-14, 2010.

## MECHANICAL DETERMINANTS OF ACCELERATION AND MAXIMAL SPRINTING SPEED IN HIGHLY TRAINED YOUNG SOCCER PLAYERS

Buchheit, M.1, Samozino, P.2, Mendez-Villanueva, A.1, Glynn, J.1, Simpson, B.M.1, Al Haddad, H.1, Di Salvo, V.1, Morin, J.B.2

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**Introduction** Both acceleration (Acc) and maximal sprinting speed (MSS) are important for success in elite soccer. Understanding their specific mechanical determinants is pivotal to design optimal training programs. To date however, research was focused on non locomotor-specific determinants, and/or vertical force application capability, which limits field applications. The aim of the present study was to examine, in highly-trained young soccer players, the mechanical and horizontal determinants of Acc and MSS (Samozino 2013). **Methods** 86 soccer players (14.1±2.4 yr) from an elite academy performed a 40-m sprint to assess Acc (10-m sprint time) and MSS (best 10-m split) (Buchheit et al. 2012). Speed was measured with a 100-Hz radar (Laveg 300C, Jenoptik, Germany). Horizontal Force/Velocity profile, theoretical maximal velocity (V0), horizontal force (F0) and horizontal power (Pmax) were calculated (Samozino 2013). Within each age group, players were classified as High Acc/Fast MSS (>2% faster than group mean), medium (between -2 and +2% of group mean), and Low/Slow (>2% slower than group mean). Results Acc and MSS were very largely correlated (-0.79, 90%CL[-0.85;-0.71]). The determinants ( $r^2=0.84$ [0.78;0.89]) of Acc were V0 (partial  $r$ :-0.80 [-0.86;-0.72]) and F0 (-0.57[-0.68;-0.44]); those of MSS ( $r^2=0.96$ [0.94;0.97]) were V0 (0.96[0.94;0.97]) and Pmax (-0.73[-0.80;-0.63]). When comparing High/Med vs. Low/Med, High/Med have likely greater F0 (Cohen's  $d$ : +0.8[0.0;1.5]), V0 (+0.6[-0.1;1.3]) and Pmax (+0.9[0.2;1.7]), and a likely more Force-oriented profile (-0.8[0.1;1.6]). When comparing High/Fast vs. High/Med, High/Fast have an almost certainly faster V0 (+2.1[1.5;2.7]) and a likely greater Pmax (+0.6[-0.1;1.3]), with no clear differences in either F0 (-0.0[-0.7;0.6]) or Force/velocity profile (0.2[-0.4;0.9]). **Discussion** Present results confirm the specificity of Acc and MSS capabilities (Little and Williams 2005; Mendez-Villanueva et al. 2011). They show however for the first time that their mechanical horizontal determinants differ. The magnitude of the relationship with V0 is greater for MSS than Acc, and while a horizontal Force-oriented profile is likely beneficial for Acc, MSS may be more exclusively dependent on V0 and Pmax. These results might suggest the need for individualizing training contents based on players' mechanical profile and on field requirements. **References** Buchheit M et al. *Int J Sports Physiol Perform* 2012, 7:76-8. Little T et al. *J Strength Cond Res* 2005, 19:76-8. Mendez-Villanueva A et al. *J Sports Sci* 2012, 29:477-84. Samozino P et al. 24th Congress of the Int Society of Biomechanic, Natal, Brazil, 2013.

## LOW- AND HIGH-VOLUME STRENGTH TRAINING INDUCES SIMILAR NEUROMUSCULAR ADAPTATION AND IMPROVEMENT ON MUSCLE QUALITY IN ELDERLY WOMEN.

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The aim of present study was to compare the effects of low- and high-volume strength training on strength, muscle activation and muscle thickness (MT) of the lower- and upper-body, and on muscle quality (MQ) of the lower-body in older women. Twenty apparently healthy elderly women were randomly assigned in two groups: low-volume (LV, n=11) and high-volume (HV, n=9). The LV group performed one-set in each exercise, and the HV group performed three-sets in each exercise, twice weekly during 13 weeks. MQ was measured by echo intensity obtained by ultrasonography (MQEI), strength per unit mass (MQST), and strength per unit mass adjusted by an allometric scale (MQAS). After the training period, it was observed a significant increase ( $p \leq 0.01$ ) in knee extension 1-RM ( $31.8 \pm 20.5\%$  for LV and  $38.3 \pm 7.3\%$  for HV) and in elbow flexion 1-RM ( $25.1 \pm 9.5\%$  for LV and  $26.6 \pm 8.9\%$  for HV) and in isometric maximal strength for lower-body ( $p \leq 0.05$ ) and for upper-body ( $p \leq 0.001$ ), with no difference between groups. The maximal electromyographic activation for both groups increased significantly ( $p \leq 0.05$ ) in the vastus medialis and biceps brachii, with no difference between groups. All MT of the lower- and upper-body increased similarly in both groups ( $p \leq 0.001$ ). After training period, similar improvement in MQEI ( $p \leq 0.01$ ), MQST, and MQAS ( $p \leq 0.001$ ) for both groups was observed. The results of present study showed low- and high-volume strength training promoted similar effects on neuromuscular adaptations of lower- and upper-body, and on MQ of the lower-body in elderly women.

## JUNIOR SUCCESS – THE WAY TO THE TOP?

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**Introduction** The talent promotion system in Germany is based on the assumption that performance development follows a progressive trend with a linear and normative ascent from junior to senior competition levels (Deutscher Sportbund, 2006). The underlying model hardly considers other trajectories, e. g. of lateral recruits or late bloomers. This investigation aims to examine the competitive transition from junior elite to senior elite level in selected sports. **Methods** Junior World Championship (JWC) participation of elite athletes in boxing, pole vault, rowing and triathlon (participants in Olympic Games and/or World Championships) was analysed retrospectively using Fisher-Freeman-Halton exact test. Comparisons of age when entering elite competition level were conducted between JWC-participants and Non-JWC-participants, using t-test for independent samples. **Results** Data in the examined sports don't provide evidence for the assumption of a normative transition from junior to senior competition success. Between 10% (male boxing, U17 JWC) and 61% (male triathlon) of the elite athletes participated in JWC. Associations between ranking in JWC and success in Olympic Games and/or World Championships differed considerably from sport to sport. In all sports under review, those athletes who didn't take part in JWC, entered the elite level at an significantly older age. **Discussion** According to Gulbin et al. (2013) and Schumacher et al. (2006), results implicate that the generalised assumption of participation in international junior competitions as a prerequisite for elite success isn't sustainable. Even this 'coarse-grained' view onto athlete development shows, that talent selection and promotion systems are needed to allow for different trajectories of performance development, depending both on the specificity of the sport and the circumstances of the individual (e. g. high-achiever, late-bloomer or lateral recruit). Further research is required to identify successful trajectories including key points and possible catalysts and obstacles more in-depth. **References** Deutscher Sportbund (Hrsg.). (2006). *Nachwuchsleistungssport-Konzept 2012. Leitlinien zur Weiterentwicklung des Nachwuchsleistungssports*. Frankfurt am Main. Gulbin, J. P., Oldenzel, K. E., Weissensteiner, J. R. & Gagné, F. (2013). Patterns of performance development in elite athletes. *European Journal of Sport Science*, 1–10. DOI: 10.1080/17461391.2012.756542. Schumacher, Y. O., Mroz, R., Mueller, P., Schmid, A. & Ruecker, G. (2006). Success in elite cycling: A prospective and retrospective analysis of race results. *Journal of Sports Sciences*, 24(11), 1149-1156.

## TECHNICAL-TACTICAL PERFORMANCE OF SUB-13 FUTSAL PLAYERS: TRAINING GAME X OFFICIAL GAME

Milisteid, M., Saad, M., Nascimento, J.V.

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**Introduction** The technical and tactical skills in team sports are understood as decisional-perceptual-motor strategies of players in the match, trying to solve the inherent game problems. The proper domain of technical and tactical actions is necessary to obtain success in team sports such as futsal. Thus, the aim of the study was to compare the technical-tactical performance of U-13 Futsal players in training game and official competition game. **Methods** 14 players participated in the research from two separate teams in the state of Santa Catarina. The Instrument of Assessment Individual Technical-Tactical Performance in Futsal (Saad, 2012) was used to analyze the components adaptation (A), decision making (DM) and efficacy (E) of technical-tactical actions of each player in different game environments. Data collection involved the complete filming of game and transcript data in training situation and the official competitive situation. Resorted to inferential statistical analysis to compare the performance achieved by players in each component evaluated using the test T for independent samples, assuming a value of  $p \leq 0.05$ . **Results** The data in this study showed that the level of technical-tactical performance of the players investigated in game situation-training were significantly higher in all variables (A = 78.9 x 71.3; DM = 79.4 x 66.5; E = 78.8 x 64.7). **Discussion** The results demonstrate that the competitive environment, where external constraints are present, has negative effects on technical-tactical performance of young futsal players. Also, confirm that the technical and tactical actions in team sports are determined by the interaction between cognitive, coordinative and psychological capacities, being the latter, most requested in the competitive environment (Greco, 2006; Canyon, 2009). Thus, the evidence found point to the need of the young athlete training at competitive situations, favoring the development of their cognitive, psychological and coordinative abilities. It is also recommended that the competition is perceived by coaches as an authentic environment for long term athletes formation. **References** GRECO, PJ (2006) Knowledge tactical-technical: pendulum model of behavior and action in team sports. *Rev. Bras. Psicol. of Esp. Exerc.* V. 20, n.1, p. 107-129. CANYON, J. (2009) Trends of tactical performance analysis in team sports: bridging the gap between research, training and competition. *Rev. Port. Cien. Desp.*, Vol. 9, n.1, p.35-46. SAAD, M. (2012). The technical-tactic futsal players in the sub categories and 13 sub-15: analysis of the teaching-learning-training. PhD Thesis. Federal University of Santa Catarina. Acknowledgement to Araucaria Foundation by financial Support.

## REVISITING CRITICAL POWER MODEL

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A well-established model, Critical Power, has been extensively used in numerous endurance sports to characterize an individual's work performance; anaerobic work capacity (AWC) and critical power (CP). A linear relationship between total work and time to fatigue was observed and can be described mathematically by  $Work = AWC + CP \cdot time$  (Monod 1957). A mathematical equivalent model,  $Power = AWC/time + CP$ , can be derived from the traditional model and has been a popular model used in research. The model makes an assumption that all types of athlete have the same responses when it comes to power and time to fatigue, however recent study showed different observation (Bundle 2012). Therefore, we proposed a modified CP model with an introduction of a relationship variable,  $n$ , to allow the freedom to describe the relationship between power and time for different types of athlete.  $Power = AWC/time^n + cp$ . **Methods** Ergometer testing results (power outputs for 1 minute, 1km, 2km, and 6km) were obtained from 31 senior (24.89yrs  $\pm$  0.78), 33 U23 (20.8yrs  $\pm$  1.47), 23 junior (16.35yrs  $\pm$  1.03) athletes. Out of the 87 athletes, 57 were male (20.89 yrs  $\pm$  2.92) and 30 were female (19.03 yrs  $\pm$  3.34). The data were fitted using nonlinear regression model on the proposed modified CP model to determine the relationship between power output and time to fatigue for each individual. Analysis of variance with Tukey correction for type I error was used to compare the means of the relationship variable  $n$  between 3 competitive categories (senior, U23, and junior) and also between sex (male, female). **Results** The relationship variable,  $n$ , were 0.4721, 0.4841, and 0.3359 for the senior, U23, and junior athletes respectively. There were significant difference between the junior athletes when compared to the senior ( $p < 0.001$ ) and U23 ( $p < 0.000$ ) athletes, however there were no significant difference between the senior and U23 athletes ( $p = 0.930$ ). There were also no differences in responses for male and female to performance and time to fatigue. **Discussion** In all three categories, the relationships were shown to be significantly different from the inverse relationship suggested by the traditional model. The senior and U23 athletes appeared to have different response to power and time to fatigue than junior athletes indicating the years of training may have altered their physiology to accommodate specific rowing performance needs. The next phase of the study will be to examine the power-time relationship between more extreme types of athletes (sprint or endurance) and across different sports. We hypothesize there will be a significant difference in power-time relationship between sprint and endurance athletes and this relationship parameter will be consistent across the different sport. **References** Monod H, Scherrer J. (1957). *Soc boil Fil*, 151(7): p.1358-62 Bundle MW. (2012). *Exerc Sport Sci.* 40(3):p.174-82

## COMPARISON OF THE SPIKE VELOCITY BETWEEN DIFFERENT GROUPS OF VOLLEYBALL PLAYERS

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**Introduction** Spiking efficacy is one of the key factors for success of one volleyball team. The fact that one team wins most of the points in the set/match with the spike (Bellendier, 2003; Marelić et al., 2005) makes this element very interesting for analysis. Besides technical – tactical diversity the key factor on high competitive level is the spiking velocity. The aim of this study was to compare the spiking velocity among three different groups of volleyball players. **Methods** Nineteen senior male volleyball players were divided into three different groups according to their quality: G1 (national team members), G2 (premiere league players) and G3 (second league players). Each volleyball player performed three spikes. Spiking velocity was measured using STALKER PRO radar in km/h. The means and SE were calculated for each tested group. Results between the groups were compared using ANOVA (Tukey HSD post – hoc test). Results Significant differences in spiking velocity were found ( $p < 0.05$ ). Using Tukey post-hoc test significant differences were found between all three groups ( $p < 0.05$ ). The speed of the spike increases according the level of the tested group (G1: 106.3 $\pm$ 5.83, G2: 97.5 $\pm$ 2.81, G3: 90.9 $\pm$ 2.96). **Discussion** The obtained results are almost identical to the previous results obtained on similar samples (Christopher, 2001; Coleman et al., 1993; Forthomme et al., 2005). Considering the importance of a spike in the structure of points scored during a set/match it may be concluded that the spiking velocity may represent important criteria in the selection process in volleyball especially at the top level. **References** Bellendier J. (2003). [http://www.efdeportes.com/Revista Digital - Buenos Aires](http://www.efdeportes.com/Revista%20Digital%20-%20Buenos%20Aires). Christopher GA. (2001). Unpublished Ph.D. Dissertation, Brigham Young University. Coleman S, Benham A, Northcott S. (1993). *J Sport Sci*, 11, 259-302. Forthomme B, Croisier L, Ciccarone

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### **MAXIMAL AEROBIC CAPACITY IN THE WINTER OLYMPIC ENDURANCE DISCIPLINES: CURRENT OLYMPIC MEDAL BENCHMARKS**

Tønnessen, E., Hem, E., Leirstein, S., Haugen, T., Seiler, S.

*The Norwegian Olympic Sports Program*

**Introduction:** Maximal oxygen uptake (VO<sub>2</sub> max) is a key performance parameter in winter Olympic endurance sports. Since 1990, the Norwegian Olympic Training Center has served as a standard testing facility for a large number of athletes across a broad range of performance levels, including multiple medal winners in cross-country skiing, biathlon, Nordic combined and speed-skating. The aim of this study was to generate Olympic medal benchmarks for VO<sub>2</sub> max in these disciplines. **Methods:** We identified male and female athletes who either won medals or ended in 4-8th place in winter Olympic Games or World Championships in the period 1990-2012. All identified athletes tested VO<sub>2</sub> max at the Norwegian Olympic Training Center within the same year of the actual competition. The treadmill testing procedures, described in Tønnessen et al. (2012) were consistent throughout the entire period, making all data comparable. **Results:** For the medal winning athletes, the following relative VO<sub>2</sub> max values (mean: 95 % CIs) for men were observed: cross-country skiing (85: 79-90) mL x min<sup>-1</sup>x kg<sup>-1</sup>(n=16), biathlon (80: 76-84) (n=9), Nordic combined (77: 74-80) (n=8) and speed-skating (74:69-80) (n=8). For the female medalists, the following VO<sub>2</sub> max values were observed: cross-country skiing (71: 63-80) mL x min<sup>-1</sup>x kg<sup>-1</sup> (n=11), biathlon (65: 60-71) (n=8). VO<sub>2</sub> max did not distinguish medal winners from athletes who ended in 4th-8th place for any of the disciplines. **Discussion:** This study provides concrete benchmark values for VO<sub>2</sub> max Olympic medal level performance in typical winter Olympic endurance disciplines. High VO<sub>2</sub> max is necessary but not sufficient in itself to deliver peak performance. Less complex disciplines seem to achieve higher values than more complex sports. World class female athletes achieve 16-19 % lower relative VO<sub>2</sub> max values than their male counterparts. The present results update the VO<sub>2</sub> max values presented by Saltin & Åstrand in 1963 and can serve as guidelines for future elite athletes. **References:** Tønnessen E, Hem E, Leirstein S, Haugen T, Seiler S. *Int J Sports Physiol Perform*. 2012 Oct 30. [Epub ahead of print] Saltin B, Åstrand P.O. (1963). *J Appl Phys*. 23(3), 353-358.

**14:00 - 15:00**

## **Mini-Orals**

### **PP-BN03 Biomechanics [BM] 3**

#### **TREADMILL VS OVERGROUND RUNNING. INFLUENCE OF THE EXHAUSTIVE RUNNING ON PLANTAR PRESSURE**

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**Introduction** Properties of different surfaces may provoke biomechanical modifications in running gait. Although the use of treadmills is becoming ever commoner (Wank et al., 1998), the differences produced when running on a treadmill vs overground (Wank et al., 1998; Hong et al., 2012) may call into question the use and validity of the treadmill as equipment used in research, training, and rehabilitation. Furthermore, how the runner's fatigue can affect the comparison between treadmill and overground running is unknown to date. Therefore, the aim of this study was to analyse under pre- and post-fatigue conditions the effect of the surface (treadmill vs overground) on plantar pressures. **Methods** Twenty-seven recreational runners (17 men, 10 women) participated in the study. On different days, the runners ran on a treadmill and overground at two different speeds (S1=3.33 m/s, S2=4.00 m/s), before and after a fatigue protocol consisting of a 30-min run at 85% of their individual maximal aerobic speed. Contact time (CT), peak pressure (PP), and relative load (RL) were analysed under 9 foot zones of the left foot using a Biofoot® in-shoe plantar pressure device. **Results** Treadmill running (compared to overground running) increases CT (7.70% in S1 - 9.91% in S2), modifies the pressure distribution (RL) and reduces PP (25.98% in S1 - 31.76% in S2), especially under the heel, medial metatarsals, and hallux. Moreover, on both surfaces, fatigue (S2) led to a reduced PP on the lateral heel and hallux (15.96% - 16.35%, respectively), and (S1) increased RL on the medial arch (9.53%). There was no significant interaction between the two factors analysed (surface and fatigue). **Discussion** Running on a treadmill compared to running overground significantly modifies the contact time as well as the magnitude and distribution of plantar pressures. On both types of surfaces, the runner's fatigue increases the relative load on the medial arch and reduces the peak pressure under the lateral heel and hallux. The effect of each surface on plantar pressure seems to be independent of the runner's fatigue state, given that no significant interaction was found between the two factors. The aforementioned surface effects should be taken into account when interpreting the results of studies that use the treadmill in their experimental protocols and when prescribing physical exercise on a treadmill. **References** Wank V, Frick U, Schmidbleicher D. (1998). Kinematics and electromyography of lower limb muscles in overground and treadmill running. *Int J Sport Med*, 19:455-461. Hong Y, Wang L, Li JX, Zhou JH. (2012). Comparison of plantar loads during treadmill and overground running. *J Sci Med Sport*, 15:554-560.

#### **COMPARISON OF MORPHOLOGICAL CHARACTERISTICS OF HIGH-RANK FEMALE JUDOKAS OF VARIOUS WEIGHT CLASSES**

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**Introduction** Data on morphological features of judokas of various weight categories are often used to select athletes and determine the course of their training. Such studies have been done mainly for male judokas (Franchini, Nunes, Moraes & Del Vecchio, 2007 et al.). Yet, morphological features of female judokas still remain poorly researched. So the aim of this study was to compare the lengths and circumferences of body segments, skinfolds, and body fat percentage of high-rank female judokas of various weight classes. **Methods**

Twenty-three Russian female judokas (Masters of Sports of Russia and Masters of Sports of Russia of International Class) took part in the investigation. Morphological characteristics of 11 judokas of lighter weight classes (under 52, 57, and 63 kg) and 12 judokas of heavier weight classes (under 70 and 78 kg) were compared. Measurements were taken in accordance with ISAK guidelines. Body fat percentage was calculated from the measurements of four skinfolds (Jackson, Pollock & Ward, 1980). One-way analysis of variance was used to examine statistical differences of data. Results No significant differences in lengths of upper arms, forearms, hands, thighs, and shins were found for the judokas of both groups ( $p > 0.05$ ). Yet, heavier judokas appeared to have significantly larger lengths of feet ( $p < 0.01$ ). Circumferences of neck, thorax at forced inspiration, arm relaxed, forearm, mid-thigh and calf were significantly larger in case of heavier judokas ( $p < 0.01-0.001$ ). No significant differences in hand circumferences were found ( $p > 0.05$ ). Eight skinfolds proved to be significantly larger in case of heavier judokas (triceps, forearm, subscapular, chest, abdominal, thigh, medial calf:  $p < 0.05-0.01$ ). Body fat percentage was significantly larger for judokas of heavier weight classes ( $p < 0.01$ ). Discussion The absence of significant differences in the lengths of body segments between female judokas of lighter and heavier weight classes (except for feet) has shown that there is no need to rely on these characteristics when selecting athletes of different weight categories. Significantly larger circumferences of most body segments, larger skinfolds and body fat percentage of heavier judokas might result in lower mobility and deficiencies in competitive performance. Big values of body fat in judokas of heavier weight classes might be the consequence of their insufficient competitive readiness, and thus might be viewed upon as a reason to adjust their training processes. References Franchini, E, Nunes, AV, Moraes, JM & Del Vecchio, FB (2007). Physical fitness and anthropometrical profile of the Brazilian male judo team. *J Physiol Anthropol*, 26 (2), 59-67. Jackson, AS, Pollock, ML, & Ward, A (1980). Generalized equations for predicting body density of women. *Med Sci Sports Exerc*, 12(3), 175-182.

### KETTLEBELL SNATCH TRAJECTORY OF ELITE LEVEL KETTLEBELL SPORT ATHLETES

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*1: Australian Catholic University*

Introduction The first Kettlebell or Girevoy Sport (GS) competition was held in Russia in 1948. The competition has a ten minute time limit per set and the aim is to perform as many repetitions as possible within that period. Interest in the sport has developed only recently in the West, leading to a paucity of research on the sport in English language scientific journals. The 'snatch', is considered the most technical event in GS and was the focus of this research. The aim was to document kettlebell trajectory and variation during the snatch when performed by elite GS athletes. Method Four elite GS athletes (age =  $38.25 \pm 6.9$  years, body mass =  $90.5 \pm 16.7$ kg, height  $180.3 \pm 7.7$ cm) completed a set of 16 repetitions of the kettlebell snatch with a 32.1kg kettlebell. Kettlebell trajectory was captured with the VICON motion analysis system (at 250 Hz) and analysed with VICON Nexus (1.7.1). Four points in the sagittal plane were noted to identify the the point at which the kettlebell trajectory changed from forwards to backwards, or backwards to forwards. At these four points means, standard deviations, absolute error and radial error (RE) were measured in the sagittal and frontal planes. This was used to ascertain a measure of consistency from trial to trial. Additionally, the distance between the midpoints of the upwards and downwards phases in the sagittal and frontal planes were recorded. Results The trajectory of the kettlebell, followed a 'C' shape in the sagittal plane, and had a larger radius on the upwards phase than the downwards phase of the snatch. There was a mean distance between upwards and downwards phases at the midpoint of 72mm in the sagittal plane and 24mm in the frontal plane. The mean peak speed occurred during the upwards phase, and was  $4.03 \pm 0.20$  m s<sup>-1</sup>, whilst measuring  $3.70 \pm 0.30$  m s<sup>-1</sup> during the downwards phase. Mean RE for the sagittal and frontal planes was  $22 \pm 6$  mm. Discussion Three dimensional motion analysis was used in this case study to document the athletes kettlebell snatch kinematics. Despite some differences, there were three major commonalities. A 'C' shape trajectory was shown during the downwards and upwards phases of the snatch. Relative to the upwards phase, the 'C' shape of the downwards phase followed a narrower trajectory. The larger radius during the upwards phase and the slower mean peak speed during the downwards phase, may reduce force placed on the finger flexors. Additionally, at the four points of the kettlebell snatch there was low movement variability. A consistent path for each repetition may have been used to reduce extraneous movements, increasing efficiency. References Tikhonov V, Suhovey A, Leonov D. (2009). Fundamentals of Kettlebell Sport: teaching motor actions and methods of training: a manual, Soviet Sport

### A NOVEL PROTOCOL FOR ASSESSING SKATING PERFORMANCE IN ICE HOCKEY

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*University of Ottawa*

Introduction: In ice hockey, the ability to skate swiftly and with skillful precision is most predictive of players' proficiency in the game<sup>1</sup>. Prior research aiming to understand the patterns and mechanics of skating has focused on measuring kinetic and kinematic variables at play during the movement<sup>2,3</sup>. While force plates have long been the gold standard for the measurement of force output, their use is limited to a laboratory environment and thus a simulated skating environment for the athlete. The purpose of this study was to establish a novel protocol for evaluating ice hockey skating performance through direct in-skate measures. Methods: Five competitive-level hockey players completed three skating acceleration trials from rest on a regulation ice hockey rink. Tekscan Inc. insoles were placed into a hockey skate equipped with a novel technology designed to optimize force transfer and control (NS), followed by participants' own skates (OS). Peak plantar force, impulse, and center of force (COF) variance (A-P and M-L axes). Results/Discussion: Significantly higher vertical plantar force and impulse were found in the NS condition when compared to the OS condition for all participants ( $p \leq 0.05$ ). COF variance and A-P COF displacement were also significantly greater for the NS condition. Maximization of dynamic stability while skating is crucial to achieve high plantar force and impulse. Impulse in particular has been identified as an important performance parameter in sprinting sports as well as skating<sup>4,5</sup>. Acting to optimize dynamic stability, the higher COF variance indicates a greater ability to move the body through the stance phase of skating with control while a greater range of force distribution in the A-P axis may indicate an increased ROM at the ankle joint. Thus, the results of this study show that direct measurement of these dynamic variables may be important indicators in evaluating skating performance in ice hockey as it relates to skate design or skill development. References 1.Upjohn et al.(2008). Three-dimensional kinematics of the lower limbs during forward ice hockey skating. *Sports Engineering*, 7(2). 2.de Koning et al. (1995). The start in speed skating: from running to gliding. *Medicine and Science in Sport and Exercise*, 27, 1703-1708. 3.Stidwill et al. (2010). Comparison of skating kinetics and kinematics on ice and on a synthetic surface. *Sports Biomechanics*, 9(1), 57-64. 4.Behm et al. (2005). Relationship between hockey skating speed and selected performance measures. *Journal of Strength and Conditioning Research*. 19(2): 326-331. 5.Kawamori et al. Relationships between ground reaction impulse and sprint acceleration performance in team-sport athletes. *Journal of Strength and Conditioning Research*.

## TRUNK MUSCLE ACTIVITY AND BODY ALIGNMENT DURING A HANDSTAND POSTURE

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**Introduction:** Handstands are frequently performed by competitive gymnasts and divers. Muscle activity and body alignment of a handstand posture differ from those of a standing posture because an individual's center of mass is controlled by their upper extremities. The purpose of this study was to clarify trunk muscle activity and body alignment during handstand posture in gymnasts. **Methods:** Seven male collegiate gymnasts who have been practicing gymnastics for more than 10 years participated in this study. Electromyographic (EMG) and body alignment data were synchronously measured during static handstand and standing postures. EMG data were obtained for the rectus abdominis (RA), external oblique (EO), internal oblique (IO), thoracic erector spinae (TES), lumbar erector spinae (LES), and rectus femoris (RF) muscles and normalized with respect to the amplitude of the maximum voluntary isometric contraction (%MVC). The angles of thoracic kyphosis, lumbar lordosis, pelvic tilting, and the hip joint in the sagittal plane were collected using 2 motion analysis system cameras. Each %MVC and alignment data were compared between experimental tasks (handstand vs. standing) by using a paired t-test ( $p < 0.05$ ). **Results:** The RA, EO, and RF activity levels during the handstand were  $6.5 \pm 4.2$  %MVC,  $6.4 \pm 5.1$  %MVC, and  $3.5 \pm 2.2$  %MVC, respectively, and were significantly higher than the values while standing. On the other hand, the LES activity during the handstand ( $1.6 \pm 1.2$  %MVC) was significantly lower than that during standing ( $4.7 \pm 3.6$  %MVC). The anterior pelvic tilting angle ( $18.2 \pm 8.6^\circ$ ) and the hip extension angle ( $11.2 \pm 5.8^\circ$ ) during the handstand were greater than those while standing. **Discussion:** These results indicated that the anterior surface muscles (RA, EO, and RF) were activated as antigravity muscles to maintain the handstand posture. In contrast, the LES muscles were activated as antigravity muscles while standing. Moreover, the alignment data showed greater angles of anterior pelvic tilting and hip extension during the handstand than while standing. Gautier et al, (2009) reported that expert gymnasts could maintain a handstand posture with less hip extension displacement than amateur gymnasts. The findings of the current study suggest that the abdominal and hip flexion muscles involved in the maintenance of a straight handstand posture in expert gymnasts.

## NEURO-MECHANICAL RESPONSES TO A 4-WEEK NORDIC HAMSTRING EXERCISE TRAINING PROGRAMME

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**Introduction** Hamstring strains are prevalent in many sports with sprinting, jumping and kicking actions (Orchard et al, 1997). The use of eccentric exercise in the prevention and rehabilitation of hamstring injuries has been advocated by numerous authors (e.g. Brockett et al, 2004). The Nordic hamstring exercise (NHE) is a popular eccentric exercise; however there is a paucity of information available regarding the biomechanical adaptations to this type of training. Accordingly, the aim of this study was to investigate the kinematic and muscle activation adaptations to a 4-week eccentric hamstring training programme. **Methods** Ten male university students (age:  $20.4 \pm 1.9$  years) were recruited and invited to visit the laboratory on three occasions (TS1, TS2, TS3), 4 weeks apart. During each laboratory visit the participants performed two sets of five repetitions each of the NHE and maximal eccentric voluntary contraction (MEVC) of the knee flexors on an isokinetic dynamometer (30deg/s) whilst knee angular displacement and electrical activity (EMG) of biceps femoris were measured. The first 4-week control period was followed by a 4-week intervention period during which the participants underwent 2 training sessions per week of up to 4 sets of 6 repetitions of the NHE. **Results** Following the training intervention, the peak knee angular velocity was significantly reduced ( $63.4$  vs  $83.2$  deg/s,  $p < 0.05$ ) whereas the angle at peak velocity increased ( $53.5$  vs  $43.0$  deg,  $p < 0.05$ ) during the performance of the NHE. Similar significant trend was observed for peak EMG ( $0.150$  vs  $0.322$  mV,  $p < 0.05$ ) and angle at peak EMG ( $72.5$  vs  $63.6$  deg,  $p < 0.05$ ). Interestingly, while there was no significant change in MEVC following the training intervention ( $174.9$  vs  $168.2$  Nm), the neuro-mechanical efficiency was significantly increased on TS3 ( $1427.2$  vs  $878.7$  Nm/mV,  $p < 0.05$ ). **Discussion** A reduction in the knee peak angular velocity, along with an increase in the angle, mean that the forward fall is broken more efficiently, which can potentially be attributed to an enhancement in eccentric muscular contraction. MEVC did not improve and this finding conflicts with the results of Iga et al (2012). However the increase in neuro-mechanical efficiency can be ascribed to an improved contractile state of the musculature, where the concurrent activation of less motor units generated the same amount of external force. Notably, this is mirrored by reduced EMG amplitude during the performance of the NHE, which can be again an indication of improved efficiency. **References** Brockett CL et al. (2004). *Med Sci Sports Exerc*, 36, 379-87 Iga J et al. (2012). *Int J Sports Med*, 33(12), 1000-4 Orchard J et al. (1997). *Am J Sports Med*, 25(1), 81-5

## THE EFFECT OF HOLDING A LACROSSE STICK AND ANTERIOR CRUCIATE LIGAMENT INJURY ON THE LATERAL TRUNK ROTATION DURING CUTTING MOVEMENT

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**【Introduction】** Each lacrosse player always carries a lacrosse stick (crosse) in a game. Holding a crosse restricts the mobility of their arm, and their trunk should be requires larger movement to their trunk for compensation. The lacrosse player with anterior cruciate ligament (ACL) injury performs an unusual motion associated with knee instability and deficit in somatosensory system. Thus, the trunk movement of the lacrosse player with ACL injury is assumed to be larger than that of the uninjured player. The purpose of this study was to determine the effect of carrying a crosse and ACL injury on lateral trunk rotation during cutting movement. **【Methods】** Ten male collegiate lacrosse players (injured group: five players, control group: five players) were voluntarily participated in this study. Subjects were instructed to run diagonally backward right and quickly change direction to turn left ( $70^\circ$ ) to the initial direction. They performed two trials in both holding and not holding a crosse conditions, then their motions were recorded by three high-speed cameras at 300 fps. From the obtained movies, bilateral anterior superior iliac spines (ASISs) and acromia were digitized in three-dimension. The trunk rotation angle was defined as the orientation of the line connecting between bilateral acromia relative to the line connecting between bilateral ASISs (positive values indicate that right acromion rotates to forward). The range of the trunk rotation and the mean rotation angles of the trunk were calculated during the contact phase of cutting movement. **【Results and Discussion】** The ranges of trunk rotation were not different between in holding a crosse condition (injured group:  $28.3 \pm 4.2^\circ$  and control group:  $30.2 \pm 5.5^\circ$ ) and in not holding a crosse condition ( $30.0 \pm 11.1^\circ$  and  $31.8 \pm 17.4^\circ$ ). Although the mean rotation angles of the trunk in the control group were similar in both conditions, those in the injured group were tended to be larger in holding a crosse condition ( $9.9 \pm 4.1^\circ$ ) than in not holding a crosse condition ( $6.6 \pm 8.5^\circ$ ) ( $p = 0.09$ ). Thus, it is indicated that the range of lateral trunk rotation during cutting movement with a crosse in the injured group was totally shifted to left side compared with that in the control group. These results suggested that the subjects in the injured

group made their trunk rotate to the next direction prior to the cutting movement in order to reduce the load on the injured knee. Further studies are needed to confirm the motion prior to the cutting movement.

### THE EFFECT OF INSTRUCTION ON THE NON-THROWING ARM ON THE 3D ARTHROKINEMATICS OF TRUNK AND UPPER LIMB IN A TEAM HANDBALL PENALTY THROW.

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**Introduction.** This abstract presents preliminary results in an ongoing study. The team-handball penalty throw has only once been studied in an interventional design in which the instructions on throwing velocity or accuracy were the independent variables and the kinematics the dependent(1). The purpose of this study was to analyze the effect of instructions on the throwing technique to the ball velocity and kinematics of other joints. Based on another study, that found that players with a constraint on the non-throwing arm threw slower and had other kinematical parameters(2), we tested if an instruction regarding the non-throwing arm could increase the ball release speed (BRS). **Methods.** Three-dimensional kinematics of 2 male subjects (students at the Topsportschool Vlaanderen, 17 years old) were measured using a 6 camera motion analysis system at 250Hz (VICON Nexus) and kinematic parameters were calculated using a Finite Helical Axis approach (FHA). We measured 3 trials for the penalty shot (PS) without any instructions and afterwards 3 trials for a penalty shot (PS.2) with the instruction to use their non-throwing arm actively during the acceleration phase ("active backward pull of the non-throwing arm"). Subjects did not know that after the initial trials, there would follow an instruction, nor were they informed as to why this instruction was given. The throws with highest BRS of both shots were used for analysis. **Results.** For subject 1, we observed a similar BRS after instruction (PS: 25.6m/s, PS.2: 25.2m/s), but for subject 2 there was a decrease discernible (PS: 21.65m/s, PS.2: 20.96m/s). Subject 1 showed consistently higher mean angular velocities (MAV's) in the PS.2 for all calculated variables (shoulder internal rotation, elbow extension, pelvis internal rotation, upper thorax internal rotation, trunk flexion, trunk internal rotation) and a shorter acceleration phase, but no higher BRS. Subject 2 showed no such pattern in MAV's or acceleration phase. **Discussion.** It was hypothesized that the momentum created by the non-throwing arm would help the trunk reach higher rotational velocities, but based on these preliminary results we cannot agree with our initial hypothesis. Further data processing on other subjects is ongoing and will lead to more insight. **References** (1)van den Tillaar & Ettema (2008) Instructions emphasizing velocity, accuracy or both in performance and kinematics of overarm throwing in experienced handball players. *Perceptual and Motor Skills*. 97: 731-742 (2)Kazuyuki & Yuichi (2004) Effects of non-throwing arm on trunk and throwing arm movements in baseball pitching. *Int. J. of Sport & Health Sciences*. 2: 119-128

### DETERMINATION OF THE FRICTION COEFFICIENT OF CROSS COUNTRY SKIS ON A NOVEL LINEAR TRIBOMETER

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**Introduction** In skiing competitions, besides aerodynamic drag, the frictional force between ski and snow is the most important performance-limiting material factor. National ski federations and ski producers have been carrying out reams of gliding tests in the field. Outdoor tests however are affected by changing environmental conditions (Nachbauer et al., 1996) and the influence of the test skier. Laboratory measurements up to now were of limited significance due to design restrictions of the measurements devices (Ducret et al., 2005; Kuroiwa, 1977). In this study, laboratory snow friction measurements of complete cross country skis at sports specific velocities are presented. **Method** A novel tribometer was developed which is based on linear movement. It consists of a guidance beam (25 m), a carriage and a trough for snow or ice. The carriage runs on the beam and is pulled via light fibre cables by a high torque electro motor. In the first section the carriage carrying ski and measurement equipment is accelerated. In the measurement section the speed is kept constant and frictional force is measured. Afterwards the carriage is decelerated. In the study, a vertical force of 420 N was applied to the ski by springs. Two stone grinded cross country ski with a roughness of 40 µm (ski A) and 15 µm (ski B) were tested. Eight test series were performed at the speed of 2.5 and 5 m/s at temperatures of -4°C and -8°C for both skis. Additionally one series was carried out at -8°C and 2.5 m/s to check repeatability. One test series consisted of 30 runs, starting on a fresh snow track. The friction coefficient was calculated by dividing horizontal friction force by the vertical force and averaging the values over the measuring track. **Results** The friction coefficient of ski A at 2.5 m/s was 0.041 (-4°C) and 0.047 (-8°C). Ski B showed friction coefficients of 0.051 (-4°C) and 0.055 (-8°C). Results at 5 m/s were similar. The measurement value deviation within one test series was lower than 3%. Two test series carried out under the same conditions but on different tracks differed by 5%. **Discussion** The measurement device in the current setup is a valuable tool for evaluating friction differences between skis. Results are in agreement with findings in the literature (Bäurle et al. 2006; Kuroiwa, 1977). Due to the complicate and demanding assessment of the snow surface properties, direct comparisons are not possible. **References** Bäurle, L., Szabo, D., Fauve, M., Rhyner, H., Spencer, N.D., 2006a. Sliding friction of polyethylene on ice: tribometer measurements. *Tribology Letters* 24, 8. Ducret, S., Zahouani, H., Midol, A., Lanteri, P., Mathia, T.G., 2005. Friction and abrasive wear of UHMWPE sliding on ice. *Wear* 258, 26-31. Kuroiwa, D., 1977. The Kinetic Friction on Snow and Ice. *Journal of Glaciology* 19, 141-152. Nachbauer, W., Schroecksadel, P., Lackinger, B., 1996. Effect of snow and air conditions on ski friction. *Skiing Trauma and Safety* 10, 6.

### TEMPORAL CHARACTERISTICS OF THE EMG PATTERNS DURING CYCLING USING DIFFERENT ANGLE SCALE NORMALIZATION METHODS

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**Introduction** Muscle activity during cycling is generally studied from a representative ensemble-averaged EMG profile obtained over consecutive cycles, with time-scale normalisation for comparison across different trials. The abscissa is typically expressed as a percentage of the duration of the complete crank cycle, based on a single position in the cycle. However, because crank speed is not constant throughout the cycle, Hug (2011) suggested interpolating between multiple crank position detection points. This notion has not yet to be specifically tested. The aim of this study was to test if the number of crank position measurements affects the calculation of the temporal characteristics (onset, offset, and peak occurrence) of the EMG patterns. We hypothesised that these temporal characteristics would be different for crank positions measured at a single angle or interpolated between 4, and 360 crank positions. **Methods** 8 trained cyclists completed a constant-cadence 5-min cycling trial at 65% maximal aerobic power. Muscle activity patterns of the vastus medialis, vastus lateralis, rectus femoris, biceps femoris, gastrocnemius lateralis, tibialis anterior and soleus muscles were recorded using surface EMG. Raw EMG traces were bandpass filtered (20-450Hz) and smoothed with a RMS moving average (25ms window). Ensemble-averages

were calculated from 50 cycles. Onset, offset, activity duration, peak activity were analysed. On a rescaled EMG pattern according to 1 measurement point (0°), interpolating between 4 measurement points (0°, 90°, 180°, 270°), and between 360 measurement points. Differences among the number of measurement points were analysed with 2-way repeated measure ANOVA (muscles (7) x method (3)). Results No statistically significant main effects were found among the used methods to analyse the EMG pattern for onset ( $p = 0.052$ ), offset ( $p = 0.241$ ), and peak occurrence ( $p = 0.623$ ). Discussion This is the first study testing the effect of crank position detection on muscle activity patterns. The results do not confirm our hypothesis. A single crank angle detection point is sufficient to produce a representative EMG pattern during cycling at constant cadence. The present study is of practical value for future cycling research, and suggests that continuous measurement of the crank position is not required. References Hug, F. (2011). *J Electromyogr Kinesiol*, 21(1), 1-12.

### THE USE OF SOFTBALLS AS TEACHING METHOD OF TENNIS

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Introduction With the popularization of tennis in the last years, new training strategies are appearing that contributed to this growth and, among these strategies, the training with lower pressure balls, that are slower, favoring the movement levels which, in theory, would be more successful (Ishizaki, 2008). The aim of the following study was to verify if the low pressure balls (soft balls) provide better results when compared if the normal-pressured balls in the learning process. Methods 8 students, between 10 and 12 years old and in an initial level of learning, were selected. They were divided in two groups (G1 and G2). G1 trained with the low pressure balls and G2 used normal-pressured balls, according to the International Tennis Federation. The training method was the same for both groups. For the G1 group, every two classes the type of ball changed, following the sequence: red balls, orange, green and regular ones. G2 used only regular balls. The movements were recorded in sagittal plane, in the first class and when a new type of ball was used. Each class lasted 50 minutes for 4 weeks. The forehand cinematic was measured by bi-dimensional videography (60 Hz), through the variables sustentation base size (SBS), elbow bending angle (EBA), inferior members positioning (IMP), movement conclusion (MC) and court delivery (CD). To analyze the data it was used median descriptive statistic and standard deviation. Results The SBS variable for the G1 group presented development in technical positioning, increasing the size. G2 developed during classes, increasing the size. However, the base increase brought a bigger variation. For the EBA variable neither groups showed technical evolution. Regarding to the IMP, MC and CD, there was improvement in G1 with the classes. For the G2 group, the variables IMP and MC didn't show any development, not improving their positioning. In the CD variable, there was an evolution as the weeks went by. Discussion Training with low pressure balls was more successful, while the ones who trained with regular balls stayed the same in the two first aspects, improving only in the delivery. Analyzing the high and continuous improvement of group G1, we can see that the soft balls, having less pressure, increase the time between hitting the ground and getting to the student, making it easy to move around and to prepare for the hit. References: Ishizaki MT. (2008). *Tênis: aprendizagem e treinamento*. Phorte, São Paulo.

### BALL-FOOT INTERACTION IN IMPACT PHASE OF KNUCKLE SHOT

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BALL-FOOT INTERACTION IN IMPACT PHASE OF KNUCKLE SHOT Introduction There are many kicking techniques in soccer, all kicks represent almost same impact time of 1/100 second at the impact between a ball and a foot. Also, such a very short impact time decides the direction of a ball after the interaction between the ball and the foot, but there are still no clear answers for the complex mechanical interaction occurred at the moment of impact between the ball and the foot. Moreover, it is easy to find the non-spinning or low-spinning soccer balls in recent soccer games in which the trajectory of balls represents a characteristic of swing that is called as a knuckle shot or knuckle ball as an unsteady phenomenon (Hong and Asai, 2011; Hong et al., 2010). However, there are virtually few knuckle shot studies on the kicking motions or ball impact characteristics; as a result, the mechanisms of this shot have not been elucidated, possibly because this phenomenon occurs at extremely high speeds. Moreover, there are relatively few soccer players who can intentionally perform knuckle shot, and even among them, most have low success rates (Hong et al., 2011). Methods We used high-speed video cameras to compare the knuckle shot with the curve shot and straight shot, and investigated the swing characteristics of the kicking leg. Furthermore, the impact process of the kicking foot was analysed, elucidating the technical mechanism of the knuckle shot. Results & Discussion Results revealed flexion of the ankle joint in an approximate L-shape at impact, similar to that of the curve shot, and ball impact with a posture closer to that of the curve shot than to that of the straight shot was observed. The curve shot was considered a kicking motion with greater lateral motion than the straight shot, and the knuckle shot was considered to have a swing motion closer to the straight shot than to the curve shot. The ankle joint in the curve shot had greater lateral motion than the other shots, but was comparatively smaller in the knuckle shot. Hip external rotation in the knuckle shot exerted greater external rotation torque of the hip joint ( $61.2 \pm 8.1 \text{ N}\cdot\text{m}$ ) than the other shots ( $37.7 \pm 3.8 \text{ N}\cdot\text{m}$ ,  $51.8 \pm 7.7 \text{ N}\cdot\text{m}$  for the straight shot, and curve shot), and the tendency to impact with the heel pushed out towards the inside of the foot was considered. Furthermore, the angle of attack in the knuckling shot ( $4.3 \pm 1.3^\circ$ ) was smaller than those in the straight and curve shots ( $20.2 \pm 3.7^\circ$  and  $35.1 \pm 0.9^\circ$ , respectively) and was believed to be a factor for balls with smaller rotational frequencies. References Hong S, Asai T. (2011). *Int J Appl. Sports Sci*, 23(2), 406-420. Hong S, Chung C, Nakayama M, Asai T. (2010). *Procedia Engineering*, 2, 2455-2460. Hong S, Chung C, Sakamoto K, Asai T. (2011). *Procedia Engineering*, 13, 176-181.

### BIOMECHANICAL PARAMETERS OF VERTICAL JUMPS IN VOLLEYBALL AND BEACH VOLLEYBALL PLAYERS: COMPERATIVE ANALYSIS

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Introduction The aim of this study was a comparison of jumping abilities between two similar sport disciplines: volleyball and beach volleyball. Assuming that the differences of playground in both disciplines results in different jumping technique and energy expenditure [1], we found it reasonable to examine and identify the differences in mechanical parameters of vertical jumps between both groups. Methods 20 volleyball and 17 beach volleyball male players took part in the experiment. Descriptive statistics of the examined groups is as follows: body height ( $190,0 \pm 5,3$  and  $197,6 \pm 6,9$  cm), body mass ( $80,0 \pm 5,94$  and  $88,1 \pm 10,1$  kg), age ( $18,5 \pm 2,8$  and  $17,9 \pm 1,2$  years) and training experience ( $6,6 \pm 2,7$  and  $6,0 \pm 2,4$  years) respectively for beach volleyball and volleyball players. All the relevant biomechanical parameters were computed from the recorded ground reaction force developed by subjects on the force plate. All subjects performed

countermovement jumps (CMJ) and akimbo countermovement jumps (ACMJ), which are commonly used to describe jumping abilities of athletes. ANOVA (with Tukey post hoc test) procedures were employed for data processing ( $p < 0,05$ ). Results Both examined groups differed significantly in respect to body mass and body height. The ACMJ test revealed significant difference in height of jump, in favor to beach volleyball players ( $0,455 \pm 0,05$  vs  $0,423 \pm 0,06$ m). On the other hand, the CMJ test showed that the both groups differed in countermovement depth ( $0,456 \pm 0,06$  vs  $0,389 \pm 0,06$ m), developed maximal ground reaction force ( $1228,3 \pm 303,5$  vs  $1456,0 \pm 229,7$ ) and maximal and average power output ( $2927,5 \pm 569,1$  vs  $3392,8 \pm 491,9$ N and  $1338,6 \pm 248,0$  vs  $1622,8 \pm 347,5$ N). No significant differences were observed for height of jump and relative power output (maximal and average power in relation to body mass). Discussion The presented results suggest that the beach volleyball players may attain better jumping abilities. Assuming that training of both disciplines is focused on power output and height of jump, the observed differences in jumping mechanics might be a result of playing and training on a different playground. Bishop [3] claimed, that differences in plyometric training performed on firm ground and on sand are caused by the lower ground reaction force developed on sand. Differences in jumping mechanics are supposedly related to the mechanism of stretch – shortening cycle. Acknowledgements: The study was supported by Ministry of Science and Higher Education. References Muramatsu S., Fukudome A., Miyama M., Arimoto M., Kijima A. (2006) Journal of Physiological Anthropology Vol. 25(1), 59-61. Buško K., Michalski R., Mazur J., Gajewski J. (2012). Biology of Sport, 29(4), 317-319. Bishop D. J. (2003) Sports Med. Phys. Fitness, 43 (4): 418-423.

### BETWEEN DECEPTION AND VERIDICALITY: A PRINCIPAL COMPONENT ANALYSIS ON BASKETBALL PASSES

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Introduction Deception is an effective tactic popularly used in basketball games of all levels. While the offensive players are trying to deceive the opponents, the defenders must detect the movement of deception in order to make the appropriate defense. Experimental works have shown that kinematics of movement are the source of the deception (Shim and Carlton, 1997) although experts were able to detect the veridical information from being deceived (Sebanz and Shiffrar, 2009). Principal Component Analysis (PCA) has been shown to be able to reduce the complex multi-segment movements to fewer dimensions, therefore the purpose of the study was to use PCA to examine the differences in the movement kinematics between the deceptive and veridical movements of basketball passes. Methods University basketball players served as the performers to make deceptive (fake passes) and veridical (true passes) motions. The GypsyGyro 18 motion digitizing system (120Hz) was used to capture the 3D kinematics of 17 joints, yielding a total of 51 dimensions of the movement data. Both position and velocity data were submitted for PCA. Results PCA on both position and velocity data show reduction of the number of principal components in the deceptive condition. The velocity data further show differences in the content of the components between the deceptive and veridical motions. The distinct slow-down of movements of the upper limbs were differentiated from the general forward motion of the majority of the body segments in the deceptive passes. Discussion The results of PCA on the movement velocity data provide useful information in distinguishing the deceptive vs. veridical motion. The results of this study may apply to the training of performing and detecting deceptive passes in basketball. Future studies with PCA will extend the scope of movements to other sports where deceptive motions play an important role in offensive tactics. References Sebanz N, Shiffrar M. (2009). Psychon Bull Rev, 16(1), 170-175. Shim J, Carlton LG. (1997). J Motor Behav, 29, 131-146.

### RELATIONS BETWEEN GROUND REACTION FORCES AND THROWING PERFORMANCE IN EXPERIENCED AND NOVICE HANDBALL PLAYERS

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Introduction Throwing performance (ThrP) differences in experienced (EP) and novice (NP) players are of particular interest (Wagner et al., 2010) for the NP's technical optimization. The ground reaction forces (GRF) during a shot is associated with the energy transferred from lower to upper extremity (Oliver and Plummer, 2011). However there is lack of data about the relations between GRF and ThrP. The study aimed to identify the GRF- ThrP relations in EP and NP. Methods Fifteen EP and 15 NP ( $24.9 \pm 2.9$  and  $21.7 \pm 0.9$  yrs) did 3-step (3SS) and jump shots (JS). The ball throwing velocity (Thr-Vel) and throwing accuracy (Thr-Acc) were used to assess ThrP (measured with a laser system and an electronic coordinate system, respectively, Bayios et al., 1998). The GRF-time curve during contact phase was recorded (Kistler-9281, 250Hz) to determine the parameters of contact time ( $t_{\text{contact}}$ ) and the maximum GRF ( $F_{\text{max:N-BW}}$ ), the time to peak ( $t_{\text{peak}}$ )  $F_{\text{max}}$  ( $\text{ms} \cdot \%t_{\text{contact}}$ ) and total impulse ( $\text{Imp:N} \cdot \text{s} \cdot \text{BW} \cdot \text{s}$ ) for the vertical ( $F_z$ ), anterior-posterior ( $F_y$ ) and lateral ( $F_x$ ) components, respectively. T-test was used for the differences between EP and NP and the Pearson coefficient for the significance of the GRF-ThrP relations (SPSS 13.0,  $p < 0.05$ ). Results The EP had better Thr-Vel and Thr-Acc in 3SS and JS ( $p < 0.05$ ). The significant GRF differences between EP and NP were not the same in 3SS and JS (3SS: EP>NP: $F_{\text{ymax}}$ , EPNP: $F_{\text{zmax}}$ ,  $F_z$ -Imp). In 3SS the NP had a non-consistent pattern of GRF peaks and dips. The GRF-ThrP relations were significant only in 3SS and only for Thr-Vel ( $p < 0.05$ ). In EP, Thr-Vel was negatively related to  $t_{\text{peak}}$ - $F_{\text{ymax}}$  & Imp- $F_x$  ( $r = -.52$  &  $-.62$ ). In NP Thr-Vel was related negatively to  $t_{\text{contact}}$  &  $t_{\text{peak}}$ - $F_{\text{ymax}}$  ( $r = -.66$  &  $-.74$ ) and positively to  $F_{\text{ymax}}$  (N - BW) ( $r = .65$  -  $.61$ ). The Thr-Acc relations with GRF were not significant ( $p < 0.05$ ). Discussion The GRF-pattern differences reveal a non-consistent force production during the 3SS in the NP which possibly highlights a technical weakness in energy transfer to the throwing upper extremity (Oliver and Plummer, 2011). The overall dissimilar pattern of GRF-ThrP relations in EP and NP is possibly associated to the shortage of technical optimization in EP and underline the necessity to identify the differences between EP and NP so as to improve the training schedule (Wagner et al., 2010). References Bayios I, Georgiadis G, Boudolos K. (1998). Proc. XVI ISBS, 59-62. Oliver GD, Plummer H. (2011). J Sport Sci 29 (10), 1071-1077. Wagner H, Buchecker M, von Duvillard S, Möller E. (2010). J Sport Sci Med, 9(1), 15-23.

14:00 - 15:00

## Mini-Orals

## PP-BN06 Biomechanics [BM] 6

**THE LUMBAR SPINE HAS AN INTRINSIC SHAPE THAT IS MAINTAINED THROUGHOUT FLEXION AND EXTENSION**

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Introduction: We have previously shown that the lumbar spine has an intrinsic shape which is maintained from sitting to standing and lying supine (1) and the magnitude of muscle forces to stabilize the spine depend on the intrinsic shape (2). The effect of intrinsic shape on movement patterns, especially during load-bearing, is unknown. This study investigates the change in spinal shape throughout a range of flexion and extension postures. Methods: Thirty healthy adults (15 males and 15 females) aged 20-52 years were recruited. Sagittal images of the lumbar spine were taken using a positional magnetic resonance imager (Fonar 0.6T Upright) with participants adopting six postures: seated extension, neutral standing, standing with 30°, 45°, 60° and full 'hanging' flexion. Active shape modelling (ASM) of the lumbar spine (L1 to S1) was used to analyse variations in spinal shape. ASM is a statistical model that uses principal components analysis to identify and quantify independent 'modes' of variation in shape. Results: ASM showed that 89.5% of the variation in the shape of the spine could be explained by the first two modes; describing the overall curvature or 'curviness' of the spine (M1, 85.3% of total variance) and the distribution of curvature or 'evenness' of the spine (M2, 4.2% of total variance). Within each of the first ten modes, scores were strongly and significantly correlated between all six postures ( $r = 0.4 - 0.97$ ,  $P < 0.05$ ), showing that intrinsic shape was maintained when changing postures. Mode scores were significantly different between postures ( $P < 0.001$ , first two modes) and pairwise comparisons revealed that the spine was most even in seated extension and had the most uneven curvature at 35° flexion ( $P < 0.05$ ). Discussion: We have extended our previous research and shown that the intrinsic shape of the lumbar spine is maintained throughout a wide range of postures from extension through to full flexion. This allows us to characterise and group individuals according to their spinal shape for analysis of motion with confidence that their intrinsic shape is maintained in the sagittal plane. Future research will use these results to investigate the effects of intrinsic spinal shape on movement and load-bearing activities. Knowledge of an individual's intrinsic posture could be important in sporting activities such as throwing and lifting. References: 1. Meakin JR, Gregory JS, Aspden RM, Smith FW, Gilbert FJ. (2009). *J Anat*, 215, 206-211. 2. Meakin JR, Aspden RM. (2012). *J Mech Med Biol*, 12(1), 1250013.

**START-UP TIME AND GAIT SPEED OF OLDER ADULTS DURING LOADED WALKING**

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Introduction The safety of older pedestrians in road crossing has received considerable attention in many countries. In the calculation of signal timings required for pedestrians to safely cross the road, both start-up time and gait speed need to be considered. This study investigated the start-up time and gait speed in older adults under loaded conditions that reflected their daily activities. Methods Thirty-two older adults (age = 69.4 (7.0) yrs) and 20 young controls (age = 23.1 (2.0) yrs) walked under four conditions: 1) unloaded, 2) pushing a stroller loaded with 10 kg, 3) pulling a shopping cart loaded with 15 kg, and 4) carrying two shopping bags each loaded with 2 kg. Upon a pedestrian crossing signal turned from red to green with an audible cue, participants walked at their comfortable pace for 10m. Start-up time was determined from video analysis, while gait speed measured by timing gates. Mixed model Analyses of Variance with repeated measures were used for statistical analyses. Results Start-up times were slower in the stroller and shopping cart conditions compared with walking unloaded and with shopping bags ( $P < .001$ ). Loading reduced walking speed, with the shopping cart being the slowest, followed by the stroller and then the shopping bags ( $P < .001$ ). Young controls reduced their speeds more substantially while handling the stroller/cart than older participants ( $P < .001$ ). Discussion Age and loading independently caused a compromise in start-up time and walking speed. Older adults were slower in starting up than their younger counter-parts, which is in agreement with a previous field study in the US (Knoblauch et al., 1996). While carrying shopping bags did not affect the start-up time, longer time was needed to initiate a stroller and a shopping cart. This is related to the extra friction that needs to be overcome to initiate motion due to the increase in load and surface contact area with the ground. In parallel with previous findings, our older participants walked slower than the young controls (e.g. Knoblauch et al., 1996; Langlois et al., 1997; Romero-Ortuno et al., 2010) but surprisingly they walked considerably faster than the older populations of similar age in other countries. A compromise in walking speed was observed in all loaded conditions. Young controls may lack experience in handling a stroller or shopping cart and therefore reduced their speed more substantially than older participants in these conditions. References Knoblauch RL, Pietrucha MT, Nitzburg M. (1996). *Transportation Research Record*, 1538, 27-38. Langlois JA, Keyl PM, Guralnik JM, Foley DJ, Marottoli R, Wallace RB. (1997). *Am J Public Health*, 87, 393-397. Romero-Ortuno R, Cogan L, Cunningham CU, Kenny RA. (2010). *Age Ageing*, 39, 80-86.

**EFFECTS OF STABILITY DEMAND ON THE POSTURAL CONTROL OF CHRONIC LOW BACK PAIN PATIENTS**

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Introduction Multiple studies have investigated upright postural control in patients with chronic low back pain (CLBP) by means of analyzing the center of pressure (CoP) excursion under different conditions. A recent review indicated that the majority of studies support worse balance control in CLBP (Rube et al, 2011). However, it seems that results depend on the type of variable measured and the conditions of assessment. We hypothesized that patients with CLBP, when placed under a higher stability demand, would demonstrate better CoP parameters than healthy adults. Methods Participants were 44 adults divided into 23 patients with CLBP (age mean 41.04, SD 11.04 years, 52.38% male) and 21 healthy adults (H) (age mean 34.75, SD 13.045 years, 56.52% male). Subjects were instructed to maintain quiet stance for 30 seconds in 2 different conditions: stable (SS) and instable surface (IS). Three trials were conducted in each condition. The center of pressure (CoP) was calculated with the use of a force platform (Kistler 9281EA) sampling at 500Hz and filtered with a cutoff frequency of 10Hz. The variables analyzed were path length (LEN), maximal displacement (MXD), mean velocity (MVe) and peak velocity

(PkVel) of the CoP in the anterior/posterior (AP) and medial/lateral (ML) directions. All variables were normalized to each individual base of support. 2 (groups) x 2 (conditions) ANOVAs with repeated measures on conditions were conducted for each variable. Results As expected, results confirmed worse postural control in IS than SS condition for all variables in both directions (all  $p < 0.01$ ). The IS condition yielded larger CoP displacements and velocities than the SS condition. Significant group effects were observed only for LEN in AP ( $p < 0.03$ ) and MXD in AP ( $p < 0.04$ ) in the SS condition. MXD in AP was significantly reduced in patients with CLBP (mean =0.106, SD=0.04) compared to H group (mean =0.077, SD=0.035). Similarly, LEN in AP was shorter in CLBP (mean =0.687, SD=0.27) than in H (mean =0.924, SD=0.42). Discussion Contrary to our hypothesis, these results suggest that subjects with CLBP may control balance at a similar level than healthy adults despite the increased stability demand. However, the shorter displacement of the CoP may be related to a decreased utilization of the hip strategy probably as a result of an increased activity of lumbo-pelvic muscles (Mok et al, 2004). Increased activity of the trunk muscles has been reported in subjects with CLBP, which may compromise the capacity to maintain equilibrium and limit trunk and hip motion. References Ruhe A, Fejer R, Walker B. (2011). *Eur Spine*, 20, 358-368. Mok N, Brauer S, Hodges P. (2004). *Spine*, 29, E107-E112.

### GAIT ANALYSIS BASED ON A SINGLE INERTIAL SENSOR: RELIABILITY OF GAIT PARAMETERS

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Introduction The advantages of gait analyses in patients with different disorders are diversified and well-known. The equipment, that is deemed the gold standard to conduct kinematic gait analyses, are camera-based motion tracking systems. However, the expense, the required time and the need for a laboratory makes these systems inefficient in clinical practice (Reininga et al., 2012). Gait analyses by inertial sensors, which are feasible in a clinical setting, offer the potential to minimize these costs. Therefore, the aim of this study was to examine the inter-day and intra-day reliability of gait parameters using a single inertial sensor. Methods Gait data of 19 healthy elderly subjects (5 male, 19 female, age:  $71 \pm 4$  years) were captured twice within the first day (m1) and also after seven days (m2). A wireless inertial motion tracker (MTw, Xsens) was fixed on the subjects' forefeet. Then, kinematic data was captured while the subjects were walking five times up and down a level hallway (distance 25 m) with their preferred walking speed. By means of a specifically designed algorithm, the inner-person averages of stride velocity (v), minimum foot clearance (mfc), stride length (sl), stance time and swing time as well as the corresponding measures of variability (coefficient of variation, CV) were calculated. Intra-day differences and inter-days differences were rated using the intraclass coefficient (ICC), the bias and the Limits of Agreement (LoA, Bland & Altman, 1986). Results Regarding average values, an ICC of 0.93-0.99 has been found for the intra-day data. Additionally, a low bias (e. g. sl: 0.001 m-0.002m, mfc: 0,000 m-0.001 m) and small LoA (e. g. sl: 0.026 m-0.047 m, mfc: 0.001 m-0.004 m) have been observed. In variability measures, the ICCs ranged from 0.600 to 0.958 (except for v in the m2 comparison, ICC: 0.484) with a bias of 0.01%-0.37% and a LoA of 0.36%-3.94%. Concerning inter-day reliability, analyses yielded ICCs ranging from 0.86 to 0.97 for average values and from 0.35-0.83 for CV. In particular, the comparison of the second gait data in m1 vs. m2 showed high ICCs for CV sl (0.83), CV mfc (0.82) and CV v (0.70) in variability measures. Discussion The results showed excellent reliability for all average parameters in both intra-day and inter-day reliability. While the intra-day reliability indicated good to excellent reliability of the variability measures, inter-day reliability ranges from poor for CV st to excellent for CV mfc and CV sl. Thus, to analyze average values as well as CV mfc and CV sl, the proposed system is suitable in a clinical setting. References Bland JM, Altman DG (1986). *Lancet*, 1, 307-310. Reininga IHF, Stevens M, Wagenmakers R, Bukstra SK, Groothoff JW, Zijlstra W (2012). *J Neuro Eng Rehabil*, 9 (3).

### JOINT COUPLING IN GAIT WITH ACTIVE SUPINATION OR PRONATION OF THE HINDFOOT

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Introduction The coupling of leg joints during walking was discussed widely in the past. There are various opinions - from the "Root biomechanics" [1] to denial of it [2]. This dispute inspired us to test the effect of active (hind)foot supination or pronation on gait kinematics of the ankle, knee and hip and to search for differences between natural and modified walking. Methods Thirty young healthy subjects completed trials of natural gait (NG), gait in active supination (SG) of the hindfoot and in active pronation (PG). The 3D kinematics (Vicon) and dynamic plantography (Footscan) were used to analyse the gait. The mean curves of joint motion were calculated for each gait type in the knee (sagittal, frontal, transversal) and hip (transversal). Differences among the gait types were estimated by a sign test at level  $p < 0.05$ . Results At the knee in SG, the flexion was reduced at FootFlat (FF) as well as during MidStance (MSI), Propulsion (PP) and Acceleration (AC). Varosity was stressed at the Heel Strike (HS), FF, MSt and valgosity was reduced during PP and AC but not at MidSwing (MSw). The external rotation was stressed at FF and PP. At the knee in PG, the flexion was stressed at HS and MSt but reduced during AC. The valgosity was stressed at HS, FF and MSt but not during PP. The internal rotation was stressed at HS, FF and MSt, at the start of Swing Phase and during MSw. Hip rotations in artificial gait are shifted to the external rotation in PG as well as in SG. Discussion The results are in agreement with "Root biomechanics" - the (hind)foot pronation is coupled with (relative) tibia internal rotation and (relative) knee flexion and the supination is coupled to (relative) tibia external rotation and relative knee extension, when the leg is working under load, which means in a closed chain. The differences between "artificial" and natural gait during the swing phase, which means in an open chain, are results of muscle synergy, but the central control must respect the (joint) anatomy as well as biomechanical principles. The movements of the hip and pelvis are more complicated due to pronounced influence of the opposite leg and trunk motion. References 1. Michaud TC. (1997). *Foot Orthoses and Other Form of Conservative Foot Care*, Thomas C. Michaud, Newton, Massachusetts. 2. Kirby KA. (2009). *Podiatry Today*, 31: 32-39.

### HOW DO NORMAL PEOPLE WALK: INVESTIGATING NORMAL GAIT USING A FORCE APPLIED TREADMILL ON FLAT SURFACES

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Introduction Normal variation of the gait cycle was investigated using a force applied treadmill. Similar assessments have been previously conducted but with fewer patients and using alternative methods. The use of a force applied treadmill has been recognised to be appropriate in the assessment of physiological gait. By use of 3D software, graphical demonstration of the gait cycle at variable speeds can be observed. The left and right strides were measured and assessed on a comparative basis. The aim therefore, is to highlight the

consistent symmetry of the gait cycle at increasing speeds for a large group of asymptomatic subjects. Methods 74 asymptomatic subjects were required to walk on a force applied treadmill enabling digital measurements to be recorded in order to plot individual gait curves. Ground reaction forces (GRF) were recorded at 100HZ over 10 seconds at 4km/hr, and then at increments of 0.5 km/hr until the subjects were comfortable with a top walking speed, all at a flat (0%) gradient. The aim was to reach a top speed without running, pain or discomfort. Walking speed was normalised to height using a formula suggested by Hof – the square root of the Froude number. A normalised speed of less than 8km/hr was considered the maximum. The raw data was extrapolated and plotted against % stride on the X axis, normalised force on the Y axis and Hof normalised speed on the Z axis. A software programme written in C++ enabled us to manipulate the data to demonstrate the actions of the feet at increasing speeds. Results The average gait curves for asymptomatic individuals walking on a flat surface have been represented graphically in a 3D manner. The use of a force applied treadmill accurately reflects forces experienced when walking on flat surfaces. There is a near identical representation between left and right strides throughout the gait cycle. This symmetry is maintained through increasing speeds, despite an amplitude increase of the overall curve. However, a difference during the push off phase between both feet is evident. Conclusions This is the first instance which exhibits gait symmetry of large numbers of asymptomatic individuals at high walking speeds. The graphs generated have been able to provide an expectant set of data when assessing gait. Its true application can be seen by allowing us to compare function of this normal gait to symptomatic patients with osteoarthritis, for example, in the future. References Dierick, F., Penta, M., Renaut, D., Detrembleur, C., 2003, A force measuring treadmill in clinical gait analysis, *Gait and Posture* 20, p. 299–303 Hof, A. L., 1996, Letter to the Editor: Scaling gait data to body size, *Gait and Posture* 4, p. 222-223

### THE INFLUENCE OF GAIT VELOCITY, GENDER AND AGE ON PLANTAR PRESSURE OF SENIORS UNDER DT CONDITIONS

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Introduction In a study, which was conducted to identify falls risks of older adults, the dual-task (DT) paradigm was used during a treadmill walk. Biomechanical gait variables like plantar pressure (pp) should be used to explain gait variability under these DT conditions. These test situations need a fixed gait velocity (v) to be standardized, which might influence gait behavior. In addition there might be other confounding factors like gender and age on the plantar pressure. Therefore, this preliminary study examined the effects of gait velocity (v), gender and age on pp to identify the amount of confounding effects on the internal validity. Methods N=58 seniors (n=41 women: 72.3 ± 6.3 y, 162.6 ± 17.2 cm, 71 ± 21.7 kg; n=17 men: 72.0 ± 4.7 y, 172.7 ± 24.9 cm, 81.7 ± 8.4 kg) were included. They were divided into three age groups (A1: n=8, 60.5 ± 3.5 y; A2: n=38, 70.0 ± 2.7 y; A3: n= 13, 78.5 ± 3.1 y). The pP (maximum pressure (px)) and gait kinematics (stride length (s), cadence (f) and stride time (t)) for the whole foot in three sections (heel (h), midfoot (mf) and forefoot (ff)) were analyzed walking barefooted on the treadmill (h/p/cosmos, FDM-T, 100Hz) in two different walking speeds (v= 3.5 and 4.5km/h). An ANOVA with repeated measures and additional determination of effect sizes ( $\eta^2$ ) as well as a partial correlation analyses (control variable: body mass) was done using SPSS 16. Results An increase of v was accompanied with a significant raise of s with a large effect size ( $p = .00$ ;  $\eta^2 = .82$ ) and an increased f ( $p = .02$ ;  $\eta^2 = .09$ ). Maximum plantar pressure px raised in all three observed foot sections (pxh, pxmf, pxff;  $p = .00$ ,  $\eta^2 = .12 - .49$ ). The age groups differed for s and f significantly with a small effect size ( $p = .04 - .05$ ,  $\eta^2 = .11$ ); the steps differed in their stride time structure. The pp distribution was only significant for pxff ( $p = .03$ ;  $\eta^2 = .13$ ). The heavier men walked under comparable f with increased s and increased vertical forces ( $p = .00 - .02$ ;  $\eta^2 = .11 - .22$ ) without significant changes in px. When the body mass was partialled out there was a positive correlation between pxff and age ( $r = .34^*$ ). Discussion The results confirmed findings by Chung & Wang (2011). Most values of pp were determined by gait velocity but not influenced by interactions of age and gender. Moreover the body mass has an important impact on plantar pressure. With rising age a larger s and f is needed to manage the same gait velocity. These changes are accompanied with an increased maximum of the plantar pressure. Future studies on plantar pressure should be arranged the fixed gait velocity in percentage of the individual preferred speed (Chung & Wang, 2011) as well as the analysis of the gait velocity in relation to individuals body mass to control confounding factors on the internal validity. In addition, for DT walking the differences between preferred and fixed gait speed have to be controlled to assign the DT effects.

### COMPARISON OF GAIT KINEMATICS OF ELDERLY PRACTITIONERS OF EXERCISE, NOT PRACTICING AND NOT-PRACTICING OBESE

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Introduction It is estimated that 85% of the population over age 65 complain of imbalance, instability and falls that come from the loss of mass and strength leading to decreased ability to promote rapid joint torque necessary for activities of daily living (Pedrinelli et al., 2009). The objective was to analyze the gait kinematics of elderly-exercising, non-practicing and non-practicing obese. Methods Sample, 23 seniors, were divided into group A, 8 elderly not practicing physical exercises, group B, 6 elderly practitioners and group C, 9 elderly and obese non-practicing. We used the International Physical Activity Questionnaire version/short. BMI was calculated using height and weight. The kinematics gait was measured by two-dimensional videography (60 Hz), temporal variables through the double support (IAD/2AD), single support (AS/RIGHT – AS/LEFT), step (TP/RIGHT – TP/LEFT), balance (FB/RIGHT – FB/LEFT), and total cycle (TPASS), and the spatial variables, stride length, cycle and walking speed. The SPSS stored the data. The test of normality Shapiro Wilk identified the variables were parametric. One way ANOVA comparing variables between groups and Post Hoc Bonferroni test showed differences between groups. The Student T-test (5%) groups compared with the adult gait. Results There are significant differences in gait 2AD time between groups B and C, duration of AS/RIGHT and time FB/LEFT between groups A and C. In comparison with adult gait (Rose and Gamble, 1998) there are significant differences, with higher values for time 1 and 2AD and lower values for AS Right/Left and FB Right/Left for groups A and C. Group B showed superior value for time to IAD and lower for AS Right and FB Left. Discussion There is a significant difference between the groups, especially between group C and others. In the groups A and B there is no significant difference, that due to the similarity in BMI. Compared with the march of the march groups of adults, differences were found for all groups, but group C, a greater number of variables, justifiable, because it has greater mass, loss of strength and power, which generate uncertainty in the realization of march, adopting it, compensatory mechanisms to produce walking safer and more stable. References Pedrinelli, A.; Garcez-Leme, L.E.; Nobre, R.S.A (2009). The effect of physical activity on locomotor the elderly. *Brazilian Journal of Orthopaedics*. São Paulo. Rose, J.; Gamble, J.G. (1998). *Human gait*. 2nd ed. São Paulo.

## DIFFERENCES OF STRIDE CHARACTERISTICS IN BAREFOOT VERSUS SHOD SPRINTING AND ITS RELATIONSHIP WITH REACTIVE LEG STRENGTH IN CHILDREN

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**Introduction** There is a hypothesis that modern sports shoes can contribute to weak feet during childhood (Lieberman, 2012). However, there are few studies to investigate the effects of the shoes on the physical abilities in this generation. The aim of this study was to compare the stride characteristics between barefoot and shod sprinting and its relationship with lower leg strength in children. **Methods** 546 healthy children (367 boys and 179 girls) aged 4 -15 yrs performed 10m sprints in barefoot and with shoes. Sprint time was measured by a timing gate. Contact time (Tc), flight time (Tf), step-length (SL), step-frequency (SF) and step-velocity (Vstep) were measured by photoelectric cells arranged 0.003 m above the floor with 0.01 m interval by 1000 Hz sampling frequency. 152 children out of all subjects were filmed with 600 fps to identify foot strike pattern. Repeated rebound jump (RJ) and counter movement jump (CMJ) were tested with three-axial accelerometer to measure jump height (JH-R), contact time (Tc-R), reactive strength (RS), and stiffness (Stiff) for RJ, and jump height (JH-C), power (Pw), force (F), and velocity (V) for CMJ. Paired t-test was used to compare the sprints in barefoot and shod. Comparison of values obtained in the subjects group who ran faster in barefoot (BF group) and in shod (SH group) was performed using independent samples t-test. **Results** Sprint time in barefoot was shorter than in shoes. Tc was shorter in barefoot than shod sprinting. Children adopted shorter SL in barefoot sprinting than in shoes. SF was higher in sprinting barefoot than in shoes. Vstep at the first step was slower in barefoot than in shoes, however, at the last step, Vstep was faster in barefoot than in shoes sprinting. Higher percentage of rear-foot strike (RFS) was observed than mid-foot strike (MFS) and fore-foot strike (FFS) in shod sprinting. In contrast, RFS decreased, and MFS and FFS increased in barefoot sprinting. BF group used shorter Tc, longer SL, and higher SF than SH group in barefoot sprinting. BF group showed higher RS, Stiff, JH-C, and V than SH group. **Discussion** These results confirm previous report that adolescents who grew up wearing shoes mostly used RFS when shod running, but adopt FFS or MFS when barefoot running (Lieberman et al., 2010). Increased percentage of FFS and MFS in barefoot sprinting appears to induce more elasticity produced in arch and Achilles tendon, which affects positively to sprint performance than shod sprinting in children. **References** Lieberman D.E., Venkadesan M., and Werbel W.A. et al. (2010), *Nature*, 463, 531-535. Lieberman D.E. (2012), *Exerc. Sport Sci. Rev.*, 40 (2), 63-72.

## EFFECT OF CUSTOM-MADE AND PREFABRICATED INSOLES ON PLANTAR PRESSURE AND KINEMATIC PARAMETERS DURING RUNNING

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**Introduction** Running involves contacting the ground 600 times per kilometer (Guo et al., 2006). Even though those impact forces are below the injury threshold, the fatigue of the athlete may reduce the ability of the biological structures to deal with that accumulative loading. Orthoses have been proved to effectively reduce impact forces (Creaby et al., 2011). However, there is a controversy whether custom-made insoles are more effective in reducing impact forces compared to prefabricated insoles. Therefore, this study aimed to compare the effect of different orthoses on kinematic and plantar pressure parameters during running. **Methods** Forty recreational runners (21 men, 19 women) participated in the study. Kinematic (contact time and stride rate) and plantar pressure (mean peak pressure [Px] and Pressure-Time Integral [PTI]) were analysed under three insole conditions (control [CI], prefabricated [PI], custom-made [CMI]) in 9 foot areas at 12km/h before and after a 15-min fatigue run with Biofoot@IBV/Valencia instrumented insoles. **Results** No difference in the plantar pressure and kinematic parameters analysed was observed due to the fatigue state. However, regarding the insole condition, CMI decreased Px under the hallux by 45%, and by 31% and 54% under the medial and lateral heel compared to CI. PI also led to reductions of Px under the toes (35%), lateral (31%) and medial (31%) arch compared to CI. When comparing both study insoles, CMI decreased Px under the medial heel by 31% and PTI under the lateral heel by 53% compared to PI. Finally, the insole conditions did not modify any of the kinematic parameters measured. **Discussion** The use of orthoses (both custom-made and prefabricated) decreased plantar loading under different foot areas (hallux, toes, foot arch and heel) compared to the control condition. In long distance races, where the accumulative effect of the impact forces can be harmful for the body structures, even a slight reduction in plantar pressure at each foot strike may suppose a significant decrease in the overall stress experienced by the foot and the observed loading reduction may involve a better pressure distribution without modifying the individual kinematic running pattern and lead to a lower injury occurrence in long distance races. **References** Guo LY, Su FC, Yang CH, Wang SH, Chang WL, Lin HT. (2006). Effects of speed and incline on lower extremity kinematics during treadmill jogging in health subjects. *Biomedical Engineering*, 18:73-79. Creaby MW, May K, Bennell KL. (2011). Insole effects on impact loading during walking. *Ergonomics*, 54:665-71.

## SUBJECTIVE MONITORING TOOL FOR LOWER LIMB COMFORT AMONG HABITUALLY SHOD RUNNERS DURING A MINIMALIST SHOE TRANSITION PROGRAMME

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**Introduction** Controversy exists around minimalist shoes (MS) which have been suggested as a means to either reduce, or potential to enhance risk of running-related injury. Monitoring of the initial transition period may be essential to help support the former notion (Rothschild, 2012). While previously applied to football players, the Lower Limb Comfort Index (LLCI) is a subjective scale that has been developed as a tool for clinicians and athletes to monitor the wellbeing of the lower limb at multiple anatomical areas (Kinchington et al., 2010). Identifying areas with the most potential for discomfort could help approximate mileage increments and predict and prevent MS running-related injury from occurring. Thus, the primary aim of this study was to determine changes in LLCI in runners undergoing a supervised MS transition programme. **Methods** Ten experienced shod male runners underwent a supervised seven-week MS (Vibram Fivefingers) transition programme. The MS training consisted of progressive increases in running mileage which started at ~ 11% to 22%, and ended at ~ 52% - 132% of the participants' usual shod training distance, recorded using global positioning system. No instruction was provided on running technique. The LLCI was used to record perceived lower limb comfort immediately prior to every training session. Each bilateral anatomical area (foot, ankle, calf-Achilles, shin and knee), was subjectively scored on a scale from 0-6 (0 = extreme discomfort; 6 = extreme comfort). **Results** T-tests showed that shin area had statistical and practical improvement in perceived comfort from start to end of the transition period (P = 0.04; Effect size (ES) = 0.96). The calf-Achilles (CA) area showed a similar trend, but only improved practically (P = 0.07; ES = 0.96). The rest of the LLCI items (feet, ankles, knees) had negligible to small practical improvements in perceived comfort (P >

0.05; ES = 0.1 - 0.17). ANOVA's showed that the calf-Achilles area had significantly more discomfort in comparison to all other anatomical areas ( $P < 0.05$ ) throughout the intervention. Discussion The CA area was found to have a significantly lower perceived comfort rating over the entire intervention period in comparison to all other LLCI areas. Runners should be aware of this significant CA discomfort during the MS transition, but should also acknowledge that CA comfort may improve with more MS experience. This could indicate positive adaptation in response to the new mechanical loads. Other areas of the LLCI (foot, ankle, and knee) may be less affected by MS training, possibly due to a redistribution of loads or kinematic adaptations. References Kinchington M, Ball K, & Naughton G. (2010). *J Sports Sci & Med*, 9, 652–663. Rothschild CE (2012). *J Str & Cond*, 26(8), 2021-2026.

### THE EFFECT ON BAREFOOT STANDING BALANCE TEST OF WEARING MBT AFTER 8 WEEKS TRAINING

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**Introduction** The "bare foot concept" is a new fashion of shoes. More and more concepts tend health, body shape, shock-absorbing and increase exercise performance. The Masai barefoot technology (MBT) was designed to improve walking balance with its unstable soles. The unstable soles could change the posture control, muscle activation and balance just like "wobble board training". Shoes with unstable soles could provide more balance training effect in life via walking weekdays. MBT is a new kind of shoes in Asia in Taiwan, so the purpose of our study is to investigate the effect of standing balance during 8 weeks wearing with MBT shoes. **Methods** There were 18 females volunteers in our study. All of them never have any experience with MBT, Reebok Easy-Tone and Sketchers Shape-up shoes. The participants have to do balance test before wearing MBT, and back to do the same test through 8 weeks. Every participant needed to complete tests in a Kistler force plate: both feet closed-eyes 10 seconds and single leg closed-eyes standing as possible as they can, the most time is 10 seconds. All the data would be collected and calculated as posture sway displacement, sway velocity, sway area and one-leg standing time. After pretest, they wear MBT 8 hours per day, 5 days per week at least. **Results** The both feet closed-eyes standing showed some significant differences in A-P sway (pre 2.30 cm vs. post 1.80 cm), sway velocity (pre 0.045 cm/s vs. post 0.036 cm/s) and sway areas (pre 6.41 cm<sup>2</sup> vs. post 1.58 cm<sup>2</sup>) before and after 8-week wearing MBT. But M-L sway (pre 3.09 cm vs. post 1.16 cm) only showed decline, on significant differences. The single leg closed-eyes standing time showed some significant differences in dominant leg and non-dominant leg before and after 8 weeks. Both were standing longer than pretest (dominant: 6.25 seconds vs. 8.22 seconds; non-dominant: 7.32 seconds vs. 8.91 seconds). **Discussion** This study participants continue every day through the 8 weeks wearing unstable shoes training, MBT shoes significant progress in the post-test results of most value dropped significantly improve the long time wearing MBT shoes can really affect bare foot balance control ability, special curved soles design can actually improve the balance standing capacity, also need a long time to adapt. The sway velocity after 8 weeks training, bare foot test significantly slower than the pre-test results. That showed participants in the eyes closed case gradually stabilized control the degree of shaking of the torso. The single leg standing test showed there were more improve in non-dominant leg. That would because it was more difficult to maintain balance in non-dominant, cause to more training effect. But the dominant legs standing time also have significant extension after 8 weeks. This results Nigg et al. (2006) findings consistent through the 12 weeks of training can effectively enhance the balance standing time; increase of the time standing on one foot to improve balance control ability, are one of the important methods to reduce the risk of falls.

### EVALUATION OF RISK FACTORS FOR ACL INJURY IN HIGH LEVEL MALE FOOTBALL PLAYERS

Ferrer-Roca, V.1, Linde, X.2, Gasol, X.2, Domínguez-Castrillo, O.1,3, Turmo, A.1,2

*1: GRSANE, Centre d'alt rendiment (CARI); 2: RCD Espanyol; 3: INEFC Barcelona, UB;*

**Introduction** Anterior Cruciate Ligament (ACL) injury is one of the most serious time-loss injuries in football. Preventing knee injuries is an important goal, and to accomplish that, the specific intrinsic risk factors must be identified. The purpose of the present study is to evaluate dynamic knee valgus and lower limb strength imbalance in high level football players during the preseason. **Methods** Thirty-five high level football players (24.3 ± 3.8 years; 75.2 ± 5.4 kg; 180.02 ± 3.89 cm) were tested during the first week of the preseason. All players signed and informed consent form prior to participation. Three vertical drop jumps were captured by a video movement analysis system (Peak Motus, Version 9.2.0; USA) with 3 digital cameras at 150Hz and two force platform (Kistler Instrument 9281B; Switzerland) at 900Hz. Frontal plane knee angle, knee flexion angle and vertical force were measured during the landing. Relative lower limb imbalance was calculated: (stronger - weaker) / stronger × 100. Intraclass correlation coefficient (ICC) was determined to assess test-retest reliability and a level of 0.05 is considered statistically significant. **Results** The ICC1.1 values were 0.92 for the knee flexion angle, 0.68 for the knee frontal angle and 0.82 for both eccentric and concentric impulse. There were significant differences between the stronger and weaker legs in eccentric impulse (32.4 Ns; CI 95% 22.9 – 41.8 Ns  $p < 0.05$ ) and concentric impulse (32.4 Ns; CI 95% 22.9 – 41.8 Ns  $p < 0.05$ ). Additionally, 31.4% of the subjects obtained a lower limb strength imbalance higher than 15%. During the vertical drop jump 24.2% of the players landed with a valgus knee alignment. Furthermore, 14.2% of the subjects obtained a frontal plane knee valgus angle higher than 20°. **Discussion** Findings of the present study are particularly significant because valgus loading appears to be an important component of the ACL injury. In the "return to sport" process the greatest acceptable imbalance should be about 15%. Less than a 10% deficit implies to normal knee function (Kvist, 2004). Furthermore, an increased in valgus knee motion at the knee suggests altered muscular control of the lower extremity in the frontal plane (ligament dominance) (Hewett et al; 2010). Results of the present study suggested that the vertical drop jump test is a good tool to identify ACL injury intrinsic risk factors in high level male football players in order to introduce the necessary preventive measures. References Hewett, T; Ford, K; Hoogemboom, B; Myer, G (2010) Understanding and preventing ACL injuries: Current biomechanical and epidemiologic considerations. *Update 2010*. *NAJSPT* 5 (4): 234-251 Impelizzieri, F; Rampinini, E; Maffiuletti, N; Marcora, S. A vertical jump force test for assessing bilateral strength asymmetry in athletes. *Med Sci Sports Exerc* 39(11): 2044-50. Kvist, J (2004). Rehabilitation following Anterior cruciate ligament injury. *Sports Med*. 34 (4): 269-280

14:00 - 15:00

## Mini-Orals

### PP-BN11 Coaching [CO] 2

#### EVALUATION OF EXERCISE PROGRAM: HIGH INTERVAL AEROBIC TRAINING COMBINED WITH SMALL SIDED GAMES

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**INTRODUCTION** The Small sided games (SSG) reproduce what happens in a soccer game, are tasks based on the training through the game, altering the game's features, areas, spaces, and adapted rules involving fewer players (Hill-Haas et al., 2011). The aim of this study is to assess changes in performance after an exercise program for 8 weeks consisting of a combination of high-intensity aerobic training and SSG in young soccer players. **METHODS** The young soccer players were divided in three groups. Control group (GC) (n=10), Specific Training (GEl) (training only with the ball) (n=9) and Intervention (GASG) (n=9): 2x4' 85% HRmax + 2x4' SSG 85% HRmax with 3 min recovery, performed twice per week for 8 weeks. After 24 h without exercise realized an: incremental running test in laboratory (start at 8 km/h with increased 1 km/h every 1 min so that exhaustion) with electrocardiograph, on a motorized treadmill (Cosmos® Pulsar 4.0), expired gases were analyzed (Medisoft®). 48 hours after RSA test of 8x30 m sprints with 25 s of active recovery, analyzing: total time (TT), mean time (MT) and best time (BT) and 2 index of fatigue: decrement (%DEC), and differences between best and worst sprint (CHANGE). 48 h after a Maximal Multistage 20-m Shuttle Run Test **RESULTS** After intervention GASG improve significantly your VO<sub>2</sub>max in 7.4% (p=0.012) from 52.37(±2.38) to 56.25(±2.87) speed anaerobic threshold in 15.8% (p=0.006) from 11.87(±0.99) to 13.75(±1.16) km/h and improve significantly TT (3.60%), MT (3.13%) and TM (3.60%). GEl group improve significantly TT (2.05%), MT (2%) and TM (2%). The GC did not obtain significant improvements in the analyzed values. VO<sub>2</sub>max was significantly correlated between lab test and field test was (r=0.554 p=0.005). **DISCUSSION** In this study, group GASG improvements obtained similar to those of other studies (Impellizzeri et al., 2006) which compared the general and specific training. The improvements were higher than other studies (Ferrari Bravo et al., 2008) using a similar protocol but without the ball. Furthermore GASG and GEl improvement significantly in absolute values in RSA test (MT, TT, and TM). Several studies show the relationship between aerobic capacity of subjects and test performance in RSA (Pyne et al., 2008). Therefore the SSG combination of high-intensity aerobic training has proven useful for increasing performance in soccer, because get similar improvements to other less specific protocols. **REFERENCES** Ferrari Bravo, D. et al. (2008). *Int J Sports Med*, 29(8), 668-674. Hill-Haas, S. et al. (2011). *Sports Med*, 41(3), 199-220. Impellizzeri, F. M. et al. (2006). *Int J Sports Med*, 27(6), 483-492. Pyne, D. B., et al. (2008). *J Strength Cond Res*, 22(5), 1633-1637.

#### THE DIAGNOSIS IN COMBAT SPORTS - THE IDENTIFICATION OF THE BODY WEIGHT PLACEMENT IN AN EXPERIMENTAL SITUATION

Lopes, H., Fernando, C., Prudente, J., Vicente, A.

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**Introduction** The relative position of the center of mass (CM) to the support base (SB) is critical for performance in combat sports. The coach's ability to recognize the placement of the CM without constant laboratory support is of great importance in terms of diagnosis in ecological context when aiming to optimize a personalized learning process (Lopes et al., 2012). The objective of this study is to identify the ability to diagnose the placement of the body weight by Sports Science university students with different levels of knowledge. **Methods** We have created an experimental situation where 46 Sport Science university students (mean age 23.7 years, 23 from 2nd year and 23 from 3rd year), had to look at 20 images (slides with 5 seconds interval between them), and identify the percentage by weight which was placed in the left of each subject who appeared on the image (20%, 40%, 60%, 80%). The images used were the result of an experimental situation which we've requested that each subject should put a previously defined percentage of their weight on a dynamometer (20%, 40%, 60%, 80%). In the 20 selected images each of the four weight percentages were performed five times. **Results** The success rate of the students was of 38.7% (38.1% 2nd year and 39.3% 3rd year), and from the four possible weight percentages participants had greater success identifying the placement of 80% of the weight (total of 40.3%, 40% 2nd year and 40.6% 3rd year) and 20% (total of 39.8% being 39.1% in the 2nd year and 40.5% in the 3rd year). There were no significant differences between students of the 2nd and 3rd years, or between different percentages of weight placements. **Discussion** Whereas the probability of properly prescription increases with the better the diagnosis, the results show that the ability to diagnose the placing of body weight in the situation analyzed was not very high (38.7%). The ability to use a variable with the importance of the CM / SB without laboratory support can however be trained so that it can promote optimization of personalization in the learning process. **References** Lopes, H., Fernando, C., Vicente, A., Simões, J., Prudente, J. (2012). *Edição Coisas de Ler*. pp. 83-92.

#### MONITORING THE EFFECT OF METHODOLOGICAL AND DIDACTICAL ACTION ON IMPROVING THE BACKSTROKE SWIMMING TECHNIQUE AT STUDENTS' EDUCATION

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**Introduction** The elementary swimming education of sports students at the University of Leipzig is based on improving the swimming techniques. Through methodical series the propulsive effective use of body surfaces and the coordination of partial movements are pursued to a total movement of backstroke. This leads in particular to a streamlined body position. **Aim** The aim of this study was to evaluate the improvement of sports students swimming backstroke under the conditions of implementation of educational content within one semester. **Methods** In this study took part 17 students with different technique levels. At test week 1 (T1, at the beginning of the semester), test week 2 (T2, after the methodical series to learn and improve the backstroke technique) and at test week 3 (T3, at the end of the semester), it was measured the swimming time of 50 m backstroke at maximal speed (t50max) and the swimming times of 4x50 m backstroke at moderate intensity (t4x50) with a passive break of one minute. Also maximal lactate values, the heart rate and the individual technique levels were determined after 4x50 m backstroke. The subjective quality rating of the swimming technique was based on a

point system. Results After 4x50 m backstroke at self-selected moderate intensity at T1 the maximal lactate was  $11.2 \pm 3.5$  mmol/l and the heart rate was  $155 \pm 22$  beats/min. The heart rate was similar at T1, T2 and T3. Significant improvement occurred for t4x50 paralleled T1 to T3 with an absolute advance of  $3.69 \pm 4.30$  s. The maximal lactate level after 4x50 m backstroke in moderate velocity was significantly lower at T3 compared to T1 with an absolute reduction of  $2.55 \pm 3.71$  mmol/l. The t50max decreased significantly from T1 to T3 with a difference of  $4.61 \pm 4.74$  s. The subjective quality rating of the backstroke technique showed a progress at T3. Conclusion After one semester of elementary swimming education the improvement of the backstroke technique was not only shown by better subjective rating but also by significant reduction in t50max and in t4x50 and in a significant decrease of maximal lactate values after 4x50 m backstroke.

## RELATIONSHIP BETWEEN BODY MASS INDEX AND PHYSICAL FITNESS IN YOUNG SWIMMERS

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**Introduction** While the relationship between body mass index (BMI) and physical fitness in the general population has been studied extensively since the obesity epidemic began, there is still little information about this relationship in sport populations. Therefore, the aim of this study was to examine the association between BMI with physical fitness components in young swimmers. **Methods** Twenty-nine female (age  $13.8 \pm 0.9$  yr, weight  $52.1 \pm 8.3$  kg, height  $1.59 \pm 0.08$  m) and 36 male competitive swimmers ( $14.1 \pm 1.1$  yr,  $58.4 \text{ kg} \pm 12.2$  kg,  $1.67 \pm 0.10$  m) were examined for body composition and physique, and they performed the physical working capacity in heart rate 170 bpm, sit-and-reach, handgrip and Wingate anaerobic test (WAnT). T-test was used to examine sex differences. **Results** Partial correlations adjusted for the effect of age were computed between BMI and physical fitness components. Results The female swimmers were lighter ( $-6.3$  kg (-11.6;-1.0), mean difference (95% CI)), shorter ( $-0.08$  m (-0.12;-0.03)), more endomorph ( $1.3$  (0.6;2.1)), with higher BF (5.6% (3.2;7.9)) and lower fat free mass ( $-8.1$  kg (-11.8;-4.5)), had higher flexibility (6.9 cm (3.6;10.3)), lower handgrip strength ( $-0.18$  kg.kg<sup>-1</sup> weight (-0.28;-0.09)), lower PWC170 in both arms ( $-0.43$  W.kg<sup>-1</sup> (-0.65;-0.21)) and legs ( $-0.53$  W.kg<sup>-1</sup> (-0.86;-0.19)), and lower Ppeak ( $-1.62$  W.kg<sup>-1</sup> (-2.14;1.09)) and Pmean ( $-1.48$  W.kg<sup>-1</sup> (-2.03;-0.93)) than their male counterparts. No sex difference was found with regard to BMI ( $20.6 \pm 2.3$  vs.  $20.8 \pm 2.9$  kg.m<sup>-2</sup>). BMI was correlated with handgrip strength in female and male swimmers ( $r = -0.41$ ,  $p = 0.035$ ;  $r = -0.47$ ,  $p = 0.006$ , respectively), while in the latter group, it was also correlated with mean power ( $r = -0.49$ ,  $p = 0.016$ ) and fatigue index of WAnT ( $r = 0.57$ ,  $p = 0.004$ ). BMI was correlated with percentage of body fat in female and male swimmers ( $r = 0.70$ ;  $r = 0.72$ ,  $p < 0.001$ , respectively), fat mass ( $r = 0.78$ ;  $r = 0.88$ ;  $p < 0.001$ ) and fat-free mass ( $r = 0.52$ ;  $r = 0.72$ ,  $p < 0.001$ ). BMI was correlated with endomorphy ( $r = 0.68$ ;  $r = 0.77$ ,  $p < 0.001$ ), mesomorphy ( $r = 0.83$ ;  $r = 0.69$ ,  $p < 0.001$ ) and ectomorphy ( $r = -0.93$ ;  $r = -0.92$ ,  $p < 0.001$ ). **Conclusions** Based on these findings, it is concluded that BMI is associated with both physique and physical fitness components, and these associations are sex-dependent. Although the abovementioned significant correlations do not imply causality between BMI and physical fitness, it is reasonable to support that a higher BMI is associated with lower particular components of physical fitness. Consequently, exercise and nutrition interventions should also focus on achieving an optimal BMI.

## RUNNING ECONOMY AND LEG ANTHROPOMETRY OF ELITE KENYAN MIDDLE- AND LONG-DISTANCE RUNNERS

Mooses, M.1, Jürimäe, J.1, Wondimu, D.2,3,4, Pitsiladis, P.2,3,4

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**Introduction** Kenyan middle- (MD) and long-distance (LD) runners have dominated distance running for more than 40 years. Previously this dominance has been attributed to superior running economy which has been proposed to be result of slim body shape. However, middle- and long-distance runners use different training volumes and intensities which lead to different adaptation in aerobic performance parameters and also in running economy. The aim of this study was to find whether leg anthropometry explains differences in running economy between top performance level middle- and long-distance runners. **Methods** VO<sub>2</sub>max and running economy were determined on an outdoor running track in 13 Kenyan MD ( $24 \pm 5$  yrs;  $60.1 \pm 5.6$  kg; IAAF score:  $988 \pm 62$  p) and 19 LD ( $26 \pm 5$  yrs;  $54.0 \pm 4.4$  kg; IAAF score:  $997 \pm 88$  p) runners using a Metamax 3B portable gas analyser. Kenyan athletes' testing was conducted in Eldoret, Kenya (altitude 2200 m a.s.l.). In total 4 girths and 5 lengths (Centurion Kit, Rosscraft, Canada) were recorded according to the protocol recommended by the International Society for Advancement of Kinanthropometry. The Achilles tendon moment arm was determined as described elsewhere (Scholz et al., 2008). **Results** Despite similar VO<sub>2</sub>max in Kenyan MD and LD runners ( $69.2 \pm 5.4$  vs.  $66.1 \pm 5.0$  ml/kg/min), a superior running economy at 16 km/h was found in LD runners compared to Kenyan MD runners ( $55.1 \pm 2.4$  vs.  $58.1 \pm 2.5$  ml/kg/min,  $p < 0.01$ ). In spite of similar body height, middle distance runners have significantly higher body mass and BMI ( $19.8 \pm 1.3$  vs.  $18.4 \pm 1.1$ ). From anthropometrical indices, long-distance runners presented significantly smaller thigh ( $48.2 \pm 2.5$  vs.  $50.6 \pm 2.2$  cm) mid-thigh ( $46.0 \pm 2.1$  vs.  $48.8 \pm 1.4$  cm), calf ( $32.5 \pm 2.8$  vs.  $35.0 \pm 1.8$  cm) and ankle ( $19.6 \pm 1.1$  vs.  $21.2 \pm 1.3$  cm) circumferences and shorter achilles tendon moment of arm ( $3.83 \pm 0.36$  vs.  $4.27 \pm 0.39$  cm) compared with middle-distance runners. Linear regression did not reveal important relation between running economy and leg anthropometry nor achilles moment arm in neither of the groups. **Discussion** Present findings in general support the notion of a better running economy in long-distance runners compared with middle-distance runners. However differences in leg anthropometry and body mass do not explain differences in elite level Kenyan middle- and long-distance runners economy. **References** Scholz M, Boobert M, van Soest A, Clark J, van Heerden J (2008). Running biomechanics: shorter heels, better economy. *J Exp Biol* 211, 3266-3271.

## THE DECISION MAKING COSTS: EFFECTS IN THE HEART RATE

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**Introduction** Walking in an irregular route that involves permanent adaptations to the terrain requires constant adjustments of the sportsman gait. These adjustments involve a process of collecting information, its interpretation and consequent assembly of the appropriate strategies to the desired skill, i.e. a decision making. There are several studies on the variation of energy cost depending on the terrain slope, the load carried, walking speed, etc., nevertheless the effect of the need to adapt, and thus the cost of the decision-making, is not well known. With this study we aim to understand what are the effects on the heart rate (HR) when a person faces a situation where there is continuous need to decide where to put the feet on the terrain to progress. **Methods** We've used a treadmill (BH Impulse) where we've put several spots along the mat to constrain the person's gait. Each subject performed two situations. A first situation (1) where walked on the treadmill for 10 minutes (min.) without any restriction, except the variation of the treadmill speed every 2 min. as follows: 2'-4.5km/h, 4'-5km/h, 6'-4km/h, 8'-5km/h, 10'-4.5km/h. In the second situation (2) the speed variation was maintained as in the first (1) but

subjects could not step the spots on the treadmill. We've used a HR monitor (Polar) to measure the HR every 30 seconds throughout each situation. The sample consisted of 20 subjects with a mean age of 25 years, 13 male and 7 female. Half of the group (10) started the first situation (1) and only after 60 min. performed the second situation (2); the other group half had the reverse procedure. Results Between both situations (2) and (1) there was a change in the HR average of 43 beats per minute (bpm) (45%). The maximum HR variation was of 153bpm and the minimum of 97bpm. The highest average variation between the two situations happened at 7.30 min and the lowest at 0.5 min.. Discussion The results showed that the constant need for decision-making implies a cost that reflects on the individual HR. This cost (45% of HR, in average) is higher than the cost identified by the increased terrain slope in 14% (Brito, J. Moreira, A. & Reis, V., 2004) where there was an average increase of 39% of the HR. We can than assume the importance of considering this factor when we need to prepare individuals for trekking activities where adaptation to terrain is crucial for the success of their performance (Fernando, C., Lopes, H. & Vicente, A. 2011). References Brito, J., Moreira, A. & Reis, V. (2004). II CIM, Estoril. Fernando, C., Lopes, H. & Vicente, A. (2011). 16th ECSS. Liverpool.

## EXPLORING THE CONSTRAINTS-LED TABLE TENNIS TRAINING PROGRAM

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EXPLORING THE CONSTRAINTS-LED TABLE TENNIS TRAINING PROGRAM Chuang, K-L., Liu, Y-T. NTNU, (Taipei, Taiwan) Introduction The competitive table tennis is a fast-paced sport where the best of the five games of 11 points determines the winner of a match. Therefore, it is crucial for players to tune up the condition in a short period of time for the best performance in the match. In addition, for the collegiate division B table tennis matches in Taiwan, a rally usually finishes within 4 strokes. As a consequence, a successful service and service return becomes key to scoring a point. Based on the constraint-led approach (Newell, 1986; Davids et al., 2008), a training program that aims for these specific goals should be able to help improve the match performances of the players. Thus the purpose of the study was to develop such effective table tennis training program. Methods Seven members of a collegiate division B table tennis team participated in the study. In addition to the game scores of each match, notational analyses were performed on the first 4 strokes of all points in all matches from an inter-collegiate table tennis competition. Based on the recorded data, a Constraint-Led Training Program (CLTP) was developed to help improve the success rate of service and service return, as well as the reduction of the warm-up decrement effect. CLTP was implemented 40 min each practice session, 2 sessions a week for 8 weeks. At the end of the 8 weeks training, a notational analysis was performed again for another inter-collegiate table tennis competition. Data recorded from the 2 competitions were compared using paired t-tests. Results The paired t-test result on the outcome of the first 2 strokes (service and service return) shows significant difference between the 2 competitions:  $t(6)=2.716$ ,  $p<.05$ . However, the first game score ratio was not significantly different between competitions:  $t(6)=.174$ ,  $p=.867$ . These results indicate that the focus of CLTP on the service and service return was effective and reflected on the performances in the competition, whereas the goal of reducing the warm-up decrement effect was not as successful as expected. Discussion The results of the study demonstrate the importance of performance feedback in developing training programs and the necessity of assessing the training program in real competitions. The training programs of competitive sports should take into consideration the actual competition situations and develop training drills that reflect in the competitions. Future studies will continue to combine the research with sports training practice to implement a scientific training program. References Davids K, Button C, Bennett S. (2008). Dynamics of skill acquisition. Champaign, USA: Human Kinetics. Newell KM. (1986). Motor development in children: Aspects of coordination and control, 341-361. Dordrecht, Netherlands: Martinus Nijhoff.

## PROFILE OF TRAINING HABITS OF WORLD CLASS PROFESSIONAL SURFERS

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Introduction Compared to other sports, training methodology is still a rather new concept for surfers. For this reason a difference between training schedules and organization of practice sessions can be found among them. This work is an attempt to create a profile of training habits of world class professional surfers and further find reappearing patterns in the execution of practice sessions. Methods In order to receive information about the trainings behavior of professional surf athletes (n=40 average of 25 years old) to further find common behavioral patterns and derive suggestions to improve the efficiency of training sessions a questionnaire was designed. Data has been collected during the Surf World Championships in Ericeira and it is limited to 35 questions to allow a shorter response time of about 10 minutes. To reply to the questionnaire the athletes (from 5 different countries) could choose between various categories of answers. The Bravais-Pearson correlation coefficient and Chi-Square test were used as statistical methods. Results The surf athletes practice on average 4 times per week with an average time of 120 minutes. Given the time it takes to prepare for the session, and time amount of time consumed by paddling, this is a reasonable practice time. The questionnaire shows that with an increasing number of practice sessions also the length of the practice sessions increases. 33,3% of the athletes have a coach. 61,5% stated to follow their professional career without a coach. Of those athletes with a coach, 60% stated the coach is doing nothing but observing their training session. Only 28,2% are being corrected during or after the practice sessions. No further relation between the age of the athlete and the presence of a coach during practice sessions could be found. 79,5% of the athletes watch surf videos focusing mainly on technique. 51,3% watch surf videos of themselves in order to analyze their performance. This habit is independently from the age of the athletes. Surfers listed Bottom-turn, Cutback, Snap, Tube and Floater to the maneuvers they execute most frequently. The list of the five maneuvers that are most desired consists of Airs, Tubes, Airs with rotation Reverse Airs and Floaters. The missing technique, the dependence on the right quality of waves, and the risk of injuries were listed as the reason why the athletes don't perform these maneuvers. Discussion Since coaching is a relatively new concept in the competitive surfing world, training characteristics, if existing, still vary among surfers. In order to help them on their progress to be a top professional surfer, and to stay there, it is advisable to adapt existing training methods from other sports to the surfing sport.

## EVALUATING THE REBOUND VELOCITY OF SQUASH RACQUETS

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Introduction Squash is a racquet-based sport played with the ball speed an important factor, particularly in club players where the greater the ball velocity the more likely the opponent may be to make an error. Ball speed is dependent on a player's physical ability and the

equipment used. Therefore, the aim of the research was to develop a method for assessing the rebound velocities of a selection of squash racquets used by club level squash players, whilst simultaneously evaluating the rebound velocity based on different racquet brands and string tensions. Methods Three racket types, based on the purchase price (well priced racquet (WPR), medium priced racquet (MPR), higher priced racquet (HPR)) were assessed at two string tension (manufacturers' string tension (MST), re-strung tension setting of 30lbs (RST)). A pre-heated squash ball (40 °C) was dropped from a height of 1.44 meters on to a stationary racquet so that impact would occur at the centre of the racquet. Ball impact was filmed using a high speed camera. The ball speed (m/s) for each rebound was calculated from the bounce height and the video frame time. Analysis was performed using videographics with statistical assessment using Statistica version 10. Results The results of the study indicated that there were differences in rebound velocities for different racquets and string tensions for different MST and RST respectively (MPR = 0.363 m/s and 0.378 m/s; WPR = 0.250 m/s and 0.360 m/s; HPR = 0.350 and 0.322). The medium priced racquet's rebound velocity was greatest for both string tensions. Discussion The MPR rebound velocity was the fastest of the three racquets while the variability of the rebound velocity was the smallest for the HPR indicating that a player who prefers a faster game (higher speed) may compensate for some loss of control (more variability) and would thus prefer the MPR to the HPR. The restringing of the racquets indicates a nominal improvement in rebound velocity for MPR and WPR, but this may come at a consistency cost and therefore it may be advantageous to replace racquet strings when purchasing a new racquet. The mean rebound velocity for the WPR with MST racquet versus all other racquets is considerably smaller and supports the thought that the racquet requires restringing if a player prefers more speed. This study proposes a video graphical method for assessing the rebound velocity of a pre-heated squash ball on a squash racquet, while the statistical evaluation of the rebound velocity of the racquets evaluated indicates that there are measurable differences in the rebound velocity based on different racquet brands and different string tensions.

### A LONGITUDINAL EXAMINATION OF HOW ATHLETES PREPARE, COPE AND REFLECT UPON DEVELOPMENT

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**Introduction** Every athletic challenge, whether expected or not, has the potential to be a crisis, or a beneficial experience depending on the individual's perception, management and support (Sinclair & Orlick, 1993). Given the complex nature of talent development, it makes sense that coaches are aware, anticipate and prepare athletes in advance of developmental challenges by clarifying support resources and coping strategies (Tamminen & Holt, 2012). The aim of this study was to examine how athletes utilised support in preparation and in management of seasonal challenges, and whether retrospective learning outcomes were achieved in the process. **Methods** A semi-structured qualitative interview design (retrospective and quasi-longitudinal) was used to gather data from purposefully sampled group developmental (n=3) and high performance (n=3) swimmers. To triangulate the data the athlete's coaches (n=2) were also recruited. Five stages of interviews were conducted one-on-one between September and August of the following year. Analysis was conducted using ATLAS TI (version 5.0.66) to inductively explore the interview transcripts (Patton, 2002). Raw data codes (quotations) emerged from the interviews and filtered into themes that best captured the substance of the group of codes (Miles & Huberman, 1984). **Results** Lack of a clear performance strategy was identified as a major source of organisational stress for both athletes and coaches. Injury and illness emerged as the most unexpected challenge, causing a 'shock-wave' like disruption to goals and life style management. Athletes that coped best demonstrated autonomous pre-empted management by maintaining a clear relationship with their coaches, revising their performance plan, and setting realistic goals. Pressure to perform well at competition and achieve qualification times and standards emerged as the only significant competition challenge experienced by athletes. This was dealt with by using mental skills, such as self-talk, imagery, focus triggers or relaxation as part of their pre-race routine. Throughout the season athletes reflected instinctively but did not purposefully utilise reflective practice techniques for learning. **Discussion** Evidence from this study suggests that the athletes tend to utilise their support resources during times of disorder as opposed to pre-empting stressors. Establishing comprehensible communication pathways throughout a sport system and the strategic use of reflective practice for learning can help athletes and coaches prepare for, manage, and benefit from developmental challenges. **References** Sinclair D.A., & Orlick T., 1993, Positive transitions from high-performance sport, *The Sport Psychologist*, 7(2), 138 - 150 Patton M.Q. *Qualitative research and evaluation methods*, 3rd edn. London: Sage Publications, 2002. Miles, M.B., & Huberman, A.M., 1984, *Qualitative data analysis*, Beverly Hills, CA; Sage Tamminen K.A., & Holt N.L., 2012, Adolescent athletes' learning about coping and the roles of parents and coaches, *Psychology of Sport and Exercise*, 13 69-79

### ANTHROPOMETRY AND PHYSICAL PERFORMANCE IN YOUNG SOCCER PLAYERS ACCORDING TO THEIR MATURITY STATUS AND CHRONOLOGICAL AGE

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**Introduction** In young soccer players there is a considerable variation in size and performance due to age and maturity (Valente-dos-Santos et al., 2012). Therefore, maturation may have an impact on talent identification and selection processes in favor of early maturing athletes. **Methods** 41 elite soccer players of the Athletic Club of Bilbao participated in this study. The following measurements were taken at the beginning of the season: -Anthropometry: height, sitting height, weight, six skinfolds, diameters and perimeters. Body composition was calculated. -Performance tests: velocity (15m), agility (Barrow's test), Yo-yo IT level 1, CMJ, handgrip. -Skeletal age (SA) was calculated using the Tanner-Whitehouse II method to divide players into 3 maturity groups: early (EM), average (AM), late (LM). -Age at peak height velocity (APHV) (Mirwald et al., 2002). -Birth-dates: BQ1 (January-March), BQ2 (April-June), BQ3 (July-September), BQ4 (October-December). SPSS v17 was used for: means and standard deviations, chi squared tests, Student's t-test and U-Mann-Whitney test. **Results** Mean chronological age was 12.06±0.68 (range 10.91-13.19 years), mean SA was 11.98±1.00 (range 10.00-14.50 years) and mean age range for APHV was 13.4 to 15.2 years. Regarding SA: 8 (19.5%) players were LM, 24 (58.5%) AM and 9 (27%) EM. We found significant differences (p<0.01) in SA (year) [13.07 (EM) - 11.87 (AM) - 11.06 (LM)], APHV (year) [13.86 (EM) - 14.37 (AM) - 14.52 (LM)], SkF (mm) [69.10 (EM) - 46.35 (AM) - 47.86 (LM)]; (p<0.05 to 0.01) in BMI [19.15 (EM) - 17.52 (AM) - 17.43 (LM)] and fat% [11.57 (EM) - 9.48 (AM) - 9.43 (LM)]; (p<0.05) in the agility test (s) [11.50 (EM) - 11.19 (AM) - 11.23 (LM)] and in Yo-yo IT level 1 (m) [920 (EM) - 1117.50 (AM) - 1320 (LM)]. 36.6% of the players were born in BQ1, 24% in BQ2, 22% in BQ3 and 17.1% in BQ4 (p<0.05). None of the LM players had been born in BQ4. **Discussion** AM was the most representative group, whereas LM and EM were equally distributed. The literature shows a balance between these two maturity groups until 13-15 years-old. LM players had significantly less fat and outperformed their mature peers in the agility test and Yo-yo IT level 1 test. In fact, studies had already reported that late maturing players remain in their sport by outperforming their early mature counterparts (Deprez et al., 2012). Nevertheless, none of the LM players were born in the last quarter of the year. Thus, we can say that it seems that late born and late maturing players are systematically excluded from selection processes in soccer. **References** Valente-dos-Santos J et

al. (2012) *Int J Sports Med* 33, 773-80 Mirwald RL et al. (2002) *Med Sci Sports Exerc* 34, 689-94 Deprez D et al. (2012) *Int J Sports Med* 33, 987-93

### RELATIONSHIP BETWEEN ARMS AND LEGS ANAEROBIC POWER IN YOUNG SWIMMERS: EFFECTS OF SEX AND AGE

Kostoulas, I., Nikolaidis, P.T.

*Hellenic Army Academy*

**Introduction** While the importance of maximal anaerobic power (Pmax) for swimming performance has been well established, there is little information with regard to the relationship between arms and legs Pmax. The aim of the present study was to examine the effect of age and sex on the ratio of Pmax between arms and legs in adolescent swimmers. **Methods** Seventeen girls (age 14.7±1.8 yr, body mass 56.5±11.5 kg, height 1.62±0.08 m, BMI 21.5±3.2 kg.m<sup>-2</sup>, BF 22.8±5.7% and fat free mass 43.1±6.0 kg) (M±SD) and 28 boys (14.6±1.4 yr, 58.2±10.4 kg, 1.68±0.09 m, 20.6±2.4 kg.m<sup>-2</sup>, 14.5±4.1%, 49.5±8.4 kg, respectively) all members of competitive swimming clubs, performed the Force-velocity test (Vandewalle et al., 1985) for both arms and legs (arm cranking and cycle ergometer Monark, respectively), which consisted by four maximal sprints, each lasting 7 s, against incremental braking force interspersed by 5-min break. Compared with other anaerobic measures, this test provides additional information about the constituents of power, i.e. force (F0) and velocity (v0). **Results** The correlations between arms and legs ranged from r=0.45 (F0) to r=0.64 (Pmax) in girls, and from r=0.40 (F0) to r=0.72 (v0) in boys. In legs, boys had higher values of Pmax (709±210 vs 565±162 W), Pmax expressed in relative to body mass values (rPmax, 12.2±2.0 vs 10.0±2.1 W.kg<sup>-1</sup>) and v0 (191±21 vs 166±14 rpm, p<0.05), while no differences were found for F0 (148±40 vs 136±37 N) and v0/F0 (1.37±0.36 vs 1.31±0.38 rpm.N<sup>-1</sup>). In arms, boys had higher values of Pmax (272±90 vs 188±76 W), rPmax (4.7±1.0 vs 3.3±1.1 W.kg<sup>-1</sup>) and v0 (153±32 vs 125±18 rpm, p<0.01), while no differences were found for F0 (72±22 vs 59±20 N, p=0.06) and v0/F0 (2.36±0.97 vs 2.31±0.78 rpm.N<sup>-1</sup>). However, no sex difference was found with regard to the ratios of Pmax (p=0.06), F0 and v0 between arms and legs. There was direct relationship between age and Pmax of legs (r=0.64 in girls; r=0.43, p<0.05 in boys) and arms (r=0.56, r=0.57, p<0.05 respectively), while there was not any significant association between age and the ratios of mechanical characteristics of upper and lower limbs. **Conclusions** The moderate to large correlations between arms and legs suggest that while arms F-v characteristics accounts for the 20.3-41.0% in girls and 16.0-51.8% in boys of legs variance, the largest proportion of variance remains unexplained. Although the sex differences in Pmax, we found that the ratio of Pmax, F0 and v0 between arms and legs was similar in boys and girls, which indicates a common training effect of swimming. These findings emphasize the need for separate evaluation of arms and legs' F-v characteristics on a regular basis and the consideration of these measures in training design. **References** Vandewalle H, Peres G, Heller J, Monod H (1985). *Eur J Appl Physiol* 54:222-229.

**14:00 - 15:00**

### Mini-Orals

#### PP-SH04 Physical Education and Pedagogics [PP] 2

### VALUES IN PHYSICAL EDUCATION CLASSES: DIFFICULTIES FOUND

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**Introduction** Values are contents of Physical Education classes disseminated consciously or unconsciously by both students and teachers. Although there is a lot of talk about the relationship between Physical Education and building of values, we know little about how it occurs in the day to day of the classes and how they appear in the curriculum framework. To liaise the building of values does not depend only of the Physical Education teacher's wish, competence or good will as many factors interfere and difficult the intervention of the teacher. Research showed that it is difficult to some teachers to implement the building of values. The objective of this study was to understand what makes difficult the work of the teachers who want to use the Physical Education classes as a space for building the systems of values of their students. **Methods** The Critical Hermeneutic is the epistemological basis of this qualitative study in which the intervention of three teachers, intentionally chosen, was observed. **Results** Difficulties were identified in relation to infrastructure and material resources available in the school; to the school team's culture notion of physical education, values and attitudes; to the physical education classes themselves; to the relationship with the students; and to the teachers' emotional state. **Discussion** Some difficulties are external to the teachers as they result from the school's structure and organization. Others, however, are related to the teachers' beliefs about the possibilities of stimulation of the students to build values in the school. Two teachers understand that it is their responsibility to make a space for the building of moral values in their classes. This could be considered as a form of illusion, used unconsciously by the teacher in a try to make sense of her practice (Bourdieu, 1983). This belief has resulted in unreal expectations, incoherence between speech and practice and, in the case of the sample of this study, in the feeling of frustration or impotence. To break up with this illusion is essential so that the teacher could adopt a critical perspective, recognizing himself as a social agent with possibilities and limits in his practice, as does one of the investigated teachers. This teacher, unlike the other two, understands that the building of moral values should diffuse through her classes as well as the other school subjects. **References** BOURDIEU, P. Esboço de uma teoria da prática. In: ORTIZ, R. Pierre Bourdieu: sociologia. São Paulo: Ática, 1983. p.46-81.

### ELEMENTARY SCHOOL STUDENTS' PERCEPTIONS OF PHYSICAL EDUCATION COURSE

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**Introduction** PEC is very important for social, psychological and physical development of elementary school students therefore, the purpose of the present study is to investigate elementary school students' perceptions of PEC. **Methods** The study was designed as a descriptive study and the study sample included elementary school students (N=408). Data regarding students' expectations on PEC were collected with a questionnaire, and content analysis was performed on the gathered data. **Results** Results revealed that students per-

ceived PEC as crucial to their physical development. Most students liked the course as it provided them a chance to be sportive, and they disliked being forced to run for a long time and skipping class. Students suggested that schools needed course-related equipment, gyms, locker rooms and showers for the efficacy of PEC. Discussion in the present study, it was realized that especially boys want to play football and girls want to play volleyball. Hill and Cleven (2005) also found out that football is the most important sport for boys and volleyball for girls. Students think PEC help their body and muscle development and improve their health and help them grow taller and fitter. Students say that PEC's offer a possibility to learn every kind of sport, PEC's help students to provide their movement need and PEC's cause them to gain the habit of doing sports regularly. Bailey (2006) also specified PEC's effect on doing sports regularly. Most students said "I like PEC, there is no point that I dislike". Furthermore, they state that they like PEC since it provides possibilities for students to do sports, play with the ball, be free and PEC is an enjoyable course. They don't like PEC when they run for a long time, there is no teacher and they do nothing, when they have to do the exercise that they don't like at all and when they do the same exercise all the time. Hill and Cleven (2005) also specified in their study that most of the students said the most favorite course was PEC for them. In another study, it is pointed out that the least liked point in PEC's is short lesson time (Rice, 1988). Students mostly said that they need a sports hall or sports room and a shower and enough equipment for each student. Couturier, Chepko and Coughlin (2007) also specified that students don't join the PEC because of some problems such as lack of showers. Supaporn and Griffin (1998) emphasized that students enjoy the PEC more if they have enough equipment and if they do not have to wait for their turns. References Bailey, R. (2006). *Journal of School Health*, 76 (8). Couturier, L.E., Chepko, S. and Coughlin, M.A. (2007). *Physical Educator*, 64 (3). Hill, G. and Cleven, B. (2005). *Physical Educator*, 62 (4). Rice, P. L. (1988). *Physical Educator*, 45. Supaporn, S. and Griffin, L.L. (1998). 55 (2)

### 15-17 YEARS TEENAGERS THAT ENGAGED AND NOT ENGAGED IN AFTER SCHOOL ACTIVITIES FEATURES OF ANXIETY

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Introduction Anxiety is undefined or imaginary danger sign. The survey about the influence of anxiety on the learning process: learning organization, knowledge testing and evaluation. B. Henker and etc. (2002) states that anxious teenagers feel angry, became sadder, often feels tired, also feel less happy than their peers. More anxious less interact with peers, rarely engage in recreational activities, focuses on the achievement, have more eating disorders, use more tobacco. Methods 208 people participated in the research: 56 % of boys and 49 % of girls. The questionnaire „Teenager Anxiety Assessment“ was given to the participants of the research, which includes thirty situations of anxiety. Results The overall girls and boys engaged in after school activities and not engaged levels of anxiety in differ ( $\chi^2(1)=6,82$ ;  $p<0,05$ ). Girls, not engaged in after school activities anxiety intensity level a little bit increased, male anxiety intensity level increased slightly. Respondents anxiety level indicators involved in after school activities are lower. Girls that not engaged in after school activities anxiety associated with group work rate is slightly increased and associated with interpersonal relationships and self-esteem-related anxiety levels - normal ( $\chi^2(2)=4,21$ ;  $p>0,05$ ). Boys that involved in after school activities anxiety associated with teamwork and self-esteem levels are slightly increased. Anxiety associated with interpersonal relationships - level is normal. Extracurricular activities not engaged in all three types of boys anxiety levels slightly increased ( $\chi^2(2)=5,01$ ;  $p<0,05$ ). References Henker, B., Whalen, C., Jamner, L.D., Delfino, R.J. (2002), Anxiety, Affect, and Activity in Teenagers: Monitoring Daily Life With Electronic Diaries. *Journal of the American Academy of Child & Adolescent Psychiatry*. 41 (6), p. 660-670. Omar Fauzee M. S., Chong Abdullah M., Meesin C., Choosakul C. (2009) Relationship between Mental Skill and Anxiety Interpretation in Secondary School Hockey Athletes. *European Journal of Social Sciences* - 9 (4), p., 651- 658. Eccles J., Barber B., Stone M., Hunt J. (2003) Extracurricular activities and adolescent development. *Journal of Social Issues*. 59 (4), p. 865-889. Schumacher Dimech D., Seiler R. (2010) The association between extra-curricular sport participation and social anxiety symptoms in children. *Journal of Clinical Sport Psychology*, Nr. 4, p. 191- 203. Steiner H., McQuivey R., Pavelski R., Pitts T., Kraemer H. (2000) Adolescents and sports: risk or benefit? *Clinical Pediatrics*, Nr. 39, p. 161-166.

### SLEEPING TIME AND STUDENTS' PHYSICAL ACTIVITY: IN PHYSICAL EDUCATION CLASSES, SCHOOL SPORTS AND EXTRA-CURRICULAR SPORTS

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1: CERNAS/ESAC/IPC (Coimbra, Portugal), 2: UTAD (Vila Real, Portugal)

Introduction Physical education plays a major role in the development of young people. It is an integral part of the total education of any child or adolescent and is closely linked to other creative and learning experiences and skills acquisition. Complementarily, extra-curricular sports are also important to increase the physical activity practice of adolescents. On the other hand, sleeping time is also an important dimension to consider since there are evidences that it facilitates memory processes. The purpose of this study was to assess the school physical activity inside physical education classes or school sports and extra-curricular sports patterns of 9-14 year old Portuguese adolescents. Methods A new questionnaire entitled "Questionnaire to Assess Physical Activity and Sedentarism, QAPAS" based on two previous questionnaires, QAPACE (Barbosa et al., 2007) and HBSC (2001-02) was developed and applied. Participants of this school-based cross-sectional study were a random sample of 1403 students, aged 9-14 (mean age: 10.64±0.76, 50.0 % males and 49.9 % females, with 0.1 % providing no answer) from 7 public schools of the municipality of the city of Viseu. Data analysis was performed using SPSS software v. 20.0. Results The great majority of adolescents (91.7%) follow the WHO recommendations for the sleeping time. Girls sleep more time in average than boys and the differences between gender were statistically significant ( $p<0.001$ ). The adolescents with the highest BMI values sleep less than the others, but a statistically significant difference was not found. Taking into account the practice of physical education classes, 98.4% of adolescents stated that they attend classes and follow the curricular programme in full. Only 28.4% of adolescents are engaged in school sports activities, with the indoor football (42.3%) being the most popular sport. On the other hand, 39.8% of adolescents practice sports in extra-school organizations or associations, and swimming (39.2%) and football (24.8%) are the most popular sports. Discussion The sleeping time reported by adolescents, in general, does not present a deficit, with the girls sleeping, in average, more time. The results showed that the frequency of attendance of physical education classes is near to 100 %. The other school sports offers presented a lower attendance. This situation needs to be analysed carefully by the National Curriculum Developing Authority. Despite the importance of the physical education classes, the promotion of sport activities inside the school must be increased and supported, not only by the teachers, but also by the parents and community. References Barbosa N, Sanchez C, Vera J, Perez W, Thalabard J, Rieu M (2007). *Journal of Sports Science and Medicine*, 6, 505-518. HBSC, US Department of Health and Human Services. *Health Behavior in School-Aged Children, 2001-2002* doi:10.3886/ICPSR04372.v2. Funding: CERNAS Research Unit is supported by National Funds through FCT - Foundation for Science and Technology under the project "PEst-OE/AGR/UI0681/2011".

**PHYSICAL ACTIVITY AND PEER RELATIONSHIPS AT SCHOOL AMONG FINNISH STUDENTS IN GRADES 4–5 AND 7–8**

Haapala, H.1,2, Hirvensalo, M.2, Laine, K.1, Laakso, L.2, Tammelin, T.1

*1: LIKES - Research Centre for Sport and Health Sciences (Jyväskylä)*

**Introduction** The Finnish school system has been acknowledged for students' learning success, but the proportion of students liking school is fairly low (OECD, 2010; Currie et al., 2012). Students with good peer relationships tend to like school more, and students' social relationships affect school well-being (Konu & Koivisto, 2011). The Finnish core curriculum for basic education emphasises a learning environment that supports interaction among students, guiding them towards team work and a positive atmosphere (National Board of Education, 2004). Participation in physical activity (PA) provides possibilities for social interaction and peer relationships. This study investigated whether students' PA within and around a school day was associated with peer relationships at school by school level and sex.

**Methods** The data were obtained from the baseline measurements of the Finnish Schools on the Move programme's pilot phase in autumn 2010, targeting enhanced PA in the school setting. The data were collected with a questionnaire in 11 local projects (19 schools) across the country from 579 students from grades 4–5 (boys 53%) and 884 students from grades 7–8 (boys 49%). Statistical analysis was made using two-way ANOVA. Results Both boys and girls reported better peer relationships at school in grades 4–5 compared to grades 7–8 ( $p=.001$ ). Students who had at least 3–4 days with over 60 minutes of moderate-to-vigorous physical activity (MVPA) per week had better peer relationships compared to those with 0–2 days of MVPA ( $p<.026$  for girls,  $p<.040$  for boys). Boys who participated in sports clubs often reported better peer relationships than those who never ( $p<.001$ ) or sometimes ( $p=.048$ ) participated. Peer relationships at school were better among students who took part in PA at recess sometimes ( $p<.001$ ) and often ( $p<.001$ ) than among those who never took part.

**Discussion** Peer relationships at school were better in grades 4–5 than in grades 7–8. Because more physically active students reported better peer relationships, PA could be a tool for enhancing peer relationships at school. In particular, PA at recess seems to be a potential context within the school day for social interaction with peers.

**References** Currie C et al. (eds.) (2012). Health behaviour in school-aged children (HBSC) study: International report from the 2009/2010 survey. Health Policy for Children and Adolescents No. 6. Copenhagen: WHO. National Board of Education. (2004). National core curriculum for basic education 2004. Helsinki: Author. Konu A, Koivisto A M. (2011). Proceedings of EDULEARN11 conference. Barcelona: IATED. OECD. (2010). PISA 2009 results (Vol. 1). Paris: OECD.

**COMPARATIVE STUDY REGARDING THE ATTITUDE OF PUPILS IN PRIMARY AND SECONDARY SCHOOLS TOWARD THE EXTRACURRICULAR SPORTS ACTIVITIES**

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**Introduction** The adult's healthy lifestyle bases are laid during the childhood, by involving the individual into different forms of physical exercise practice. School assumes more and more often the role of modeling pupils' attitudes through educational offers including extracurricular sports activities. Methods In our study, we used the 10 item questionnaire-based inquiry, administered to 210 pupils in primary and secondary cycles, from Bucharest. The main variables pursued were pupils' involvement into extracurricular sports activities, performance sports practice, pupils' time budget structure, social factors supporting pupils' involvement in these activities. These variables were analyzed in relation to pupils' age and number of physical education lessons per week. Results The obtained results illustrate significant differences among the elementary school pupils, as compared to the secondary school pupils, as for their attitude toward the practice of extracurricular sports activities; even pupils desire to participate in the compulsory lessons, there is a significant difference on their preference for some sports contents/branches. This difference was analyzed in relation to the age. Other variables, although they didn't show significant differences, represent important landmarks for the application of educational methods destined to optimize pupils' attitude toward the extracurricular sports activities.

**Discussion** Our study results show that the time allotted to extracurricular sports activities counts about 4 hours/week, in elementary school pupils, and 2.5 hours/week, in secondary school pupils. According to Blair (2004), physical exercises should be daily practiced for at least 30 minutes. At the same time, we can ascertain that parents' involvement in the creation of an attitude favorable to physical exercise practice is very important. This was also highlighted by A. Wagner et al. (2004). The paper also includes discussions regarding children's implication in the practice of different sports branches, during their leisure time. The results obtained by us partially confirm the specialty literature data (Sunnegardh et al., 1985).

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**EDUCATION IN VALUES IN PHYSICAL EDUCATION CLASSES: ANALYSIS OF A PROJECT FOR THE AUTONOMY OF THE STUDENTS**

Molina, F.F.1, Freire, E.1,2, Miranda, M.L.1

*1: São Judas University; 2: Mackenzie Presbyterian University*

**Introduction** Although there is much discussion about the possibility of building values in Physical Education classes, we know little about how this building occurs in the routine of classes. Frequently teachers try to reinforce positive attitudes and to inhibit those considered as negatives and in doing so they use strategies of submission, stimulating heteronomous behavior in their pupils. The objective of this study was to analyze the use of a pedagogical project aimed to stimulate the moral autonomy of students and to identify the vision of both teacher and students regarding the project. Methods A qualitative approach with a case study research was conducted in a private school. The sample was composed by 56 students and a Physical Education teacher. The education in values was used in 34 classes and information was gathered through observation and interview. In this project the teacher made a panel with the expected attitudes during the classes trying to stimulate the reflection about the behavior rules. The students assumed roles of responsibility and the use of dialogue to solve conflicts emerged in the classes was stimulated. Results The students' critical understanding was stimulated during the experiment with the possibility of discussing their own attitudes, their colleagues' and also the teacher's. The perception about the results are different among students and teacher. Students appreciate the teacher's initiative and compare the actual classes to the ones of past years. The evaluation of the teacher evolves during the project. In the beginning, her perception is that the students are changing and actively participating in the proposed activities. Nevertheless, in her final interview, she is disappointed and recognizes that attitudes generating exclusion of the less skilled are still in course.

**Discussion** The adopted strategies were adequate to reach the objectives of the Project. It is also true the need for a re-thinking of the time and way for building rules so that students do not see this process as some-

thing theoretical or external to Physical Education classes. Also the process of choice of the teams for the games should be changed. Although it is a resource that allow students to assume responsibility, peers' pressure limits the freedom of the person who makes the choices and, consequently, the responsibility about his own acts.

### THE JOINT ACTIVITY IN A TEACHING AND LEARNING SEQUENCE OF RUGBY. A DESCRIPTIVE ANALYSIS

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**Introduction** Social constructivism shows how teacher and learners are in a joint activity around a specific content in which they exert mutual influences (e.g. Rovegno & Dolly, 2006). It also displays how the teaching and learning process responds to the way in which this joint activity organization evolves (e.g. Coll, Onrubia & Mauri, 2008). Several studies in sports initiation show how this joint activity is, its evolution, and its characteristics (e.g. López-Ros, in press). In the present paper we analyse the joint activity and its evolution in a rugby initiation sequence of three sessions. **Methods** We used interpretative methodology in accordance with the model and units of analysis employed in other researches (e.g. Coll, Onrubia & Mauri, 2008). Data collection was based on video and audio recording. The units of analysis are the segments of interactivity (SI) obtained from the transcription and video analysis of the sessions. We describe their characteristics and evolution through the three sessions of this teaching and learning sequence. **Results** We found six types of SI according to their instructional function: Activity Organization (SIAO), Guided Practice (SIGP), Autonomous Practice (SIAP), Discussion (SID), Recapitulation (SIR) and Transition (SIT). The number of SI for each session remains quite stable (32, 35 and 35). In relation to the percentage of time of the SI in each session, there is a decrease of SIAO in the last session (19.7, 22.1 and 13.3), the SIGP remains similar in all the sessions (59.9, 63.7 and 58.6) and the SIAP increases in the third session (8.3, 4.7 and 13.0). **Discussion** Joint activity organization is partially unpredictable and appears on the fly (Durand, 2001). Its analysis using segments of interactivity gives an image of its evolution in relation to the cession of the learning responsibility and control from the teacher to the students (Coll, Onrubia & Mauri, 2008). In our sequence we highlight the decrease of the organization segments and the increase of the autonomous practice that could be an evidence of this transfer of control to the learners in accordance with other works (López-Ros, in press). **References** Coll, C, Onrubia, J & Mauri, T (2008). Supporting learning in educational contexts: the exercise of educational influence and the analysis of teaching. *Rev Ed*, 346, 33-70. Durand, M (2001). *Chronomètre et survêtement*. Paris: Éditions EPS. López-Ros, V (in press). La organización de la actividad conjunta en la enseñanza escolar de los deportes colectivos. In Castejón FJ, Giménez, FJ, Jiménez, F & López-Ros, V (coord.). *Investigaciones en formación deportiva*. Sevilla: Wanceulen. Rovegno, I & Dolly, JP (2006). Constructivist perspectives on learning. In Kirk, D, MacDonald, D & O'Sullivan, M (Eds.). *The Handbook of Physical Education*. London: Sage (242-261). Do not insert authors here

### "SPORT FOR ALL" SCHOOL PROGRAMME - A NEW WAY OF ORGANIZING AND PRACTICING CHILDREN'S SPORT?

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*Department of Health Sciences*

**Introduction** This study focuses on organized "Sport for All" activities, offered in cooperation between schools and sport clubs; targeting children aged 7-12. In Sweden there has been an increasing implementation of these kinds of sport activities for children in the past fifteen years. But, although the great will to implement these programmes, there is a lack of knowledge on the logic underpinning these activities. The present study investigates the logic of the practice revealed when children and engaged adults (teachers, sport leaders and management) describe their experiences of a Sport for All Programme in school (SAP). **Methods** This study has a case study design. Fifteen single interviews were conducted with the programme manager, three school teachers, two sport club leaders and nine children (five girls and four boys aged 9-10). The data were categorized based upon the core themes of the interviews (Silverman, 2010). In this study, Bourdieu's (1990) as well as Lave and Wenger's (1991) theoretical models are used as an analytic tool to study the Sport for all - programme as a "childing practice" with a focus on the participants agency (Alanen, 2001; James & James, 2003) in relation to the context of the logic of practice in an SAP. **Results** The result analysis shows that the organization and the practice of the activities are noticeably related to conventionally organized sport. Further, it also prove to be a new way of organizing and practicing children's sport - with its own logic. **Discussion** The history of sport has contributed to a conscious and unconscious idea of the meaning and function of competitive sport. The absence of organized competition, less intensive activities, more flexibility and variation in the SAP, challenge this dominant hegemony, especially in children's sport. When the adjusted and developed "Sport for All" initiatives are implemented, sport will be offered in a new context with other meanings and functions compared to conventionally organized sport. Consequently, the SAP concept calls for a new way of approaching children's sport, and new demands on those who organize and lead the activities. **References** Alanen, L. (2001). *Childhood as a generational condition: Children's daily lives in a central Finland town*. In: Leena, Alanen & Berry, Mayall (Eds.). *Conceptualizing child adult relations*. London: Routledge. Bourdieu, P. (1990). *The Logic of Practice*. Stanford: Stanford University Press. James, A., & James, A. (2003). *Constructing childhood: theory, policy and social practice*. London: Palgrave. Lave, L., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: University press. Silverman, D. (2010). *Doing qualitative research*. (3rd edn) London: Sage.

### THE SWIMMING FULLY-CLOTHED IN ELEMENTARY SCHOOLS IN JAPAN

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**Introduction:** Children have much chance touching water. Pool, pound, lake and a road following make children fun, pleasure and adventurous. However, water could be dangerous. Lots of disaster at sea and pool in Japan was reported rather than other countries. The swimming class in Japan has been based on Government Course Guidelines. It includes contents about playing in water in grade 1 and 2, floating and swimming in grade 3 and 4, and swimming in grade 5 and 6. The swimming fully-clothed is entrusted to each schools, not required content. The aim of present study was to investigate the actual conditions concerning swimming fully-clothed of elementary schools in Japan. **Methods:** We created original questionnaires survey for the elementary schools, and mailed them to 513 elementary schools of Shikoku where is around the sea in 2012. The survey contained the following questions. Q1: Does your school have the class of swimming fully-clothed? - Yes or No. Q1-1: Which grade does it have? Q1-2: Where does it have? Q1-3: How many times does your school have it in a year? Q1-4: What is the purpose? Q1-5: How to teach it? Q1-6: Who is the leading teacher? Q2: Have you have the instruction of swimming fully-clothed before? -Yes or No. Q3: Why not having the class of swimming fully-clothed? **Results:** 256 schools completed the questionnaires and return to researchers. The percentage of Q1 that it was YES was 49.6 % (n=127). Q1-1 was 48.0%, 47.2%, 55.1%,

60.0%, 78.7% and 87.4% from in grade 1 to grade 6 respectively. The percentage of Q1-2 was pool (99.2%) and river (0.8%). Q1-3 was once (81.1%), twice (15.7%) in a year. Q1-4: The purpose was guarding one's life (98.4%), learning to rescue (28.3%), and understanding nature (10.2%). Q1-5 was floating with fully-clothed (96.1%), floating with goods (88.2%), and swimming with fully-clothed (86.6%). Q1-6 was teacher (58.3%), fireman (16.5%), maritime safety staff (6.3%), and swimming coach (2.4%). Q2 was YES (79.3%) and NO (18.8%) before learning of swimming fully-clothed. Q3: Half of schools answered that they cannot make safe environments, keep sanitation of the pool, have enough instructors and set aside enough time. Discussion: Schools instructing children the swimming fully-clothed were less than half in Shikoku area around the sea. In order to increase the number of schools instructing the swimming fully-clothed, teachers should have chances to learn how to instruct, and also need to make safe environments.

### **DECISION MAKING PROCESSES OF PRIMARY SCHOOL PHYSICAL EDUCATION TEACHERS TO IMPROVE INCLUSION OF FEMALE IMMIGRANTS**

Nieva Boza, C., Lleixà Arribas, T.

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In recent decades, physical education has undergone important social and cultural change. In the Baix Llobregat area (2010-2011), 9.3% of the students registered were foreigners, mainly from Latin America and the Magreb. This immigration has changed the working environment in primary education classrooms. In reference to cultural diversity, authors such as Capllonch, Godall & Lleixà (2007), and Soler, Gonzalo & Prat (2012), state that in the area of physical education, teachers can improve the inclusion of immigrant students, since it is an area characterized by socializing, with intrinsic motivation, which encourages participation among students of both genders. This paper shows the second set of results of a PhD research that analyzes the decision-making processes of primary school physical education teachers regarding inclusion of female immigrants, a minority group with its own peculiarities. METHODS This paper is focused on the results of a questionnaire filled in by 87 teachers. Analyzed variables include teacher's knowledge, immigrant female student characteristics, decision making processes, etc. RESULTS Student characteristics: 77% of teachers state that immigrant female students participate in all kind of activities and they do it together with the rest of the class. 75% of teachers consider that these students have mainly hygiene and health needs, and they need affection. Teacher expectations: 53% of teachers recognize that immigrant female students participate in all of the five content areas, although this participation is different in some of them. Teachers believe that the most difficult physical contents for these students are hygiene and health, and body expression. According to Dagkas (2006), there are different notions in Islamic culture about body and gender that influence physical education classes. In conclusion, teachers perceive some differences between these students and the rest of the class. Therefore, it is recommended to implement training programmes for teachers that include contents such as inclusion, coeducation and knowledge about other cultures, in order to improve these students inclusion. In fact, authors like Pastor, González, Cuevas and Gil (2010) state that the training offered by public administration is insufficient to approach cultural realities. REFERENCES -Capllonch, M.; Godall, T. y Lleixà, T. (2007) "El professorat d'Educació Física a l'escola multicultural. Percepcions del context i necessitats de formació". *Temps d'Educació*, 33, 61-74. -Dagkas, S. and Benn, T. (2006). Young Muslim women's experiences of Islam and physical education in Greece and Britain: a comparative study. *Sport, Education and Society* 11 (1), 21-38. -Pastor, J.C., González, S., Cuevas, R. Gil, P. (2010) "El profesorado de Educación Física ante la inmigración". *Cuadernos de Psicología del Deporte*, 10, 79-84. -Soler, S.; Flores, G.; Prat, M. (2012) "La Educación Física y el Deporte como herramientas de inclusión de la población inmigrante en Cataluña: el papel de la escuela y la administración local". *Pensar a Práctica*, 15, n.1

### **INCLUSIVE PHYSICAL EDUCATION IN SERBIA: CURRENT SITUATION AND PROSPECTS**

Djordjic, V., Tubic, T.

*University of Novi Sad*

Introduction The main strategic orientation in Serbia is the inclusive approach in education, which provides every student with equal rights and availabilities of education (Law on the Fundamentals of the Education System, 2009). Although education of disabled children in Serbia still goes on in three routes: special schools for disabled students, special classes within regular schools and inclusive classes within regular schools, the number of disabled students enrolled in regular education is growing. Since physical education has potential to be one of the most supportive and active pieces in inclusion process in schools (Rouse, 2009), the study was conducted aiming to define current situation and prospects of inclusive physical education in Serbia. Methods The secondary and primary data analyses were combined in order to get a comprehensive insight in current status and future perspectives of inclusive physical education in Serbia. Results According to current data, 1,570 (5.44%) children with disabilities were enrolled in 38% of regular primary schools in Serbia: 258 (0.82%) children with physical disabilities and 1,312 (4.62%) children with developmental disorders (intellectual and communicative). Around one fifth of teaching staff attended additional trainings for inclusive teaching. However, the lack of pre- and in-service training oriented toward inclusive physical education exists, as well as adequate professional support. Material resources for inclusive teaching are unsatisfactory: almost 37% of schools do not possess proper indoor facilities while quality and quantity of equipment is insufficient. Class size in Serbian schools, comprising 30 do 34 students, is inconvenient for inclusive teaching. Personal or teaching assistant is an option, yet not widely used. As for the teachers' attitudes toward inclusive physical education, most of them reported moderately positive attitudes (Djordjic, 2012). Discussion Radical educational reform in Serbia requires further development of systemic support to operationalization of proclaimed principles of equity and inclusion. Considering inclusive physical education, main lines of actions include: quality pre- and in-service training of teaching staff, adequate provision of material resources and professional support, as well as development of inclusive culture in broader societal context. References Law on the Fundamentals of the Education System (2009). Belgrade: Ministry of education. Rouse P. (2009). *Inclusion in Physical Education: Fitness, Motor and Social Skills for Students of All Abilities*. Champaign, IL: Human Kinetics. Djordjic V. (Ed). *Inclusive physical education in Vojvodina's schools: challenges and perspectives*. Novi Sad: University of Novi Sad, Faculty of Sport and Physical Education.

### **STRONG AND WEAK POINTS IN PHYSICAL EDUCATION WHEN ATTENDING TO IMMIGRANT STUDENTS: THE TEACHER'S VOICE IN A MULTICULTURAL SCHOOL**

Flores Aguilar, G.1, Prat Grau, M.1, Soler Prat, S.2

*1. Universitat Autònoma Barcelona 2. INEFC Barcelona*

Introduction Over recent years, Catalan public schools have seen a progressive increase in their students' cultural diversification. To face the challenge of educating citizens capable of living harmoniously in such a plural society, physical education (PE) may well be an excel-

lent tool for fostering respect, tolerance and exchange between different cultures (UNESCO, 1978). This study aims to "give voice to the PE teacher" who has years of experience in multicultural contexts. With this, we aim to ascertain those points considered to be strong and weak within this subject when attending to immigrant students. In this way, we also hope to analyse the manner in which PE and sport contribute to the social cohesion and inclusion of students at school. Methods The interpretative orientation of this educational research has allowed us to develop a multiple case study consisting of 12 cases: 7 women and 5 men, with more than five years' work experience, belonging to 10 schools whose immigrant student population exceeds 50%. Semi-structured interviews and non-participant observation were the techniques used in the study. For results analysis, the NVivo programme (eighth edition) was used to analyse content. Results On the basis of PE teachers' opinion, some of the strong and weak points in PE that have been identified are: Strong: imitation diminishes students' language problems; students tend to be motivated with respect to the subject and its content; there is more relationship and interaction amongst students. This favours the socialisation and inclusion of newcomers, and helps in breaking prejudices and stereotypes through education in values (respect, tolerance, etc.); and PE may increase the students' personal safety, confidence and self-respect, particularly that of those with greater abilities. Weak: greater student-student contact may facilitate greater conflict; there are many female students who are highly unmotivated, particularly amongst Asians; the negation of the body promoted by certain families creates significant dilemmas amongst immigrant students; verbal explanations create difficulties of comprehension for those students who are not fluent; and the universality of certain sports diminishes students' motivation for participating in other less well-known sports activities. Discussion PE may well be a privileged tool with which to attend to immigrant students (Soler, 2004), always providing that PE teachers act in a constructive manner so as to limit the subject's weak points and in order to take advantage of the opportunities that it offers for students' inclusion and cohesion. References Soler Prat, S. (2004). Formación de profesionales de educación física y deporte: El tratamiento de la diversidad cultural. In T. Lleixà & S. Soler (Eds.), *Actividad física y deporte en sociedades multiculturales: ¿integración o segregación?* (pp. 111-133). Barcelona: Horsori. UNESCO (1978). *Carta Internacional de Educación Física y del Deporte*.

### PE TEACHERS' PERCEPTIONS ON THE SIGNIFICANCE OF CAPACITIES FOR TEAM AND INDIVIDUAL SPORTS IN 6-8 YEAR OLD HIGH SPORT POTENTIALS

Platvoet, S., Elferink-Gemser, M., Niet, M., Visscher, C.

*HAN University of Applied Sciences*

Introduction According to physical education (PE) teachers a high sport potential can be identified in the setting of PE by six capacities; work attitude, developmental-, motor-, creative-, interpersonal-, and intellectual capacity (Platvoet et al., 2012). The predictive value of identifying high sport potentials in some sports may be higher than in other sports as there might be a different number of essential performance components (Vaeyens et al, 2008). Therefore, the relative significance of each capacity for different types of sports needs to be clarified. The aim of this study was to determine the relative significance of the six capacities for team versus individual sports. Method 134 primary PE teachers with experience as trainer/coach (n= 68 team sports, n= 66 individual sports) filled a questionnaire with statements on a five point scale constructing the six capacities. Independent sample t-test were used to determine differences in relative significance of each capacity. Effect sizes were calculated to determine if effects were substantive. Results All subscales had sufficient internal consistencies (Cronbach's  $\alpha = .70$  to  $.86$ ). For individual sports ( $M = 4.31$ ,  $SE = 0.08$ ) the relevance of motor capacity is significantly higher than for team sports ( $M = 4.01$ ,  $SE = 0.07$ ;  $t(131) = 2.86$ ,  $p < 0.05$ ). The effect size is small ( $r = 0.24$ ). Interpersonal capacity has a significantly higher relevance for team sports ( $M = 3.80$ ,  $SE = 0.08$ ) than for individual sports ( $M = 3.05$ ,  $SE = 0.08$ ;  $t(126) = -6.64$ ,  $p < 0.05$ ) with a large effect size ( $r = 0.51$ ). Also for intellectual capacity the relevance for team sports ( $M = 3.28$ ,  $SE = 0.09$ ) is significantly higher than for individual sports ( $M = 2.80$ ,  $SE = 0.09$ ;  $t(126) = -3.67$ ,  $p < 0.05$ ) with a medium-sized effect ( $r = 0.31$ ). For the other three capacities no significant differences were found ( $p > .05$ ) and effect sizes were all small. Discussion In the perceptions of PE teachers motor capacity, interpersonal capacity, and intellectual capacity have a significant different relevance for the identification of high sport potentials in individual and team sports. This can be explained by the different performance demands of team and individual sports and confirms statements of Vaeyens et al., (2008) that the relative components may have a different impact on performance in different sports. A next step will be to develop an instrument based on the capacities that PE teachers can use to identify high sport potentials for different kind of sports. References Platvoet S, Niet M, Elferink-Gemser, M. (2012). *LO*, 6, 4-5 Vaeyens R, Lenoir, M, Williams, M, Philippaerts, R. (2008). *Sports Med*, 38, 703-714 Tranckle P, & Cushion C. (2006). *Quest*, 58, 265-282

14:00 - 15:00

## Mini-Orals

### PP-SH09 Psychology [PS] 2

#### COMPARING ORGANIZATIONAL INTERVENTIONS TO ENHANCE PERFORMANCE IN ELITE SPORT

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Introduction This study intended to contribute to the growing body research on positive organizational psychology in sport (POPS). The purpose of this research was to compare the perceived effectiveness of two intervention approaches aimed at improving organizational functioning in an Olympic National Sport Organization. Specifically, we compared the utility of adopting one-to-one (e.g., coaching) or organization-wide (e.g., educational workshop) interventions to facilitate optimal performance through enhancing emotion ability and regulation strategy use. Methods We examined the data from a recent action research intervention in an Olympic sport organization, which comprised two intervention approaches. The first intervention approach involved delivering educational workshops to individuals fulfilling a range of roles (i.e., board of directors, chief executive officer, heads of performance and development, staff, national coaches and team managers, club coaches, national talent academy athletes) across the organization over a 6-month period. The second intervention involved providing one-to-one coaching to national managers for 3 months. Data regarding the perceived effectiveness of the interventions were collected from three national managers who completed both interventions and involved analyzing participant daily diaries, a researcher's log, and social validation interviews. Results Whilst data analysis procedures indicated that both intervention approaches were effective at improving individual, team, and organizational functioning, participants perceived the one-to-one coaching

intervention approach to be more effective. Specifically, participants perceived the educational workshops to be effective for learning emotion regulation strategies (i.e., techniques) for use in building and maintaining interpersonal relationships. However, they perceived the coaching intervention to be more effective at developing emotion abilities (e.g., intelligent selection and use of emotion regulation strategies) for optimal intrapersonal and interpersonal outcomes. Discussion The findings indicate generic workshop interventions may have utility for educating participants about emotion regulation strategies, with the use of more ideographic, solution-focused coaching more beneficial for facilitating an understanding of when and how to use these strategies for optimal relational outcomes in sport organizations. Hence, it would appear that, where possible, applied practitioners should match intervention approaches to their intended outcomes.

## RELATIONSHIP OF SPORT PARTICIPATION AND SELF-PERCEIVED ACADEMIC COMPETENCE

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**Introduction** The notions that sport participation negatively influence academic achievement has currently been by far overcome. However, previous findings suggest that there is low to moderate relationship between academic and sports achievement (Bradley et al., 2013; Donaldson and Ronan, 2006). The purpose of this paper was to study the relations between sport participation and academic competence from the aspect of social perception; we were interested whether the participants of both genders differed in self-perception of academic competence depending on their sports participation (individual and team), as well as whether and to what extent sports duration and/or level of sports engagement contributed to the obtained differences. **Methods** The sample included 786 college students, 366 males and 420 females. Out of the total sample, 253 students were not engaged in sport, 182 were engaged in individual sports and 351 in team sports. Within the category of sportsmen, 124 students have been engaged in sports up to three years, 75 up to five years, and 334 for more than five years. Concerning the level of sports engagement, 319 students were at local-level, 134 national, and 80 international. The research applied the subscale of self-perception of scholastic competence from the questionnaire Self-perception Profile for College Students (Neeman and Harter, 1986). **Results** Univariate GLM results confirmed that there was statistically significant effect of duration/level mutual interaction of sports engagement on self-perception of scholastic competence among subjects of different gender and sports engagement ( $F=5.39$ ;  $p= .01$ ). Considering the effects of individual factors on the dependent variable, female students had significantly higher scores on academic competence than the males ( $F=10.52$ ;  $p= .01$ ), whereas other obtained differences were not statistically significant. **Discussion** It is possible to explain the relationship between sports engagement and perceived scholastic competence in terms of the effect of essential underlying factors of both types of activities, such as increasing motivation i.e. task orientation, cooperation, as well as the experience of satisfaction leading to success in general. In addition, sport participation helped students build discipline, organize time and develop self-confidence, which can positively affect self-perception of academic competence. **References** Bradley J, Keone FK, Crawford S (2013). School sport and academic achievement. *Journal of School Health*, 83(1), 8-13. Donaldson SJ, Ronan KR (2006). The effects of sports participation on young adolescents' emotional well-being. *Adolescence*, 41, 369-389. Neemann J, Harter S (1986). *Manual for the Self-Perception Profile for College Students*. Denver, CO: University of Denver.

## UNDERSTANDING INSPIRATION IN SPORT: ATHLETES PERCEPTIONS

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**Introduction** An event such as the Olympics can inspire athletes to emulate the success of their sporting heroes and achieve a feat once thought of as impossible. Whilst inspiration has been researched within the mainstream psychology literature (Thrash & Elliot, 2003, 2004) the concept has received little research attention within the sport psychology literature. The aim of the present research therefore, was to define inspiration in sport and explore athletes' understanding of inspiration by ascertaining what inspires them to participate and compete. **Method** An IPA (Smith & Osborn, 2008) approach was employed to gain athletes' subjective experiences of inspiration. Six sprinters (4=male, 2=female) were purposefully sampled and participated in a semi-structured interview (Patton, 1987) to explore early and current experiences of inspiration. Interviews were transcribed and analysed in line with IPA guidelines. **Results** Data analysis revealed four super-ordinate themes addressing the antecedents of inspiration: 1) the role of influential people 2) a strong desire to succeed 3) continued commitment towards goals and 4) the role of positive and negative emotions. It emerged that many antecedents of inspiration occurred during the participants' early experiences in childhood which had a continual impact throughout the athletes' lives. Particularly, the latter two sources of inspiration became more prominent during current experiences. **Discussion** These findings reveal key sources of inspiration for athletes and the importance of these in initiating motivation. Findings also assisted in the development of the first sport specific 'working' definition of inspiration presented within the sport psychology literature. As such, more research needs to be conducted across various sports and standards to build upon this definition, whilst also providing a greater insight into what factors contribute to inspiration and hence, motivation within athletes. **References** Patton, MQ. (1987). *How to use qualitative methods in evaluation*. London: Sage. Smith, JA, Osborn, M. (2008). In J A. Smith (Ed.), *Qualitative psychology: A practical guide to research methods*, 53-80. London: Sage. Thrash, TM, & Elliot, AJ. (2003). *J Personality & Soc Psy*, 84, 871-889. Thrash, TM, & Elliot, AJ. (2004). *J Personality & Soc Psy*, 87, 957-973.

## INTERNAL TASKS HIDDEN IN ATHLETIC PERFORMANCE PROBLEMS IN COLLEGE ATHLETES: ANALYSIS BY THE LANDSCAPE MONTAGE TECHNIQUE

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**Introduction** The purpose of this study is to examine the feature of internal tasks hidden in athletic performance problems in college athletes by using the Landscape Montage Technique (LMT). In psychological supports for athletes, they consult about the troubles related to the athletic performance. For example, when they are playing a game, they say that "I can't demonstrate my ability", "I lost the eagerness for my sport", and "I can't decide at the crucial moment", etc. It is often their performance are not enough progressed by giving the psychological skill training corresponding with their performance problems they mentioned. Therefore, it is important in psychological support to grasp their problems as not only their performance but also internal tasks even if they mention only their performance. **Methods** The study asked 30 colleges athlete to answer the questionnaire: Diagnostic Inventory of Psychological-Competitive Ability for Athletes (DIPCA), and to draw the Landscape Montage Technique (LMT). By answering DIPCA, this study let them notice their abilities and

then write the abilities they need. The aim of the creation of LMT was to identify the internal tasks that they hold. Results This study considered the relationship between the contents of athletic performance problems that they identified from the results of DIPCA and the features of LMT that they drew. In particular, it analyzed paying attention to the reference of 'I have no confidence in my performance'. As a result, the difference was looked at by depiction of a way and a person. Discussion The result of this study indicated that there are various internal tasks in the background that they said 'I have no confidence in my performance' or "I can't decide at the crucial moment". The characteristics are summarized in the following two points. 1) Depiction that the road is interrupted is considered to be an expression with an indefinite meaning which tackles an activity. 2) Depiction of a person like a stick figure was considered to be an expression in the state where it is difficult to an athlete's own ability.

### **ATHLETES' JUSTICE PERCEPTIONS OF COACHES' LEADERSHIP- ANTECEDENTS AND CONSEQUENCES**

Huang, L.W., Liao, C.M., Tien, C.Y., Chao, Y.C., Hsieh, Y.S., Chieh, C.C., Liang, F.W., Liu, C.H.

*National Taiwan Sport University*

**Introduction** The importance of team members' justice perceptions of their leaders has been well documented in organizational psychology. In sport, however, how and why athletes perceive their coaches' behaviors as being just and what consequences will athletes' justice perceptions of their coaches bring about have not been systematically studied. The purpose of this study was to conceptualize athletes' perceptions of justice by exploring the antecedents and consequences of justice perceptions via interviewing elite athletes. In addition, interview data were analyzed based on the three different values (equity, equality, and need) used as the basis for distributive justice proposed by Deutsch (1975) to examine possible situational specificity. **Methods** Nine athletes were interviewed by the first author either individually or in a focus group. The athletes were from college level or above (mean age 21.56, 5 males and 4 females) with 4 from Taekwondo, 2 from basketball, 2 from track and field, and 1 from baseball. Interviews were taped, transferred into qualitative data, and analyzed following the standard protocol of content analysis. **Results** Content analysis revealed that justice perception is multidimensional, consisting of distributive justice, procedural justice, voice, interpersonal justice, and informational justice. Antecedents of athletes' justice perception were categorized into 7 characteristics of coaches, including caring about the athletes, open-mindedness, emotional control, patience, coaching ability, attribution of athletes' performance, and motivation. Athletes also indicated that their perceived justice would influence their trust and satisfaction of the coach, coach-athlete relationship, as well as team cohesion. In addition, athletes reported that the basis for evaluating justice was situational specific. The rule of equity was essential in deciding starting lineups (the more the contribution, the more the playing time); the rule of need should be followed in practice (the needier gets more instructions); and finally, the rule of equality should be applied in finance-related issues and social activities. **Discussion** The findings of this study support the notion proposed in organizational psychology that justice perception is multidimensional in nature. In sport, athletes' justice perception of their coaches' behaviors comes from various sources. Coaches who are more open-minded and willing to give more chances to athletes are more likely to be perceived as fair. Athletes emphasized that perceived justice influenced their relationship with coaches and team cohesiveness. However, athletes appear to use different rules to evaluate their coaches' behaviors across situations. Coaches should apply different strategies accordingly for having their athletes perceive them as just. **References** Deutsch, M. (1975). Equity, equality, and need: What determines which value will be used as the basis for distributive justice? *Journal of Social Issues*, 31, 137-149.

### **STUDENT-ATHLETES' TIME COMMITMENT TO ATHLETICS AND ACADEMICS: AN EXPLORATORY STUDY IN TAIWAN**

Yang, C.H., Liao, C.M.

*National Taiwan Sport University*

**Introduction** Student-athletes play two roles and the roles of student and athlete are usually conflicting in nature. In the USA, to ensure that student-athletes can keep a balance between student and athlete's duty, National College Athletic Association (NCAA) has limited the time for student-athletes engaging in athletically related activities to a maximum of 20 hours per week in-season and 8 hours per week off-season (NCAA, 2011). A survey showed that most of the student-athletes in the USA followed this NCAA rule and were satisfied with their time commitment in sports (Ayers, Pazmino-Cevallos, & Dohose, 2012). In Taiwan, no regulation has been set by the authority to limit student-athletes' time engagement in athletically related activities. How much time do student-athletes spend on athletic and academic activities, and how their time commitments influence their psychological and social development, have not been systematically studied. In this study, we interviewed university student-athletes from Taiwan to explore their perceptions of the time they spend to lay the basis for future studies regarding the antecedents and consequences of time commitment of student-athletes. **Method** Eight university student-athletes were interviewed by the first author individually. They were from the highest college level (6 males and 2 females) with 3 from swimming, 3 from handball, 1 from badminton, and 1 from table tennis. Interviews were taped, transferred into qualitative data, and analyzed following the standard protocol of content analysis. **Results** Results showed that training hours varied according to sports. Swimmers and badminton players trained around 12 and 15 hours per week, while table tennis and handball players trained more than 21 and 25 hours per week. The long training hours for table tennis and handball players were because they trained two times a day. In terms of academic activities, they spent 14 to 22 hours per week depending on how many course hours they took. All interviewees reported that they were satisfied with their time commitments. **Discussion** It appears that some of the university student-athletes may spend too much time in sport training, and some even train twice a day. Although there is no time regulation for student-athletes in Taiwan, training over 20 hours per week is certainly an issue of concern in assuring a quality education. It is also worrying that all interviewees in our study are satisfied with their time allocation despite long training hours. Athletic achievement seems to be overly-emphasized and academic duty be neglected. This may result in maladaptive career and identity development. **References** Ayers, K., Pazmino-Cevallos, M., & Dohose, C. (2012). The 20-Hour Rule: Student-Athletes Time Commitment to Athletics and Academics. *Virginia Journal*, 33(1), 22-26. National Collegiate Athletic Association. (2011). 2011-12 NCAA Division I Manual. (2011-12) Indianapolis, IN: National Collegiate Athletic Association.

### **DEVELOPING AND MAINTAINING PURPOSE IN YOUNG ATHLETES**

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A growing body of literature suggests that purpose plays a significant role in the development of positive young people. Damon, Menon, and Bronk (2003) defined purpose as a stable and generalized intention to accomplish something that is at once meaningful to the self and of consequence to the world beyond the self. Despite this growth in research, scholars and practitioners know little about young

people with purpose, particularly young people who spend significant time in a sporting context. Young people spend large amounts of leisure time participating in sports activities, and sport provides a salient context for positive youth development (Larson, 2000). Therefore, study of purpose in sport is warranted. The aims of this study were to examine the kinds of noble purposes inspiring today's young, and how young people have been introduced to these purposes. We adopted a qualitative description methodology (Sandelowski, 2000) and purposefully sampled eight members of the same university rugby team from the UK. All participants were aged 18-25 years. We conducted an iterative cycle of data collection and analysis, whereby each interview was collected and analyzed before conducted the next interview. We audio recorded and transcribed each interview verbatim. We then used a thematic analysis procedure in line with Sandelowski's (2000) recommendations. Results revealed that not all the participants were living a purposeful life (i.e., they were not engaging in activities that were meaningful to the self and of consequence to the world beyond the self). Of those young people who described living or searching for a purposeful life, the most common types of purpose to search for and find were forming intimate relationships, becoming a teacher/ coach, and having a family. Participants described social agents (e.g., parents, peers, and teachers) in developing a sense of purpose. Current findings correspond with Erikson's stages of psychosocial development, which suggest that young adulthood (e.g., ages 18-30 years) is about love (intimacy vs. isolation) and middle adulthood is about care (generativity vs. stagnation). Exploring both the content of young athlete's purpose as well as the ways in which they work in pursuit of purpose can help individuals increase the likelihood of maintaining respective purposes over time. Damon, W., Menon, J., & Cotton Bronk, K. (2003). The developmental of purpose during adolescence. *Applied Developmental Science*, 7, 119-128 Larson, R. W. (2000). Toward a psychology of positive youth development. *American Psychologist*, 55, 170-183 Sandelowski, M. (2000) Focus on research methods: Whatever happened to qualitative description? *Research in Nursing & Health*, 23, 334-340

### A STUDY OF LIFE SKILLS ACQUISITION FOR UNIVERSITY ATHLETES

Hatta, N., Shimizu, Y., Daigo, E.

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**Introduction** One of the prevalent problems in university sport clubs is athletes' maladjustment to teams and dropout from clubs. In order to enhance the university athletes' adjustment to atmosphere and interpersonal relationships in the club activities, psychological factors based on life skills need to be explored. A number of studies in the field of sports psychology have been conducted to examine the influence of sports experience on acquisition of life skills. However, there are few studies that have focused the psychological effects on negative factors such as stressor. The purpose of this study is to clarify the relationship among life skills acquisition, athletes' stressor, sport commitment and sport enthusiasm. **Methods** The subjects of 272 college athletes (Male=228, Female=44, mean age=19.9, SD=1.15) were asked answer a questionnaire composed of socio-demographic question items, Sport Life Skill Scale (SLSS), Sport Stressor Scale (SSS), Sport Commitment Scale (SCS) and Sport Enthusiasm Scale (SES). Previous studies developed SLSS, SSS, SCS and SES, and confirmed the reliabilities and structural validities of each scale. Correlation analysis and covariance structural analysis were conducted to examine the relationships among each scale. **Results** The result of correlation analysis showed that both 'SCS' and 'SES' are positively associated with the subscales of "SLSS" (both 'Personal Skills' and 'Individual Skills'). The result also showed that 'SES' is positively associated with "SSS" ( $r = 0.12, p < 0.05$ ). Covariance structural analysis showed that the path coefficients between 'SCS' and "SLSS" and between "SCS" and "SLSS" were statistically significant, but other coefficients in the structural equation model were not statistically significant. **Discussion** The results suggested that athletes with high sport commitment and enthusiasm enhance their life skills in ordinary college life and sport club activities. The results imply that sport club activities for university athletes promote their life skills even if the activity level is high and practices are recognized severe. Future research with larger sample size and the sample of ordinary university students will be needed in order to explore effective life skills acquisition. **References** Naoki HATTA, Yasuo SHIMIZU, Eiji DAIGO (2013). Japanese Society of Test and Measurement in Health and Physical Education, Conference proceeding. Naoki HATTA, Yasuo SHIMIZU, Eiji DAIGO (2013). Japanese Society of Behavioral Medicine, Conference proceeding. Naoki HATTA, Yasuo SHIMIZU, Masayuki YAMAZAKI, Tetsuji ISHII, Eiji DAIGO (2013). Kyushu Society of Sport Psychology, Conference proceeding.

### PSYCHOLOGICAL PREPARATION OF BRAZILIAN GYMNASTS PARTICIPATING IN OLYMPIC GAMES

Schiavon, L., Paes, R.R., Toledo, E.

*State University of São Paulo*

**PSYCHOLOGICAL PREPARATION OF BRAZILIAN GYMNASTS PARTICIPATING IN OLYMPIC GAMES** **Introduction** This paper is part of a research on the sports career of all the Brazilian gymnasts who participated in Olympic Games (OG) in Women's Artistic Gymnastics (WAG), from 1980 to 2004, which objective was to register and analyze this process of formation (Schiavon, 2009). This paper will cover the psychological preparation of the gymnasts. **Method** This qualitative research used the Oral History method, with the techniques of "oral testimonial" and crossed analysis (Thompson, 2002) with non-structured interviews (Laville and Dionne, 1999). **Criteria:** Brazilian gymnasts participating in OG till 2004 (WAG). **Subjects:** 10 gymnasts (100% of the universe) since the first Brazilian participation in OG in 1980. For a better analysis, the gymnasts were divided in three groups: "pioneers" (1980-1992), "transition" (1996-2000) and "new generation" (2004). **Results and Discussion** In the generation of the "pioneer" gymnasts it was verified that there was not enough or continuous support from sports psychology professionals. When they happened, they were very specific and without continuity. The "transition" and "new generation" groups obtained psychological support only when the trainings were transferred to the Artistic Gymnastics (AG) Excellence Center. Many times, coaches themselves take care of the gymnasts "psychological issues" because there is no structure or financial conditions to hire a professional. In other cases, this is an option, as they consider that they know better their gymnasts (Arkaev and Schilin, 2004). Nevertheless, often these coaches do not know how to deal with some emotional situations emerging from trainings and competitions. Many gymnasts are afraid to talk with their coaches, and this is a cultural trait in the AG, specially stimulated by both the inflexible behavior of the coaches (Gervis and Dunn, 2004) and by their childlike handling of the gymnasts. Together these aspects could generate an insurmountable barrier and a threat to the emotional wellbeing of elite young athletes, and could even jeopardize the results. **References** Arkaev L, Suchilin N. (2004). *Gymnastics: how to create champions*. Meyer & Meyer Sport, Oxford. Gervis M, Dunn N. (2004). *The Emotional Abuse of Elite Child Athletes by their Coaches*. *Child Abuse review*, 13, 215-223. Laville C, Dionne J. (1999). *A construção do saber: manual de metodologia da pesquisa em ciências humanas*. Artes Médicas Sul. Schiavon LM. (2009). *Ginástica artística feminina e história oral: a formação desportiva de atletas brasileiras participantes de Jogos Olímpicos (1980-2004)*. Doctoral dissertation, Brazil: State University of Campinas. Thompson P. (2002). *História oral: a voz do passado*. Paz e Terra.

### **RHYTHMIC GYMNASTS' REFLECTIONS ON COPING AND SOCIAL SUPPORT FOLLOWING A MISTAKE AT AN OLYMPIC GAMES: THE IMMEDIATE AND LONG-TERM AFTERMATH**

Magnisali, V., Mc Cullough, D.

*Roehampton University*

**Introduction** Making a mistake during competition can be a stressful experience for an athlete (Nicholls et al., 2009). However, little research has focused on the psychological impact of making a mistake during an Olympic Games. This was the purpose of the present investigation. Specifically, this study aimed to explore retired Olympic rhythmic gymnasts' reflections of coping and social support immediately after the mistake occurred and the long-term aftermath. **Method** Semi-structured interviews (Patton, 1987) were conducted with a purposeful sample of eight retired Greek Olympic rhythmic gymnasts. These were transcribed verbatim and analysed using Interpretative Phenomenological Analysis (IPA, Smith & Eatough, 2007). **Results** Athletes' feelings immediately after the mistake related to disappointment, sadness, anger, guilt, enhanced motivation, worry about the coaches' reaction and fear of another mistake. Problem-focused, emotion-focused, avoidance coping and no coping were reported during this time with emotional, esteem and informational support being highlighted as fundamental in helping the athletes cope. In terms of the long-term aftermath, some gymnasts had changed their perception of the mistake from negative to positive overtime, but a few still had strong negative feelings. Problem-focused, emotion-focused and avoidance coping were utilised over time with emotional and esteem support being perceived as important for coping effectively. **Discussion** Findings indicated that coaches' negative informational support can influence the way in which gymnasts coped with the immediate and long-term aftermath of a mistake. The majority of athletes' perceptions changed over time through the use of a combination of coping strategies, which reflects previous studies (Poczwardowski & Conroy, 2002). Moreover, perceived social support from family, friends and fans was identified as a crucial coping factor (Rees & Hardy, 2000). Two main implications arise from this study: (a) Enhancing coaches' awareness of how their support can affect athletes' ability to cope effectively; (b) The important role of significant others in helping athletes cope more effectively immediately after making a mistake at a major competition and over time. **References** Nicholls, AR, Jones, CR, Polman, RC, Borkoles, E. (2009). *Scandinavian J Med and Sci in Sports*, 19 (1), 113-120. Patton, M. (1987). *How to use qual methods in evaluation*, California: Sage Poczwardowski, A, Conroy, DE. (2002). *J Applied Sport Psy*, 14, 313 – 329. Rees, T, Hardy, L. (2000). *The Sport Psy*, 14: 327–347. Smith, AJ, Eatough, V. (2007). In E. Lyons, & A. Coyle (Ed.), *Analysing Qua Data in Psy* 35-50. London, England: Sage.

### **EXAMINING THE DEVELOPMENT ENVIRONMENTS OF ELITE YOUTH SOCCER ACADEMIES IN ENGLAND: THE PLAYERS' PERSPECTIVE**

Mills, A., Maynard, I., Butt, J., Harwood, C.

*Sheffield Hallam University*

**EXAMINING THE DEVELOPMENT ENVIRONMENTS OF ELITE YOUTH SOCCER ACADEMIES IN ENGLAND: THE PLAYERS' PERSPECTIVE** **Introduction** While the development and eventual success of a gifted young soccer player is considered to be influenced by a variety of psychological and behavioural factors (cf. Mills, Butt, Maynard & Harwood, 2012); few would dispute that it is also shaped by their environmental experience (Reilly, Williams & Richardson, 2003). Despite this, scant research exists regarding the environments that are created for developing players. The purpose of the present study was to examine elite youth players' perceptions of the quality of their development environment at a crucial stage in their progression to the professional level. **Method** With institutional ethics approval, the Talent Development Environment Questionnaire (TDEQ; Martindale, et al. 2010) was used to survey 50 elite youth soccer players aged 16-18 (m 17.1,  $\pm$  s = 0.6 years). The players were recruited from the academies of a range of elite English Premier League clubs. In the analysis, the internal consistency of the TDEQ's factors was established and the mean subscale scores were calculated for each factor. Subsequently, all individual item mean scores were ranked by proportion of agreement. **Results** Overall, players reported that their environment emphasised long-term development, had effective communication, and robust support networks. Specific strengths included: Varied and individualised development plans and access to a wide-range of support professionals. Areas for improvement related to: Opportunities to train with senior players; interest shown in life outside of sport; and discussing players' well-being. **Discussion** The results suggest that the development environments of elite youth academies are perceived to be of a good quality. However, while academies appeared strong in areas related to organisation, planning, and coaching; they were not as strong in areas related to players' socio-emotional needs. From an applied perspective, the findings underline the need for academies to pay close attention to the psychosocial environments they create for players at a critical stage in their development. **References** Mills, A., Butt, J., Maynard, I., & Harwood, C. (2012). Identifying factors perceived to influence the development of elite football academy players in England. *Journal of Sport Sciences*, 30, (15), 1593-1604. Martindale, R.J.J., Collins, D., Wang, J., McNeill, M., Sonk Lee, K., Sproule, J., & Westbury T. (2010). Development of the Talent Development Environment Questionnaire (TDEQ) for Sports. *Journal of Sports Sciences*, 28 (11), 1209-1221. Reilly, T., Williams, A. M. and Richardson, D. (2003) Identifying talented players. In: Science and Soccer II (Eds. T. Reilly and A.M. Williams), pp. 307-326. London: Routledge.

### **DEVELOPMENT OF A "PERFORMANCE TRANSITION" PROGRAMME FOR OLYMPIC AND PARALYMPIC ATHLETES TO SUPPORT GAMES' READINESS AND RECOVERY.**

Moore, P.1,2, Lynch, K.1, Sheridan, D.1, Lyons, D.1

*1: Irish Institute of Sport (Dublin, Ireland), 2: Manchester Metropolitan University (UK)*

**Introduction** Research into athlete career transitions has predominantly focused on transitions into and out of elite sport with less attention on within-career transitions (Wylleman & Lavallee, 2004). Similarly, whilst the in-games and post-games experiences of athletes have been well documented, little has been written regarding the pre-games period. For those charged with providing support to athletes there is a relatively sparse evidence base in the preparation for the Olympic games. The aim of this paper is to outline the development stages in the process of designing a holistic transition-based model for support services to Olympic and Paralympic athletes in the preparation for the London Games. **Methods** One year prior to the London Olympics, the Irish Institute of Sport (IIS), in partnership with the performance directors of sports aspiring to qualify athletes for the Games, identified an athlete pool of 219 potential Olympic (155) and Paralympic (64) athletes. Between September and December 2011, athletes were surveyed by interview (in person, skype or telephone) to build a profile of potential Olympians in the year before the Games. The survey addressed four areas – qualification pathway; training, funding, lifestyle and health status; support services used; and perceived critical performance factors. **Results** 201 athletes responded to the survey invitation (92%). Three qualification pathways were identified; via standards (ie athletics); via direct competition and elimination (ie boxing, sailing) and via ranking points (ie triathlon, pentathlon). At the end of the data collection period, 22 Olympic athletes and 34

Paralympic athletes had achieved qualification status. This represented around one third of the final Olympic team and two thirds of the final Paralympic team. 67% of athletes were carded (funded). 40% classified themselves as full-time athletes, 37% as full-time plus part-time education or employment and 23% as full-time in education or employment. 25% of athletes indicated that they had no plans or were deferring planning until after the Games. Of the full-time athletes, 48% had no plans for after the games. Critical performance factors identified by athletes most frequently were physical (104), technical (73), mental (63) and lifestyle (31). Discussion Based on the profiles generated, sport and athlete-specific interventions were developed. Of particular interest was the lifestyle profile relating to post-games planning. Identification of "at-risk" profiles (full-time, no post-games plans) allowed for early intervention and specific preparation for the post-games support. Wylleman, P., & Lavallee, D. (2004). A developmental perspective on transitions faced by athletes. *Developmental sport and exercise psychology: A lifespan perspective*, 507-527.

**14:00 - 15:00**

## Mini-Orals

### PP-SH13 Psychology [PS] 6

#### EFFECTS OF PROGRESSIVE FATIGUE AND EXPERTISE ON SELF-TALK CONTENT IN RUNNING: AN AMBULATORY ASSESSMENT APPROACH

Nieuwenhuys, A., Veltman, L.J., Braakman-Jansen, L.M.A., Davis, P.A.

*Behavioural Science Institute, Radboud University Nijmegen*

**Effects of Progressive Fatigue and Expertise on Self-Talk Content in Running: An Ambulatory Assessment Approach** Arne Nieuwenhuys (1)\*, Laurens J. Veltman (2), Louise M.A. Braakman-Jansen (2), & Paul A. Davis (3) (1) Behavioural Science Institute, Radboud University Nijmegen, The Netherlands (2) Institute for Behavioral Research, Twente University, The Netherlands (3) Department of Sport Development, Northumbria University, United Kingdom  
**Introduction** In this study we investigated how progressive fatigue differentially affects self-talk use (nr. of statements) and content (instructional, motivational, positive, negative) in recreational and competitive runners, by using a new ambulatory assessment method called "PsyqRun" – a smartphone application that enables online assessment of psychological states and variables (e.g. self-perceived exertion, self-talk) during exercise. **Methods** 42 participants (20 recreational runners, 22 competitive runners) performed a strenuous running exercise in which they attempted to reach a maximal distance over eight 2-minute intervals. Self-perceived exertion (RPE) and self-talk were assessed at the end of every interval by using the PsyqRun application. Heart rate was measured continuously with a heart rate monitor. **Results** RPE scores and heart rate measurement confirmed that fatigue systematically increased as a function of exercise interval. Under high levels of fatigue (i.e., at later intervals) participants generally reported more self-talk statements than under low levels of fatigue (i.e., at earlier intervals). More specifically, with increasing fatigue, participants' use of positive and motivational self-talk strongly increased at the cost of instructional self-talk, which strongly decreased. Finally, a marginally significant effect of expertise ( $p = .058$ ) indicated that competitive runners used more instructional self-talk than recreational runners – also under high levels of fatigue. **Discussion** Using modern smartphone technology, the current study was the first to provide an online assessment of fatigue and self-talk in running. Findings indicated that participants actively focused on their running technique at the start of the exercise (e.g., "keep running smoothly") but shifted to self-motivation and perseverance during later intervals, when they became more fatigued (e.g., "just one more interval!"). These results are consistent with research on fatigue and attentional focus and indicate that – with increasing fatigue – runners' thoughts and attention are automatically drawn inwards towards the monitoring of internal states and processes. Finally, it is suggested that by using more instructional self-talk, competitive runners may be able to maintain a more efficient running technique, also under high levels of fatigue. Further development of the PsyqRun application should clarify this matter, by relating the assessment of self-talk to objective measures of running technique and performance.

#### EXERCISE-INDUCED FATIGUE CHANGES THE WIDTH AND DIRECTION OF ATTENTION FOCUS

Aragonés, D.1, Marbà, J.1, Hristovski, R.2, Balagué, N.1, Tenenbaum, G.3

*1: INEFC Barcelona (Spain), 2: Ss. Cyril and Methodius University, Skopje (Rep. of Macedonia), 3: Florida State University (USA)*

**Introduction** Research has reported a shift from the dissociative to the associative mode of attention as a function of workload accumulation (Balagué et al., 2012; Tenenbaum, 2001). However, the effects of exercise-induced fatigue on the width and direction of thought contents have yet to be investigated. The aim of this study was to examine the effects of a constant-power cycling exercise performed until voluntary exhaustion on the width (broad/narrow) and direction (internal/external) of attention focus. **Methods** Twelve physically active participants previously familiarized with the experimental procedures performed twice a constant-power cycling exercise at 80% of their maximum workload until voluntary exhaustion. The first aimed at establishing their intrinsic dynamics of attention focus. The second required participants to impose and maintain any Task-Unrelated Thought (TUT) and report back about changes in their thought contents by using a key word. After the test they were interviewed in order to describe more precisely those thoughts, which were classified as IB (internal/broad), EB (external/broad), EN (external narrow) or IN (internal/narrow). Time spent in each of these thought subcategories and the entropy of thought dynamics throughout the trial were calculated and compared by non-parametric repeated measures Friedman ANOVA. **Results** All participants started the second test with thoughts classified as IB. The Friedman ANOVA revealed a significant effect of exertion time on IB ( $X^2(12, 4) = 35.41, p < .0001$ , decreasing probability), and IN ( $X^2(12, 4) = 28.60, p < .0001$ , increasing probability). The Friedman ANOVA applied to the entropy change showed a significant effect of exertion time on the entropy of thought dynamics,  $X^2(12, 5) = 32.9, p < .0001$ . **Discussion** Although no specific TUT subcategory (IB or EB) was required by researchers, all participants started the second test with IB. However, it could not be maintained when effort accumulated and EB, EN and IN were emerging and stabilizing. This produced a dominant metastable thought dynamics with switches between the different thought subcategories. As fatigue developed, IB (which requires more active degrees of freedom), lost its stability, whereas stability was gained by IN. Minor changes were noticed in EB and EN. In conclusion, the width and direction of attention focus was changed according to the reduction of active degrees of freedom as voluntary exhaustion approached. **References** Balagué, N., Hristovski, R., Aragonés, D., & Tenenbaum, G. (2012). *Psycho Sport Ex.*, 13(5), 591-597. Tenenbaum, G. (2001). *Handbook of sport psychology* (pp. 810–820). New York, NY: Wiley.

### **META-STABLE SPATIO-TEMPORAL DYNAMICS OF TOPOLOGICALLY DEFINED AREAS OF PERCEIVED DISCOMFORT DURING CYCLING AND RUNNING UNTIL VOLITIONAL EXHAUSTION**

Slapsinskaite, A.1, Balagué, N.2, Hristovski, R.3

*LUHS (Kaunas, Lithuania), 2. INEF(Barcelona, Spain), 3 University of Ss Cyril and Methodius (Skopje, Macedonia)*

**Introduction** The aim of this study was to unravel the spatio-temporal dynamics of topologically defined areas of perceived body discomfort in trained participants while cycling and running at constant high intensity until voluntary exhaustion. **Methods** Eleven students (7 males, 4 females),  $M=20.83$ ,  $SD=1.27$  years old, previously familiarized with the experimental tasks participated voluntarily in the study. They performed a constant cycling and running exercises, respectively, at an intensity corresponding to  $RPE=15$  (Borg's RPE 6-20 scale) until voluntary exhaustion. During both exercises they self-monitored and reported the locations of pain, discomfort/strain according to a scoring template for pain drawing (Margolis et al. 1986) every 15s. These locations were transformed in time ordered binary vectors containing the topological configurations for each time interval. A hierarchical principal component (PC) analysis of these vectors was performed to obtain the temporal structure and dynamics of discomfort perceptions. **Results** Maximum number of obtained primary PC by HPCA was 7 and the minimum was 3 in both tasks. The average proportion of explained variance by the set of PCs was 90.56% and 92.00% for the cycling and the running task, respectively. Each primary component obtained the largest projections of temporal vectors containing topological information about the active areas. These primary components were correlated, so a higher order structure was revealed. For most of the participants only one general PC was obtained in both tasks, signifying a highly correlated perceptual dynamics. Component scores revealed that in both tasks areas 17 and 18 (left and right quadriceps area) were predominantly active as well as the area 49 (left knee joint) specific in the cycling task. Toracal discomfort was only detected in the running task. Other areas were making temporary motifs and were idiosyncratically distributed among participants. **Discussion** The dynamics of body discomfort areas showed a clear metastable behavior characterized by intermittent integration and segregation of distinct topologically defined communities. These communities almost invariably contained a few persistent areas which were active over the whole period of exercise. These areas were the skeleton of the globally correlated activity of topologically local discomfort perceptions. We further hypothesize that this metastable dynamics is formed by a cooperative action of peripheral afferent information coming from active body regions during the exercise and the attention focus of participants. **References** Margolis, R.B., Tait, R.C. & Krause, S.J. (1986). Pain, 24, 57-65.

### **THE FLUCTUATING DYNAMICS OF THE RATING OF PERCEIVED EXERTION CHANGES WITH EXERCISE INTENSITY**

Aragonés, D.1, Aguirre, C.1, Hristovski, R.2, Balagué, N.1, Tenenbaum, G.3

*1: INEFC Barcelona (Spain), 2: Ss. Cyril and Methodius University, Skopje (Rep. of Macedonia), 3: Florida State University (USA)*

**Introduction** Recent research has shown that changes in the rating of perceived exertion (RPE) have a dominant fluctuating dynamics (alternating increased and decreased perceptions) during constant-power cycling (Aragonés et al., submitted). The aim of this study was to compare the RPE dynamics at different constant-power cycling intensities (from somewhat hard to extremely hard). **Methods** 51 voluntary physical education students (27 males and 24 females), previously familiarized with the experimental procedures and randomly assigned to 4 groups, performed a constant-power cycling exercise until voluntary exhaustion at different intensities corresponding to 13, 15, 17 and 19 on the Borg's RPE 6-20 scale. RPE changes, reported when occurring, were recorded during the trials. The individual time series of increases/decreases reports were divided into non-overlapping temporal windows and the percentages of RPE increases were calculated for each window. The differences were analyzed by means of non-parametric repeated measures Friedman ANOVA. Effect sizes (Cohen's  $d$ ) were computed to demonstrate means' differences where effects reached accepted significance level. **Results** The Friedman ANOVA showed a fluctuating dynamics during the whole trial in the RPE 13 group ( $X^2(13, 4) = 6.72$ ,  $p < .15$ ) and a dominant fluctuating dynamics changing to non-fluctuating dynamics (only increased perceptions) close to voluntary exhaustion in the RPE 15 group ( $X^2(12, 4) = 25.29$ ,  $p < .0001$ ). Cohen's  $d$  values were: 0.19, -1.45, and -1.69 for means between the first and third, first and fifth, and third and fifth time window, respectively. A dominant non-fluctuating dynamics was found during the whole trial in the RPE 17 and RPE 19 groups, respectively. **Discussion** Results show that although a fluctuating RPE dynamics was dominant during the somewhat hard (moderate) and hard cycling intensities, the last period in the hard exercise performed until voluntary exhaustion and the whole trial in the very hard and extremely hard cycling exercise were characterized by a non-fluctuating RPE dynamics. **In conclusion**, the RPE fluctuating dynamics changes according to the exercise intensity. **References** Aragonés, D., Balagué, N., Hristovski, R., Pol, R., & Tenenbaum, G. *Psycho Sport Ex.* (submitted)

### **CARDIORESPIRATORY FITNESS IS ASSOCIATED WITH COGNITIVE FLEXIBILITY IN PREADOLESCENT CHILDREN**

Kamijo, K., Bae, S.R., Masaki, H.

*Waseda University*

**Introduction** Recent neuroelectric studies using event-related brain potentials, and in particular the P3 component, have suggested that greater cardiorespiratory fitness is associated with better cognitive control in children (Hillman et al., 2009; Pontifex et al., 2011). The goal of this study was to provide new insights into the association between cardiorespiratory fitness and cognitive flexibility, which is one aspect of cognitive control, by manipulating the probability of trial types during a modified flanker task. **Methods** Preadolescent participants were separated into higher-fit and lower-fit groups according to their performance on a field test of cardiorespiratory capacity. We compared higher-fit and lower-fit children's task performance and the P3 component during a modified flanker task performed under two conditions, in which the probability of congruent and incongruent trials was manipulated, such that in the mostly congruent condition, 70% of trials were congruent and 30% were incongruent, whereas in the mostly incongruent condition, 30% of trials were congruent and 70% were incongruent. **Results** There were no significant differences in fitness between the groups on task performance measures. Neuroelectric data indicated larger P3 amplitude for the higher-fit group relative to the lower-fit group, replicating previous findings (Hillman et al., 2009; Pontifex et al., 2011). Further, planned comparisons revealed that higher-fit children had larger P3 amplitude relative to lower-fit children in the mostly incongruent condition, whereas no group difference was observed in the mostly congruent condition. **Discussion** It has been suggested that when most trials are incongruent, adult participants would be biased toward adopting a proactive control strategy to optimize task performance within the environment, which reduces conflicts with increased and sustained lateral prefrontal cortex activation (De Pisapia and Braver, 2006). Based on this theory, the larger P3 amplitude observed in the higher-fit group for the mostly incongruent condition might reflect a strategic shift from bottom-up reactive control to top-down proactive control. These data suggest that greater cardiorespiratory fitness is associated with an increased flexibility in the modulation of cognitive control networks involving the prefrontal cortex. **References** De Pisapia N, Braver TS. (2006). *Neurocomputing*, 69, 1322-1326. Hillman CH, Buck SM,

Themanson JR, Pontifex MB, Castelli DM. (2009). *Dev Psychol*, 45, 114-129. Pontifex MB, Raine LB, Johnson CR, Chaddock L, Voss MW, Cohen NJ, Kramer AF, Hillman CH. (in press). *J Cogn Neurosci*.

### **DON'T BELIEVE YOUR EYES! THE IMPACT OF VISUAL ILLUSIONS ON QUIET EYE, KINEMATICS**

Vine, S., Wood, G., Wilson, M.R.

*University of Exeter*

Introduction: Research has shown that prior performance can influence subsequent perceptions of target size. For example, Witt et al. (2008) found that golfers who performed well made larger target size estimates. This phenomenon has been labelled action-specific influences on perception (Witt & Proffitt, 2008) and similar findings have been reported in a number of targeting tasks (e.g. Cañal-Bruland et al., 2010). The current study will attempt to explore if the relationship between action-specific perception and performance is bi-directional. We aim to extend previous research (Witt et al., 2012) revealing that the Ebbinghaus illusion can influence performance in golf putting, by exploring potential underlying explanations for this effect. Method: Thirty participants (mean age of 20.40 years, SD = 3.36) putted to identically sized target holes that appeared smaller or larger depending on the size of surrounding 'flanker' circles (Ebbinghaus illusion). Task appraisal was assessed using the cognitive appraisal ratio (CAR, Tomaka et al., 1993); Gaze control (quiet eye; QE) was assessed using an ASL eye tracker (ASL; Bedford, MA); Putter head acceleration was assessed using an accelerometer (LIS3L06AL, ST Microelectronics; Geneva, Switzerland); Performance was assessed as distance from the hole (cm). Results: Results indicated that the illusion was effective in facilitating differences in perceived target size [4.20cm vs. 3.83cm,  $p = .003$ ] and that perceiving the hole as bigger lead to more accurate putting [24.51cm vs. 27.29cm,  $p = .027$ ]. These performance differences were underpinned by changes in task appraisal, gaze control and kinematics. Specifically, when participants perceived the target to be bigger they perceived the demands of the task to decrease [4.80 vs. 5.03,  $p = .05$ ], displayed longer QE dwell durations [294ms vs. 213ms,  $p = .004$ ] and increased putter head acceleration [2.57 ms<sup>-2</sup> vs 2.41 ms<sup>-2</sup>,  $p = .042$ ]. Discussion: This research is the first to explore mechanisms underlying how and why perceptions of target size can influence subsequent performance. Perceptually bigger targets appear to improve performance by reducing the demands of the task, and improving the gaze control and motor control of the performer. Such enquiry may eventually lead to the formulation of interventions designed to help when action-specific influences on perception become counterproductive. References: Cañal-Bruland. et al. (2012). Close, and a cigar! Why size perception relates to performance. *Perception*, 41, 354. Tomaka et al. (1993). Subjective, physiological, and behavioural effects of threat and challenge appraisal. *J Pers Soc Psych*, 65, 248-260. Witt et al. (2008). Putting to a bigger hole: Golf performance relates to perceived size. *Psych Bulletin & Review*, 15, 581-585. Witt et al. (2008). Action-specific influences on distance perception: A role for motor simulation. *JEP: HPP*, 34, 1479-1492. Witt et al. (2012). Get me out of this slump! Visual illusions improve sports performance. *Psych Sci*, 23, 397-399.

### **ENHANCING COMBAT SPORT DECISION-MAKING WITH AN IMPLICIT PERCEPTUAL TRAINING PROGRAM : EFFECT ON VISUAL SEARCH STRATEGY**

Milazzo, N.1, Farrow, D.2, Fournier, J.1

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In combat sports, perceptual-cognitive abilities are indispensable in order to adapt one's actions before contact with the opponent's strike (Wilk, McNair, & Feld, 1983). Video-based perceptual training has shown a number of advantages for the optimization of these skills (Hopwood, Mann, Farrow, & Nielsen, 2011). Recently, a growing number of studies have suggested the benefits of implicit learning during video perceptual training. The present study demonstrates the effect of implicit video perceptual training on performance in the laboratory, on the field and on visual-search behavior in elite Karate athletes. Twelve elite athletes volunteered to take part in perceptual training over 12 sessions. Athletes were split into a placebo group and an implicit learning group. During video training, participants were required to place themselves in the role of one of the two fighters on screen. When the screen was then occluded, participants had to mime the move that they would have made had they been in the fight situation that they were observing. In order to facilitate implicit learning, the results of the sequences were not disclosed and no instructions were given during or after the training sessions. In addition, participants were required to process a secondary task simultaneously (counting in two's aloud). The placebo group had to hit targets on a dummy as soon as they lit up. Results indicated a significant increase in decision accuracy for the implicit learning group from pre-test to post-test compared with the placebo group. Furthermore, a change in eye movement behavior was observed post-test for implicit group only. Indeed, results highlight for this group a significant decrease in the mean number of visual fixations per sequence from pre-test to post-test. Analysis of means of fixation locations for both groups indicate that participants tended to fix their eyes on the upper-body. This study shows the effectiveness of implicit video training session on decision-making in karate. We hypothesize that participants learned to identify and interpret environmental cues in order to better understand the situation. In addition, as the results for eye movements have shown, it is also likely that the performance increase was a result of more effective visual search behavior of the participants, who were better able to read the kinematic information coming from their opponent's movement. Wilk, S.R., McNair, R.E., & Feld, M.S. (1983). The Physics of Karate. *American Journal of Physics*, 51, 783- 790. Hopwood, M.J., Mann, D.L., Farrow, D., & Nielson, T. (2011). Does visual-perceptual training augment the fielding performance of skilled cricketers? *International Journal of Sports Science and Coaching*, 6(4), 523-535.

### **KEEP YOUR EYE ON THE BALL? EXAMINING THE IMPORTANCE OF QUIET EYE LOCATION.**

Vine, S., Lee, D., Uiga, L., Wilson, M.R.

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Introduction: Research has established the benefits of QE training (QET) for the acquisition and resilient performance of targeting skills (Vine et al., 2012). In this experiment we manipulated QE location in putting, to explore how QET aids performance. If the QE provides visual information required for planning and execution (Moore et al., 2012), then adjusting its location should have an adverse effect on performance. Methods: 33 novices (mean age = 22.82, SD =2.98) performed putts in one of 3 groups. All groups followed a QET intervention (as Moore et al., 2012) but the location of the QE varied. Group 1 were asked to fixate the back of the ball (ball); group 2 a paper ball placed on the green 45cm above the ball (above); and group 3 a paper ball placed on the green 45cm in front of the ball on the putting line (front). Participants performed 40 baseline putts (B) from 10 feet, followed by 320 training putts, 80 retention putts (R) to assess learning, and 20 pressure putts (P) to assess resilience against anxiety. Anxiety was manipulated via financial incentives and assessed using the mental readiness form (MRF-3, Krane, 1994). Performance was measured as distance from the hole (cm). Gaze was measured

using an ASL mobile eye tracker. Performance and QE data were subjected to a 3 group vs. 3 condition (B, R, P) ANOVA. Anxiety data were subjected to paired sample t-tests (R vs. P). Results: Performance: ANOVA revealed a significant main effect for condition [ $F(2,60) = 37.36, p < .001$ ], but no group [ $F(2,30) = 1.27, p = .30$ ] or interaction [ $F(4,60) = .31, p = .87$ ] effect. All groups improved from B to R ( $p < .001$ ) and remained robust at P ( $p = .97$ ). QE: ANOVA revealed a significant main effect for condition [ $F(2,54) = 126.44, p < .001$ ], but no group [ $F(2,27) = .83, p = .45$ ] or interaction [ $F(4,54) = 1.16, p = .34$ ] effect. All groups displayed longer QE at R ( $p < .001$ ), which remained stable at P ( $p = .93$ ). Anxiety: Anxiety was higher at P compared with R ( $p < .001$ ). Conclusion: Fixating the ball may not be crucial to achieving the benefits of QET. There are 2 potential explanations for this finding. (1) QE training simply promotes an external focus of attention (Wulf et al., 2007); (2) the above and front groups were able to use peripheral vision to gain appropriate target information. Future research could examine putter head acceleration to establish if movement variability increases when QE location is changed. References: Krane V. (1994). The mental readiness form as a measure of competitive state anxiety. *The Sport Psychologist*, 8, 189–202. Moore et al. (2012). Quiet eye training expedites motor learning and aids performance under heightened anxiety: The roles of response programming and external attention. *Psychophysiology*, 49: 1005-15. Vine et al. (2012). Quiet eye training: The acquisition, refinement and resilient performance of targeting skills. *Eur J Sport Sci*. doi:10.1080/17461391.2012.683815. Wulf G. (2007). Attention and motor skill learning. *Champaign, IL: Human Kinematics*.

## EYE-TRACKING INVESTIGATION OF ELITE GOLFERS IN FIELD SITUATIONS

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Most published studies on gaze-analysis are based on indoor putting. Gaze strategies of golfers on the field are unknown partly for technical reasons. Eye tracking devices were used indoors to prevent conflict between sunlight and the infrared light used to create corneal reflection in order to track the gaze. In addition, most studies involve a task of repeated putting. In these cases, judging the slope of a green (reading the green) is not taken into consideration, as the task consists of putting on a flat, artificial green: a mat, with an artificial continuous light. All shots are identical from one try to the next, so no information other than the distance and the smoothness of the mat is needed. In contrast, the present communication reports observation of gaze strategies of golfers putting in their natural setting. The participants were 12 elite junior golfers, alternating identical putts (same hole) and different putts (different holes) on a grass putting green. Gaze was recorded using the 2012 SMI tracking glasses connected to a portable recording unit, allowing outdoor gaze monitoring. Results showed that the pre-shot routines (duration, number of practice swings) were different across putts and across golfers. Gaze strategies were also different across golfers and across putts. When repeating the same putts, golfers took less time and fewer looks at the hole and ball trajectory compared to putting in different holes each time. Hence, regardless of the gaze training intervention (Vine, Moore, & Wilson, 2011), it seems urgent to explore the ability to read the green in real life settings. Vine SJ, Moore LJ and Wilson MR (2011) Quiet eye training facilitates competitive putting performance in elite golfers. *Front. Psychology* 2:8. doi: 10.3389/fpsyg.2011.00008

## WHEN THREAT DUE TO PHYSICAL ENGAGEMENT IMPROVES OUT-GROUP ATTITUDES : THE IMPORTANCE OF THE CONTEXT IN INTERGROUP RELATIONS

Rull, M.

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Introduction One main stake in physical education and in the policies of social integration through sport is to improve intergroup attitudes. Theoretical models only explain intergroup relations by intergroup emotions and cognitions (Allport, 1954; Fiske et al., 2002). However, affiliation under threat (e.g., Schachter, 1959) assumes that a shared threat improves interpersonal relations. We expect that an intergroup contact under shared threat, nevertheless independent of intergroup emotion and cognition, improves intergroup attitudes. Methods Thirty-six pupils of traditional classes who were inexperienced climbers (18 girls and 18 boys) ( $M = 14.03$  years old,  $SD = 1.31$ ) participated with two disabled pupils from a special education class in the same climbing exercise that took place under threat (at the top of the climbing area) or in control condition (bottom of the climbing area). Judgments of warmth ( $\alpha = .87$ ), positive behavioral intentions ( $\alpha = .86$ ) towards special education pupils (Fiske et al., 2002) and implicit out-group attitudes (Corcoran et al., 2009) were measured. Results The threatening context improved judgments of warmth ( $F(1, 34) = 16.48, p < .0001$ ), positive behavioral intentions ( $F(1, 34) = 38.71, p < .001$ ) and implicit attitudes ( $F(1, 34) = 18.70, p < .001$ ) towards special education pupils. Besides the threatening context decreased negative behavioral intentions ( $F(1, 34) = 9.18, p < .004$ ) towards special education pupils. Discussion This study shows the prosocial dimension of body commitment at implicit and explicit levels of intergroup attitudes. Physical activities and more consistently risky sports appeared as efficient vectors of policies of social integration and struggle against discrimination. From a more theoretical perspective, these results provide evidence that the context and more specifically the physiological and psychological states it carries are neglected in the models which explain the building and evolution of intergroup relations. References Allport GW. (1954). *The nature of prejudice*. Cambridge, MA, Addison-Wesley. Corcoran K, Hundhammer T, Mussweiler T. (2009). *J Exp Soc Psychol*, 45(4), 1008-1011. Fiske ST, Cuddy AJ, Glick P, Xu J. (2002). *J Pers Soc Psychol*, 82(6), 878-902. Schachter Q. (1959). *J Psychol*, 23, 46-59.

## THE EFFECT OF PHYSICAL EXERCISE IN HYPOXIA CONDITION IMPROVES REACTION TIME

Lemos, V.A.1,2, Bittar, I.G.L.2, Caris, A.V.1, Silva, E.A.1,2, Rosa, J.P.P.1,2, Santos, R.V.T.2,3, Lira, F.S.1,2, Antunes, H.K.M.2,3, Tufik, S.1,2, De Mello, M.T.1,2

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Introduction Although hypoxia condition impairs the reaction time, some studies show that physical exercise in normoxia condition can improve reaction time. The aim of this study was to evaluate the influence of acute exercise on reaction time in hypoxia condition equivalent to 4500-m for 29 hours. Methods Thirty-eight healthy men were enrolled in this study, randomly divided into four groups: (Hypoxia  $n = 10$ , Normoxia  $n = 10$ , Exercise in Normoxia  $n = 10$  and Exercise in Hypoxia  $n = 8$ ). The mean values were: age (years) - ( $23 \pm 8$ ), body mass (kg) - ( $71 \pm 7$ ), height (m) - ( $1.76 \pm 0$ ), BMI (kg/m<sup>2</sup>) - ( $22 \pm 9$ ) and VO<sub>2</sub> peak (ml/kg/min) - ( $47 \pm 4.2$ ). The reaction time was evaluated using the Vienna Test System (Schuhfried, 1998), in all groups. In the groups that performed the sessions of exercise, the test was applied on the first day before the first session and after a night's sleep it was reapplied after the second exercise session of 60 minutes at 50% VO<sub>2</sub> peak- ml/kg/min. The groups hypoxia and exercise in hypoxia were exposed in hypoxic condition in Colorado Altitude Training™/12 CAT-Air Unit). Statistical analyzes were conducted using the Mann-Whitney U test with Bonferroni correction, the level of significance was set at  $p \leq 0.016$ . Results There was a significant improvement in reaction time ( $p = 0.0005$ ) in the hypoxia exercise group when compared

with the hypoxia group. In the hypoxia group there was a significant worsening on reaction time ( $p = 0.0005$ ) when compared with normoxia group. The exercise in normoxia group presented a significant improvement on reaction time ( $p = 0.003$ ) when compared with normoxia group. Discussion These results are similar to experimental conditions performed at sea level (Davranche et al., 2009). This study shows that even in conditions of hypoxia, which impairs reaction time, (Pettrassi et al., 2012), can be reversed by exercise performed under these conditions. This association may occur due the effect of exercise on improving sleep quality (Youngstedt et al., 1997), which might improve reaction time. Thus, we suggest that exercise, in hypoxia condition, can improve the reaction time; however further studies are needed to better understand the mechanisms involved. References Davranche K, Hall B, McMorris T. (2009). *J Sport Exerc Psychol*, 31(5), 628-39. Pettrassi FA, Hodkinson PD, Walters PL, Gaydos SJ. (2012). *Aviat Space Environ Med*, 83(10), 975-84. Schuhfried G. (1998). Moedling: Dr. G. Schuhfried GmbH; Youngstedt SD, O'Connor PJ, Dishman RK. (1997). *Sleep*, 20(3), 203-14.

**14:00 - 15:00**

## Mini-Orals

### PP-SH21 Sport Management [SP] 2

#### FEATURES OF SPORTS ORGANIZATION BRANDING STRATEGY FORMATION

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Introduction In recent years, scientists actively creates and develops brand-building models in an effort to fill in the missing gaps in sports branding strategy theory. In the modern world sport organizations are focusing more on the marketing strategies of implementation and purposeful image. Many researchers of this field, studying the marketing process emphasises that investing in brand awareness is purposefully and long. Well and carefully chosen organizations branding strategy – the real value of the organization, which influences the success of the organization, while at the same time increasing the value to the organization. Branding strategy provides organizations with the formation of the market value added, which enhances and ensures reliability and competitive advantage. Methods – systematic, comparative and logical analysis. Results Sports branding concepts analysis by macro level revealed that in the literature dominates two main provisions: some theorists states that this activity is designed to create, maintain or change people's attitude towards certain sports, others opinion includes the development of design, planning and communication delivery name and identity, in order to form or manage reputation. The analysis proposed by the authors of branding concepts, it can be said that there is no consensus on sports branding and brand development concepts of consumption. Done sports organizations branding models and their elements revealed, that most of the models have clearly defined the elements, but they are often intermittent nature; unclear design consistency; sports brand development models are not sufficiently detailed and informatively analyzed a limited amount of the factors often impose final sports branding actions that leads sports brand development models incompleteness and limited practical use. References Brassington, F. And Pettitt, S. (2000), *Principles of Marketing*, 2nd edn, Pearson Education, Amis, J., Pant, N., & Slack, T. (1997). Achieving a sustainable competitive advantage: A resource-based view of sport sponsorship. *Journal of Sport Management*, 11, 80-96 Arthur, D., Scott, D., & Woods, T. (1997). A conceptual model of the corporate decision-making process of sport sponsorship acquisition. *Journal of Sport Management*, 11, 223-233. Brooks, C. (1994). *Sports marketing. Competitive business strategies for sports*. Englewood Cliffs, NJ: Prentice Hall. Cornwell, T. B. (1995). Sponsorship-linked marketing development. *Sport Marketing Quarterly*, 4(4), 13-24. Shilbury, D., Quick, S., & Westerbeek, H. (2003). *Strategic sport marketing* (2nd ed.). St. Leonards, NSW, Australia: Allen & Unwin. Stollar, D. K. (2001). *Developing successful sport sponsorship plans*. Morgantown, WV: Fitness Information Technology.

#### HOW DOES ADVERTISING THROUGH SPORT WORK? EVIDENCE FROM MONTENEGRO.

Popovic, S.1, Bjelica, D.1, Jaksic, D.2, Georgiev, G.3

1: *University of Montenegro (Niksic, Montenegro)*, 2: *University of Novi Sad (Novi Sad, Serbia)*, 3: *Ss. Cyril and Methodius University (Skopje, Macedonia)*

Introduction The first purpose of this study was to compare consumers' attitudes towards advertising through sport with their attitudes towards advertising in general. The second purpose of this study was to analyze the relationships between beliefs about and attitude towards advertising through sport, mostly due to the reason that it was expected that companies should profit from the use of sport as an advertising medium and the identification of specified beliefs influencing to positive attitudes would enhance advertising strategies. Methods The data was collected from randomly selected 433 stakeholders in Montenegro (male: 217; female: 216) during the spring semester of 2010. The system of variables consist 45 items, modeled by seven-point Likert scale, of attitudes and beliefs about and 6 demographic items that were modified from Pyun (2006) original items to fit each area. The factor analysis were employed to take the best item of each question, while Wilcoxon Signed Ranks Test was used to test consumers' attitudes towards advertising through sport with their attitudes towards advertising in general. Then, Optimal Scaling Method was employed to reveal the relationships between beliefs about and attitude towards advertising through sport. Results The customers' attitudes towards advertising through sport were significantly more positive than their attitudes towards advertising in general, while all beliefs, except materialism significantly influenced attitude towards advertising through sport. Discussion The current findings support the authors' hypothesis that the consumers' attitudes toward advertising through sport in Montenegro are significantly more positive than advertising in general. These findings were consistent with the previous evidences (Mittal, 1994; Schlosser et al., 1999; Pyun et al., 2012). However, this study that recruited whole Montenegro's population didn't show consistent findings with the previous studies that were conducted using college students as a research sample (Pyun & James, 2009, 2011; Pyun et al., 2012), mostly due to the reason this study found much more advertising beliefs significantly influenced consumers' attitude towards advertising through sport. The authors believe these findings were caused because the sample covered whole population, but it could be also caused, due to the reason that the generalisability of results could vary from one population to other populations. Anyway, these findings with certainty provide a cornerstone for understanding the growth of consumers' attitude towards advertising through sport in Montenegro. References Mittal B (1994). *J Advertising Res*, 34(1), 35-53. Pyun DY (2006). The proposed model of attitude toward advertising through sport (Unpublished doctoral dissertation), Florida State University, Tallahassee.

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### **PROFILE OF SKI RESORTS CONSUMERS: A CUSTOMER SATISFACTION APPROACH**

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**Introduction** The global ski destination market is highly significant, involving around 80 countries worldwide with an annual total of approximately 400 million skier visits (Vanat, 2010). Identifying the attributes most valued by tourists generates a tool for developing strategies able to enhance the competitiveness of that tourist destination (Kyle, Theodorakis, Karageorgiou, & Lafazani, 2011). Therefore, the propose of this study is to analyze the degree of satisfaction with the services provided by a ski resort. Methods A questionnaire adapted from Hudson and Shephard (1998), was applied to 200 tourists (57.5 % male; 42.5 % female) in the ski resort Serra da Estrela (Portugal). To determine de consumer profile, a factor analysis was done to identify the satisfaction factors, used subsequently in cluster analysis. Results Five factors were identified with the preferences of different consumer segments discriminated through the identification of five clusters. Significant differences between clusters were found as regards: gender ( $X^2 = 10.75$ ,  $P < .05$ ); reason for the journey ( $X^2 = 13.14$ ,  $P < .05$ ); length of stay ( $X^2 = 28.72$ ,  $P < .05$ ); and experience in other winter sports resorts ( $X^2 = 26.16$ ,  $P < .05$ ). Discussion The main reason for visiting the ski resort was for leisure/holidays (77%), making understandable the trend to appreciate attributes ranging beyond specific ski attributes. On the other hand the trend demonstrated by visitors who never experienced other resorts and demonstrated their completely satisfaction about the resorts services, must be carefully analyzed. This information must therefore be taken into account by managers who should identify what proportion of a season's clients display these characteristics as they may prove less demanding. We also conclude that this destination is visited mostly by consumers aged between 20 and 40, who live near the resort and stay only 1-day, indicating the need to attract consumers staying for longer periods of winter sports practice and consequently consuming accommodation and restaurant services and thereby contributing to developing regional tourism. We would also emphasise that the means attributed to the different factors related to levels of satisfaction vary between 2.50 and 2.72. This fact suggests the opportunity for greater improvement in a set of attributes that would drive improved consumer satisfaction with intervention in aspects able to boost destination competitiveness. References Hudson, S., & Shephard, G. (1998). *Journal of Travel & Tourism Marketing*, 7(3), 61-77. Kyle, G. T., Theodorakis, N. D., Karageorgiou, A., & Lafazani, M. (2011). *Journal of Park and Recreation Administration*, 28(1), 1-15. Vanat, L. (2010). Overview of the key industry figures for alpine resorts. (pp. 56). Genève.

### **UNIFYING SPORT SCIENCE WITHIN HIGH PERFORMANCE SPORT: REFLECTIONS ON BEST PRACTICE FROM CANADA, AUSTRALIA NEW ZEALAND AND QATAR.**

Patrick, T., Hatcher, D.

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**Introduction** Many have argued for the need to integrate appropriate sport science and medicine support into training in order to facilitate enhanced performance (e.g. Smith & Norris, 2000; Tuffey Riewald, 2002). While there is ample evidence within the literature pertaining to the efficacy of sport science interventions (e.g. Burkett & Mellifont, 2008) and on the research needs for elite coaching practice (Williams & Kendall, 2007), little has been written on the nature of effective sport science service delivery as it pertains to enhancing coaching practice and athletic performance. Methods Dorgo (2009) acknowledged, "that most aspects of the participant's practical knowledge were developed through field experience, real-life practices, and other professionals" (p. 17). Given the author's collective experience totaling over 50 years working in high performance environments as part of National Sport Institutes in Canada, Australia, New Zealand and Qatar, key themes that emerged as part of several learning conversations together eventuated into the emergence of important characteristics of effective integration. Results and Discussion When sport science integration was optimal, a shared philosophy existed amongst the coaches, athletes and sport scientists. This process often required a series of discussions where all team members shared their personal and professional perspectives from which they grounded their practice. Frequent interaction and effective communication were also essential components. Whenever possible, team members achieved and maintained an interdisciplinary form of interprofessional collaboration. A coach driven approach was adopted and respected. As Petosa (1996) stated "the effectiveness of the performance enhancement program is dependent on the coaches' acceptance and confidence in the program" (p. 64). It was also important for sport science teams to slowly and purposefully integrate team members into the program (Smith & Norris, 2000). Finally, the implementation of practically relevant knowledge became one of the most important outcomes for sport science teams to achieve. References Dorgo, S. (2009). Unfolding the practical knowledge of an expert strength and conditioning coach. *International Journal of Sports Science & Coaching*, 4, 17 – 30. Petosa, S. (1996). A sport science model for enhancing intercollegiate performance. *Strength and Conditioning*, 18(2), 58-64. Smith, D. & Norris, S. (2000). Building a sport science program. *Coaches Report*, 6(4), 19-21. Tuffey Riewald, S. (2002). Lessons from Salt Lake 2002. *Olympic Coach*, 12(2), 8-9. Williams, J. & Kendall, L. (2007). Perceptions of elite coaches and sports scientists of the research needs for elite coaching practice. *Journal of Sports Sciences*, 25(14), 1577 – 1586.

### **INVESTIGATING THE SPORT PARTICIPATION LEGACIES OF THE LONDON 2012 OLYMPIC GAMES: CAN THE OLYMPIC GAMES INCREASE SPORTS PARTICIPATION IN UNPOPULAR SPORTS?**

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*INEFC- KENT UNIVERSITY*

Research scholars are currently questioning the possible effects that Mega-Sport Events might have in increasing the sport participation of the host population at a grass root level. One of the most prominent key pledges set out from the organisers of the 2012 Games was to make the UK a world-leading sporting nation and to increase sport participation. However evidence for the effect of the Games on sustained participation and health legacies in sport is open to doubt. Research does not offer clear results to argue that Mega-Sport Events increase long-term sport participation. There is much anecdotal evidence based on "mega events" and their assumed positive effect upon grass roots participation for the host nation, although there is scarce empirical evidence to support it. This study is a contribution to the lack of empirical evidence of the long term influence of such a mega event. Sport England has administered a standardised survey, the Active People Survey (APS) annually since 2005 which would act as a suitable tool to analyse the effects of the London 2012 Olympic Games in decades to come. This research project will utilise the APS data as secondary data to assess the number of Judo and Fencing participants prior to the Games. Judo and fencing have being targeted for a measure of a boost in grass roots participation because both

sports are relatively unpopular Olympic sports in UK (0.1% of people that are active participate in those two Sports (AP2, 2008)) so any changes of participation as a percentage would be greater, and more identifiable. Objective: The aim of this project is to investigate whether the grass root participation of two unpopular sports in UK (Judo and fencing) in the county of Kent has noticeably changed following the London 2012 Olympics in comparison to 2005 after the Olympics were announced to be held in London. Methodology: The participant sample to be used in this research comprises of coaches and managers of Judo and Fencing clubs. This is a multi-disciplinary study using a mixture of quantitative and qualitative research and both primary and secondary data. The qualitative data consisted of recorded semi-structured interviews with coaches and managers. The quantitative data are based on an analysis of the membership rates of the participants since from 2005 till 2013.

### **SPORTS AID – WHAT IS NORWEGIAN SPORTS AID ORGANIZATIONS TRUE MOTIVATION FOR THEIR DONATIONS?**

Moen, A.

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**Introduction** Norwegian aid to countries in Africa, especially south of Sahara, goes all the way back to the 1950s with the Norwegian Peace corps (Fredskorpset, 2012). Back then they focused on aid to hunger-crisis or post-war reparations. This thesis is going to look closer at the two biggest sports aid organizations in Norway today – Right to Play and Norwegian Sports Organizations aidprogramme – Sports Peace corps. The aim here is to look closer at the motives behind their aid and who benefits from this. Methods I chose to use qualitative method, both interviewing and document analysis (Rapley, 2007; Tjora, 2010; Widerberg, 2005) and people from the organizations were interviewed. Because of long distances they were interviewed by phone. The analyzed documents were political documents and the guidelines from both of the organizations. Results Sports Peace Corps representatives repeatedly said that they had to do things Norads way to make sure they got financial aid. When Spc wright their recommendation letter they have a recipe for what it should say. Rtp on the other hand are not willing to change their visions or goals just to please Norad. Both Rtp and Spc works with local partners and their grassroots-projects. The difference between the two is that Rtp is doing it for the kids growing up in underdeveloped countries, while Spc is doing it for the Norwegian volunteers who go to Africa and their cultural experiences. They want the teenagers to learn about themselves first and foremost, almost like a cultural and spiritual experience that they can talk about when they get back to Norway. **Discussion** The research shows big differences between the two organizations. Rtp works for the recipients in Africa, while Spc works for the teenagers that go to Africa. Which one is better than the other? They both work in the hopes of a better world. They both work with local partners in the countries they go to. On the other hand, both organizations gets economic aid from Norad, and it is obvious that Norad has a lot of power through their donations to sports aid. This might be fair regarding the millions they donate to aid every year. **References** Fredskorpset. (2012). Fredskorpset, <http://fredskorpset.no/no/Fredskorpset/>. Retrieved 08.03.12 Rapley, Tim. (2007). Interviews. In C. Seale, Giampietro Gobo, Jaber F. Gubrium & D. Silverman (Eds.), *Qualitative Research Practice* (pp. 15-33). London: SAGE Publications Ltd. Tjora, Aksel. (2010). *Kvalitative forskningsmetoder i praksis*. Oslo: Gyldendal Akademiske. Widerberg, Karin. (2005). *Historien om et kvalitativt forskningsprosjekt*. Oslo: Universitetsforlaget.

### **SPORT AS A FOUNDATION FOR THE CONCEPT OF REGIONAL DEVELOPMENT: A CASE STUDY FROM THE CZECH REPUBLIC**

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*Palacky University*

**Introduction:**The new political-economic position within the framework of the new regional structure of the Czech Republic has lead, among other things, to an increase in regional disparities. The dynamic growth of sports tourism effectively contributes to improving the situation of regions with structural problems. In economically weak regions sports tourism has served a so-called "multiplier effect" in contributing to their development. In the strategic management of the regions, support for sport can significantly contribute to the development of tourism and thus to the development of the region. For a client to choose a destination, the secondary offering – infrastructure – must also be suitable. Every city and region today includes a conception for sports, as well as a conception for tourism development, in its strategic development plan. The main objective of this conception is the modernization, renovation, construction, operation or maintenance of sports and recreational facilities. This paper deals with the issue of sport as a basis for regional tourism development. The aim is to ascertain the extent to which the regions take advantage of tourism as a tool for regional development in their programs using the specific example of the Olomouc region. This region was chosen for its diverse sports and tourism potential, determined by its natural conditions. The region has both flat terrain suitable for summer sports and mountains suitable for winter sports. Grant programs supporting sports connected with tourism are also an important instrument of regional policy. Currently, the main sources of funding for individual activities in the Czech Republic are EU structural funds. The operational objective is also to analyze operational programs aimed at financing the planned activities and projects within these strategies. **Methods:**The foundation of this study based on an analysis of regional policy for the development of sport and tourism consisted of the four strategic documents. We have chosen a qualitative approach for our basic understanding of the problems. The study and content analysis of documents provided the data, through which the link between tourism and regional development was then interpreted. These documents form the only data base for the study. In analyzing the documents we used our own system of classifying information into categories, based on which the text was searched for occurrence of the given categories. **Discussion:**In examining the indicators listed above, it was confirmed that the supported projects in the field of sport analyzed are clearly in line with the available strategies pertaining to the given territory, which the region fully supports in accordance with its established goals and priorities. Projects receiving support in the areas observed have a positive impact on the region, its citizens and potential visitors (tourists). The area of sports and leisure is addressed in all the strategic documents examined.

### **THE REVENUE OF SPORTS CLUBS IN EGYPT - A COMPARATIVE STUDY WITH GERMAN NON-PROFIT SPORTS CLUBS**

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**Introduction** Non Profit Sports clubs are some of the main social bodies concerned with the sporting activities in the Arab Republic of Egypt (Al-Kholy, 1995). These Sports clubs undertake to promote different sports and develop the teams representing Egypt in the local, regional, continental and international Olympic competitions (Abdel Maksoud, 1997). The German Olympic Sports Confederation (GOSC) states that there are more than 90,000 sports clubs comprising over 27 million memberships (GOSC, 2009). Finance plays an important role in the fulfillment of planned targets in sports clubs. The Egyptian sports clubs examined in the course of this study especially the

revenue sources. Meanwhile, different sports clubs were entered into the revenue sources presented and compared with German sports clubs and their revenue sources. Methods This study was undertaken in two parts. -The document analysis of the annual reports (2009-2010) to the Directorates of Youth and Sport of the biggest four cities in Egypt (Cairo, Alexandria, Giza and Port-Said) n=120. -The data source is the Sport Development Report (Breuer, 2007), which is a nationwide panel survey of non-profit sports clubs in Germany (2005/06) (n=2964). Results Not every sports club in both countries is using all possible sources of revenue. The majority of German and Egyptian sports club received membership fees (99%/100%), donations (80%/60%) and subsidies (62%/88%). There are also a few sports clubs which have different sources of income. 0.7% of German sports clubs get revenue through broadcasting rights and 3.3% through borrowing. In Egypt, the borrowing and its own business association were used in about 8% and 4.17% of the sports clubs. The other sources of income are here at levels between 10.83% and 46.67%. Discussion Sports clubs in both countries have several different unused opportunities that could enhance the internal funding sources. The membership fees and revenues - despite their significance as steady resource and differentiation from one sports club to another - are not sufficient to cover annual total costs of sport clubs. This basically has its origin in the system that sport clubs use for collecting their fees. References Abdel Maksoud, I. (1997). Sport und Tourismus. Kairo: Dar Al-Fikr Al-Arabi. Al-Kholy, A. (1995). Sport und Gesellschaft. Kuwait: Welt des Wissens. Breuer, C. (2007). Sport development report 2005/2006. Analysis of the sports clubs' situation in Germany. In C. Breuer. Cologne: Sportverlag Strauß. GOSC. (2009). Bestandserhebung 2008 des Deutschen Olympischen Sportbundes. Abgerufen am 04. 02 2013 von [http://www.dosb.de/fileadmin/fm\\_dosb/downloads/bestandserhebung/2008.3\\_Bestandserhebung.pdf](http://www.dosb.de/fileadmin/fm_dosb/downloads/bestandserhebung/2008.3_Bestandserhebung.pdf)

## STATE ECONOMIC REGULATION OF SPORTS IN RUSSIA

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Introduction. Modern economic research pays more and more attention to the activities of the state. State role strengthening finds its reflection in an increase of the state expenses and significant expansion of direct legal regulation of the economic life. The state support of physical education and sports is carried out by two principal methods: • direct financing of various activities and • by creating favorable conditions for sports organizations and facilities. Methods. The basis of the studies is provided by a systemic approach to the sports development as well as by methods of economic and institutional analysis, the structural and statistical analysis, socio-economic planning and prognostics. We used complex scientific approaches, such as hypothetical, deductive, abstract-logical, structural-functional, comprehensive and systemic. Results. When analyzing the model of the state physical education and sports regulation in Russia, the following is to note: • market mechanisms only insignificantly act in the regulation of physical education and sports; • the structure of the state sports governing is stable and focused on the state support provision; • physical education and sports in Russia are financed by the federal, regional and local budgets; • in 2001-2012 physical education and sports were financed in an increasing mode; annual budgetary allotments are increased; • the state carries on a paternalism policy in the physical education and sports sphere; • the basic expenses are sport events financing, maintenance of sport teams and sports universities expenses. Discussion. So, the sports sphere state regulation in Russia is based on the federal, regional and local budgets, and the state policy of paternalism in the physical education and sports area is of a tremendous importance. Sports finance analysis in Russia allows it to conclude that in the latest decade the state only gave a priority to some fields of international competition sportsmen training to a search of investments, maintenance and support of some sporting infrastructures and to international sport cooperation

## ECO-COUNTERS. STEP-FREQUENCY ANALYSIS FOR THE DESIGN OF A SPORTS-TOURIST PATH

Ingles, E., Funollet, F., Fuster, J.

*INEFC*

Introduction The main objective of the international project "FFCF: Making on the Frontier a Path Towards Education" (presented in the 07-13 POCTEFA: Operational Programme of Territorial Cooperation Spain-France-Andorra, and with an overall budget of 2,846,772) was to revitalize the territories involved (Alt Urgell, Andorra and Ariège). One of the main actions of the project was to create a path to link these territories and to give relevance to their values. Thus, the aim of this study is to evaluate the step-frequency of the path before its promoting and marketing and to evaluate the design of the route. Method 4 eco-counters were placed in 4 strategic points along the path to gather the step-frequency data (Pettebone et al., 2010). The eco-counters consist of a slab 10 cm underground, sensitive to micro pressure variations, that can discern steps, connected to a hidden counter that collects them. Thus, the method used was the re-counting of the pressures on these 4 eco-counters (Sep11-Sep12). Results The first control point (Bescaran, Cat) has a step-frequency much lower than the rest (5.7%), and it only exists in the summer season (Jun-Au). The only point frequented during the winter season (Dec-Mar) is the one in Coll de les Cases (And). The two points located in Andorra collect 80% of the total frequency. Considering the amount of hikers who have gone through the 4 control points, the maximum step-frequency estimation is 282 steps (Sep11-Sep12). Discussion It has been difficult to estimate the number of hikers going over the full path, because the route is still being tested and not completely operational: unlabelled sections, accommodations far from the points of arrival and departure, etc. We have observed that at the point of Port de Rat (And), which had been studied previously (2009), the step-frequency has not increased since the development of the path (Marquilló, 2012). This fact together with the low frequency detected in controls 1 and 4 suggest the need of promotion of the path and improvement of the signposting. Conclusions Eco-counters are a useful tool for the study of the step-frequency of a natural area (Bates et al., 2007) and, more specifically, of the suitability of a path route. We have been able to evaluate the usage of the path and therefore the efficiency of the actions undertaken for its preparation. The data has helped us to design improvements and strategies of promotion. The eco-counters can also provide data about the impact caused by erosion and pollution. References Bates, M., Wallace, G., Vaske, J. J. (2007). Estimating visitor use in Rocky Mountain National Park (HDNRU Report N° 74). Report for Rocky Mountain National Park. Colorado State University, Human Dimensions in Natural Resources Unit, Fort. Marquilló, L. (2012). Estudi de freqüentació del sender. FFCF. Non-published technical report. Pettebone, D., Newman, P., & Lawson, S. R. (2010). Estimating Visitor Use at Attraction Sites and Trailheads in Yosemite National Park Using Automated Visitor Counters. *Landscape and Urban Planning*, 97(4), 229-238.

15:00 - 16:00

## Mini-Orals

## PP-PM30 Nutrition [NU] 4

**ENERGY INTAKE AND DISTRIBUTION OF MACRONUTRIENTS IN THE DIET OF ADOLESCENT SWIMMERS**

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**Introduction** In adolescents, both total energy intake (EI) and macronutrients seem to have an important role to ensure a good bone development (Vicente-Rodríguez et al., 2008). Adolescent swimmers are required to consume a high amount of calories due to their high energy expenditure (Slattery KM et al., 2012). Therefore, we aimed to evaluate whether energy intake of adolescent swimmers is adequate in relation to their physical activity levels and to describe the distribution of macronutrients in their diet. **Methods** Twenty adolescent swimmers (11 females;  $14.68 \pm 1.73$  y) participated in the study. A 24 h dietary recall was performed by using the Helena-DIAT (Dietary Assessment Tool). CESNID table of food composition was used to calculate EI, carbohydrates, proteins and lipids. Total energy expenditure was estimated as resting energy expenditure plus the physical activity level of each participant expressed by the metabolic equivalent value plus the thermogenic effect of food. Spanish recommendations of macronutrients for the general population (50-55% of the total energy of the diet should be carbohydrates, 30-35% fats and 10-15% proteins) were taken into account to compare with the diet of adolescent swimmers. **Results** Forty five percentage of swimmers were over and 55% under EI. 95%, 77% and 82% of the participants did not comply with carbohydrates, proteins and lipids recommendations, respectively. **Conclusion** Adolescent swimmers did not follow the recommended calorie intake in terms of total energy expenditure. Macronutrients intake of adolescent swimmers diet is not well-distributed according to dietary recommendations for the overall Spanish population. Further studies should be focused on consequences of a poor diet in performance and health of adolescent swimmers and the design of interventions to achieve dietary guidelines. **References** Vicente-Rodríguez G, Ezquerro J, Mesana MI, Fernández-Alvira JM, Rey-López JP, Casajús JA, Moreno LA. (2008). J Bone Miner Metab, 26, 416-424. Slattery KM, Coutts AJ, Wallace LK. (2012). J Sports Med Phys Fitness, 52, 501-5.

**COMPARATIVE ANALYSIS OF ANTHROPOMETRIC IN DIFFERENT POSITIONS IN BRAZILIAN YOUTH SOCCER PLAYERS**

Sousa, S., Rodrigues, E.Q., Cintra Filho, D.A.

Londrina State University

In soccer there are positions that differ both in game tactical aspect as in motor applications, as the players' anthropometric profile can be different depending on the position the player acts on the field. Thus, it is essential to investigate anthropometric profile, because what are differences between playing position? **Methods:** 50 young soccer players were divided into five groups, group 1: 9 central defenders (age  $15.2 \pm 0.4$ ; body mass  $73.4 \pm 7.8$ ; height  $1.82 \pm 0.0$ ); group 2: 8 external defenders (age  $15.5 \pm 0.5$ ; body mass  $73.4 \pm 7.8$ ; height  $1.77 \pm 0.0$ ); group 3: 17 midfielders (age  $15.2 \pm 0.4$ ; body mass  $66.3 \pm 6.8$ ; height  $1.75 \pm 0.0$ ); group 4: 12 forwards (age  $15.3 \pm 0.4$ ; body mass  $68.7 \pm 12$ ; height  $1.75 \pm 0.0$ ) and group 5: 4 goalkeepers (age  $15.0 \pm 0.0$ ; body mass  $80.5 \pm 7.7$ ; height  $1.84 \pm 0.0$ ). They were analyzed skinfold thickness, which were subjected to analysis of skinfold calf, thigh, suprailliac, abdominal, subscapular and triceps for subsequent calculation of fat weight, lean weight and fat percentage, using the equation of Faulkner (1968). Statistical analysis was performed using the Shapiro-Wilk normality and for analysis of variance (ANOVA) with extension to the Post Hoc Tukey test for multiple comparisons. In all cases the level of significance was pre-set for  $P < 0.05$ . SPSS 17.0 was used. **Results:** The main differences were related to % fat and fat weight (FW) between goalkeepers (G5) x external defenders ( $p = 0.04$ ) and defenders x external defenders ( $p = 0.01$ ). **Discussion:** The group 5 (G5) showed more differences for % fat and fat weight (FW) between groups, ie in this case the goalkeepers have more fat, especially that side (G2) and midfielders (G3). Group 1 similarly showed differences in % fat and FW, but only 2 differences between G1 (central defenders) and G2 (external defenders), in this case the quarterbacks have more fat than the external defenders. As explanation, the study LAGO-PENAS et al (2011) in a study of young footballers aged similar study that goalkeepers and defenders showed higher fat percentage as well as in absolute (FW), which corroborates with this study. In the search GIL et al (2007) only in the goalkeepers % fat and were superior differently from the present study it was observed compared to forwards. **References** FAULKNER, J. A. Physiology, swimming and diving, In: Falls H. Exercise Physiology. Baltimore: Academic Press, 1968. p. 415-46. GIL, S. M.; GIL, J.; RUIZ, F.; IRAZUSTA, A.; IRAZUSTA, J. Physiological and anthropometric characteristics of young soccer players according to their playing position: relevance for the selection process. Journal of Strength and Conditioning Research, v.12, n.2, p.438-445, 2007. LAGO-PENAS, C.; CASAIS, L.; DELLAL, A.; REY, E.; DOMÍNGUEZ, E. Anthropometric and physiological characteristics of young soccer players according to their playing positions: relevance for competition success. Journal of Strength and Conditioning Research, v.28, n.7, p.689-698, may, 2011.

**DO I TRAIN TO LOSE BODY WEIGHT IF I AM ALREADY FOLLOWING A DIET?**

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**Introduction** Most studies have described how the weight loss is when different treatments are compared (1-3), showing that there are no statistical differences between them when the diet is included. The aim of this study was to compare the effect of training added to a calorie restriction on the body weight (BW) loss. **Methods** Eighty-five people, with BMI  $25-34.9 \text{ kg} \cdot \text{m}^{-2}$ , aged from 18 to 50 years, participated in the study during 6 months. Two types of treatments were randomly assigned: combined strength + endurance training group (SE,  $n=46$ ), and physical recommendations group (C,  $n=39$ ). All participants followed a 25-30% calorie restriction diet. A Student's t test was used to compare the BW loss in both groups. Probability level for statistical significance was set at  $\alpha=0.05$ . **Results** The BW loss was similar for both groups in kg ( $t_{83}=1.302$ ;  $p=0.196$ ) and in percentage ( $t_{83}=-1.224$ ;  $p=0.224$ ). The BW loss was for SE group  $-9.37 \pm 3.58 \text{ kg}$  ( $-10.51 \pm 3.58 \%$ ) and for C group  $-8.15 \pm 5$  ( $-9.27 \pm 5.64$ ). **Discussion** Although weight loss was similar in both groups, we suggest that any weight loss program should include exercise because it maintains the FFM, contributing to the body's overall energy expenditure rate (4), and has greater cardiometabolic health benefits (3). All body weight loss would be due to fat mass loss if exercise is included. However,

since exercise cannot produce a 25% caloric restriction by itself (approximately 120 min for women and 90 min for men would be required), a daunting task today (5), it would be desirable to combine diet and exercise. References 1. Brochu M, et al. Resistance training does not contribute to improving the metabolic profile after a 6-month weight loss program in overweight and obese postmenopausal women. *J Clin Endocrinol Metab.* 2009 Sep;94(9):3226-33. 2. Del Corral P, et al. Effect of dietary adherence with or without exercise on weight loss: a mechanistic approach to a global problem. *J Clin Endocrinol Metab.* 2009 May;94(5):1602-7. 3. Larson-Meyer DE, et al. Caloric Restriction with or without Exercise: The Fitness vs. Fatness Debate. *Med Sci Sports Exerc.* 2010;42(1):152-9. 4. Ravussin E, et al. Determinants of 24-hour energy expenditure in man. Methods and results using a respiratory chamber. *J Clin Invest.* 1986;78:1568-78. 5. Redman LM, et al. Effect of Calorie Restriction with or without Exercise on Body Composition and Fat Distribution. *The Journal of Clinical Endocrinology & Metabolism.* 2007;92(3):865-72.

### **THE EFFECTS OF AN EXERCISE INTERVENTION ON DIETARY INTAKE DURING THE MENSTRUAL CYCLE IN WOMEN SUFFERING FROM PREMENSTRUAL SYNDROME**

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Introduction Energy and carbohydrate (CHO) intake are reported to increase during the luteal phase of the menstrual cycle in women with premenstrual syndrome (PMS) (Wurtman et al., 1989). The current study investigated whether energy and macronutrient intake, particularly that of non-milk extrinsic sugars (NMES), was affected by a moderately intensive exercise regime in women with PMS; both over the entire menstrual cycle and between cycle phases. Methods Twenty-five sedentary women, suffering from moderate PMS symptoms, were recruited to a randomised control trial spanning four menstrual cycles, the first serving as a baseline followed by three cycles of intervention. Participants were randomised into either an exercise (EX) group (n=13), which included three supervised 30-minute moderate-intensity exercise sessions per week (70-80% HR max) or a control (CON) group which included a 90-minute, one-to-one meeting once per week (n=12). Dietary intake was assessed by a 24-hour dietary recall interview once per week during each cycle. Venous blood samples were collected three times per week during Cycle 1 and 4 to determine menstrual cycle phase according to plasma estradiol and progesterone concentrations. Results There was no difference in energy intake or macronutrient intake as a proportion of total energy intake (%TEI) between menstrual cycle phases at baseline (Cycle 1). Further, there was no difference in energy intake (2487 vs. 2457 kcal) or macronutrient intake (%TEI) (Protein: 14.4% vs. 14.6%; Fat: 35.1% vs. 34.5%; CHO: 48.5% vs. 49.4%; NMES: 17.4% vs. 16.1%), as a result of the exercise intervention (EX vs. CON). However, over the three cycles of the intervention period, CHO intake was lower during the luteal phase in the EX group, as compared to the menstrual (45.5% vs. 50.1%,  $P<0.05$ ) and follicular (45.5 vs. 49.9%,  $P<0.05$ ) phases. No difference was found between menstrual cycle phases in the CON group. There was no difference in plasma estradiol or progesterone concentrations between Cycle 1 and 4, in either group. Discussion CHO intake during the luteal phase is reduced following moderately intensive exercise over three cycles. However, overall energy intake does not change. Previous evidence suggested that CHO intake may increase during the luteal phase and as such the findings of this study are unexpected and require further confirmation. References Wurtman J, Brzezinski A, Wurtman R, Laferrere B (1989). *Am J Obstet Gynecol*, 161, (5), 1228-1234

### **PHYSICAL FITNESS AND BODY COMPOSITION OF OTAGO ADOLESCENTS.**

Black, K.

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It was recently shown that over a third of New Zealanders aged 15-18 years were overweight or obese (1). Poor physical fitness and obesity have been identified as independent risk factors for cardiovascular disease. Habits formed during adolescence continue into adulthood (2). This cross sectional study aimed to describe the relationship between fitness and body composition of adolescents aged 15-18 in Otago, New Zealand. Ethical approval was obtained from the University of Otago Human Ethics Committee. Body composition was measured using segmental bio-electrical impedance and students completed the multistage fitness test, which was used to calculate  $VO_2\max$  (3). Linear regression analysis was undertaken and was adjusted for age, gender and school as these have been shown to affect fitness. In total 269 students participated in both the body composition and fitness testing. Of these 79 % were classed as normal weight with the remaining students classed as overweight (16 %) or obese (4 %). The mean estimated  $VO_2\max$  was 46.3 (6.7) mL/kg/min, it was higher in males than females (48.9(7.0) and 43.2(5.6) mL/kg/min ( $p<0.01$ )). There was a significant association between all of the body composition measures (BMI z-scores and fat-to-lean mass ratio) and  $VO_2\max$ . The females had similar  $VO_2\max$  values to previous studies amongst European populations; in comparison the males had lower  $VO_2\max$  values than their Spanish counterparts (4). BMI was slightly higher than previously reported for European adolescents (4). There was a strong association between body composition and fitness in adolescent females, which was weaker in boys. It is not possible from this study to determine whether fitness influences body composition or vice-versa. However, the low fitness seen in the boys in combination with associations between fitness and body composition suggests initiatives to tackle weight should also focus on fitness. Funding This study was funded by the National Heart Foundation of New Zealand, Lottery Health Research New Zealand and the University of Otago.

### **CONTROLLED NUTRITION INTAKE AFTER WORKOUT IMPROVES LEAN BODY MASS AND MENTAL STATE OF HIGH SCHOOL BASEBALL PLAYERS IN SUMMER SEASON**

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Introduction A young athlete requires sufficient energy intake, not only for the increased energy expenditure, but also for the adequate growth. A high school baseball player shows much more energy expenditure (1). It is practically known that the substantial decrease of the lean body mass occurs in the summer season because of the negative energy balance. The summer season is important for them, as the national high school baseball championship is held. Accordingly, it is necessary to develop the nutrition education that appropriately controls their nutrient intakes for the summer season. The purpose of this study was, therefore, to examine the effects of controlled nutrition intake after workout on the physical and mental functions of the high school baseball players during the summer season. Method Seventy-seven high school baseball players participated in this study for 4 months. The subjects in intervention group (n = 34) were regularly provided controlled nutrition intake after the workout and received the nutrition education. On the other hand, the subjects in control group (n = 43) were only with the nutrition education. In each group, the body composition (height, body mass, % body fat), nutrient intakes, and mental states (profile of mood states, POMS) were measured before, during, and after the intervention. Results The

results showed that the lean body mass in the intervention group significantly increased at 6 and 8 weeks (8wk and 6wk) after the start of the nutrition instruction ( $P < 0.05$ ). On the other hand, the lean body mass in the control group at 8wk was significantly lower than that at 6wk ( $P < 0.05$ ). The energy intake and carbohydrate intake were significantly increased only in the intervention group ( $P < 0.05$ ). Furthermore, the results of the POMS showed that, in the control group, the tension-anxiety score significantly increased ( $P < 0.05$ ) and the fatigue score unchanged. In contrast, in the intervention group, the tension-anxiety score tended to decrease and the fatigue score significantly increased after the intervention ( $P < 0.05$ ). Discussion These results suggest that the controlled nutrition intake after workout, in addition to the nutrition instruction, prevents the lean body mass decrease in the high school baseball players during summer season. This effect can be accounted for by the increase of carbohydrate intake. The effect of the intervention on the mental state was also observed.

### IMPACT OF AN INTERVENTION ON POSTPARTUM WEIGHT RETENTION

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**Introduction** Women of childbearing age are at risk for weight gain because of biological and behavioral reasons, and the development of obesity has important implications, as diabetes and hypertension (Schmitt et al, 2007). In pregnant women, excessive weight gain is linked with greater postpartum weight retention and longer-term effects on obesity risk (Nehring et al, 2011). The objective of this study was to evaluate the impact of an intervention program on postpartum weight retention (PPWR). **Methods** Healthy pregnant women were monitored from early pregnancy until 1-year postpartum. Seventy nine women in the intervention group (IG) received individual counseling by professional nutritionists at gestational and postpartum period about diet and physical activity. One hundred-six women in control group (CG) receive routine care of health service. PPWR was analyzed using hierarchical mixed models analysis. Results One year postpartum, the average weight retention was 2.44kg in CG and 3.09kg in IG, however there was no difference between groups ( $p > 0.05$ ). There were difference between nutritional status, overweight and obese women had 9.44kg and 23.62kg more than normal weight women, respectively ( $p < 0.05$  for both). Postpartum women in IG who gained weight higher than recommended gestational weight gain by IOM (2009) retained 7.41kg more than did women who gained weight below/within the guidelines ( $p < 0.05$ ). Breastfeeding, physical activity and other lifestyle factors (having partner, parity) haven't been related to PPWR. Discussion Only nutritional status and gestational weight gain (GWG) did – Nehring et al (2011) meta-analysis showed that GWG in accordance with the IOM recommendations could help to reduce long-term postpartum weight retention. On the other hand, studies aiming to reduce GWG through lifestyle changes have inconclusive results. Gardner et al (2011) meta-analysis showed that dietary and/or physical activity change programmes produced a significant gestational weight gain reduction. Streuling et al (2010) suggests that weight monitoring was associated with effective interventions – inform participants of their weight, raising their awareness of weight gain could change behaviour. Not sharing weight information, as happened in the present study, would not be expected to influence behaviour. References Gardner B, Wardle J, Poston L, Croker H. (2011). *Obes Rev*, 12(7):e602-20. IOM. (2009). *Weight Gain During Pregnancy: Reexamining the Guidelines*. National Academy Press, Washington. Nehring I, Schmolz S, Beyerlein A, Hauner H, von Kries R. (2011). *Am J Clin Nutr*, 94(5):1225-31. Schmitt NM, Nicholson WK, Schmitt J. (2007). *Int J Obes*, 31(11):1642-51. Streuling I, Beyerlein A, von Kries R. (2010). *Am J Clin Nutr*, 92(4):678-87.

### NUTRITIONAL INTAKE, BODY COMPOSITION AND RISK FACTORS FOR DISORDERED EATING IN MALE ATHLETES

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**Introduction** Achieving and maintaining the desired body shape for a sport involves eating control practices to adjust the body to the requirements and demands of competitive sports environments. Participation in sports that require a low body fat percentage or low body weight has been described as a risk factor for the development of eating disorders. Therefore, the aim of this study was to evaluate food intake, body composition and the presence of risk for developing eating disorders in men practicing sports with aesthetic ideals. **Methods** Fifty adult males participated in this cross-sectional study. Practiced sports were ballet, jazz, contemporary dance, gymnastics and figure skating. Food intake was analyzed using a Food Frequency Questionnaire. We employed three self-report questionnaires in eating disorders research in their translated and validated Brazilian Portuguese versions: Eating Attitudes Test (EAT-26), Bulimic Investigatory Test of Edinburgh (BITE), and Body Shape Questionnaire (BSQ). Body fat was assessed by seven skinfold measures. Statistical analyses were performed using SPSS 20.0 at a 0.05 significance level. Results are presented as mean  $\pm$  SD. Results Participants were 24.9  $\pm$  8.2 y, 68.7  $\pm$  9.1 kg, 1.74  $\pm$  0.08 m, and 9.5  $\pm$  4.5% body fat. Forty-six percent were below the reference values of body fat to the sport practiced. Daily energy expenditure was 3285  $\pm$  665 kcal and daily energy consumption was 3205  $\pm$  1240 kcal. Nutrient intake was above the recommendation for proteins (46%) and lipids (52%), and below the recommendation for carbohydrates (44%), calcium (56%), magnesium (52%) and vitamin A (92%). Positive results for EAT-26, BITE and BSQ have been verified in 6%, 30% and 20% of the athletes, respectively. An association was detected between body image dissatisfaction and disordered eating behavior ( $r = 0.677$ ;  $p < 0.001$ ). Discussion We found an association between body image dissatisfaction and disordered eating behavior that was found in previous study (Milligan and Pritchard, 2006). As well as in Canadian athletes (Lun et al, 2009), some athletes presented food consumption below recommendation. Opposite to Petri et al (2008), the pattern observed in the present study suggests that maintaining low body fat levels is not associated with an increased time spent with exercise, nor the restriction of energy intake. References Milligan BA, Pritchard M (2006). *Ath Ins*, 8,32-46 Lun V, Erdman KA, Reimer RA (2009) *Clin J Sport Med*, 19,405-411 Petrie TA, Greenleaf C, Reel J, Carter J (2008) *Psychol Men Masc*, 9,267-277

### EFFECT OF MIXTURE OF BAS ON EXERCISE PERFORMANCE OF JUDOISTS

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*National Research and Practical Centre of Physical Culture*

**Introduction** At intensive physical loads, there arise multiple deficits, while the use just of one or two biologically active supplements (BAS) cannot address all objectives for generating an optimum metabolic background needed for advancing the certain physical capacities. Goal of the study was to assess the effect of a mixture of BAS on exercise performance of judoists. **Methods** Twenty-five elite judoists (12 athletes – experimental group, 13 athletes – control group) have been examined. Both groups were coached with the same program and catered in the same canteen. Pedagogic testing was performed. Determination of maximum oxygen consumption ( $VO_{2max}$ ), anaerobic threshold (AT) by blood lactate concentration, exercise performance (PWC 130, 150, 170 and max.) at veloergometry, complete blood

count were performed. Athletes of experimental group were administered a mixture of 7 BAS for 8 weeks. After completion of BAS intake, the both groups were tested again. Results Intake of BAS mixture resulted in improvement of muscle-strengthening exercises – chin-up on horizontal bar – 10 times for speed exercise (11.78 sec – at the first examination, 10.26 sec – at the second examination) and for the number of times (30.75 and 34.7, respectively), as well as a test for special endurance – number of back throw fighting dummy (in 5 minutes has increased by 2). No positive dynamic of tests was noted in the control group. Besides the numbers, the quality of back throws was assessed by a five-grade scale. In experimental group, the quality of back throws has improved slightly (from  $4.75 \pm 0.08$  to  $4.83 \pm 0.07$  points), while in the control group it stayed on the same level. No change of  $VO_{2max}$  was noted in both groups. In the experimental group the exercise performance at different heart rate tended to increase while in the control group its has decreased slightly at heart rates 130, 150 and 170 bpm, and did not change at the maximal heart rate. In the experimental group, after intake of BAS, there was noted the increase in red blood cell count from  $4.47 \pm 0.12$  to  $4.93 \pm 0.17 \cdot 10^{12}/l$ , hemoglobin concentration from  $142.1 \pm 3.1$  to  $150.9 \pm 3.4$  g/l. While the control group showed a slight decrease of erythrocytes and hemoglobin. AT shows better than  $VO_{2max}$  the processes occurring in the body at middle and submaximal physical loads. The experimental group demonstrated growth of AT from  $140.1 \pm 3.9$  to  $149.3 \pm 3.4$  bpm. No change of AT was noted in the control group. Conclusion Intake of mixture of BAS by judoists had a positive effect on their exercise performance. No positive dynamics was noted in the control group.

### **PATTERNS OF WEIGHT LOSS OF YOUNG WRESTLERS DURING THE BRAZILIAN NATIONAL HIGH-SCHOOL GAMES**

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**Introduction** The aim of this study was to evaluate the weight loss patterns of Brazilian wrestlers during the national high-school games. **Methods** Thirty-one high-school wrestlers, female ( $n=16$ ;  $13 \pm 2$  yrs) and male ( $n=15$ ;  $13 \pm 2$  yrs) agreed to participate in the study. First, subjects were weighed 24 h prior to competition at the official weigh-in. Immediately following the official weigh-in the athletes answered a standardized weight loss questionnaire. The next day, immediately prior to the first competitive match, the athletes were submitted to a pre-match weigh-in. Additionally, sodium, potassium, chloride, hematocrit and hemoglobin were measured immediately before the first competitive match (24h after the official weigh-in) by STAT Blood Gas Analyzer (iSTAT® Abbott, USA). Results A significant weight gain was detected from the official weigh-in to the pre-match weigh-in (Females:  $+2.7 \pm 1.4$ kg and Males:  $+1.5 \pm 0.9$ kg) ( $p < 0.05$ ). Weight loss practices were employed by 42% of the subjects and they have started to reduce their weight for wrestling competitions before the age of 13 ( $12.1 \pm 1.3$  yrs). The majority of athletes, reported side effects (61.5%) and 46.2% said that these side effects negatively altered performance. The most common methods employed by wrestlers to produce a rapid reduction in weight included: increased amount of exercise (84.6%) and reduced food intake per meal (84.6%). Sodium, potassium, chloride, hematocrit and hemoglobin were in the normal range at the pre-match weigh-in compared to the reference levels. **Discussion** The results demonstrate that the high-school wrestlers gained weight from the official weigh-in to the pre-match weigh-in just 24 h later. These results suggest that wrestlers likely lost a significant amount of weight in a short period of time prior to the official weigh-in. Rapid weight loss prior to competition has become part of the culture of wrestling and the athletes are resistant to change, despite reporting negative side effects on performance. Interestingly, immediately prior to competition, the athletes achieved normal levels of electrolytes and hydration. However, preventative measures are needed to discourage wrestlers from continuing to practice rapid weight loss, especially at such young age. Moreover, educational programs should be developed with coaches and parents aiming to preserve high school wrestlers' health and performance.

### **SPORTS NUTRITION: SUPPLEMENT AND PRODUCT USE IN THE DUTCH GENERAL POPULATION**

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1: HAN University of Applied Sciences (Nijmegen, NL), 2: Wageningen University (Wageningen, NL).

**Introduction** Nutritional supplements and sports nutrition products (e.g. drinks, bars or shakes) are widely used among (elite) athletes; estimations range from 44% up to 100%, depending on age, type of sport and level of the athletes investigated (Molinero & Márquez, 2009). Information from the recreationally-active part of the general population is limited. Therefore, as part of the Dutch National Sport Investigation (NSO 2012) we investigated the self-reported consumption rate of nutritional supplements and sport products in relation to age, sex and sports participation in the Dutch general population. **Methods** The objective of the NSO is to gain insight into sports participation, level of physical activity and the attitude towards sports-related topics of the Dutch general population aged 15 to 80 years. In a representative sample (1647 subjects), 5 questions were asked about nutritional supplement and sports nutrition products use, and self-reported knowledge about this topic. Chi-square test was used to determine differences between sexes and subgroups for age and participation level. Level of significance was set on  $P \leq 0.05$ . Results Response rate was 62% ( $n=1015$ ). 727 individuals (72%) indicated to be active in sports during the last 12 months. Among them, 5.8% used supplements to improve performance, while 21.6% used sports nutrition products before, during or after exercise. Supplements and products were used more frequently by men than women (suppl: 8.8% vs. 2.7%, products: 29.5% vs. 13.6%,  $p < 0.05$ ). Both, supplement and product use was more prevalent in younger people, and those being a member of a sports club; while use of sports nutrition products, but not supplements, was more common in people more regular active in sports. General knowledge about nutrition and sports was considered sufficient in 41% of the population. Remarkably no sex difference was seen for this question, while specific knowledge about 'nutritional supplements and performance' and 'use of sport specific nutrition' was more frequently reported to be sufficient in men than women (26.9% vs. 15.8% and 29.3 vs. 17.6% respectively,  $p < 0.05$ ). Again, younger age, higher sports participation and being a member of a club were associated with better self-reported knowledge. **Conclusion** The use of nutritional supplements and sports nutrition products in the Dutch general population is lower than previously reported intake in recreational and elite athletes. A typical consumer of nutritional supplements and sport nutrition products is a young (< 35 years) male, frequently active in sports (> 1 time/week), and member of a club. References Molinero, O. and Márquez, S. *Nutrición Hospitalaria* 2009;24(2):128-134

## EFFECT OF NUTRITION INTERVENTION PROGRAM IN HANDBALL ATHLETES: CONSEQUENCES ON ANTIOXIDANT STATUS

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**Introduction** The signalling function of ROS also plays a role in mediating the physiological adaptations gathered from regular exercise. The regular training induced adaptations in blood antioxidant capacity and the following attenuated exercise-induced oxidative stress have been clearly demonstrated in adult athletes. To study the effect of nutrition education and polymineral supplementation (Mn, Zn, Cu and Se), on total antioxidant power (PAO) levels in sports performance in a population of elite athletes. **Methods** Longitudinal study of 14 professional handball players > 18a, with intense intermittent training and nutrition education for 2 months, were supplemented with 50% RDAs for Cu, Zn and Se; and 100% RDA for Mn. Training variables were monitored: load, intensity and perceived exertion (RPE). Mineral intake and PAO levels were recorded by 72 h reminder Nutriber® software, and Paglia and Valentine method, respectively. All controls were performed at baseline, after 2 month with supplementation, and after another 2 month without supplementation. Results 7.1% and 35.7% of subjects were initially below the RDA for Se and Cu for healthy population, respectively. Mn, Cu, Zn and Se intake were significantly increased ( $p < 0.05$ ) following supplementation being no influenced by nutritional education. Zn plasma level was significantly correlated ( $r = -0.83$ ) with Cu in plasma. Zn ( $r = -0.66$ ), Mn ( $r = -0.81$ ) and Cu ( $r = -0.80$ ,  $r = -0$  to 75) plasma levels were significantly correlated with PAO after supplementation ( $p < 0.05$ ). PAO increased significantly from baseline ( $p < 0.001$ ) at final of experimental period. **Discussion** The maintenance of the redox balance might partly result from the integrative effect of augmentation of individual antioxidant in adaptation to chronic exercise. Such adaptive endogenous processes in athletes might be associated with their habitual intakes of antioxidant nutrients. Elite athletes should be monitored by a clinical-nutritional follow up to avoid deficiencies that alter antioxidant status in critical situations, so supplementation may be necessary to optimize athletic performance. **References** Tong TK, Lin H, Lippi G, Nie J, Tian Y (2012). *Oxid Med Cell Longev.* 1-7. Kiyici F, Kishali NF (2012) *J Sports Med Phys Fitness.* 52(1):107-11. Margaritis I, Rousseau AS (2008) *Nutr Res Rev.* 21(1):3-12. Marin DP, dos Santos R de CM, Bolin AP, et al. (2011) *Oxid Med Cell Longev.* doi: 10.1155/2011/804873.

## THE INFLUENCE OF CHANGING LIFESTYLE IN OBESITY: 'WEIGHT LOSS CHALLENGE' APPROACH

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**Introduction** The primary objective of this study was to investigate the effects of programmed moderate intensity exercise and dietary regime on the reduction of body weight and body fat in obese people, as well as reducing cardiovascular risk factors. The advantage of nonpharmacologic 'Weight Loss Challenge' approach in treatment of obesity is in joining groups according to the similarity of body weight (BW), health status, body shape and nutritional habits with aim to train and respect diet, with constant medical support. **Methods** Inclusion criteria for this pilot intervention study was BMI  $\geq 30$ . Measurements and tests conducted at the beginning and at the end of the program that lasted three months were: anthropometry, waist circumference, body composition, blood pressure (TA), ergospirometry, blood and biochemical analyses, three-day diet record, Beck Depression Inventory (BDI), Pittsburgh Sleep Quality Index (PSQI) and International Physical Activity Questionnaire (IPAQ). Three basic components were complied: 1) special diet regime using meal replacement, 2) nutrition education and workshops in club and 3) programmed moderate physical activity three times/week. Weekly control were conducted by physician. Results 13 individuals (6 male and 7 female), aged  $46.2 \pm 12.0$  yr had average BMI  $36.6 \pm 5.8$  kg/m<sup>2</sup>, mean BW  $109.0 \pm 24.9$  kg and body fat percentage (F%)  $38.2 \pm 6.6$  at the start of program. The most common comorbidity was metabolic syndrome (80%) and hypertension (50%). Half participants had PSQI category 'poor sleepers'. BDI at start registered moderate and severe depression in three patients. Average VO<sub>2</sub> max ( $21.6 \pm 4.7$  ml/kg/min) indicates a low oxygen consumption. All participants had insufficient or low levels of physical activity according to IPAQ. At the end of program there was a statistically significant difference ( $p < 0.05$ ) for: body weight ( $106.5 \pm 24.3$ kg), BMI ( $35.6 \pm 5.5$ ), body fat mass ( $2.5 \pm 21$ .1kg), F% and fat mass in both arms. Systolic TA were significantly lowered for  $21.8 \pm 11.9$  mmHg and diastolic for  $20.7 \pm 12.0$  mmHg. Fat free mass did not change. **Discussion** The multidisciplinary program, which involves moderate physical activity, dietary regime with meal replacement, regular medical supervision and behavior modification lead to a greater reduction in BW without consequences on health status. Treatment caused a significant change in the body composition, morphological and nutritional status in obese people. This pilot study requires further evaluation and follow-up data of additional participants resulting certain recommendations. **References** Lagerros YT, Rössner S. (2013) *Therap Adv Gastroenterol.* Jan; 6:77-88

## THE NUTRITIONAL SITUATION OF VICTIMS OF THE NORTH-EASTERN JAPAN EARTHQUAKE

Sugiura, K.1, Yamauchi, T.1, Sakai, K.2, Uenishi, K.3

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**Introduction** The enormous earthquake off the coast of North-Eastern Japan on March 11, 2011 and the ensuing massive tsunami devastated a wide area of the North-Eastern coastal area of Japan. The number of dead and missing currently stands at over 19,000, with over 390,000 buildings either completely or partially destroyed. At the peak, there were over 400,000 evacuees who were forced to live in temporary housing units for a prolonged period of time. Food deliveries for evacuees who moved into temporary housing units in the autumn of 2011 were ended and the victims given their privacy. However, as a result it became difficult to gauge their health, or to measure their dietary, nutritional or exercise intakes behind the closed doors of their temporary housing units. Therefore, this research investigated nutritional intakes and physical activity of two groups of elderly housewives: the first residing in temporary housing units and the second in their own original houses, lived in a Kesenuma Oshima Island (population 3,478, with 1,127 homes and an area 9.05km<sup>2</sup> as of March 2008), Miyagi Pref., Japan. **Methods** The subjects of the study were 11 elderly housewife victims (4 residing in temporary housing units, aged  $79 \pm 2$  yrs, height  $146.5 \pm 2$ cm, weight,  $45.8 \pm 7.8$ kg and BMI  $21.2 \pm 3.0$ ; and 7 residing in their original houses, aged  $50 \pm 4$  yrs, height  $158.9 \pm 4.4$ cm, weight  $62.6 \pm 6.9$ kg, and BMI  $24.8 \pm 2.5$ ). Both the groups' nutritional intakes and total energy expenditure were measured in February 2012, and the comparisons made between them, as well as with the 2010 dietary reference intakes (DRIs) of a Japanese person. **Results** The group residing in temporary housing units had an average intake of  $1402 \pm 237$ kcal per day, compared to  $1933 \pm 381$ kcal the group living in their own houses ( $p < 0.05$ ). The temporary housing unit group consumed  $1495 \pm 295$ kcal, compared to  $2127 \pm 198$ kcal of the own housing group ( $p = 0.231$ ). Protein, calcium and iron intakes of the temporary housing unit group were significantly lower than own housing group. The food intake of the temporary housing unit group was 300kcal lower compared to the DRIs for people over 70; and they also consumed 200kcal less. Calcium and vitamin intakes were also found to be insufficient. **Discussion** Since

the subjects in the temporary housing unit group are elderly, they have a heightened risk of developing Locomotive syndrome. It is therefore vital that they have access to adequate nutrition, exercise and health information and support. Since the research was carried out in winter, there is a high likelihood that they were unable to get enough exercise or buy enough food. In light of this, after a year of retrieving adequate health and information support, a second investigation was carried out in February 2013, with the results to be discussed.

## 15:00 - 16:00

### Mini-Orals

#### PP-PM37 Physiology [PH] 4

##### THE EFFECTS OF A FORMAL EXERCISE TRAINING PROGRAMME ON HORMONE CONCENTRATIONS AND BODY COMPOSITION IN PREVIOUSLY SEDENTARY AGING MEN.

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Alteration in body composition, physical function, and substrate metabolism occur with advancing age. These changes may be attenuated by exercise. This study examined whether twenty eight, previously sedentary males ( $62.5 \pm 5.3$  years of age; body mass of  $89.7 \pm 16.4$  kg) adhering to the ACSM minimum guidelines for aerobic exercise for six weeks would improve exercise capabilities, body composition and hormone profiles. After six weeks of adhering to the guidelines, salivary testosterone and  $vo_{2max}$  (absolute and relative) increased ( $p < 0.05$ ), whilst body fat percentage and body mass decreased ( $p < 0.05$ ). Peak power output, fat free mass and cortisol values were not significantly different. Interestingly, salivary testosterone correlated inversely with body fat percentage ( $R^2 = .285$ ,  $p = 0.011$ ). These results suggest that despite previous inactivity, older males can achieve improvements in cardiorespiratory fitness, body composition and anabolism by adhering to simple lifestyle changes.

##### THE INFLUENCE OF MENSTRUAL STATUS UPON POST EXERCISE HYPOTENSION IN ENDURANCE ATHLETES

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*Japan Institute of Sports Sciences*

**【Introduction】** Previous study demonstrated that buffering of post exercise hypotension (PEH) appears to be enhanced in the late follicular phase and midluteal phase where estrogen concentrations are known to be elevated in eumenorrheic female (Esformes et al., 2005). However, the impact of menstrual status upon PEH has not been evaluated. Exercise-associated amenorrhea and oligomenorrhea are in a state of estrogen deficiency compared with eumenorrhea. Thus, it is possible that the PEH may be different between eumenorrheic and non-eumenorrheic (including oligomenorrhea and amenorrhea) athletes. Therefore, in the present study we investigated the temporal pattern of cardiovascular recovery from an acute bout of exercise in female endurance athletes, in two groups of eumenorrhea and non-eumenorrhea. **【Methods】** Eighteen healthy female athletes volunteered for this study and signed an informed consent in accordance with Ethics Committee of the Japan Institute of Sports Sciences. The subjects were divided into two groups based on their menstrual status: ten eumenorrheic athlete (EA,  $19.0 \pm 0.7$  years) and eight menstrual disorders athlete (DA,  $18.2 \pm 0.4$  years, 5 were amenorrhea and 3 were oligomenorrhea). EA group was studied on follicular phase and DA group was studied on an arbitrary day. In the supine position, arterial blood pressure (BP), heart rate (HR), cardiac output (CO), total peripheral resistance (TPR) and spontaneous baroreflex sensitivity (SBRs) were determined before and after 15, 30 and 60 minutes after a graded cycling to exhaustion.

**【Results】** There was no difference in estrogen concentration between EA and DA groups (EA,  $26.1 \pm 12.4$  pg/ml; DA,  $25.4 \pm 11.1$  pg/ml). Systolic BP was reduced in post-exercise compared with pre-exercise ( $p < 0.05$ ) in both groups, and the degree of change was higher in DA than EA groups ( $p < 0.05$ ). Diastolic BP and mean BP were reduced in post-exercise compared with pre-exercise ( $p < 0.05$ ), but the degree of change was not different between the two groups. There was no group difference in TPR reduction after the exercise. We found no significant differences in index of SBRs between pre-exercise and post-exercise phases in both groups. **【Conclusion】** PEH was observed in eumenorrheic and non-eumenorrheic athletes. However, the pattern of PEH was different between eumenorrheic and non-eumenorrheic athletes. **【References】** Esformes, J., Norman, F., Sigley, J. and Birch, K. (2005), *Med Sci Sport Med.*, 38(3), 484-491.

##### ENDOCRINE RESPONSES DURING DIFFERENT MICROCYCLES IN PROFESSIONAL BASKETBALL PLAYERS: A FOUR-YEARS FOLLOW-UP STUDY.

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**Introduction** The aim of this study was to investigate differences in anabolic-catabolic balance depending on week's structure (including training sessions and one competitive game, two-games or non-game) throughout four consecutive seasons in professional basketball players. **Methods** Thirty-five male players from the same team, with regular training and competition in Spanish 1st Division (ACB) volunteered to take part in this study (age:  $27.0 \pm 4.2$  yr; height:  $195.7 \pm 7.4$  cm; weight:  $93.7 \pm 10.1$  kg). A gathering of consecutive detailed blood samples were collected to analyze different blood parameters in relation to seasonal changes depending on type of microcycle (training and game exposure). Blood samples were collected every 4-6 weeks during regular season (277 total samples). **Results** Cortisol was significantly lower after two-games microcycle ( $0.470 \mu\text{Mol/L}$ ) in comparison with one-game microcycle ( $p=0.000$ ,  $\Delta: 0.34$ ). Moreover, the variation of testosterone-to-cortisol ratio was significantly higher after no-game microcycle ( $+12.2\%$ ) compared to one-game microcycle ( $+0.3\%$ ) ( $p=0.006$ ,  $\Delta: 0.27$ ). **Conclusion:** Regular blood samples reveal significant changes that may be related to training and game pattern week. No-game microcycle, but with regular training, stimulates anabolism. These results highlight that regular analyzes of blood samples could be an important method to monitoring training and competition process to optimize training/competition load for better adaptation, but sampling has to be regular and a database has to be build for each individual player. **References** 1. Manzi V, D'Ottavio S, Impellizzeri F, et al. Profile of weekly training load in elite male professional basketball players. *J Strength Cond Res*

2010;24(5):1399-406. 2. Viru A, Viru M. Cortisol – essential adaptation hormone in exercise. *Int J Sports Med* 2004;25:461-464. 3. González-Bono E, Salvador A, Serrano MA, et al. Salivary testosterone and cortisol responses to cycle ergometry in basketball players with different training volume. *J Psychophysiol* 2002;16(3).

### EFFECT OF 48H ULTRA MARATHON RUN ON BIOACTIVE SPHINGOLIPIDS LEVELS IN PLASMA AND ERYTHROCYTES

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**Introduction** The bioactive sphingolipids, i.e. sphingosine-1-phosphate (S1P), sphingosine (SPH), sphinganine (SA), sphinganine-1-phosphate (SA1P) and ceramide (CER) are present in human plasma. The most powerful is S1P that binds to plasma membrane receptors and activates G protein. S1P exerts strong cardioprotective, immunoregulatory, pro-proliferative and anti-apoptotic effects. The main source of plasma S1P are red blood cells (RBC). Previous studies showed that muscular work affects metabolism of sphingolipids in skeletal muscles. The aim of this study was to investigate effects of 48h ultra-marathon run on bioactive sphingolipids levels in plasma and RBC. **Methods** Seven runners aged 35-59yrs volunteered to provide blood samples before the run, after 24 and 48h running and after 1 and 2 days of recovery for analyses of bioactive sphingolipids by HPLC and of routine biochemical indices. The runners were allowed free intake of food and beverages during the run. Results Blood glucose and lactate levels were stable throughout the race, free fatty acids increased ~4-fold after 24h and almost 3-fold after 48h running, and returned to normal during recovery. Plasma S1P (pmol/ml) decreased ( $P<0.05$ ) from  $233.5\pm30.6$  pre-run; to  $153.5\pm35.1$  after 24 h,  $121.7\pm22.6$  at the finish, and to  $115.9\pm13.9$  and  $120.7\pm17.7$  after 1 and 2 days of recovery. Plasma levels of SPH and SA were not affected by the run although SPH decreased after 24h and SA after 48h rest ( $p<0.05$ ). The level of SA1P decreased after 48h running and during recovery ( $p<0.05$ ). Plasma CER level remained stable during the event. The level of S1P in RBC was fairly stable during the run but it increased after 24h rest ( $p<0.05$ ). 24h running led to a significant ( $p<0.05$ ) increase in SA1P in RBC, which returned to baseline thereafter. The level of SPH in RBC rose only in the 2nd day of recovery ( $p<0.05$ ), while SA and CER contents were not affected by the run. **Discussion** It is known that S1P and SA1P are not taken by any cell. Prolonged 48h running reduced S1P and SA1P contents in plasma, but not in RBC. Therefore, the decrease in plasma contents of these sphingolipids was most likely due to their enhanced breakdown in this blood compartment. The drop in the plasma S1P has certainly blunted its cardioprotective and other effects both during the run and in the recovery. **References** Błażnio-Zabielska AU, Zabielski P, Baranowski M, Górski J. (2011) *Lipids*, 46, 229-238. Dobrzyń A, Górski J. (2002) *Am J Physiol Endocrinol Metab*, 282, E277-85. Knapp M. (2011) *J Physiol Pharmacol* 62,601-607.

### RELATIONSHIP BETWEEN ANDROGENS AND CORTICOSTEROIDS IN PLASMA AND URINE IN PRE AND POSTMENOPAUSAL WOMEN AFTER 6 MONTHS OF AEROBIC TRAINING.

Maynar, M., Robles, M.C., Crespo, C., Llerena, F., Toribio, A.F.

*University of Extremadura*

**Introduction:** The postmenopausal period is associated with an estrogen and androgens deficiency and a corticosteroids increase. These hormonal alterations could be responsible for the increased morbidity. Physical activity could have an important regulating effect on female hormonal metabolism, although not necessarily the same in pre or postmenopausal women. **Purpose:** To evaluate the effect of 6 months of aerobic exercise on relationship between androgens and corticosteroids levels in plasma and urine in pre and postmenopausal women. **Method:** 20 premenopausal (PRE) ( $45.56 \pm 4.06$  years) and 20 postmenopausal (POST) ( $52.27 \pm 3.80$  years) women, all sedentary, were studied before and after a supervised 6 months exercise training program based on aerobic dance (60- 70% maximal heart rate, 60 min/day, 3 days/week). Before and after the program, anthropometric data and VO2 max were measured and overnight fasting urines and plasma samples were collected and analyzed by gas chromatography/mass spectrometry (GC/QMS). Steroids values were expressed as  $\mu\text{g steroid/g creatinine (cr)}$ . The data was analyzed by one-way ANOVA and by repeated measures. **Results:** Both groups improved their VO2 max after the aerobic exercise program ( $32.59\pm6.0$  before vs  $37.60\pm8.2$  ml/min/kg after exercise in PRE  $p<0.01$ ;  $31.84\pm6.0$  before vs  $36.94\pm6.3$  ml/min/kg after exercise in POST  $p<0.01$ ). Important differences were observed between relationship androgens/corticosteroids in plasma and urine in both groups in basal values (Table 1). After the exercise program, no changes in plasma and urinary levels were observed in premenopausal women. However, the aerobic exercise caused a significant increase in urinary relationship DHEA+androstenedione/glucocorticoids in postmenopausal women (Table 2). **Conclusion:** Pre and postmenopausal women presented important differences in the basal levels. In postmenopausal women, the elevation of the relationship androgens /glucocorticoids could bring health benefits, because it could indicate a reduction in glucocorticoid levels, reducing the risk of diseases such as obesity, diabetes, cardiovascular disease and depression.

### IVGTT BUT NOT OGTT DETECTS INSULIN SENSITIVITY IMPROVEMENTS AFTER A BOUT OF EXERCISE IN HEALTHY MEN

Ortega, J.F., Fernández-Eliás, V.E., Hamouti, N., Mora-Rodríguez, R.

*University of Castilla-La Mancha*

**Introduction:** Euglycemic hyperinsulinemic clamp (EHC) is the gold standard method to assess insulin sensitivity (IS). However, few researchers can carry it out since it requires costly and complex equipment. In addition, the infusion of insulin is not risk free and it requires trained hospital staff to avoid complications and to obtain accurate measures (1). Exercise science professionals, that cannot implement EHC, are in need of an affordable and simple diagnosis test to gauge the effects of exercise interventions on insulin actions. This index, besides of valid, must be highly reproducible since otherwise the benefits of exercise could remain hidden underneath the variability of the measurement. To our knowledge, there is a scarcity of data comparing the reliability and response to exercise of technically and economically affordable IS indices. **Purpose:** To compare the reproducibility and post-exercise response of two glucose tolerance tests to estimate IS, with different routes of glucose administration; i.e., oral (OGTT) vs. intravenous (IVGTT). **Methods:** Ten healthy moderately-fit young men ( $\text{VO2peak}$ :  $45.4\pm1.8$  mL•kg<sup>-1</sup>•min<sup>-1</sup>; age  $27.5\pm2.7$  yrs) underwent four OGTT's and four IVGTT's in different days after a standardized dinner and overnight fast. One of the OGTT and one of the IVGTT were carried out right after 55-min of cycle-ergometer exercise at 60%  $\text{VO2peak}$ . Matsuda's insulin sensitivity index (MISI) was calculated from OGTT (2-hour blood sample collection). Tura's calculated IS index (CSI) (2) was calculated from IVGTT (50-min blood sample collection). Coefficient of variation (CV) and intraclass reliability (ICR) were used to assess absolute and relative within-subject reproducibility, respectively. Improvements in IS after exercise were evaluated using one-way repeated measures ANOVA. **Results:** After exercise, MISI improved 29% without reaching statistical significance ( $P=0.182$ ) due in part to its low reproducibility (CV  $16\pm3$  %; ICR 0.846). However, CSI improved by 50% after exercise ( $P<0.001$ ) and showed better

reproducibility (CV  $13 \pm 4\%$ ; ICR 0.955). Calculated sample sizes based on observed IS differences (rest vs. post-exercise) showed that 7 subjects were required for detecting the effects of exercise when using CSI while 81 when using MISI. Conclusions: At rest, CSI is more reproducible than MISI in healthy young men. Our data suggest the preferential use of IVGTT to assess the beneficial effects of exercise on IS, at least in a young and moderately-fit non-diabetic population. References 1. Muniyappa, R., et al. *Am J Physiol Endocrinol Metab.* (2008). 2. Tura A. et al. *Diabetologia* (2010).

### **SPRINT INTERVAL EXERCISE INCREASES INSULIN SENSITIVITY ABOVE CONTINUOUS EXERCISE OF HIGH AND LOW INTENSITY**

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**Introduction:** The American College of Sports Medicine and the American Diabetes Association recommend at least 150 min•week<sup>-1</sup> of moderate-vigorous aerobic exercise for type 2 diabetic patients (1). Sprint interval exercise (SIE) is a time-efficient strategy to induce similar health benefits and training adaptations than continuous endurance exercise (2). However, it is unclear if SIE has similar effect on insulin sensitivity (IS) than typically recommended continuous exercise. **Purpose:** To compare the immediate and short-term effects of continuous exercise vs. SIE on glucose and fat metabolism. **Methods:** Ten young, healthy and physically active men underwent three exercise trials in a random and counter-balanced order separated by at least four days: a) continuous exercise for 60 min at 45% VO<sub>2peak</sub> (CLow), b) continuous exercise for ~35 min at 80% VO<sub>2peak</sub> (CHigh), or c) SIE consisting in 4 all-out 30-s sprints interspersed with 4.5-min of active recovery. CLow and CHigh were matched for energy expenditure while during SIE 32% less energy was expended. IS calculated from 50-min intravenous glucose tolerance test (CSI index (3)) was measured at rest, immediately post-exercise (IPE), and 24-h and 48-h after each trial. Muscle glycogen use was measured IPE from vastus lateralis. Plasma free fatty acids (FFA) were measured before each IS assessment. Two-way (time•exercise model) repeated measures ANOVA was used to determine differences and Pearson coefficient for correlations. **Results:** During exercise, total carbohydrate oxidation was higher during CHigh ( $P < 0.05$ ). Glycogen use was different from rest in both CLow and CHigh ( $P < 0.05$ ) but not after SIE. Fat oxidation and IPE circulating FFA were higher in CLow ( $P < 0.05$ ). Although CSI increased IPE in all trials, SIE was higher than CLow and CHigh (133%, 75% and 70%, respectively;  $P < 0.05$ ). CSI enhancement persisted up to 48-h after CLow and CHigh but only up to 24-h after SIE. CSI improvements did not correlate with energy expenditure, glycogen use, substrates oxidation and blood FFA concentration. **Conclusion:** SIE is superior to CHigh and CLow on immediately post-exercise IS improvements. However, continuous exercise maintains the effects longer. The lack of correlation between energy or muscle glycogen expenditure and substrates oxidation with IS suggests that other factors are important mediators of post-exercise insulin sensitivity enhancement. References 1. Colberg, S.R., et al. American College of Sports Medicine and the American Diabetes Association joint position statement. *Med Sci Sports Exerc.* 2010. 2. Gibala, M.J. and S.L. McGee. *Exerc Sport Sci Rev.* 2008. 3. Tura A. et al. *Diabetologia* (2010)

### **PHYSICAL TRAINING PREVENTS INSULIN RESISTANCE BY ACTIVATING THE AMPK PROTEIN IN SKELETAL MUSCLE**

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**Introduction:** The adaptation of skeletal muscle induced by physical training (PT) has been associated with the prevention of insulin resistance (IR). We investigated the role of AMP-activated protein kinase (AMPK)/acetyl CoA carboxylase (ACC) pathway behind this response. **Methods:** Male C57BL/6J mice were assigned into chow-fed controls (C, n=8), cafeteria diet (CAF, n=8), chow-fed trained (TR, n=8), and cafeteria diet plus trained (CAF-TR, n=8). PT was performed simultaneously with diet and consisted of 8-wk running session of 60 min, 5 days/wk. Exercise tolerance (ET) was determined by graded treadmill test, intraperitoneal insulin tolerance test (ITT), insulin, leptin and adiponectin levels were measured after PT. The weight of skeletal muscles, fiber type, capillary number and density, and the content of muscle lipids were determined. The expression of AMPK, AMPK phosphorylation at  $\alpha$ -Thr172 (p-AMPK), ACC and ACC phosphorylation at Ser 79 (p-ACC) in skeletal muscle were determined by Western blot. **Results:** After PT, TR and CAF-TR increased ET, CAF showed hyperinsulinemia and insulin resistance compared to TR and CAF-TR. Leptin did not differ among groups, but adiponectin was decreased in CAF compared to C group and increased in TR and CAF-TR compared to C and CAF groups. The weight and the content of fiber type 1, 2a and 2b in soleus, plantaris and gastrocnemius muscles did not differ among groups. Capillary number and density did not differ, but the content of muscle lipids in the soleus was decreased in TR compared to CAF-TR. AMPK expression was higher in CAF-TR compared to C, CAF and TR, p-AMPK increased in CAF-TR compared to C, ACC and p-ACC increased in CAF-TR compared to C and CAF groups. **Discussion:** The metabolic potential of skeletal muscle is largely modulated by the activity of AMPK (McGee & Hargreaves, 2010). Although the PT has been associated with morphological changes in skeletal muscle (Burr et al., 2010), our results showed that PT prevented IR by activating the AMPK/ACC pathway which was associated with increased adiponectin level but not with change in skeletal muscle morphological phenotype. Increases in adiponectin are associated with improved insulin sensitivity and glucose homeostasis (Yamaguchi et al., 2002). References: Burr JF, Rowan CP, Jamnik VK, Riddell MC. (2010). *The physician sports medicine*, 38, 72–82. McGee SL, Hargreaves M. (2010). *Clinical Science*, 118, 507-518. Yamaguchi T. et al. (2002). *Nature Medicine*, 8, 1288-1295. Supported by FAPESP (2011/02126-6).

### **NEUROPEPTIDE W MODULATED OF FOOD INTAKE BY STRESS RESPONSE AND VOLUNTARY EXERCISE IN MOUSE**

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**Introduction** Neuropeptide W (NPW), which was isolated from the porcine hypothalamus, which belong to the G protein-coupled receptor family. Centrally administered NPW is known to suppress feeding behaviour and promotes to secret adrenocorticotropin hormone (ACTH) and corticosterone. However, the target neurones of this action have not been clarified. The present study aimed to determine features of the NPW-mediated neuronal feeding pathway in rat. Moreover, generally voluntary wheel running reduces the activation of HPA axis to stimuli. Therefore, we studied to clarify the effect of infusion of by stress response and voluntary exercise in mouse. **Methods** To clarify the neuronal interaction between NPW-containing neuron and stress response and suppress feeding regulate peptide of corticotropin-releasing hormone (CRH) neuron. NPW i.c.v. injection with or without CRH antagonist pretreatment. Mouse were icv infusion of the vehicle and NPW (2 n mol) once a day. Body weight, food intake, water intake and locomotor activity were measured 24 hours later. Moreover compared it was the voluntary exercise and none by DAB staining of c-Fos positive cell in rat hypothalamus. **Results** NPW axon terminals

were found to make synapses on CRH immunoreactive cell bodies and dendritic processes in the PVN. Suppress feeding behaviour of NPW were canceled by CRH antagonist pretreatment. Mouse did not affect Body weight, food intake, water intake and locomotor activity milage with voluntary excise by NPW icv infusion. Voluntary wheel running canceled the NPW-induced anorexia and c-FOS decreases in the PVN. Discussion These results suggested that NPW mediated neuronal feeding pathway via CRH neurons in hypothalamus of the mouse. Moreover, the voluntary exercise stimulated the HPA axis and influence the feeding regulation in the mouse. References [1]Shimomura Y, Harada M, et al. (2002) *J Biol Chem* 277, 35826-35832. [2]Takenoya F, Kageyama H, Shioda S, et al. (2010) *Neuropeptides*, 44:99-106. [3]Takenoya F, Kageyama H, Shioda S, et al. (2010) *Ann N Y Acad Sci* 1200,162-169. [4]Date Y, Kageyama H, Takenoya F, Shioda S, et al. (2010) *Endocrinology*, 151: 2200-2210. [5]Takenoya F, Kageyama H, Hirako S, et al. (2013) *Front Endocrinol (Lausanne)*, 3-171.

### **CARDIORESPIRATORY ADAPTATION AND HORMONAL RESPONSES TO ENDURANCE EXERCISE IN FEMALE CROSS-COUNTRY SKIERS**

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*Academy of Physical Education*

**Cardiorespiratory Adaptation and Hormonal Responses to Endurance Exercise in Female Cross-country Skiers**  
Introduction Competitive cross-country skiing is one of the most demanding sports disciplines. It requires a high maximal oxygen uptake, fast force production and ability to resist fatigue (Carter et al., 2001, Widdowson et al., 2009). During short uphill skiing, finishing burst and during new sprint skiing, the energy demand exceeds maximum oxygen uptake and, consequently, anaerobic energy production has been found to have an important role in cross-country skiing performance. The purpose of our study was to compare serum catabolic and anabolic hormones concentrations in relation to cardiorespiratory performance of elite female cross-country skiers of the Polish National World Cup Team. Methods We investigated the response of testosterone (T), growth hormone (GH), cortisol (C), steroid hormone binding globulin (SHBG), insulin-like growth factor (IGF-1), insulin-like growth factor binding protein-3 (IGFBP-3), and some anabolic-catabolic indexes, i.e.: T/C, T/SHBG, and IGF-1/IGFBP-3 to maximal aerobic exercise in twelve female cross-country skiers (mean age: 22±2 years). In all subjects M-mode and two-dimension Doppler echocardiography were analyzed before exercise. Pulmonary ventilation and oxygen uptake (VO<sub>2</sub>) were measured continuously during the exercise (Oxycon; Jaeger, Germany). Results The elite female skiers demonstrated high level of aerobic performance (VO<sub>2</sub>max: 55.6 ± 2.8 ml/kg/min. The maximal exercise test induced an increase in post-exercise GH (p<0.001), and T (p<0.01) and SHBG (p<0.01) concentration. Significant differences of IGF-1/IGFBP-3 and T/SHBG were seen between the resting and post-exercise levels. The results indicate differences in myocardial parameters depending on training status, and suggest a beneficial effect of endurance training on heart muscle function (Wernstedt et al., 2002). No significant associations were observed in left ventricular mass and anabolic hormones levels. Left ventricular mass and stroke volume correlated with VO<sub>2</sub>max (p<0.01). Conclusions We conclude that hormone changes following endurance training were different in female athletes, which may have both metabolic and hypertrophic implications [1, 2, 3]. Greater IGF-1/IGFBP-3 and T/SHBG elevation after exercise might suggest that both total and free fractions of these hormones may play an important role in adaptive mechanism and enhanced exercise performance of female athletes. The obtained results indicate differences in myocardial contractility parameters depending on training overload, and suggest a beneficial effect of endurance training on heart muscle function. 1. Carter SL, Renni CD, Hamilton SJ, Tarnopolski MA. (2001) *Canad J Physiol Pharm*, 79, 386-392. 2. Widdowson WM, Healy ML, Sönksen P, Gibney J. (2009) *Growth Horm IGF Res*, 19, 308-319. 3. Wernstedt P, Sjostedt C, Ekman I, et al. (2002) *Scand J Med Sci Sports*, 12, 17-25.

### **EFFECTS OF ACUTE EXERCISE ON CYTOKINE AND IMMUNO-ENDOCRINE RESPONSES IN DIFFERENT AMBIENT TEMPERATURES**

Gagnon, D.D., Gagnon, S.S., Rintamäki, H., Karhu, T., Kyröläinen, H., Herzig, K.H.

*University of Jyväskylä*

**Introduction** Acute exercise and ambient temperature are both stressors that modulate the immune and endocrine systems. It is known that both systems communicate bi-directionally through hormone and cytokine production (Haddad et al., 2002). Much work has been done investigating the effects of exercise and heat stress on the immune-endocrine system whereas little is known regarding the effects of exercise and cold. Therefore, this study examined the effects of combined exercise and cold exposures on cytokine and immune-endocrine functions. Methods Nine healthy males with normal body weight, dressed in shorts and t-shirts, completed 6 exercise trials on separate days. They walked or ran (50% and 70% of maximal oxygen consumption (VO<sub>2</sub>max), for 60-min on a treadmill in a climatic chamber set at 22°C (Neutral, NT), 0°C (Cold, CD), or at 0°C following a low-intensity shivering cooling period (Cold-Shivering, CS). Leukocyte counts and subsets, catecholamines (epinephrine and norepinephrine), ACTH, cortisol, and cytokines were measured pre and post exercise. Results Leukocyte and granulocyte counts increased during exercise and were greater at 70% VO<sub>2</sub>max. Lymphocyte and monocyte counts were greater in NT compared to CD at post. ACTH and cortisol increased in NT and at 70% VO<sub>2</sub>max but remained unchanged in CD, CS and at 50% VO<sub>2</sub>max. Norepinephrine was also greater in NT and at 70% VO<sub>2</sub>max. Regarding cytokines, IL-1b, IL-7, IL-13, IP-10, MCP-1, MIP-1b, PDGF-bb, RANTES, VEGF, and IFN-g concentrations were greater in NT compared to CD (p < 0.05). Greater concentrations of IL-1b, IL-10, IL-13, MIP-1b, PDGF-bb, VEGF, and IFN-g were observed at 70% compared to 50% VO<sub>2</sub>max (p < 0.05). Finally, IL-1b, IL-13 and PDGF-bb concentrations were greater in CS as compared to CD (p < 0.05). Discussion During exercise, the immune and endocrine systems responded more strongly in the neutral ambient temperature indicating an immuno-suppressive effect from the cold. Exercise intensity also affected the endocrine-immune response as the 70% VO<sub>2</sub>max condition induced stronger cytokine and hormonal responses. Shivering in the cold also produced a stimulatory immune response compared to cold alone. In conclusion, exercising in a cold environment without the simultaneous presence of shivering suppresses immune-endocrine responses associated with exercise and heat stress during low and moderate exercise intensities. References Haddad JJ, et al. (2002) *J Neuroimmunol* 133, 1-19

### **ENDURANCE TRAINING AND INSULIN THERAPY ARE BOTH REQUIRED TO OBTAIN THE FULL THERAPEUTIC BENEFIT ON OXIDANT STRESS AND GLYCEMIC REGULATION IN DIABETIC RATS**

Groussard, C., Malarde, L., Le Douairon-Lahaye, S., Zguira, M.S., Vincent, S., Lemoine-Morel, S., Gratas-Delamarche, A.

*M2S Laboratory (Rennes, France).*

**Introduction** In type 1 diabetic subjects, hyperglycaemia-induced oxidant stress (OS) is a central mechanism in the onset and development of diabetic complications (Brownlee 2001). This study aimed to assess the effects of an endurance training program and insulin therapy,

alone or in combination, on glycaemic regulation, oxidant stress markers, and the antioxidant system in diabetic rats. Methods Forty male Wistar rats were divided into diabetic (D), insulin-treated diabetic (D-Ins), diabetic trained (D-Tr), or insulin-treated diabetic trained (D-Ins+Tr) groups. An additional healthy group served as a control group. Insulin therapy (Lantus, insulin glargine, Sanofi) and endurance training (a treadmill run of 60 min/day, 25 m/min, 5 days/week) began one week after diabetes induction by streptozotocine (45 mg/kg) and continued for 8 weeks. At the end of the protocol, blood glycaemia and fructosamine levels were evaluated, and skeletal muscle OS markers (CML, isoprostanes, GSH/GSSG) and the antioxidant system (SOD and GPx activity, ORAC) were measured. Results Diabetic rats exhibited altered glycaemic regulation and higher OS markers but no antioxidant system modifications. Insulin treatment improved the pro-antioxidant status and fructosamine levels but failed to correct glycaemia. Endurance training decreased OS markers without improving antioxidant enzyme activity. Endurance training and insulin therapy in combination extended insulin action, leading to decreased glycaemia in the D-Ins+Tr group. Moreover, endurance training, when associated with insulin treatment, exerted antioxidant effect by increasing SOD activity. Conclusion Our results demonstrate that a combination of insulin treatment and endurance training potentiates their respective effects on glycaemic regulation and oxidant status. References Brownlee M. *Nature* (2001). 414:813-20

## CYTOKINE RELEASE FOLLOWING CONTINUOUS AND INTERVAL EXERCISE OF CONTRASTING VOLUME

Cullen, T., Thomas, A., Webb, R., Hughes, M.

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**Introduction** The cytokines interleukin-6 (IL-6) and interleukin-10 (IL-10) are known to play a role in metabolism and immune function during periods of stress. The responses of these cytokines have been well characterized in the context of long duration aerobic exercise (Petersen and Pedersen 2005). However responses to shorter, high intensity interval training (HIT) remains unknown. The aim of the current study was to characterize the response of the cytokines IL-6 and IL-10 to high intensity interval exercise, and to evaluate the sensitivity of these measures to variations in exercise intensity. **Methods** Five male and five females (mean SD  $VO_{2peak} = 49.1 \pm 4.5$  ml kg<sup>-1</sup> min<sup>-1</sup>) completed three exercise tests on a cycle ergometer: LOW (35 min, 50%  $VO_{2peak}$ ), MODERATE (5 X 2 min, 80%  $VO_{2peak}$  interspersed with 5 min relative recovery at 50%  $VO_{2peak}$ ) and HIGH (5 x 4 min, 80%  $VO_{2peak}$  interspersed with 3 min relative recovery at 50%  $VO_{2peak}$ ). Exercise tests were performed in a randomized and counterbalanced order with each test separated by a minimum of three days. IL-6 and IL-10 concentration were determined from blood samples taken pre and immediately post exercise. **Results** The average oxygen uptake during each bout was  $50.4 \pm 4.6\%$   $VO_{2peak}$  (LOW),  $59.3 \pm 3.1\%$   $VO_{2peak}$  (MODERATE) and  $69.2 \pm 2.2\%$   $VO_{2peak}$  (HIGH). The end test blood lactate was  $1.4 \pm 0.6$  mmol (LOW),  $3.0 \pm 1.4$  mmol (MODERATE) and  $5.8 \pm 3.2$  mmol (HIGH). Compared to pre-exercise IL-6 increased significantly in all 3 conditions: 1.4±0.32 fold (P<0.01) (LOW), 1.95±0.80 fold (P<0.01) (MODERATE), 2.7±1.51 fold (P<0.01)(HIGH). The increase in IL-6 was significantly greater in the HIGH protocol than the LOW protocol (P=0.04), and showed a trend towards significance when compared to the protocol MODERATE (P=0.11). IL-10 showed no significant change from pre to post in any of the exercise protocols. **Discussion** This study demonstrates that IL-6 release is sensitive to short duration aerobic exercise lasting 35 minutes and that the response to HIT style exercise (HIGH) is greater than that of steady state moderate intensity exercise. It is possible that with a larger sample size a statistically significant difference would have been observed between the MODERATE and HIGH protocols. While previous studies have shown that IL-10 does increase as a result of longer durations of exercise (Cox et al., 2007) this study suggests that IL-10 is not sensitive to exercise intensity during exercise lasting 35 minutes. References Petersen AM, Pedersen BK. *J Appl Physiol*. 2005 Apr;98(4):1154-62. Review. Cox AJ, Pyne DB, Saunders PU, Callister R, Gleeson M. *Med Sci Sports Exerc*. 2007 Nov;39(11):1918-26.

## 15:00 - 16:00

### Mini-Orals

#### PP-PM42 Physiology [PH] 9

#### THE IMPACT OF PARACETAMOL ON THERMOREGULATORY RESPONSES DURING EXERCISE

Veltmeijer, M.T.W.1, Eijsvogels, T.M.H.1,3, Netea, M.G.2, Van der Meer, J.W.M.2, Hopman, M.T.E.1

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**INTRODUCTION** Exercise typically results in elevation of core body temperature (CBT), which may lead to a decreased exercise performance and/or the development of heat-related illnesses. While the role of inflammatory cytokines in the induction of fever is clearly established, their pyrogenic effect during exercise has not been studied extensively. The aim of this study was to examine whether exercise leads to upregulation of the hypothalamic set-point by the production of inflammatory mediator prostaglandin E2 (PGE2) based on an increased release of interleukin-6 (IL-6). We hypothesized that blocking PGE2 production with paracetamol would result in a lower CBT during exercise compared to the use of a placebo. **METHODS** A randomized double-blind cross-over design was applied in which 11 healthy subjects (52±5 years, BMI 25.2±2.6) were administered 1000 mg paracetamol or placebo on two separate days. After 30 minutes of rest, subjects performed 30 minutes of continuous treadmill exercise with speed adjusted to maintain 85% of their maximal heart rate. Subsequently, subjects continued with 30 min of intermittent exercise keeping running speed constant and alternating 2 minutes of running at a 10% incline and 2 minutes at a 0% incline. IL-6 plasma levels were determined from venous blood samples drawn immediately before and after the test. CBT was measured continuously using a wireless telemetry system. **RESULTS** Running speed did not differ between the paracetamol (8.4±0.7 km/h) and placebo (8.6±0.5 km/h) condition (p=0.07). Baseline IL-6 levels were similar (4.1±3.6 vs. 3.8±1.9 pg/mL, p=0.68), increased significantly (p=0.03), and were similar in both conditions post-exercise (5.2±4.4 vs. 5.3±3.4 pg/mL, p=0.86). Baseline CBT did not differ between the paracetamol (37.0±0.3 °C) and placebo (37.1±0.3 °C) condition (p=0.29), and increased significantly in all subjects (p<0.001). Although the course of CBT increase during exercise was not different between the conditions (p=0.10), peak CBT was slightly but significantly lower in the paracetamol (38.9±0.4 °C) compared to the placebo (39.1±0.4 °C) condition (p=0.04). **CONCLUSION** The significant rise of plasma IL-6 demonstrates a similar stimulus for PGE2 production in both conditions. Interestingly, we found a significantly lower peak CBT after administration of paracetamol, indicating that part of the elevated CBT during exercise is due to PGE2 release. These results suggest that the exercise-induced elevation in CBT may be partially due to an upward shift of the hypothalamic set-point, with the remainder of the temperature rise being caused by a hyperthermic response.

### EFFECTS OF TIME OF DAY ON REPEATED SPRINT ABILITY ON A NON-MOTORISED TREADMILL.

Pullinger, S.A., Brocklehurst, E., Iveson, R., Waterhouse, J.M., Burniston, J., Doran, D., Edwards, B.J.

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Time-of-day differences in short-term anaerobic sprint performance (<6s) in trained males have been well established, with improved performance evident in the evening (Racinais et al., 2004; Souissi et al., 2004). This diurnal variation is attributed to motivational, peripheral and central factors, and possibly higher core and muscle temperatures observed in the evening (Edwards et al., 2013). What has received little attention is the possible diurnal variation in repeated sprint ability (RSA) a fundamental variable in team-sports games. The purpose of the present study was to investigate whether, in team-sport trained subjects, a daily variation in RSA (assessed on a non-motorised treadmill) exists. Sixteen healthy active males (mean  $\pm$  SD: age, 20.8  $\pm$  2.2 yrs; body mass, 78.7  $\pm$  10.5 kg; height, 1.78  $\pm$  0.6 m) completed the study, which was approved by the local University Ethics Committee. The subjects were familiarized with the techniques and protocol and then completed two experiment sessions (separated by at least 48h) counterbalanced in order of administration: morning (07:30h) and evening (17:30h) sessions. Rectal (T<sub>rec</sub>) and muscle (T<sub>m</sub>) temperatures were measured after the subjects had re-learned for 30min at the start of the protocol and during a 5-min active warm-up at 10km.h<sup>-1</sup>. Each session comprised of 3 task-specific warm-up sprints at 50, 70 and 80% maximum and 10 x 3s sprints with 30s recovery between each of them, performed on a non-motorised treadmill (Woodway Force 3.0, Waukesha, WI, USA). Distance covered (m), peak power output (W), average power output (W), peak velocity (km.h<sup>-1</sup>) and average velocity (km.h<sup>-1</sup>) were measured in all sprints. Heart rate (HR), thermal comfort (TC), rating of perceived exertion (RPE) and effort (on a 0-10 scale: 0 meaning no effort and 10 maximal effort) were recorded throughout. Data were analysed using General Linear Models with repeated measures. Resting T<sub>rec</sub> and T<sub>m</sub> values were higher at rest in the evening than in the morning (by 0.44°C and 0.47°C respectively,  $p < .05$ ). Total distance covered, peak power, average power, peak velocity and average velocity over the ten sprints all showed significantly higher values in the evening compared to the morning (an average range of 3.2-7.6%,  $p < .05$  in all cases). All subjects reported maximal values for RPE for each sprint. In summary, in this population of motivated subjects, effects of time of day were seen in all measures of RSA indicative of performance, in general agreement with past research. Both T<sub>rec</sub> and T<sub>m</sub> values also showed significant diurnal variation. This diurnal variation in RSA could potentially be attributed to a combination of motivational, peripheral and central factors, as well as the higher rectal and muscle temperatures observed in the evening. Key words: Rectal and Muscle temperature, RSA, diurnal variation.

### THE EFFECT OF EXTREME ENVIRONMENTAL CONDITIONS ON THE DECISION MAKING PERFORMANCE OF ON FIELD REFEREES AND GOAL LINE OFFICIALS

Watkins, S.1, Fitch, N.1, Aldous, J.1, Mauger, A.R.2, Castle, P.1, Brewer, J.1, Taylor, L.1

1. University of Bedfordshire, UK, 2. University of Kent, UK

Introduction UEFA cup competitions are international in nature and as a result are played in a diverse set of climatic conditions, eg Moscow (-5 oC) and Madrid (+30 oC). It is currently unknown how these environmental conditions impact the decision making ability of on-field soccer referees (REF) and soccer goal line officials (GLO) and how such conditions combine with the differing movement patterns of REF and GLO. Methods 24 physically active males were randomly split into 2 groups (n=12), group 1: REF; group 2: GLO. Both groups were exposed to 3 environmental conditions: cold (-5 oC, 50%RH); temperate (18 oC, 50%RH); hot (30 oC, 50%RH) for 90 min with a 15 min half time break following 45 min exposure. Throughout 90 min exposure REF carried out an intermittent sprint protocol (Drust, Reilly et al. 2000) where as GLO were allowed only small lateral movements. Decision making performance was assessed using the PSYCHE software package (Vigilance and Dual Task) (Hope, Woolman et al. 1998). Traditional environmental physiology measures were also recorded (Rectal and Skin temperature, Heart rate, Thermal Sensation). Results reported as percentages of change and qualitative interpretations of effect size. Results 1st 45 min Exposure: REF negative responses during the dual task increased by 33% in the heat compared to temperate (ES: 0.8, Large). Negative responses of GLO increased during cold exposure when compared to temperate by 86% during the vigilance task (ES: 3.2, Large) and 94% in the dual task (ES: 1.2, Large) when compared to temperate condition. 2nd 45 min Exposure: The negative responses of REF increased by 17% in the heat compared to temperate for both vigilance and dual tasks. GLO negative responses increased by 90% during the vigilance task and 69% during the dual task when compared to scores in temperate conditions. Discussion A greater number of errors in decision making were observed in GLO in-line with reductions in endogenous temperatures and thermal comfort when exposed to cold. In contrast, heat exposure induced an increase in REF endogenous temperatures leading to reductions in thermal comfort and decision making performance. Such findings may have implications on the use of GLO in future tournaments and the implementation of goal line technology. References Drust, B., T. Reilly, et al. (2000). 'Physiological responses to laboratory-based soccer-specific intermittent and continuous exercise.' *Journal of Sports Sciences* 18(11): 885-892. Hope, A., P. Woolman, et al. (1998). 'A system for psychomotor evaluation; design, implementation and practice effects in volunteers.' *Anaesthesia* 53(6): 545-550.

### INFLUENCE OF COMPETITION ON PERFORMANCE AND THERMOREGULATION DURING EXERCISE IN THE HEAT

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Introduction It is suggested that the reduced power during self-paced exercise in the heat represents a form of behavioural thermoregulation to avoid a critical rise in body temperature (Marino, 2004). However, it has recently been shown that performance is improved when participants believe they are competing against another athlete compared to exercise alone (Corbett et al., 2011), although this study used short duration exercise in temperate conditions. The present study examined the effect of competition on performance and thermoregulation during prolonged exercise in a hot environment. Method Six physically active males undertook a 20 km preliminary cycling time trial (TT) (15°C, 50% R.H.) and three 20 km experimental TTs in a balanced order: (15°C & 50% R.H [15SOLO]; 30°C & 50% R.H [30SOLO]; 30°C & 50% RH 'head to head' competition [30HH]). During 'solo' trials an avatar of the participant cycling on a virtual 20 km course (constructed with Velotron 3D software) was displayed enabling them to gauge their progress. During HH competitions participants were separated by a screen and avatars of both were generated on the racecourse, although the competitor performance was actually generated by the software using the preliminary trial data obtained under cooler conditions; the participants were not aware of this deception. Performance times and aural temperature (T<sub>aural</sub>) were recorded. For safety, trials were terminated if T<sub>aural</sub> >39°C. Where this occurred the shortest distance completed before termination in any trial was defined as the 'endpoint' across all trials for that participant. Repeated measures ANOVA and post-hoc T-tests were used to examine between-trials differences. Results Endpoint times were 2097 $\pm$ 381 s, 2125 $\pm$ 384 s, and 2059 $\pm$ 396 s for 15SOLO, 30SOLO and 30HH, respectively. Endpoint times for 30HH were faster than

either 15SOLO or 30SOLO ( $P < 0.05$ ). Endpoint Taural was  $37.2 \pm 0.4^\circ\text{C}$ ,  $38.1 \pm 0.5^\circ\text{C}$ ,  $38.5 \pm 0.3^\circ\text{C}$  for 15SOLO, 30SOLO and 30HH and was different between all conditions ( $P < 0.05$ ). Discussion Performance was improved in HH competition in hot conditions relative to the same exercise performed alone in the same ambient conditions, or performed alone under cooler conditions. The higher Taural in 30HH indicates that HH competition may encourage participants to override thermal cues which might otherwise be used to regulate performance, although this hypothesis requires further investigation given that performance was not significantly impaired in 30SOLO relative to 15SOLO. The improved performance in HH competition in a warm environment is consistent with the concept of a physiologic reserve (Corbett et al., 2011). References Corbett J, Barwood MJ, Ouzounoglou A, Thelwell R, Dicks M. (2011). *Med Sci Sport Exerc*, 44(3), 509-515. Marino F. (2004). *Comp Biochem Physiol B Biochem Mol Biol*, 139(4), 561-9.

### TRAINING WITH HEAT DISSIPATION COMPRESSIVE T-SHIRT: THERMOREGULATORY AND CARDIOVASCULAR EFFECTS.

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Introduction: It is well known that hyperthermia causes fatigue, in other words, endurance can be impaired in hot compared with temperate climates (1,2). To prevent hyperthermia some of the strategies that have been used over the years are rehydration and ventilation (3). Nowadays new strategies as cooling vest or heat dissipation clothes are becoming important to prevent heat stroke. One of these strategies, heat dissipation compressive T-shirt (X-Bionic Energy Accumulator) is the one we use in this research. The aim of this study was to know the utility of the heat dissipation clothing, to prevent hyperthermia during moderate intensity training. Methods: 16 subjects were recruited for this study. All the subjects performed two randomized protocols separated each other by a minimum of 7 days: Control group (Control) and compressive T-shirt (experimental). They exercised at 60% of maximum oxygen consumption ( $\text{VO}_2\text{max}$ ) on a cycle ergometer for 30 min maintaining the same cadency in a thermoneutral environment ( $25^\circ\text{C}$ ) (4). Skin (Thermocouple), rectal (YSI), tympanic and forehead temperature were measured every 5 minutes. HR,  $\text{VO}_2/\text{VCO}_2$  (Vacumed) and body weight were also measured. Results: 1. Weight Loss: Control vs. experimental ( $0.36 \pm 0.2$  vs.  $0.24 \pm 0.2$  L)  $P < 0.05$ . It shows that compressive T-shirt allows you to lose less body fluid. 2. Heart Rate: Control vs. experimental at min. 30 ( $147.1 \pm 21$  bpm vs.  $143.6 \pm 25.6$  bpm)  $P = 0.07$ . HR is reduced at the end of the protocol wearing compressive T-shirt. 3.  $\text{VO}_2$ : Control vs. experimental at min. 30 ( $2.2 \pm 21$  L/min vs.  $1.8 \pm 25.6$  L/min)  $P > 0.05$ . Data shows tendency to reduce  $\text{VO}_2$  during experimental protocol. 4. Skin Temperature: Control vs. experimental at min. 30 ( $32.9 \pm 0.5^\circ\text{C}$  vs.  $33.8 \pm 1.6^\circ\text{C}$ )  $P > 0.05$ . Result shows tendency to increase skin temperature when wearing compressive T-shirt. 5. Rectal Temperature: Control vs. experimental at min. 30 ( $38.2 \pm 0.6^\circ\text{C}$  vs.  $37.9 \pm 0.5^\circ\text{C}$ )  $P > 0.05$ . Result shows tendency to reduce rectal temperature when wearing compressive T-shirt. Discussion: Heat dissipation compressive T-shirt allows you to prevent dehydration, reducing HR, which is reflected in the same way in a smaller aerobic necessity. At the same time, this clothing reduces the increase of rectal temperature, probably due to a better heat dissipation of temperature through the skin, considering that plasma volume might not be so reduce. References: 1. Burdon, C. (2013). Effect of drink temperature on core temperature and endurance cycling performance in warm, humid conditions. 2. Gonzalez-Alonso, J. (1999). Influence of body temperature on the development of fatigue during prolonged exercise in the heat. 3. Mora-Rodriguez, R. (2007). Separate and combined effects of airflow and rehydration during exercise in the heat. 4. Mora-Rodriguez, R. (2010). Aerobically trained individuals have greater increases in rectal temperature than untrained ones during exercise in the heat at similar relative intensities.

### THERMOREGULATION AND TEMPERATURE PERCEPTION IN SUBJECTS SUBMITTED TO 30-HOURS OF EXERCISE AND SLEEP DEPRIVATION

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Introduction Participants of outdoor ultra-endurance events lasting more than 24 hours often perceive temperature inadequately in latter stages of exercise. Thus, the aim of the present study was to compare the core temperature and temperature perception in subjects submitted to prolonged exercise combined with complete sleep deprivation. Methods Core temperature was measured with a single use, swallowed sensor (Vital Sense, USA) in ambient temperature of  $19^\circ\text{C}$  at rest for 30 min and during graded exercise test to exhaustion in 11 endurance trained men before (B) and immediately after (A) 30 hours of prolonged exercise (simulated adventure race) combined with complete sleep deprivation. Perception of temperature was evaluated using a 6 grade ASHRAE thermal sensation scale. Subjects were dressed in standardized, single layer of cycling shorts and T-shirt. Results Core temperature increased during rest period already in 10th min and remained elevated for 30 min in both trials (trial B from  $36.96 \pm 0.04^\circ\text{C}$  to  $37.07 \pm 0.05^\circ\text{C}$  in 10th min ( $p < 0.05$ ) and to  $37.14 \pm 0.06^\circ\text{C}$  in 30th min ( $p < 0.01$ ); trial A from  $36.99 \pm 0.06^\circ\text{C}$  to  $37.08 \pm 0.06^\circ\text{C}$  in 10th min ( $p < 0.05$ ) and to  $37.18 \pm 0.08^\circ\text{C}$  in 30th min ( $p < 0.01$ )). There were no differences in core temperature between trials B and A. Perception of temperature was significantly "colder" in trial A than B ( $-1.7 \pm 0.2$  vs.  $-1.0 \pm 0.2$ ,  $p < 0.001$ ). Exercise induced increase in core temperature and maximal temperature at exhaustion were similar in both trials B and A. Discussion Sitting in thin clothes in ambient temperature below comfort stimulates cold receptors on the skin surface leading to induced thermogenesis and limited skin blood flow. Therefore, in moderately cold environment enhanced heat production and decreased heat loss can produce increase in core temperature, what probably have happened in both experimental trials. Definitely different perception of temperature after prolonged exercise and sleep deprivation may reflect the impaired function of overstrained nervous system, probably in cortex, whereas rear part of hypothalamus governing maintenance of the heat functions correctly. Thermoregulation during exercise worked properly, as it is handled by hypothalamus with simple reflexes.

### EFFECTS OF A HOT AND HUMID ENVIRONMENT ON DRUMMING PERFORMANCE – A CASE STUDY.

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Hot and humid environments have been shown to impair health and performance in military (Adolph et al., 1947), occupation (Wilkinson et al., 2007) and sport (Chan et al., 2008) settings. Anecdotal evidence from professional drummers report heat stress when performing at hot and humid venues [personal communications: Clem Burke, drummer Blondie (2011) and Mark Richardson, drummer Skunk Anansie (2012)]. The aim of this study was to investigate the thermal challenge of drumming during a live performance at an indoor venue. The participant was a volunteer professional drummer (punk rock band UKSUBS: 27yr, 1.80m and 76.5kg). All data acquisition took place at the 100 Club (London, UK). Environmental temperature ( $^{\circ}\text{C}$ ) and relative humidity (%) were measured using a USB sensor and

data logger (Lasca EL USB2+, Lasca Electronics Ltd, Salisbury, UK). Core temperature was measured using a gastrointestinal pill (HQ Inc, Palmetto, USA) consumed 3hr prior to the performance. Body mass was recorded pre- and post-concert to estimate sweat rate (Seca 880 scales, Birmingham, UK). Heart rate was measured using short-range telemetry (Polar S810i, Kempele, Finland). The concert lasted 62min, comprising 22 songs. During the concert air temperature increased from 25 to 34°C and relative humidity from 68 to 84%. Body mass decreased by 2.6%, equating to a sweat rate response of 2.0L.hr<sup>-1</sup>. Peak core temperature increased from 37.4°C at baseline to 39.0°C after 30min, when 500ml of chilled water was consumed. Heart rate ranged between 115-208b.min<sup>-1</sup> with an average for the whole performance of 195b.min<sup>-1</sup>. It is evident from the data that small indoor venues pose a significant thermal challenge to the drummer. Therefore, drummers should adopt an appropriate fluid replacement strategy to reduce the risk of impaired performance and health.

### **A COMPARATIVE STUDY OF TOTAL SWEAT LOSS , BODY TEMPERATURE AND SWEAT CONCENTRATIONS OF AFTER EXERCISE OF TRAINED AND UNTRAINED ADULTS <18-20> YEARS OLD.**

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Introduction Eccrine sweat glands play a clear and vital role in our ability to survive heat stress and maintain remarkably constant homeothermic conditions under thermal loads (Quinton PM 1983) , on the other hand the physical loads are playing an important role for sweat secretion and they regulated the active of cells, physiological systems and glands especially in sweat glands which result to physiological adaptations to exercise and improving the ability of the athletes for exercised in a hot environment and decrease the injury risk of many heat disease methode Six Male well-trained athletes from different sport events, (age 19.1 ± 4.6 years; mass 76.4 ± 6.9 kg; peak oxygen consumption 5.10 ± 0.85 l min<sup>-1</sup>; mean ± s.d first exercise a continuous (75)watts at (10) minutes after (5) minutes for worm up and second exercise a continuous (100) watts at (8) minutes at 30°C (50% relative humidity) . Results sweat concentrations and body temperature were generally greater, at the first exercise: total sweat loss(0.22 ±0.139),( 0.685±0.268) (p<0.01)respectively, body temperature difference (1.97 ±0.456) ( 1.4±0.26) (p<0.05) respectively and sweating concentrations of phosphate(1.935±0.441)(3.94±0.625) respectively (p<0.01) , sodium (93.24±4.634)(71.553±2.436)(p<0.01) and chloride(37.53±3.547)(22.834±6.677) (p<0.01) respectively during trained group compared to the untrained group, and the second exercise : total sweat loss(0.20 ±0.805),( 0.60±0.171) (p<0.01)respectively, body temperature difference (1.93 ±0.36) ( 1.52±0.43) (p<0.05) respectively and sweating concentrations of phosphate (1.721±0.214) (3.45±0.752) respectively (p<0.01) , sodium (87.34±2.511) (64.942±2.732) (p<0.01) and chloride (47.22±2.87) (20.655±4.330) (p<0.01) respectively during trained group compared to the untrained group Discussion The sweat phosphate concentration was decreased in the trained group compared to the untrained group because of the role of physical training which enhances the decrease of sweat phosphate to rise the function of sweat glands to product high energy compounds inside the sweat glands tissues (fadhel k. mathkor 1997 ) .the same result has been shown for sodium and chloride concentrations in the trained group compared to the untrained group these results are agree with the (fadhel k. mathkor 1997; fukumoto T. et. al 1988; Kirk , JM. 1992; Michal E. Bergeron 1995. Knowledge of sweat production might also be valuable specially when comparison of these data showed that the sweat ions may be as indicated to comparative between trained and untrained group and should take the concentration of sweat such as sodium

### **INFLUENCE OF PASSIVE HYPERTHERMIA ON ARM CRANKING ENDURANCE CAPACITY AND ISOKINETIC TORQUE OF EXERCISED AND NON-EXERCISED MUSCLE GROUPS**

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Introduction: It has been reported that hyperthermia elicits the reduction in isometric force production in the exercised and non-exercised limb following cycling exercise. However, the effects of hyperthermia on arm cranking endurance capacity and isokinetic force production of exercised and non-exercised muscles following arm-crank exercise are poorly understood. The aim of this study was to examine the effect of passive hyperthermia on arm cranking endurance capacity and isokinetic torque of exercised (elbow flexors) and non-exercised (knee extensors) muscle groups. Methods: Eight healthy males were immersed to the upper chest in water at 36 degrees C (control) or 40 degrees C (hyperthermia) for 30 min, and then exercised on an arm cranking ergometer at 60% of maximal oxygen uptake until voluntary exhaustion in a 25 degrees C and 50%RH environment. Pre- and post-immersion and immediately following the exercise, subjects performed two series of isokinetic shortening and lengthening maximal voluntary contractions (MVCs) of the elbow flexors and knee extensors: one series of single MVCs and one series of 25 endurance MVCs. Electromyography (EMG) was recorded with surface electrodes over the biceps brachii and vastus lateralis during isokinetic MVCs. Rectal temperature, skin temperature, heart rate, skin blood flow and blood pressure were recorded at rest and during exercise. Results: Rectal temperature at the end of immersion was 37.1 ± 0.3 degrees C (± SD) and 38.1 ± 0.3 degrees C in the control and hyperthermia trials, respectively. During arm-crank exercise, time to exhaustion was less in the hyperthermia trial than in the control trial (control 52 ± 12 min; hyperthermia 41 ± 13 min, P < 0.01). There was no difference in rectal temperature at exhaustion between trials (control 37.7 ± 0.3 degrees C; hyperthermia 37.8 ± 0.4 degrees C). At post-immersion, peak torque for shortening single MVC of the elbow flexors (control 56.4 ± 13.1 Nm; hyperthermia 42.1 ± 7.1 Nm, P < 0.01) and integrated EMG at biceps brachii (control 79.7 ± 18.9%; hyperthermia 57.7 ± 9.2%, P < 0.05) were lower in the hyperthermia trial than in the control trial. Conclusion: This study demonstrates that passive hyperthermia elicits significant reductions in arm cranking endurance capacity and isokinetic torque for shortening single MVC of the elbow flexors. This decrement in isokinetic elbow flexion torque is accompanied by a lower integrated EMG. However, no statistically differences in isokinetic torque of exercised and non-exercised muscle groups following arm-crank exercise are apparent between trials.

### **DO WELL-TRAINED ENDURANCE ATHLETES BENEFIT FROM A FABRIC WITH IMPROVED EVAPORATIVE PROPERTIES?**

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*University of Wuppertal*

Introduction While thermoregulation can limit performance when exercising in the heat clothing itself presents a layer of insulation thereby impeding heat dissipation (Gavin 2003, Sports Med). It was shown, that synthetic fabrics have higher moisture transfer capacities in comparison to cotton thereby retaining less moisture and diminishing the rise in body temperature and humidity during submaximal exercise in untrained individuals (Dai et al. 2008, Eur J Appl Physiol). Therefore, we hypothesised that wearing shirts made of a synthetic

fabric with improved evaporative properties would reduced body temperature, humidity, cardio-respiratory and metabolic strain thereby improving performance in well-trained endurance athletes. Methods 6 male, well-trained endurance athletes volunteered for this study ( $71.7 \pm 5.4$  kg,  $177 \pm 6$  cm,  $9.5 \pm 2.9\%$ ,  $62.0 \pm 4.0$  ml/min/kg). The exercise protocol consisted of a submaximal running effort for 30min running at 70% of  $VO_{2peak}$  followed by a ramp test to voluntary exhaustion and a recovery period of 10min walking. All participants performed two trials in a climatic chamber ( $30.3 \pm 0.7^{\circ}\text{C}$ ,  $36.4 \pm 9.1\%$  RH,  $1.0$  m/s air flow) wearing a synthetic fabric (91% polyester, 9% lycra) and a cotton shirt in a randomized order. During the trials  $VO_2$ , VE, and HR were measured continuously with an open breath-by-breath analyzer (ZANN600, Oberthulba, Germany). Body temperature and humidity was determined using adhesive temperature sensors, an ingestible sensor pill (Mini Mitter Co., Inc., Bend, OR) and humidity sensors (MSR, Glatfbrugg, Switzerland). Capillary blood samples were taken in 5min intervals and analysed using amperometric-enzymatic determination of lactate (Eppendorf, Hamburg, Germany). At the same time points the subjects rated their perceived exertion (BORG's scale) and sensation of humidity on a 4-point likert scale from 1 (dry) to 4 (wet). Results While changes in body mass were unaffected ( $p=0.17$ ), gain in shirt mass was lower in the synthetic fabric ( $p<0.01$ ). During recovery, the synthetic fabric reduced core ( $p<0.01$ ) and skin temperature ( $p=0.02$ ). Humidity between shirt and skin was reduced during all three time points at the chest ( $p\leq 0.04$ ) and back ( $p\leq 0.01$ ). Cardio-respiratory and metabolic measures ( $p\geq 0.20$ ) as well as perceived exertion remained unchanged ( $p\geq 0.46$ ). Sensation of humidity was reduced during recovery only ( $p=0.04$ ). Although thermoregulation was improved, statistical analysis did not reveal any improvements in performance of well-trained endurance athletes due to the synthetic fabric ( $p=0.28$ ). Discussion & Conclusion Under hot environmental conditions, thermoregulation was improved due to a synthetic fabric in well-trained endurance athletes. However, performance was unaffected.

### IMPAIRED COGNITIVE FUNCTION FOLLOWING MATCH-PLAY TENNIS IN THE HEAT

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Introduction Success in match-play tennis requires both physical strength and the mental capacity to anticipate, react and make split second decisions. During matches, the repetition of high-intensity efforts over several hours leads to the development of fatigue, which is manifested by alterations in neuromuscular function. However, it remains unknown whether match-play tennis results in impaired cognitive function and the extent to which this may be exacerbated by playing in a hot environment, or influenced by hydration status. Methods Eleven competitive male tennis players (ITF rank 2-3) undertook three matches separated by 72 hrs. Each match consisted of 20 min of effective play, separated in two 10 min segments. One match was played in a control, temperature environment (CON:  $22^{\circ}\text{C}$  and 70% RH) and the remaining two were played in hot environments ( $\sim 36^{\circ}\text{C}$  and 35% RH); Based on the first match in the heat (HOT), an individualized hydration regimen was developed and implemented during the second match (HYD). Executive function (OTS with 2 level of complexity: OTS-4 and OTS-6), sustained attention (RVP, Rapid Visual Processing), and reaction time (CRT, Choice Reaction Time) were assessed before (PRE) and after (POST) match-play using the Cambridge Neuropsychological Test Automated Battery (CANTAB). Results OTS: the overall mean latency to first response was significantly shorter after match play (PRE: 10.9s, POST: 9.3s,  $p=0.02$ ). The overall mean latency to correct response was significantly shorter after match play (PRE: 11.6s, POST: 9.9s,  $p=0.01$ ), and the complex task (PRE: 34.5, POST: 26.3,  $p=0.01$ ), but not the simple task (PRE: 7.3, POST: 6.0,  $p=0.11$ ). There was a main effect of condition on the number of correct problems solved (range 0-4) on the complex task only (CON: 3.5, HOT: 2.8, HYD: 3.2; pair-wise comparisons were: HOT vs. HYD ( $p=0.01$ ), HOT vs. CON ( $p=0.03$ ), and HYD vs. CON ( $p=0.13$ ). There were no significant main effects on all measures of RVP and CRT. Discussion This study demonstrates a paradoxical effect of match-play tennis in the heat on cognitive function. While athletes had faster response rates and no change in simple cognitive function, complex cognitive function was impaired after match-play in the heat. Further research is needed to confirm whether an individualized hydration strategy attenuates cognitive impairment after match-play tennis in the heat.

### EVALUATION OF THE MUSCLE ARCHITECTURE OF THE RAT GASTROCNEMIUS MUSCLE AFTER AEROBIC TRAINING

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*University of Coimbra*

Do not insert authors here Introduction Human activity requires a movement or at least a muscle contraction, either for walking or running or other functions. This enormous diversity of muscle functions is reflected by its size and shapes. The maintenance of skeletal muscle architecture is essential for its contraction and performance. One of the parameters that is considered in the muscle architecture is the pennation angle. In pennate muscle the fiber are obliquely inserted into the tendon or in the deep aponeurosis, and because this arrangement is termed pennate. In this type of muscles the fibers are shorter than those in a fusiform belly, because they pull on the tendon or aponeuroses at an certain angle. The force developed by this muscles, which depends on the cross sectional area of all fibers, is increase proportionately. In previous works we demonstrated that aerobic exercise changes skeletal muscle fiber type that changes the skeletal muscle architecture. Thus, the aim of this study was to investigate the alterations in muscle architecture with aerobic exercise. Methods To perform this work an exercise animal model was used. All the animals' experiments and treatments were in agreement with the national and international guidelines regarding the experimental use of animals. Eighteen male Wistar adults' rats ( $\sim 250$  g) were used. The animals were divided in two groups: a control and an exercise group. The exercise group performed an aerobic training for 8 weeks in a treadmill. At the end of this period the training efficiency was assessed by a resistance/velocity test. After training, an ultrasound analysis of the medial gastrocnemius muscle was taken (GE, Hologic E; 12 MHz transducer). The evaluation of the gastrocnemius was based in the measurements of the pennate angle, between the deep aponeuroses and the fascicle of the muscle. Then, the medial gastrocnemius muscle, laterally and in its antero-posterior face, was measured with a caliper rule. The gastrocnemius muscle was removed, weighted and stored for further analyses. Results The exercise group under aerobic training for 8 weeks showed a good performance. Concerning muscle architecture parameters no changes were observed in the pennation angle, muscle weight or on the thickness of the muscle. Moreover, no changes were observed in the ultrasound analysis of muscle measurements. Discussion Our results showed no changes in muscle architecture despite the slight change in fiber type and increase in performance. These findings suggest that aerobic training for eight weeks increases muscle rats performance without changing gastrocnemius architecture.

15:00 - 16:00

## Mini-Orals

## PP-PM48 Physiology [PH] 15

**CONFIGURATIONS OF FOOTBALL MATCH PLAY AND THEIR IMPACT ON CARDIOVASCULAR STRESS**

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Do not insert authors here Introduction Heart rate (HR) has been used as an index of physiological strain in footballers during game and is closely correlated to the work-rate profiles. Workload of players can also change with configurations or systems of play, such as, 4-4-2 or 4-3-3. Methods VO<sub>2</sub>max, HRmax and HR at anaerobic threshold (HRAT) of footballers (N=20) were determined in laboratory. Finally, HR of the players was measured during selection matches. The first two matches were played between two common teams of equal skill and fitness status. The first match was played in configuration known as 4-3-3 (i.e., 4 defenders [D], 3 midfielders [M], 3 forwards [F]) while 4-4-2 was the formation of the second match. HR of 7 players of different playing positions (1 G, 2 D, 3 M, and 1 F) was recorded in the first game. In the second match also, HR of 7 players (1 G, 1 D, 3 M, and 2 F) was recorded, of which 3 M were common to the first match. The third match was played between two other teams. A total of 9 players (3 each of D, M, and F) were studied in the third match. Maximum Heart Rate Reserve (MHRR) was calculated using the formula (ACSM 1987):  $MHRR = [Exercise\ HR - Resting\ HR] \times 100 / [HRmax - Resting\ HR]$  Results In both the systems, mean HR of the M were almost identical (169.4±13.8 beats/min and 170.3±14.1 beats/min respectively). MHRR is highest on the M (75.2±2.2%) followed by F (73.1±3.5%), D (65.9±4.2%) and G (28.5±0.4%). Outfield footballers played majority of the time in the aerobic zone (76±5.9%, 79.8±4.1%, and 92.5±3.3% of the total time of play in F, M and D respectively), but G played almost completely in the aerobic zone. Discussion HR-VO<sub>2</sub> relationship shows that outfield players were exercising at an average of 71 to 76% and with a mean value of 74% of their VO<sub>2</sub>max, whereas G utilized about 44% of their VO<sub>2</sub>max. Systems of play in football game have been expected to alter the work rate profile of a player (Reilly and Thomas, 1976; Mendez-Villanueva A, 2013). In the match, which employed the 4-3-3 team formation, 3 M were supposed to take the major workload in the midfield against 4 M in the team configuration of 4-4-2 system of play, and thus total workload may be expected higher in the midfielders in 4-3-3 system. But results suggest that workload on the M in both the configurations of play were identical. Probably, the excess load on the 3 M, played in 4-3-3 system was distributed by other outfield teammates. Aerobic process plays the predominant role for energy supplement in football game. References American College of Sports Medicine position statement (1978). Med Sci Sports Exerc, 10:vii-x. Ghosh AK, Goswami A, Mazumder P, Mathur DN (1991). Indian J Med Res, 94, 351-356. Mendez-Villanueva A, Buchheit M, Simpson B, Bourdon PC (2013). Int J Sports Med, 34, 101-110. Reilly T, Thomas V. (1976). J. Human Movement Studies 2, 87-97.

**PEDAL FORCE AND METABOLIC STRESS RESPONSES TO DIFFERENT PEDAL RATES DURING CYCLING**

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*1:Kurume University, 2:Kyushu Kyoritsu University, 3:Kyushu Institute of Technology*

Introduction External power output (EP) for pedaling cycle ergometer is estimated by product of load to wheel inducing mainly by developed tension of exercising muscle and pedal rate (PR) depending on muscle contraction velocity. It has been thought that the pedal force (PF) would be unchanged at a constant load even if the PR is changed. To our knowledge, there have been no assessments as to the PF with changing PR. Therefore we assessed PF, which reflects the developed tension of leg muscle, and physiological responses to three different pedal rates during constant-load cycling exercise, and investigated the associations with physiological variables. Methods Ten healthy male volunteers (mean±SD: age, 21.1±0.3 yr; height, 169.6±3.9 cm; weight, 66.7±8.4 kg) performed a load-incremental cycling exercise and three trials of constant-load cycling exercise. The load-incremental exercise test started at 0.5 kp for 2 min, followed by an increase of 0.5 kp every 2 min at a constant pedal rate (60 rpm) until the exhaustion point. After the test, the subjects performed three tests at different pedal rates (40, 80, and 120 rpm) during constant-load exercise (1.0 kp) for 6 min. The order of three trials with 40, 80, and 120 rpm of pedal rates was carried out at random. Oxygen uptake (VO<sub>2</sub>) and PF were measured during all exercise tests, and the comparisons of these values for three different pedal rates were made by using an average of 30 sec between 4 min 30 sec and 5 min. Blood lactate accumulation above rest ([ΔLa]) was measured during constant-load exercise with three pedal rates. Results and Discussion During constant-load (1.0kp) exercise, EP was increased according to an increase of pedal rate. It is not surprising because EP is controlled by load to wheel and/or PR. As a result, VO<sub>2</sub> and [ΔLa] also showed higher values with an increase of pedal rate. Furthermore, despite the same load to wheel of cycle ergometer, greater peak value of PF was observed with an increase of PR, which is mainly interesting finding because we hypothesized that only increase of PR could not affect exerted tension of leg muscles, assuming that a constant load is maintained. Conversely, integral of PF per one cycle was lower value with an increase of PR. As a result of greater peak PF and lower integral of PF per one cycle, integrated value of PF for 30 sec was increased with an increase of PR. These results suggest that extremely high pedal rate dependent on muscle contraction velocity affects an exerted tension of muscle and metabolic stress during cycling exercise.

**INFLUENCE OF HIGH-INTENSITY AEROBIC TRAINING ON EXERCISE-INDUCED GROWTH HORMONE RESPONSE, ABDOMINAL AND ECTOPIC FAT.**

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Introduction The enhancement of growth hormone (GH) secretion is considered to be important to prevent obesity, because GH has a powerful lipolytic effect. Although exercise is a potent stimulus for GH secretion, obese people show lower exercise-induced GH response. A previous study (Salvadori et al., 2010) suggested that moderate aerobic exercise training may be an effective tool to augment GH response. Considering that the magnitude of GH response depends on exercise intensity, high-intensity aerobic training would be more beneficial for improving exercise-induced GH response. Furthermore, growing evidences suggest that fat accumulation in abdominal as well as non-adipose tissue (ectopic fat) attenuates GH secretion. Therefore, the purpose of this study is to investigate the

effects of high-intensity aerobic training on exercised-induced GH secretion, abdominal and ectopic fat accumulation. Methods Twenty-four sedentary men were randomized to either high-intensity aerobic training (HT) group or low-intensity aerobic training (LT) group. The HT group performed intermittent exercise (10x1min with 30s rest between sets) at 85% of  $\dot{V}O_2\text{max}$ . The LT group performed continuous aerobic exercise (lasting 22min) at 45% of  $\dot{V}O_2\text{max}$ . Each training session was conducted 3days per week for 4weeks. Before and after the training period, hormonal and metabolic response to an acute exercise, abdominal fat area, intramyocellular and hepatic lipid contents were determined. Results Acute exercise significantly increased GH concentrations in both groups ( $P < 0.05$ ). However, these responses were not significantly different between before and after the training period in either group. Visceral fat area (evaluated by MRI), hepatic and intramyocellular lipid contents (evaluated by  $^1\text{H-MRS}$ ) did not change after the training period in either groups. Discussion The present results were not consistent with previous findings (Salvadori et al., 2010) that demonstrated moderate intensity aerobic training augmented exercise-induced GH response. In the present study, intramyocellular and hepatic lipid contents did not change before and after the training period in either group. We consider that the lack of abdominal and ectopic lipid content would be a reason why high-intensity aerobic training did not change the magnitude of exercise-induced GH secretion. In conclusion, 4week of high intensity aerobic training did not change exercise-induced GH response, abdominal fat area or ectopic lipid content in healthy sedentary men. References Salvadori A, Fanari P, Marzullo P, Codecasa F, Tovaglieri I, Cornacchia M, Walker G, Brunani A, Longhini E. (2010). Clin Endocrinol (Oxf), 73(4), 491-496.

### GPS-DERIVED RUNNING LOADS AND INJURY RISK IN ELITE AUSTRALIAN FOOTBALLERS

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Introduction An upward trend in injury prevalence in the last decade in Australian football (Orchard et al. 2012) has prompted great interest in the multifactorial aspects of injury prevention. Coaches and sport scientists often attribute training overload as an important (although largely preventable) cause of injury (particularly soft tissue). The purpose of this study was to investigate the relationship between overall physical workload measures (derived from GPS data) and injury risk in elite Australian football players across an entire season. Methods Forty-six elite Australian footballers participated in this study. GPS data and intrinsic injury incidence was monitored across pre-season and in-season (18 matches) phases. A multiple regression model was used to compare cumulative (1-, 2-, 3-, 4-weekly loads) and absolute change (from the previous-to-current week) in workloads between injured and uninjured players for all GPS-derived variables: total distance; V1 distance (total distance above individuals' aerobic threshold speed); V2 distance (total distance above an individual's anaerobic threshold speed); force load; velocity load and relative velocity change. Consistent with previous research (Rogalski et al. 2012), odds ratios (OR) were reported against a reference group of the lowest training load range. Results During pre-season, 3-weekly total distance (between 73721 and 86662 m, OR= 5.489,  $p=0.008$ ) and 3-weekly sprint distance (>1453m, OR= 3.667,  $p=0.074$ ) were most indicative of greater intrinsic injury risk. Higher in-season cumulative loads showed the strongest relationship with intrinsic injury risk. In particular, 3-weekly force load (> 5397 AU, OR=2.530,  $p=0.031$ ), 4-weekly relative velocity change load (>102 AU, OR= 2.244,  $p=0.035$ ), and 2-weekly V2 distance (>4431 m, OR= 3.091,  $p=0.016$ ) were associated with a greater risk of intrinsic injury. No differences in intrinsic injury risk between years of AFL experience and GPS load data were seen, although 7+ year players had the highest injury incidence. Discussion From an injury prevention perspective, these findings support the careful management of running load variables (GPS) in AFL players, in order to reduce injury risk. In particular, cumulative workloads should be closely monitored; with 3-weekly running loads most indicative of a greater injury risk across both phases of the season. References Orchard, J, Seward, H, Orchard, J (2012) '20th Annual Injury Report: Season 2011'. Available online from: <http://www.afl.com.au/injury%20report/tabid/13706/default.aspx>. [27th August 2012]. Rogalski, B, Dawson, B, Heasman, J, Gabbett, T (2012). Training and game loads and injury risk in elite Australian footballers'. Journal of Science and Medicine in Sport, In press, 2013.

### THE EFFECT OF PLANNED OVERREACHING AND SUBSEQUENT SHORT-TERM DETRAINING ON SPRINT PERFORMANCE

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Do not insert authors here Introduction In a previous study, a significant increase in resting intramuscular phosphocreatine (PCr) level has been shown by 14 sessions of daily high-intensity sprint training (Parra et al., 2000). However, sprint performance did not improve after the training period. The finding suggests that overreaching was occurred due to the insufficient recovery from the accumulated fatigue of daily training. We hypothesized that consecutive exercise training would enhance sprint performance dramatically when short-term detraining period was provided following the last session of the exercise training. Therefore, the purpose of this study is to investigate the effect of the training program consisting of planned overreaching and subsequent short-term detraining on sprint performance. Methods 24 physically active men participated in 18 days of sprint training program. They were divided into two groups; OR-DT (12 days daily training + 6 days detraining), or CON (12 days training with a rest day every 3 days). Power output during maximal pedaling was recorded in each training session. Resting intramuscular PCr concentration was determined using magnetic resonance spectroscopy ( $^31\text{P-MRS}$ ). Resting blood samples were collected to evaluate changes in blood hormone concentrations over the training period. Result Peak power output during 30s maximal pedaling significantly increased after 6 days of detraining period in OR-DT compared to pre-training value ( $P < 0.05$ ), whereas no change was observed in CON. Average power output significantly increased after detraining in OR-DT ( $P < 0.05$ ), but CON showed a significant increase throughout the whole training period ( $P < 0.05$ ). Intramuscular PCr concentration significantly increased after 12 days of daily training in OR-DT and it was maintained after the detraining period ( $P < 0.05$ ). However, no change was observed in CON. Serum leptin concentration significantly increased after detraining period in OR-DT when compared to the values of Day-6 and Day-12 ( $P < 0.05$ ). Discussion In contrast to the present findings, previous study using 14 days successive training sessions (Parra et al., 2000) failed to improve sprint performance, despite the large increase in resting PCr level and enzyme activities. This is probably because of insufficient recovery from accumulated fatigue. Based on this finding, training program for OR-DT was designed to set 6 days of detraining period following the 12 days successive sprint training. Consequently, a significant increase in power output was found after the detraining period. Increased intramuscular PCr concentration and recovery from accumulated fatigue may be related to the improvement of this sprint performance. Reference Parra, J., et al., Acta Physiol Scand, 2000. 169(2): p. 157-65.

## DIFFERENCES IN HEART RATE RESPONSE BETWEEN FAST AND SLOW SUPERMOTO RACE RIDERS

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**Introduction** Supermoto racing is a sport performed by different riders from different categories, also as training for other competitions (e.g. Motogp, Moto2 and Superbike athletes). The highest percentage of practicing and competing for this sport is located in Europe and North America. Anecdotally it requires fitness condition, riding experience, off-road skills. However not much is known about the responses in heart rate (HR) during supermoto racing. The aim of this study was to investigate HR response during a 12 lap supermoto race in national race riders, on the racing track, without the off-road part. **Methods** Sixteen supermoto race drivers (Means  $\pm$  SDs, Age:  $29 \pm 9$ ; BMI:  $23.0 \pm 2.4$ ; Years of experience with supermoto:  $4 \pm 3$ ) performed 12 laps on an international circuit 1200 m long in Italy. Mean temperature and humidity during the race were  $31.6 \pm 0.5$  °C and  $53.5 \pm 2.0\%$  respectively. Heart rate of the race drivers was monitored throughout the 12 laps. **Results** The mean HR in the 16 supermoto race drivers during the 12 lap race simulation was  $168 \pm 16$  bpm. The peak HR was  $177 \pm 15$  bpm, which corresponded to 94% of the HRmax. We found a positive relationship between the best racing performance (fastest lap time) and the mean HR over the whole duration of the race ( $r=0.747$ ,  $p<0.001$ ,  $n=16$ ). Fastest lap time also positively correlated with the peak HR ( $r=0.722$ ,  $p<0.01$ ,  $n=16$ ) and the peak HR% of HRmax ( $r=0.642$ ,  $p<0.01$ ,  $n=16$ ) over the whole duration of the race. When the fastest 5 supermoto race drivers were assigned to the fast group (F group), and the remaining 11 to the average to slow group (AtS group) we found that mean and peak HR were significantly higher in the AtS group than in the F group (Mean HR:  $174.917 \pm 12.363$  (bpm) vs.  $154.556 \pm 13.256$  (bpm),  $p = 0.010$ ; Peak HR:  $182.846 \pm 11.052$  (bpm) vs.  $163.553 \pm 15.782$  (bpm),  $p = 0.013$  respectively). **Discussion** We have found that the faster supermoto race drivers have a lower mean as well as peak HR than slower drivers. This could be due to the fact that the HR rising due to cognitive causes in faster drivers is less than in the slower drivers. Alternatively it could be that the cardio-respiratory fitness of the faster race drivers is higher than in the slower drivers. Understanding what determines the difference in HR that we have found between fast and slow race drivers can be crucial to improve racing performance. It is still to be determined whether training in this sport should focus on improving cognitive skills such as reaction times and attentiveness or aerobic capacity.

## EFFECTS OF ACTIVE ORTHOSTATIC TASK ON HEART RATE VARIABILITY IN SOCCER PLAYERS.

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**Introduction** For the evaluation of autonomic cardiac regulation heart rate variability (HRV) is usually determined in supine position. Standing or active orthostatic task (AOT) has been used to induce changes in HRV to obtain additional data about cardiac regulation in athletes (1). Studies with HRV during AOT, evaluating athletes from sports with both aerobic and anaerobic training such as soccer, are scarce. Aim of this investigation was to assess the differences in HRV parameters between active and former soccer players in supine position and after standing. **Methods** In the study participated 12 active soccer players (age= $21.6 \pm 1.4$  years) and 14 former soccer players (age= $21.8 \pm 2.5$  years). The active players were studied during competitive season. In supine position after 20 min of rest RR intervals of each subject were recorded for 5 min with Polar S810i heart rate monitor. After that subjects actively stood up (AOT) and data were collected for 5 min from 3th to 8th minutes in upright position. With Kubios HRV 2.0 software were obtained mean heart rate (Mean HR) and HRV indices: Mean RR, SDNN, RMSSD, pNN50%, LF and HF power in absolute and normalized units (ms<sup>2</sup> and nu), and LF/HF ratio. Cardio-respiratory fitness was assessed with PWC170 cycle ergometer test. **Results** There were no differences in physical work capacity between both groups. During supine rest Mean RR, SDNN, RMSSD, pNN50%, LF ms<sup>2</sup> and HF ms<sup>2</sup> were significantly higher ( $p<0.05$ ) in active players than in former players. Active players also demonstrated lower Mean HR at rest. During AOT in both groups there were significant increase ( $p<0.05$ ) in Mean HR, LF nu and HF/LF ratio and significant decrease ( $p<0.05$ ) in Mean RR, RMSSD, pNN50%, HF ms<sup>2</sup> and HF nu. After standing SDNN, RMSSD, pNN50% and LF ms<sup>2</sup> remained significantly higher in active players than in former players, but there were no statistical differences between the groups in Mean HR, Mean RR, and HF ms<sup>2</sup>. There were no differences between the groups in LF nu, HF nu and HF/LF ratio during both supine and standing positions. **Discussion** These results indicate that active players have an increased parasympathetic influence on heart rate in supine position in comparison with former players. In both groups AOT induces identical changes in HRV indices, showing decrease of vagal activity and increase of sympathetic activity. Active standing eliminates some differences in HRV between active and former players, established in supine rest. The study shows that HRV during AOT does not provide additional information about the characteristics of cardiac autonomic regulation of active players in comparison with former players. **References** 1. Mourou L, Bouhaddi M, Perrey S, Rouillon JD & Regnard J. (2004). *Eur J Appl Physiol*, 91, 79-87.

## RELIABILITY OF HEART RATE VARIABILITY UNDER RESTING CONDITIONS

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**Introduction** Heart rate variability (HRV) is used for the evaluation and assessment of the cardiac autonomic regulation. Its usefulness has been reported not only in experimental research, but also as a diagnostic tool for athletes. Although the methodology of HRV measurement has been extensively used, the reliability and reproducibility of parameters, particularly for short-term recordings (2-20 min) seems to be insufficient and inadequate. Therefore the aim of this study was to investigate the reliability of three different testing procedures under resting conditions. **Methods** Ten healthy male subjects (mean  $\pm$  SD, age:  $33.4 \pm 10.0$  years; weight:  $80.3 \pm 5.8$  kg; height:  $183.7 \pm 5.3$  cm) participated in the study. Measurements included heart rate (HR; Polar RS800cx) after waking up in the morning, in three different situations: (a) 3 min in supine position + 3 min in standing position; (b) 3 min in sitting position + 3 min in standing position, and (c) 2 min sitting + 3 min standing. Each subject performed 4 tests over a one-week period. Absolute reliability was assessed by the standard error of measurement (SEM) and the relative reliability by the intraclass correlation coefficient (ICC). Data obtained and computed from the RR-intervals were indices in the time (MeanRR, SDNN, RMSSD and NN50) and the frequency domain (Low-Frequency, High-Frequency and Low-/High-Frequency). **Results** Protocol 1 (3 min in supine and standing position) showed significant ( $p<0.05$ ) and high correlations of the HRV indices SDNN (ICC=0.878), RMSSD (ICC=0.958), NN50 (ICC=0.954), Low-Frequency (ICC=0.924), High-Frequency (ICC=0.924) and Low-/High-Frequency (ICC=0.873). Protocol 2 and protocol 3 show also good correlation for the different HRV indices, except for SDNN (ICC= 0.263-0.962), whereas both measurements show similar results for the absolute (RMSSD SEM=6.84/6.25) and relative reliability (RMSSD ICC=0.938/0.934). **Discussion** Comparing the three different short-term protocols of heart rate variability, protocol 1 (3 min in supine and standing position) shows the highest and the best correlations for almost every index of the time and the frequency domain. The frequency domain indices (Low-Frequency, High-Frequency and Low-/High-Frequency), which are commonly used for short-term recordings, showed high reproducibility, although an effect of a controlled breathing rhythm improves the reliability of the HRV indices,

which was previously reported in the literature. Summarizing protocol 1 is the most appropriate measurement for short-term HRV under resting conditions for healthy subjects. References Atkinson, G. & Nevill, A.M. (1998). *Sports Med.* 26 (4). 27-238. Brodie, D.A., Bromley, P.D. & Sandercock, G.R.H. (2005). *Int J Cardiol*, 103, 238-247. Danilowicz-Szymanowicz, L., La Rovere, M.T., Maestri, R., Pinna, G.D., Raczak, G. & Szwoch, M. (2007). *Clin Sci*, 11, 1-140. Hautala, A.J., Karjalainen, J., Kinnunen, H., Kiviniemi, A.M., Nissila, J., Tulppo, M.P. & Virtanen, P. (2010). *Med Sci Sports Exer*, 42 (7), 1355-1363.

### COMPARISON OF THE HEART-TYPE FATTY ACID-BINDING PROTEIN WITH THE HIGH SENSITIVE CARDIAC TROPONIN T IN HEALTHY RUNNERS

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*University Hospital of Liège*

Background: Heart-type fatty acid-binding protein (H-FABP) is a low molecular weight protein involved in the intracellular uptake and buffering of long chain fatty in the myocardium. It is an early marker for acute coronary syndrome. Troponin T (TnT) is a component of the contractile apparatus of the striated musculature. Cardiac TnT is a cardio-specific, highly sensitive marker for myocardial damage. The aim of our study was to compare the results obtained with the H-FABP and the highly sensitive cardiac troponins (hsTnT) and to test their cardio-specificity in healthy runners. Methods: Twenty three runners (marathon) were enrolled. We drew samples at three times: just before (T0), just after (T1), and three hours after the end of the race (T3). H-FABP was determined with a Randox immunoturbidimetric assay and hsTnT with a Roche electrochemiluminescence immunoassay, both on Cobas 6000. A linear regression was calculated to observe if there is any correlation between the two biomarkers. Values above the 95th percentile for H-FABP (2.5ng/mL) and the 99th percentile for hsTnT (14ng/L) were considered as positive. Results: At T0, none of the subjects were positive for hsTnT but 35% were positive for H-FABP; at T1, 83% for hsTnT and 100% for H-FABP; at T3, 83% for hsTnT and 96% for H-FABP. At T0, the regression equation was  $H-FABP_{T0} = 3.9454 - 0.1001 \times hsTnT_{T0}$ ; at T1:  $H-FABP_{T1} = 51.838 - 1.7026 \times hsTnT_{T1}$ ; at T3:  $H-FABP_{T3} = 47.977 - 1.6193 \times hsTnT_{T3}$ . No correlation was observed between the two biomarkers at the different time. Conclusions: We observed a significant increase of H-FABP and hsTnT in runners. These markers are independent to each other. These values could biologically correspond to a heart ischemia. However, we suggested that exercise-induced cardiac hsTnT and H-FABP release is not a marker of exercise-induced pathology but likely a physiologic response to effort or an exercise-induced cardiac remodelling.

### CHANGES IN HEART RATE VARIABILITY AFTER A QI GONG SESSION IN AN ELDERLY PEOPLE GROUP

Calvo, E.1, Niño, O.2, Alamo, J.M.2, Javierre, C.2, Cutillas, B.1, Falcó, A.1  
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Introduction Qi Gong is a physical activity that combines slow body movements, coordinated breathing and mental focus search. Several authors have suggested that one or more of these components of Qi Gong, as Tai Chi Chuan, have a positive impact on the heart autonomic control (Audette et al., 2006; Jahnke et al., 2010). The aim of the study was to quantify the changes in heart rate variability (HRV) during a session of Qi Gong, monitoring the relative intensity of the specific exercise. Methods Descriptive Study. Ten healthy subjects physically active, (age  $62 \pm 2$  years), (3 men and 7 women) performed a session of Qi Gong during 90' with heart rate monitoring beat by beat. Polar Team 2 (Polar, Finland) heart rate monitor was used to recode HRV through the R-R interval. HRV parameters were obtained with Polar Precision Performance software. Two evaluations of heart rate variability in supine rest position were conducted during 10': pre-training and post-training, spectral analysis of HRV (high-frequency, low-frequency power as well as high- and low-frequency power in normalized units) as a measure of autonomic control of the heart, were done (Pichon et al., 2004). Student's t-tests for paired samples was used to evaluate differences between before and after Qi Gong session. Results The relative intensity respect theoretical maximal heart rate was of  $61 \pm 4$  %. At the begin of the session, RR was  $783.8 \pm 86.5$  ms and in post-training evaluation was  $776.5 \pm 112.6$  ms, without differences. HF % showed statistical decreases between before and after training analysis ( $21.0 \pm 8.7$  to  $12.4 \pm 2.7$ ,  $p < 0.05$ ). Discussion A single session of Qi Gong increase the heart parasympathetic activity, a positive effect respect the studied group. Despite the relatively moderate intensity activity during the session of Qi Gong (about 60% of the theoretical maximum heart rate), there is an immediate effect on parasympathetic activity. This fact is particularly relevant in people of this population group because presenting major risk of high blood pressure, musculoskeletal and endocrine disorders. Immediate positive results obtained with a simple Qi Gong session, we recommend further studies of the cardiac effects at medium and long term of this moderate physical activity. References - Audette JF, Soo Y, Newcomer R, Stein L, Duncan G, Frontera WR. Age and Aging 2006; 35:388-393. - Jahnke R, Larkey L, Rogers C, Etnier J, Lin F. Am J Health Promot. 2010; 24(6):e1-e25. - Pichon A.P., de Bisschop C., Roulaud M., Denjean A., Papelier Y. Med Sci Sports Exer. 2004;36(10):1702-1708. Do not insert authors here

### THE EFFECT OF TAI CHI TRAINING ON AUTONOMIC RE-ACTIVITY AND BODY KINETICS DURING A MOCK BOXING ROUND IN SOCCER PLAYERS: A FEASIBILITY STUDY

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Introduction Very rapid movement execution in athletes is best done subcortically; with cortical modulation only necessary for movement modifications. However, rapid movement execution is usually associated with sympathetic up-regulation, which may increase cortical modulation at the expense of subcortically regulated central pattern generators (CPGs) (Rauch et al., 2013). This study quantified the effects of a 10 session Tai Chi training program designed by a Tai Chi Master on heart rate variability (HRV) and on the ability to maintain optimal joint angles during a 2 min boxing sparring performance (box) round in professional soccer players; and further to access if these two variables were correlated. Methods Fourteen professional soccer players aged  $18 \pm 3$  years were recruited and randomly assigned to either a Tai Chi group (TAI) – who completed 10 sessions of Tai Chi training over 4 weeks - or a control group (CON). All participants underwent 45 min of box training and individually completed a 2 min familiarisation box round, and the next day, a pre intervention 2 min box round. Participants' heart rates were recorded telemetrically (at 1000Hz) and markers for 3D camera analysis were placed at appropriate distances on each participant's head, back, arms, hands, hips, legs and feet to continuously monitor their joint angles during the 2 min box rounds. Results The delta heart rates in the post vs. pre box rounds correlated with the delta (LF+HF) power values in the participants' cardiac spectrograms ( $R^2 = 0.93$ ,  $p < 0.000$ ). There was a positive correlation ( $R^2 = 0.76$ ,  $p < 0.01$ ) between the inter-foot angles of participants and the log of their cardiac (LF+HF) spectral power values during the pre training box round. After the Tai Chi training program the inter-foot angles of participants in the post box round were negatively correlated to the log of their delta cardiac (LF+HF)

spectral power values ( $R^2 = 0.70$ ,  $p < 0.02$ ). Discussion The significant correlation between delta heart rates and HRV values in the post vs. pre box rounds showed that cardiac (LF+HF) spectral power was an excellent marker for cardiac vagal modulation during the box rounds. Participants who demonstrated greater cardiac vagal modulation during the pre box round had wider inter-foot angles (more on the back-foot), but during the post box round, the participants who demonstrated greater vagal modulatory improvements had more parallel inter-foot angles (more on the front-foot). This provides evidence that Tai Chi training facilitated vagal modulatory control over the heart and enabled those participants who were more front-footed to also be more centred (ANS balanced) during the post box round. References Rauch, H.G.L., Schönbacher, G. and Noakes, T.D.: 2013, 'Neural Correlates of Motor Vigour and Motor Urgency during Exercise', Sports Medicine. 43 In Press.

### METHODOLOGICAL CONSIDERATIONS OF HIGH-INTENSITY INTERVAL EXERCISE IN CARDIAC REHABILITATION

Tschakert, G.1, Pichlhoefer, P.1, Kroepfl, J.1, Mueller, A.1, Harpf, H.2, Traninger, H.2, Wallner-Liebmann, S.3, Hofmann, P.1  
 1Karl-Franzens-University Graz (Graz, Austria) 2Center for Ambulatory Rehabilitation Graz (Graz, Austria) 3Medical University Graz (Graz, Austria)

Introduction Aerobic high-intensity interval exercise (HIIE) is successfully applied in the field of cardiac rehabilitation (Gibala et al. 2012). However, the optimal prescription of aerobic HIIE in heart disease patients is still unclear. The aim of this study was to compare acute metabolic and cardiorespiratory responses during short and long HIIE to moderate continuous exercise (CE). Methods 8 patients undergoing phase III cardiac rehabilitation (7 males, 1 female; age:  $63.0 \pm 9.4$  yrs; ht:  $174.1 \pm 4.6$  cm; wt:  $83.6 \pm 8.7$  kg), treated with  $\beta$ -blocking agents, performed a maximal symptom-limited incremental exercise test (IET). Subsequently, the participants performed three various exercise tests matched by mean load ( $P_{mean}$ ) which was set 20 % below the second lactate turn point (LTP2): 1) short HIIE with peak workload durations ( $t_{peak}$ ) of 20 sec, peak workloads ( $P_{peak}$ ) equal to  $P_{max}$  from IET, recovery workloads ( $P_{rec}$ ) 10 % below the first lactate turn point (LTP1), and a calculated recovery duration ( $t_{rec}$ ); 2) long HIIE ( $t_{peak}$  4 min,  $P_{peak}$  corresponding to the power output at 85 %  $HR_{max}$  from IET,  $t_{rec}$  3 min,  $P_{rec}$  calculated); 3) CE with a target workload equal to  $P_{mean}$  of both types of HIIE. Sessions took 28 min and were randomly assigned and interspersed by at least 2 days. For statistical analysis, repeated measures ANOVAs with Fisher's-LSD (least significant difference) were used. Results In long HIIE,  $HR_{peak}$  ( $124.0 \pm 24.9$  b/min) was significantly higher than in CE ( $111.3 \pm 18.0$  b/min;  $p < 0.05$ ) and by trend higher than in short HIIE ( $116.3 \pm 22.8$  b/min;  $p = 0.08$ ).  $HR_{peak}$  in long HIIE was also markedly higher compared to HR at LTP2 from IET ( $111.7 \pm 17.7$  b/min). Significantly higher peak  $VO_2$  values were found in long HIIE ( $1.9 \pm 0.6$  l/min) compared to short HIIE ( $1.6 \pm 0.4$  l/min) and CE ( $1.5 \pm 0.3$  l/min) ( $p < 0.05$ ). Mean and peak  $La$  values were significantly higher during long HIIE (mean:  $4.8 \pm 2.6$ ; peak:  $5.5 \pm 2.9$  mmol/l) than during short HIIE (mean:  $3.4 \pm 1.7$ ; peak:  $3.9 \pm 2.0$  mmol/l) and CE (mean:  $3.2 \pm 1.6$ ; peak:  $3.6 \pm 1.7$  mmol/l) ( $p < 0.05$ ). Between short HIIE and CE, no significant difference could be found for any parameter. Discussion Acute metabolic and peak cardiorespiratory responses during short aerobic HIIE were significantly lower compared to long HIIE and similar to CE despite considerably higher peak workload intensities in short HIIE. Therefore, short intervals may be associated with lower health risks than long HIIE. The training effects elicited by short HIIE have to be proven in randomized controlled training studies. References Gibala MJ, Little JP, MacDonald MJ, Hawley JA. (2012). J Physiol, 590, 1077-1084.

15:00 - 16:00

### Mini-Orals

#### PP-PM56 Rehabilitation [RE] 3

### PREVALENCE AND CORRELATIONS OF DEPRESSION, ANXIETY AND PHYSICAL CAPACITY OF PATIENTS WITH OCCUPATIONAL RESPIRATORY DISEASES

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Introduction The prevalence of depression (10-60%) and anxiety (11-45%) is higher for patients with Chronic Obstructive Pulmonary Disease (COPD) than for patients with cardiac insufficiency. Further, current research results indicate that symptoms of depression seem to be significant determinants for exacerbation and days of hospital stay as well as for a worse physical capacity (Spruit et al., 2010). However, there is a lack of studies concerning the specific illness-characteristics of COPD. Consequently, the purpose of the present study is to analyze prevalence and correlations of depression and anxiety with physical capacity of patients with occupational respiratory diseases. Methods During a rehabilitation process in the clinic of occupational diseases in Falkenstein (Germany), 243 patients with occupational respiratory diseases (Age:  $M=71.51$ ;  $SD=9.13$ ) participated in the study. At the beginning (T1) and at the end (T2) of the clinical stay, data giving evidence about levels of depression and anxiety (BDI-II, HADS-D) have been collected with the help of a questionnaire and the physical capacity has been assessed using the six minute walking distance (6MWD). Results At T1, 26.4% of the patients show clinical relevant depression values and 18.2% have clinical relevant anxiety values. The results indicate that the correlation between the 6MWD and the levels of depression depends on the occupational diseases ( $r = -0.332$  to  $-0.708$ ,  $p < 0.01$  to  $0.001$ ). Further, the mean anxiety values differ depending on occupational disease ( $F(4.237) = 3.860$ ,  $p < 0.01$ ). Additionally, for patients with low 6MWD-values ( $< 326.30$ m), there are significant differences regarding depression ( $F(1.234) = 32.210$ ,  $p < 0.001$ ) and anxiety ( $F(1.234) = 3.396$ ,  $p < 0.05$ ). At T2, the 6MWD-values increase and the depression-values significantly decrease for the total of participants. Discussion The present results concerning prevalence of depression and anxiety in patients with occupational respiratory diseases confirm the current state of research regarding COPD. Since there is a correlation between the physical capacity, depression, and anxiety, increasing the factor of physical capacity can decrease the psychological symptoms of COPD-patients. In future, intervention studies including a control group and a follow up with additional objective parameters are necessary to further investigate causal relationships among the above mentioned determinants. References Spruit, MA, Watkins, ML, Edwards, LD, Vestbo, J, Calverley, PMA, Pinto-Plata, V, Celli, BR, Tal-Singer, R, Wouters, EFM. (2010). Determinants of poor 6-min walking distance in patients with COPD: The ECLIPSE cohort. Respir Med, 104 (6), 849-857.

## EFFECT OF MUSIC THERAPY ON BRAIN FUNCTION AS ASSESSED BY LEVELS OF BRAIN-DERIVED NEUROTROPHIC FACTOR

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Background and aims: In various types of rehabilitation, effects on psychological and nervous functions much more difficult to objectively assess than effects on the body. Brain-derived neurotrophic factor (BDNF) is a nerve growth factor that plays central roles in the survival, growth, and maintenance of neurons (Sakuma K. J Biomed Biotechnol 2011). BDNF has been reported to be associated with learning, memory, cognitive function, and depression (Leibrock J. Nature 1989, Barde YA. J Biomed Biotechnol 1990, Huang EJ. Annu Rev Neurosci 2001). The possibility has also been suggested that blood BDNF represents a biomarker for memory and cognitive function (Laske C. J Neural Transm 2005). We investigated the effect on serum BDNF of music therapy, as higher function rehabilitation, made with the purpose of improving brain function. Methods and results: Conventional blood biochemical parameters (blood profiles, lipids, glucose metabolism, and uric acid), serum BDNF, and State-Trait Anxiety Inventory (STAI) scores to assess mental function were measured before and after music therapy in 13 patients with mild dementia (age range, 71-103 years). Music therapy was implemented with six programs consisting of singing and playing simple instruments. Music therapy sessions were 60 min each, with two sessions a week for 4 weeks, oriented to achievement of a task. At the final session, nearly all subjects had achieved the tasks. After intervention, no changes in conventional parameters or STAI were seen, but serum BDNF levels were significantly increased compared to baseline ( $16,798 \pm 1588$  pg/mL vs.  $19,410 \pm 1507$  pg/mL,  $P < 0.05$ ). Conclusion: These findings suggest that effects of music therapy on brain function may be reflected in increased BDNF levels and the utility of interventional methods for the maintenance of brain function from a new perspective, and at the same time suggest possibilities for methods of objectively evaluating art therapy, which has so far been difficult.

## THE INFLUENCE OF SPORTS CLIMBING ON SELF-EFFICACY, SELF-ESTEEM AND DEPRESSION IN PATIENTS WITH MULTIPLE SCLEROSIS

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Purpose Multiple Sclerosis (MS) is a chronically, progressive disease with a highly social-medical importance. In Germany about 130.000 adults suffer from MS. Even though research on immunomodulation drugs is increasing, there is still no cure to MS. Following Turner et al. (2009) a key-point to enhance psycho-social constitution and quality of life in patients with MS is the facilitation of physical activity. The aim of this study was to investigate if sports climbing (SC) improves self-efficacy, self-esteem and depression in patients with MS. Methods This study consisted of 27 patients (17 females), mean age  $45.8 \pm 7.2$  years, randomized into SC-group ( $n=12$ ) and control-group (CG) ( $n=15$ ). The SC-program consisted of 20 sessions over 2 hours for duration of 6 months. Inclusion-criteria are 'range 1-6.5 on the Expanded Disability Status Scale (EDSS)' and 'assured diagnoses of MS'; exclusion-criteria are 'attendance in less than 18 sessions' or 'relapse during intervention'. Data were collected pre and post intervention for self-esteem (Multidimensionale Selbstwertkala, Schütz/Sellin), self-efficacy (Skala zur allgemeinen Selbstwirksamkeit, Jerusalem/Schwarzer) and depression (Allgemeine Depressionsskala, Hautzinger). Self-reports were used to detect alterations of their physical and mental condition. Results EDSS score in SC-group ( $n=10$ ) decreased significantly from  $4.6 \pm 1.7$  to  $4.1 \pm 2.1$ ,  $p=0.068$ , whereas no changes occurred in CG ( $n=14$ , EDSS  $4.2 \pm 1.7$ ,  $p=0.157$ ). Significant changes could be demonstrated in self-efficacy over time, whereas self-esteem and depression did not reveal significant improvements. The mean value for self-efficacy increased in SC-group from  $25.9 \pm 6.49$  to  $28.7 \pm 4.52$ , significant over the time period ( $p = 0.005$ ), whereas results in CG also increased slightly from  $28.0 \pm 6.42$  to  $29.0 \pm 6.18$ , but not significant over time period  $p = 0.107$ . The mean value in self-esteem did not change significantly in the SC group pre  $51.4 \pm 9.63$ , post  $53.6 \pm 13.1$ ; neither in CG pre  $52.5 \pm 11.55$ , post  $51.36 \pm 10.13$ . For depression both groups ( $n = 18$ ) showed similar, not significant results: SC group pre  $15.5 \pm 12.6$ , post  $10.38 \pm 8.47$ ; CG pre  $14.7 \pm 11.96$  post  $10.1 \pm 6.88$ . Results from self-reports revealed that all of the patients with MS felt "better" after climbing. Conclusions Patients with MS can psychologically benefit from a SC-intervention. Self efficacy, as a more predictive value for short-time changes, showed significant improvements over time. Subjective self-report was over all positive. Further research should elucidate psychologically long term effects of SC on patients with MS, especially for self-esteem and depression.

## FUNCTIONAL PERFORMANCE AT RETURN TO PLAY FOLLOWING ACUTE INVERSION ANKLE SPRAIN AMONG COMPETITIVE COLLEGIATE BASKETBALL PLAYERS

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Introduction Previous studies have shown that functional performance tests (FPTs) that stress the lateral aspect of the ankle are able to detect functional performance deficits among the chronically unstable ankles. No study, however, has examined the FPTs' effectiveness to detect the functional deficits at return-to-play phase of acute inversion ankle sprains among competitive athletes. Method Nineteen collegiate basketball players with an acute inversion ankle sprain (height =  $173 \pm 9.05$  cm, mass =  $67.4 \pm 10.11$  kg, age =  $19.5 \pm 1.35$  years, days lost due to injury =  $11.01 \pm 8.01$  days), and a control group of 19 gender and leg dominance matched collegiate basketball players (height =  $173 \pm 10.27$  cm, mass =  $67.0 \pm 9.71$  kg, age =  $20.1 \pm 1.54$  years) participated in the study. The participants completed two FPTs; Square hop test (SQ) and Side Hop test (SH). For the time measurement, the means of 2 trials for each FPT were recorded (in seconds). After completing each FPT, the subjects were asked to rate the perceived pain, instability and difficulty on the 10cm VAS (in cm) (VAS score). One-way factorial ANOVA was performed to identify time differences for each FPT among the injured (Injured), uninjured (Uninjured) and control (Control) limbs. Kruskal-Wallis one-way analysis and Mann-Whitney U Test were performed to identify significant differences of the VAS scores among the groups. Alpha for all analyses was set at  $p < .01$ . Results No significant difference of the time measurements was found among the groups for SQ ( $p=.729$ ), or SH ( $p=.131$ ). For the VAS scores of SQ, the self-reported pain of the Injured ( $1.3 \pm 1.92$ ) was significantly higher than the Control ( $0.47 \pm 0.21$ ),  $p=.006$ , while the self-reported instability of the Injured ( $1.9 \pm 1.64$ ) was also significantly higher than the Uninjured ( $0.5 \pm 0.98$ ),  $p=.003$ , and Control ( $0.2 \pm 1.06$ ),  $p<.001$ . For the VAS scores of SH, the self-reported pain of the Injured ( $1.8 \pm 1.82$ ) was significantly higher than the Uninjured ( $0.2 \pm 0.67$ ),  $p=.003$ , and Control ( $0.2 \pm 0.54$ ),  $p<.001$  while the self-reported instability of the Injured ( $2.6 \pm 1.98$ ) was significantly higher than the Uninjured ( $0.24 \pm 0.70$ ),  $p<.001$ , and Control ( $0.31 \pm 1.04$ ),  $p<.001$ . No significant differences were found for the self-perceived difficulty among the groups for the SQ ( $p=.156$ ) or SH ( $p=.073$ ). Conclusions Based upon the self-reported pain and instabilities, the FPTs were able to effectively detect functional deficits among competitive basketball players at return-to-play phase following acute inversion ankle sprains.

### WALKING ECONOMY AND REHABILITATION INDEX OF SELF-SELECT SPEED IN TRANSFEMORAL AMPUTEES

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**Introduction** In healthy subjects, the self-selected walking speed (SSWS) corresponds to the lowest cost of transport (CT) or most economical walking (Saibene & Minetti, 2003). This study tested the hypothesis that SSWS in amputee would not be the most economical speed, which is often called the optimal walking speed (OWS), when compared with healthy controls. Furthermore, was also tested a rehabilitation index (RI) (Figueiredo et al., 2013), which could be assist in the rehabilitation of individuals with walking limitations. **Methods** Ten transfemoral amputees (30.3±4.7 years old, 73.3±15.0 kg, 1.78±0.1 m) and ten healthy controls (23.1 ± 2.9 years old, 71.6±6.5 kg, 1.78±0.06 m) were compared. Both groups were submitted to a walking cost protocol on the treadmill at the SSWS, at 2 speeds below and 2 speeds above (Figueiredo et al., 2013). The RI was calculated based on the Froud Number equation (Farley & Ferris, 1998), based in leg length and was called RI theoretical (RI<sub>the</sub>), and the quadratic equation (Daijro et al., 2008), based in gas analyzer and was called RI experimental (RI<sub>exp</sub>). For both RI's the closer to 100% this result gets the closer to OWS will the subject be. Comparisons between amputee and control characteristics were carried out with an unpaired t-test and were used repeated measures ANOVA to verify the influence of walking speed. **Results** Amputee's patients had a lower SSWS than healthy controls (2.95±0.41 vs 4.0±0.3; p <0.05). Among the 5 speeds, the control was most economical in SSWS. For the amputees, the SSWS was less economical than the higher speeds. Controls presented higher RI than amputees, where RI<sub>exp</sub> was 98.4±0.05 vs 79.83±0.05; p <0.05, and RI<sub>the</sub> was 84.8±0.06 vs 73.08±0.04; p <0.05, respectively. **Discussion** We confirm our hypothesis and the amputee's patients chose a SSWS with a higher CT unlike of the healthy individuals. The mechanisms responsible for this choice are not readily apparent from our data. Both the theoretical and the experimental RI values were closer to 100% in the control group, which may indicate that these subjects are walking closer to their OWS. With this finding we suggest that the theoretical RI may be a simple and easy method for every usage to establish a goal for rehabilitation. **References** Farley CT, Ferris DP. (1998). *Exerc Sport Sci Rev*, 26, 253–285. Saibene F, Minetti AE. (2003). *Eur J Appl Physiol*, 88, 297-316. Daijro A, Muraki S, Yasukouchi A. (2008). *Appl Ergon*, 39, 392-398. Figueiredo P, Ribeiro PA, Bona RL, Peyré-Tartaruga LA, Ribeiro JP. (2012 Oct 10. [Epub ahead of print]). *Med Sci Sports Exerc*.

### SELF SELECT SPEED OF TRANSFEMORAL AMPUTEES: ECONOMY AND PENDULAR MECHANISM

Peyré-Tartaruga, L.A., Tartaruga, M.P., Bona, R., Figueiredo, P., Gomeñuka, N.A., Bonezi, A., Storniolo, J.L.L., Ribeiro, J.P. (in memoriam)

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**Introduction** The lower limb mass and loss of muscle function result at lower self-select walking speed (SSWS) in above-knee amputees (TF) when compared to non-handicapped. The mechanisms underlying the choice of SSWS in amputees have not been well defined. Recovery that represents the pendular mechanism (Cavagna & Kaneko, 1977), in physical handicapped subjects, such as TF, is lower than non-handicapped (Saibene & Minetti, 2003) suggesting that this energy expenditure minimization system may be altered and this may influence the SSWS (Detrembleur et al., 2005). The aim of this study was to test the influence of walking speed in pendular mechanism and cost of transport (C) in TF and control group. **Methods** Ten traumatic unilateral TF (30.3±4.7 years old, 73.3±15.0 kg, 1.78±0.1 m) performed treadmill level walking with prostheses at five speeds (SSWS 2.95 ±0.46 km.h<sup>-1</sup>, two speeds below were 2.44 ±0.46 km.h<sup>-1</sup> and 1.94 ±0.46 km.h<sup>-1</sup>; their speeds above were 3.42 ±0.46 km.h<sup>-1</sup> and 3.63 ±0.10 km.h<sup>-1</sup>) and ten healthy controls (23.1 ± 2.9 years old, 71.6±6.5 kg, 1.78±0.06 m) on average, the SSWS was 3.96 ±0.25 km.h<sup>-1</sup>; their two speeds below were 2.98 ±0.14 km.h<sup>-1</sup> and 1.98 ±0.25 km.h<sup>-1</sup>, and their speeds above were 4.96 ±0.25 km.h<sup>-1</sup> and 5.97 ±0.28 km.h<sup>-1</sup>. 18 anatomical reflective markers were used to every speed and they were videotaped (50 Hz) 3D during the last minute. Routines in Matlab 6.3 (Mathworks, Inc, USA) were developed for the data analysis. We used the method proposed by Cavagna and Kaneko (1977) for calculation of recovery and C. Were used repeated measures ANOVA. **Results** C was higher in the amputees. The controls presented the smallest economy of walk in the first speed of the protocol. In contrast, the amputees presented the lowest C at speeds above their SSWS. For recovery, the control group, the largest change occurred between the mechanical energies in the intermediate speeds. This optimization was already at the highest speed of walking in this protocol for the amputees **Discussion** According to our starting hypothesis, we found that the C of TF is minimal; in other words, the greatest economy of walking is presented above SSWS (higher walking speed during protocol on treadmill). Similarly, the conversion between mechanical energy (potential and kinetic) during one step (recovery) showed the maximum value at the higher walking speed performed during the trials. Therefore, the energetic optimal speed of amputees is above the freely chosen speed. **References** Cavagna GA, Kaneko M. (1977). *J Physiol*, 268, 467-481. Saibene F, Minetti AE. (2003). *Eur J Appl Physiol*, 88,297-316. Detrembleur C, Vanmarsenille J, Cuyper F. (2005). *Gait Posture*, 21, 333-340.

### WHAT ARE THE DIFFERENCES IN PHYSICAL STRAIN AND MECHANICAL EFFICIENCY BETWEEN A LEVER PROPELLED WHEELCHAIR AND A HAND RIM PROPELLED WHEELCHAIR?

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**Purpose** In those in a wheelchair, handrim (HA) propulsion is straining for the shoulder joint with a low mechanical efficiency. Therefore, the Aspire Centre for Disability Sciences developed the NuDrive (ND), which is a unidirectional lever propelled wheelchair system that can be added to an ordinary HA wheelchair. Literature suggests that lever propelled wheelchairs are more efficient and less straining due to the cyclic movement and the involvement of a greater muscle mass. **Methods** Nine able bodied participants (21,3 ± 1,2 yrs) without wheelchair experience participated in this study. The participants performed a submaximal test with- and without the ND in a randomised order. Submaximal testing was performed on a motor driven treadmill (constant velocity: 0.56 m/s; inclination: start 0% and +1% per 3 minutes). Respiratory and metabolic parameters (oxygen uptake (VO<sub>2</sub>), heart rate (HR) & ventilation (VE)) were measured by a gas analyser on the 0% and 4% condition. Power output (PO) was calculated by a drag test before every test. Mechanical efficiency (ME) was calculated as the ratio between PO and metabolic power (P<sub>met</sub>). **Results** No differences in ME, HR and PO (0% condition, HA-ND: ME 4.7-4.4%, HR 73-81bpm, PO 10.5-11.2W; 4% condition, HA-ND: ME 8.6-8.1%, HR 84-82bpm, PO 27.5-28.7W) were found between ND and HA propulsion for all conditions. However, higher values for ND were found for VO<sub>2</sub> (0%-4% condition: 14% - 24%) and VE (0% - 4% condition: 12% - 20%). **Conclusion** ND-propulsion induced a greater physiological strain (i.e. increased VO<sub>2</sub> and VE) probably explained by the greater mass (3 kg added) of the ND system. This results in a higher required PO at a similar % and velocity. ME of both ND and HA was similar in the present study. In earlier literature, bidirectional lever systems were used while the ND is a unidirectional lever system. Con-

sequently, shorter push times are possible for the ND, possibly being less efficient. It has to be kept in mind though that learning effects may have a great influence on ME. In ND propulsion, it is essential to move in a straight line forwards-backwards. Any deviations in left-right direction result in activating the brake mechanism or shifting gears. This movement is not intuitive, and might require a different and more extensive learning process than HA propulsion. Future studies should incorporate these learning aspects. Besides this, the ND could provide variety in propulsion mode and could be suitable for people with very low active muscle mass, and should be evaluated for different patient groups.

### **THE EFFECT OF ALPINE SKIING ON LEG MUSCLE STRENGTH ASYMMETRY IN PARTICIPANTS WITH TOTAL KNEE ARTHROPLASTY**

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**INTRODUCTION** Total knee arthroplasty (TKA) is one of the most common surgery interventions for end stage knee osteoarthritis. The annual incidence of TKA is on average 175 procedures per 100 000 population (1). It has been demonstrated that force deficits (asymmetry) between operated (OP) and non operated (NOP) legs exist (2), which may persist for years after TKA, and are associated with functional limitations (3). In alpine regions, skiing is an extremely popular leisure-time activity for individuals of all ages. An increase in functional performance through skiing was found in elderly without TKA (4). The purpose of this study was to investigate if a 10 wk skiing intervention reduces asymmetry in leg strength and in force distribution during skiing. **METHODS** Thirteen participants (2 ♀, 11 ♂; 66±4 yrs.; 2.1±1.1 yrs. post OP) with unilateral TKA and intermediate skiing skills underwent a 10 wk (30 skiing days) guided skiing intervention. Pressure insoles (Novel, Germany) were used to determine the kinetic data (mean GRF) during skiing on a defined course pre and post intervention. The maximal isometric leg strength (120° knee angle) was measured unilaterally on both legs using a leg press during pre and post intervention. Paired sample t-tests ( $p < .05$ ) were used for statistical analyses. **RESULTS** Asymmetry in ground reaction forces while skiing between OP and NOP leg was found, neither in pre nor in post test. Maximal isometric leg strength was significantly lower in OP leg compared to NOP leg in pre (OP 12.6±4.35; NOP 14.2±3.6 N/kg) ( $p = .031$ ) and post test (OP 14.1±3.6; NOP 15.3±2.9 N/kg) ( $p = .020$ ). Improvements in leg strength were determined in the OP leg ( $p = .006$ ) but not in the NOP leg ( $p = .051$ ). Asymmetry between dominant and non dominant leg strength could be significantly reduced from 15.8±10.6 to 8.7±8.8 % ( $p = .012$ ). **DISCUSSION AND CONCLUSIONS** Interestingly, the existing leg strength asymmetry in the lab test did not occur during alpine skiing as it was found in gait analyses (3). Even though alpine skiing is a bilateral training, a significant improvement in leg strength was found only in the OP leg. However, based on the classification of dominant vs. non dominant leg, the results showed that leg strength asymmetry was reduced. This potentially plays a beneficial role to reduce increased fatigue rate, fall risk and limitation of mobility. **REFERENCES** (1) Kurtz SM, et al. (2011). *Int Orthop*, 35, 1783-1789 (2) Meier W, et al. (2008). *J Orthop Sports Phys Ther*, 38(5), 246-256 (3) LaRoche DP, et al. (2012). *Med Sci Sports Exerc*, 44(11) 2172-2181 (4) Müller E, et al. (2011). *Scand J Med Sci Sports*, 21 (Suppl. 1), 9-22 Do not insert authors here

### **RELATIONSHIPS BETWEEN SELF-PERCEIVED KNEE FUNCTION AND INDICES OF MUSCULOSKELETAL PERFORMANCE IN AN ACL-RECONSTRUCTED POPULATION**

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**Introduction** Rupture of the anterior cruciate ligament (ACL) is a potentially career-threatening injury for sports performers, invariably requiring reconstructive surgery to restore knee function (1) and considerable rehabilitative temporal and fiscal costs. Two-thirds of patients have not returned to competitive sport within 12 months of surgery (1). Knee joint function is usually evaluated from a combination of clinical assessment and patient perceptions obtained from rating scales and questionnaires. Limited research has focused on how these inventories in an ACL-reconstructed population relate to objective measures, which is the focus of this study. **Methods** 31 patients (27 males, 4 females) were selected randomly from those presenting with arthroscopically verified unilateral ACL rupture. Patients underwent a standardised rehabilitation and were assessed at pre-, 6 weeks, 12 weeks, 24 weeks and 48 weeks following surgery. Knee extensor (KE) and flexor (KF) peak force (PF) and rate of force development (RFD), ACL laxity (LAX) and single leg hop for distance were assessed. Perceptions of knee function were obtained using the IKDC Subjective Knee Evaluation form (IKDC) and performance profiling (PP). Relationships between self-perceived and objective measures were calculated for the injured limb expressed as a percentage of the corresponding value for the non-injured limb to produce a limb symmetry index (2). **Results** Anticipated patterns of altered musculoskeletal performance were evident following surgery. Knee laxity significantly improved (56.5%) from pre-surgery to 6 weeks. Following impairment to most indices of performance (injured limb) over this same time-period (e.g. KE PF: 35.3%; KF PF: 26.9% decrease), continual improvements to each index was observed at all time-points thereafter ( $p < 0.001$ ). Increases in PP ( $p < 0.001$ ) and IKDC ( $p < 0.001$ ) scores indicated progressively improved perceived knee function. A lack of significant concomitant and latent correlations between indices of perceived and objective outcomes were evident throughout most of the rehabilitation, although at 48 weeks moderate concomitant correlations were observed with various indices (e.g. hop: 0.45; KERFD: 0.57;  $p < 0.001$ ). **Discussion** Discrepancies between self-perceived and actual function may reflect a lack of efficacy of the self-reported inventories, or possibly a misplaced level of confidence in the capabilities of the reconstructed knee. Both of which might prompt overly cautious approaches to rehabilitation. **References** 1. Ardern et al. (2011) *Br J Sp Med*, 45: 596-606. 2. Thomee et al. (2011). *Knee Surg Sports Traumatol Arthrosc* 19 :1798-1805.

### **THE RELATION BETWEEN THE PERFORMANCE OF TRANSITION PHASE OF SIT-TO-WALK TASK AND STRENGTH COMPONENTS IN PARKINSON'S DISEASE PATIENTS**

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**Introduction** The Parkinson's disease (PD) is characterized by bradykinesia, rigidity, tremor and deficit balance. This symptom leads PD patients to a poorer performance in activities of daily living (ADL) as rising up from a chair and walking. To perform ADL muscular strength is required. It is known that PD patients are weaker than healthy pairs, however there is the need to investigate other strength components, as the rate of force development (RFD) in these subjects (Stevens-Lapsley et al., 2012). It is also important to determine if these variables play an important role in ADL, as the transition phase of sit-to-walk (STW). Therefore, the aim of this study was to analyze the differences between the performance of PD patients and healthy subjects on STW task (Kerr et al., 2004), mainly in transition phase (TP) and on force production. We also analyzed the RFD in 50, 100 and 200 ms after the force onset and the correlation between force varia-

bles to task performance and to clinical measures (only for the PD group). Methods Participated 12 PD patients and 12 healthy subjects (CG). The subjects were instructed to walk as fast as possible to answer a telephone (positioned at 3m apart) after hearing its signal. To analyze the TP, we captured subjects' movements with a digital camera and the task was defined as between the ring signal and the first step toe off. The isometric knee extension strength was measured using a leg-press through a force cell. Results Student t-test showed differences between groups in: TM ( $p=0,029$ ), PF ( $p=0,009$ ), RFD-50ms ( $p=0,002$ ), RFD-100ms ( $p=0,003$ ) and RFD-200ms ( $p=0,008$ ). The Pearson correlation showed correlations for PD (TMxUPDRS II -  $r=0,721/p=0,008$ ; and TMxHY -  $r=0,660/p=0,02$ ) as for CG (TMxRFD-50ms -  $r=-0,601/p=0,039$ ; TMxRFD-100ms -  $r=-0,606/p=0,037$ ; TMxRFD-200ms -  $r=-0,629/p=0,028$ ). Discussion PD patients showed a poorer performance on TP and on strength variables. However, the correlation tests failed to point a relation between PD clinical characteristics and force production. These results demonstrate: i) the TP performance of PD patients is more influenced by disease characteristics than to force production, whereas in CG, it is highly influenced by these variables; ii) the strength test could not be sensitive to PD characteristics, (as no correlation between RFD and clinical signs – as bradykinesia – was found) and should be replaced on further studies. Finally, this slowness could explain the poorer performance on TM. References Kerr A et al. (2004). Clin Biomech, 19, 385-390. Stevens-Lapsley J et al. (2012). Neurorehabil Neural Repair, 26, 5, 533-541.

### **CHRONIC EXERCISE INFLUENCE ON THE AMPHETAMINE-DEPENDENT BEHAVIOUR AND DOPAMINE IN STRIATUM, FRONTAL CORTEX AND HIPPOCAMPUS IN THE RAT**

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**Introduction** The dopaminergic mesocorticolimbic and nigrostriatal systems are involved in drug addiction. However, there is little information about the effect of exercise on addiction and on the synthesis, metabolism and action of dopamine (DA) in the presence of amphetamines. This work aimed to verify the influence of exercise on addiction using an amphetamine (AMPH)-induced conditioned place-preference (CPP) in rats, and to determine DA and respective metabolites in striatum, frontal cortex and hippocampus. **Methods** Adult male Sprague-Dawley rats were randomly separated in two groups: one with and another without exercise (8 weeks running program in a treadmill, with increasing intensity). The CPP test was performed in both groups. There were three phases: 1st- Pre-conditioning: free access to both compartments, 20 min sessions with registration of the time spent in each compartment; 2nd- Conditioning: 8 consecutive days (45 min sessions) in the alternated compartments (4 days of 2 mg/kg AMPH alternated with saline injections); 3rd- Test day: free access to both compartments, 20 min sessions with registration of the time spent in each compartment. Animals were sacrificed 24 h after the last AMPH or saline, and striatum, hippocampus and frontal cortex were dissected for DA and metabolites measurement by HPLC-ECD. **Results** Since in the pre-conditioning phase none of the animals presented preference for a compartment, all the animals were used. Rats without exercise showed preference for the compartment associated with AMPH, an effect which did not occur with the animals with training. Amphetamine decreased striatal DA content and turnover from trained and untrained rats. Training reduced and increased DA content in frontal cortex and hippocampus, respectively. **Discussion** Exercise may prevent the AMPH-seeking behaviour but not changes the AMPH impact on striatal DA. Exercise may alter DA dynamics in the frontal cortex and hippocampus which may be correlated with addiction.

### **EFFECT OF EARLY IMPLEMENTATION OF ELECTRICAL MUSCLE STIMULATION TO PREVENT MUSCLE WEAKNESS IN PATIENTS AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION**

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**Introduction** Following anterior cruciate ligament (ACL) reconstruction, restricted weight bearing and immobilization results in thigh and calf muscle atrophy and weakness. Electrical muscle stimulation (EMS) is available as a training tool to prevent muscle weakness and atrophy, but there are currently no reports in which EMS was started during the early rehabilitation stage after surgery. The purpose of this study was to assess the effect of EMS on prevention of muscle atrophy in patients during the early rehabilitation stage after ACL reconstruction using the wave form of 20Hz exponential pulse. **Methods** Twenty patients with acute ACL tears were divided into two groups. The control group (CON group) participated in only the usual rehabilitation program. In addition to this protocol, the electrical muscle stimulation group (EMS group) received EMS training from the 2nd post-operative day to 4 weeks after the surgery. The muscle thicknesses of the rectus femoris (RF), vastus intermedius (VI), vastus lateralis (VL), and calf (CA) muscles were measured as well as knee extensor muscle strength before the operation and at 4 weeks and 3 months after surgery. **Results** Muscle thickness of VL and CA increased significantly 4 weeks after surgery in the EMS group, while it decreased significantly in the CON group. The decline of knee extension strength was significantly less in the EMS group than in the CON group at 4 weeks after the surgery, and the EMS group showed greater recovery of knee extension strength at 3 months after surgery. **Discussion** There have been some controversial findings regarding the effects of EMS following ACL reconstruction. Lieber et al. demonstrated that 50 Hz neuromuscular electrical stimulation and voluntary muscle contraction treatments, when performed at the same intensity, are equally effective in strengthening skeletal muscle that has been weakened by surgical repair of the ACL. On the other hand, Snyder-Mackler et al. reported that quadriceps strength averaged at least 70% of the strength on the uninvolved side in patients treated with high-intensity electrical stimulation (either alone or combined with low-intensity electrical stimulation), 57% in patients treated with high-level active exercise, and 51% in patients treated only with low-intensity electrical stimulation. Our present results confirmed significant efficacy of EMS training following ACL surgery, but differ from previous studies on some points. Our current data indicated that EMS training not only prevented muscle atrophy following ACL reconstruction, but also resulted in VL and CA hypertrophy, which have not been reported previously. We believe these different results are caused by differences in the start timing of EMS, the EMS protocol, and the electrodes. **References** Lieber RL, Silva PD, Daniel DM. (1996). Journal of Orthopedic Research. 14, 131-138. Snyder-Mackler L, Delitto A, Bailey SL, Stralka SW. (1995). Journal of Bone Joint Surgery. 77, 1166-1173.

### **EFFECT OF A PREPARATION PROGRAM AFTER SURGERY ON REPEATED ANTERIOR SHOULDER DISLOCATION**

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**Introduction** A fall onto an outstretched arm or a collision on the playing field often leads to an acute anterior shoulder dislocation for high school- and college-age athletes. The diagnosis is usually made by history and physical exam. Despite immobilization, supervised

rehabilitation, and gradual return to full activity, dislocation recurrence ranges from 60% to 94% in patients younger than 25. The purpose of this study was to review the effect of a mobilization exercise and strengthening program with dynamic splint on prevention of repeated shoulder dislocation in professional athletes. Methods In this retrospective quasi experimental study, 18 athletes with mean age of 25 years suffering from repeated anterior shoulder dislocation with effective trauma were reviewed in a mobilization and strengthening program with dynamic splint of shoulder. The results were evaluated by Constant Shoulder Score (CSS), descriptive analysis, and t- test ( $P < 0.05$ ). Results The decreased range of motion in shoulder joint in abduction and external rotation in comparison with healthy shoulders was 36 degrees. The training program had a significant effect on reduction on repeated anterior shoulder dislocation. In radiology, 3 cases of premature arthritis which had restriction in external rotation were observed. Discussion Rate of instability after mobilization and strengthening program with dynamic splint was low but due to the restriction that dynamic splint induces in external rotation of shoulder joint, this program should be done by professional athletes in a way that in the final stages of the training program splints are used less. References 1.Iannotti JP, Gabriel J, Schneck S, Evans B, Misra S. The normal glenohumeral relationships. An anatomical study of one hundred and forty shoulders. *The Journal of Bone and Joint Surgery*. 1992;74(4):491-500. 2.Krøner K, Lind T, Jensen J. The epidemiology of shoulder dislocations. *Archives of Orthopaedic and Trauma Surgery*. 1989;108(5):288-290. 3.Rowe C, Zarins B. Recurrent transient subluxation of the shoulder. *The Journal of Bone and Joint Surgery*. 1981;63(6):863-872. 4.Mclaughlin HI, Maclellan Di. Recurrent anterior dislocation of the shoulder II. A comparative study. *The Journal of Trauma*. 1967;7(2):191-201 5.Itoi E, Motzkin NE, Morrey BF, An KN. Scapular inclination and inferior stability of the shoulder. *Journal of Shoulder and Elbow Surgery*. 1992;1(3):131-139. 6.Rowe C, Zarins B, Ciullo J. Recurrent anterior dislocation of the shoulder after surgical repair. Apparent causes of failure and treatment. *The Journal of Bone and Joint Surgery*. 1984; 66(2): 159-168. 7.Yamamoto T, Yoshiya S, Kurosaka M, Nagira K, Nabeshima Y. Luxatio erecta (inferior dislocation of the shoulder): a report of 5 cases and a review of the literature. *The American journal of orthopedics*. 2003; 32(12): 601-603. 8.Dowdy PA, O'Driscoll SW. Recurrent anterior shoulder instability. *The American Journal of Sports Medicine*. 1994; 22(4): 489-492.

### MOTOR ABILITY AND DEPRESSIVE SYMPTOMS ARE RELATED AFTER ISCHEMIC STROKE

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**Introduction** Motor impairment is one of most common deficit after ischemic stroke. It is estimated that 80% of patients remain with some motor deficit (1). Other common difficulty is a depression, which has a negative impact in patient's life. Depressive symptoms are estimated between 10-78% in post-stroke patients (2). Motor impairment and depression affect directly the quality of life in stroke patients (3). **Objective** Verify the relationship between motor ability and depressive symptoms after ischemic stroke. **Methods** We evaluated patients with first anterior circulation unilateral ischemic stroke. Motor function was appraised by Fulg-Meyer Motor Scale (FMMS). Depressive symptoms were evaluated by Beck Depression Inventory (BDI). We also got general information as: age, sex, stroke lateralization, NIHSS. A linear regression model was used to assess the independent factors associated with motor impairment. **Results** We performed an evaluation in 58 patients (36 men;  $62.4 \pm 12.9$  years; 35 had a left sided ischemic stroke). The median time to evaluation was 178 (IQR 118-397) days, median NIHSS at the time of evaluation was 2 (IQR 0-4), mean FMMS was  $92.8 (\pm 25)$  and mean BDI score was  $11 (\pm 7.2)$ . After adjusting for BDI score, stroke lateralization, sex, age and NIHSS, only depressive symptoms ( $\beta = -0.84$ ,  $p = 0.04$ ) and NIHSS ( $\beta = -4.3$ ,  $p < 0.001$ ) were independently associated with motor function. There was a strong trend for women to have better motor function ( $\beta = 9$ ,  $p = 0.09$ ). **Discussion** The relationship between motor impairment and depression could be explained by Kim and colleagues (2005) (4) that found motor dysfunction affecting mobility and self-care. It influences mood, consequently, depression could be manifested. Our result also collaborates to the Van de Port and Colleagues (2007) (5), who found the relationship between motor impairment and depression in chronic post stroke patients, emphasizing an association between post stroke depression and post stroke fatigue. **References** 1.Barker W. H., Mullooly J. P. (1997). Stroke in a defined elderly population, 1967-1985. A less lethal and disabling but no less common disease. *Stroke*. 28: 284-290 2.Singh A et al. (1998). The importance of lesion location in post-stroke depression: a critical review. *Can J Psychiatry*; 43: 921-7 3. Carod-Artal J., et al. (2000). Quality of life among stroke survivors evaluated 1 year after stroke. Experience of a stroke unit. *Stroke* 31, 2995-3000 4.Kim JS, et al. (2005). Factors affecting the quality of life after ischemic stroke: young versus old patients. *J Clin Neurol*. 59-68 5.Van de Port, I. L., et al. (2007). Determinants of depression on chronic stroke? A prospective cohort study. *Disability and Rehabilitation*, 5, 353-358

15:00 - 16:00

## Mini-Orals

### PP-PM60 Sports Medicine [SM] 4

#### BLOOD PRESSURE RESPONSES TO DIFFERENT TRAININGS.

Niño, O.1, Alamo, J.M.1, Aragonés, D.2, Balagué, N.2, Cos, F.2, Guillamó, E.1,2, Ventura, J.L.1, Javierre, C.1

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**Introduction** The purpose of this study was to evaluate the values of blood pressure at rest and at submaximal exercise after different training modalities: aerobic (AET), resistance (RET) and mixed (MIX). **Methods** Forty-three healthy male subjects physically active, (age  $21.2 \pm 2.4$  years) were randomly distributed in four different training groups: AET, RET, MIX and control (CON). They were trained for six weeks except the control group. Before (1st day), after training period (2nd day) and three weeks after the training (3rd day) the subjects were evaluated in the cycle ergometer during 6 minutes with a constant workload corresponding to 60% of maximal aerobic power. **Results** Blood pressure decreased in the three training groups. A/ At rest: systolic blood pressure (SBP) between the 1st and the 3rd day in the AET group ( $10.1 \pm 5.6$  mmHg), in the RET group ( $8.9 \pm 5.0$  mmHg) and significantly in the MIX group ( $19.1 \pm 7.2$  mmHg) ( $p = 0.038$ ); diastolic blood pressure (DBP) ( $9.9 \pm 4.3$  mmHg) ( $p = 0.049$ ) and mean blood pressure (MBP) ( $12.4 \pm 5.0$  mmHg) ( $p = 0.043$ ) in the MIX group. B/ At exercise, the AET group showed differences between the 1st and the 3rd day for: SBP ( $18.7 \pm 5.2$  mmHg) ( $p = 0.003$ ), DBP ( $7.6 \pm 3.1$  mmHg) ( $p = 0.035$ ) and MBP ( $12.4 \pm 3.2$  mmHg) ( $p = 0.004$ ); the RET group showed differences between the 1st and the 2nd day for SBP ( $17.6 \pm 6.0$  mmHg) ( $p = 0.016$ ), DBP ( $7.8 \pm 2.3$  mmHg) ( $p = 0.009$ ) and MBP ( $11.3 \pm 3.5$  mmHg) ( $p = 0.010$ ) and between the 1st and the 3rd day for SBP ( $25.8 \pm 8.4$  mmHg) ( $p = 0.013$ ), DBP ( $11.3 \pm 4.1$  mmHg) ( $p = 0.022$ ) and MBP ( $16.7 \pm 5.7$  mmHg) ( $p = 0.017$ ) and the MIX group showed differ-

ences between the 1st and the 2nd day in DBP ( $6.8 \pm 2.4$  mmHg) ( $p=0.021$ ) and between the 1st and the 3rd day SBP ( $16.2 \pm 4.4$  mmHg) ( $p=0.006$ ) and MBP ( $11.4 \pm 5.0$  mmHg) ( $p=0.043$ ). Discussion The blood pressure response to resistance training or to mixed training can be at least as effective as aerobic training, with positive effects lasting 3 weeks after finishing the exercise program. Mixed training seems to provoke a bigger decrease at rest. References Cornelissen VA, Buys R, Smart NA, Buys R. (2013) J.Hypertens. (ahead of print). Cornelissen VA, Fagard RH, Coeckelberghs E, Vanhees L (2011) Hypertension 58:950-958.

### CHANGES OF BIOCHEMICAL AND CARDIOVASCULAR SYSTEM FUNCTIONAL PARAMETERS OF MIDDLE-AGED MEN OF DIFFERENT PHYSICAL ACTIVITY DURING EXERCISE

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Introduction In the middle age, most of the time people spend on profession, household needs, child care that affect their lifestyle and at the same time and physical activity. The aim of the study was to establish how physical activity and age effects on cholesterol and glucose levels in the blood, heart, and circulatory system function of middle-aged men during increasing physical load. Methods In the research participated 95 Lithuanian soldiers. Participants were divided into low, medium and high physical activity groups to evaluate physical activity level. Biochemical blood tests were carried out (blood glucose level, cholesterol amount in the blood), recorded and measured electrocardiogram (ECG), calculated heart rate (HR) and blood pressure (BP) during the rest time. Participants did exercise test to determine exercise capacity and changes of cardiovascular systems function with measured standardized load. Results. Cholesterol of physically inactive reserached participants was 80 mmol / l higher than physically active - 50 mmol / l. Glucose in the blood of physically inactive participatns are 68 mmol / l - physically active - 31,3 mmol / l. Heart rate of physically inactive participants rised much faster than medium and high physical active participants ant they earlier reached the sub-maximal heart rate. Both systolic and diastolic blood pressure during exercise came faster for physically inactive participants than physical active, regardless to physical activity level for all participants blood recovered after 8 minutes. Conclusions: The results of the study showed that physical activity in the middle age has a positive effect on biochemical and cardiovascular functional parameters during and after exercise. The only cardiovascular rate - systolic blood pressure was significantly higher of older research participants than younger, all other parameters researched age had no effect. References Booth, F. W., Chakravarthy, M. V. (2002). Cost and Consequences of Sedentary Living: New Battleground for an Old Enemy Research Digest, 16, 1—8. Dishman, R. K., Washburn R. A., Heath, G. W. (2004). Physical Activity Epidemiology. Champaign, IL, USA: Human Kinetics. Deen, D. (2004). Metabolic Sindrome: Time for Action. American Family Physician, 69 (12), 2875–2882. Kodama, S., Tanaka, S., Saito, K. et al. (2008). Effect of Aerobic Exercise Training on Serum Levels of High-Density Lipoprotein Cholesterol: A Meta-analysis. Clinical Journal of Sports Medicine, 18 (1), 107–108. Kraus, W. E., Houmar, J. A., Duscha, B. D., Knetzger, K. J., Wharton, M. B (2002). Effects of the amount ant intensity of exercise on plasma lipoproteins. The New England Journal of Medicine, 347 (19), 1483-1492.

### THE INFLUENCES OF ACUTE EXERCISE ON ENDOTHELIUM-DEPENDENT VASORELAXATION AND ANTIOXIDANT ACTIVITY IN POSTMENOPAUSE WITH HYPERTENSION

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Introduction Menopause-related estrogen deficiency increases the risk of cardiovascular disease, which could be further aggravated by the presence of hypertension. Regular exercise has been reported to improve cardiovascular function and antioxidant activity. However, whether acute exercise influences endothelium-dependent vasorelaxation and antioxidant activity in postmenopause with hypertension remains unclear. Therefore, the aim of this study was to investigate the influences of a single bout of exercise on endothelium-dependent vasorelaxation and antioxidant activity in postmenopausal hypertensive rats. Methods Four-month-old female spontaneously hypertensive rats were divided into three groups: (1) the sham-operated control group (sham); (2) the ovariectomy without exercise group (OVX); and (3) the ovariectomy with exercise group (OVX+EX). A single bout of exercise was conducted by treadmill running at moderate intensity for 1 hour in the OVX+EX group. Rat thoracic aortas were isolated for the measurement of the endothelium-dependent (acetylcholine, ACh) and endothelium-independent (sodium nitroprusside, SNP) vasorelaxation by the organ bath system. The serum levels of antioxidant and oxidant activities, such as catalase and thiobarbituric acid reactive substance (TBARS), were also evaluated. Results The single bout of exercise significantly improved ACh-induced vasorelaxation in the OVX+EX group compared with the OVX group ( $p<0.05$ ). However, there was no significant difference in the SNP-induced vasorelaxation among three groups. Furthermore, the single bout of exercise significantly increased the catalase activity ( $p<0.05$ ), but not TBARS level, in the OVX+EX group compared with the OVX group. Discussion Our results indicated that a single bout of exercise could acutely improve endothelium-dependent vasorelaxation and antioxidant activity in postmenopausal hypertensive rats. It implicated that exercise would ameliorate the cardiovascular function in the population of postmenopause with hypertension. Since our study only explored the influences of a single bout of exercise, further studies would be encouraged to examine the effects of long-term exercise intervention for this population. References Barton M, Meyer MR. (2009) Hypertension, 54(1), 11-18. Karolkiewicz J, Michalak E, Pospieszna B, Deskur-Smielecka E, Nowak A, Pilaczyńska-Szcześniak Ł. (2009) Arch Gerontol Geriatr, 49(1), e67-e71. Staffileno BA, Braun LT, Rosenson RS. (2001) J Cardiovasc Risk, 8(5), 283-290.

### THE EFFECTS OF ACUPUNCTURE ON TISSUE-BLOOD VOLUME

Kaneko, Y.1,2, Kime, R.1, Takagi, S.1, Murase, N.1, Osada, T.1, Katsumura, T.1, Kihira, A.2, Uehara, A.2, Furuya, E.2, Sakamoto, A.2

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[Objective] Acupuncture is widely used for musculoskeletal disorders such as low back pain, shoulder pain, knee pain or osteoarthritis in complementary and alternative medicine. It is considered as one of the reasonable referral option for chronic pain (Vickers, et al. 2012). Acupuncture may help athletes who complain of their injuries by reducing the pain. One of the physiological effects of acupuncture is increasing blood circulation and it may help to ease pain or fasten the recovery from injuries (Kubo et al. 2011). The aim of this study was to examine the effects of acupuncture on tissue-blood volume in both local and distant area at the same time. [Methods] Subjects were 10 healthy male. Near Infrared Spectroscopy (NIRS, HB-14, ASTEM Co.,Ltd.) were used to detect Oxyhemoglobin (OxHb), Deoxyhemoglobin (DxHb), Total hemoglobin (ToHb), and Tissue-Oxygen Saturation (StO2). The probes of NIRS were placed on the right and left side of erector spinae at S1 level (RS1, LS1), the right side of erector spinae at L4 level (RL4), and the belly of gastrocnemius on the right (RG). Subjects lay on their belly and rested. The acupuncture needle (0.25\*50mm, SEIRIN Co.ltd.) was inserted into right side of erector spinae at S1 level,

then manipulated for 1 minute and left for 9 minutes. Subjects kept rested after removal of needle for 10 minutes. OxHb, DxHb, ToHb, and StO<sub>2</sub> at rest (Pre) and after the acupuncture stimulation (Post) were evaluated. [Result] At RS1 where the needle were inserted, OxHb was increased from 39.8±11.7µM to 43.9±12.8µM (p<0.01). No change was observed in DxHb (8.0±4.1µM to 7.9±4.5µM). ToHb was increased from 47.8±14.1µM to 51.8±15.5µM (p<0.01). StO<sub>2</sub> was increased from 83.8±6.0% to 85.4±6.1% (p<0.01). At LS1 OxHb was increased from 30.6±9.6µM to 32.7±10.5µM (p<0.01). No change was observed in DxHb (7.6±3.7µM to 7.6±3.9µM). ToHb was increased from 38.2±13.0µM to 40.3±14.1µM (p<0.01). StO<sub>2</sub> was increased from 80.9±5.2% to 82.0±5.1% (p<0.05). At RL4 OxHb was increased from 36.1±7.8µM to 41.0±9.2µM (p<0.01). No change was observed in DxHb (8.5±4.4µM to 8.9±3.6µM). ToHb was increased from 44.1±11.0µM to 49.8±12.3µM (p<0.01). StO<sub>2</sub> was increased from 81.2±5.1% to 82.8±4.2% (p<0.01). At RG OxHb was increased from 77.7±34.2µM to 80.7±36.6µM (p<0.05). DxHb was increased from 27.4±7.7µM to 28.7±7.4µM (p<0.05). ToHb was increased from 105.2±40.3µM to 109.2±42.3µM (p<0.01). There was no change in StO<sub>2</sub> (72.8±4.9% to 72.4±5.5%). [Conclusion] The different effects of acupuncture on tissue-blood volume were observed in local and distant area. These results indicate that the acupuncture stimulation may affect differently to local and distant area such as by axon reflex and by segmental effects. [References] Vickers et al. (2012) Arch Intern Med. 2012;172(19):1444-1453. Kubo et al. (2011) Int J Sports Med. 2011 Oct;32(10):807-13.

### THE EFFECT OF MUSIC TYPE IN CARDIOPULMONARY CAPACITY DURING AEROBIC EXERCISE

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Introduction Favorite music can make one delight, however, displeasure music may become the source of the stress. Previous studies showed that music can affect human automatic nervous system and change one's blood pressure and heart rate (Potteiger et al., 2000). Therefore, listening music during exercise may affect exercise performance. The purpose of this study was to discuss the effect of music type in cardiopulmonary function during cycling. Methods Seven male college students without any cardiopulmonary system syndrome were recruited in this study. Before testing, the subjects were asked to have a Physical activity Readiness Questionnaire (PAR-Q) to make sure the subjects could afford the testing. During the test, the pulmonary gas exchange system was used to record the cardiopulmonary parameters during cycling. The subjects were asked to keep at rest for five minutes and doing cycling at 30W resistance, 60 rpm pedaling rate for warm up for four minutes. After warm up, the resistance increased to 60W and the subjects' heart rate must reach 75% maxima heart rate within one minute. During data collection, the resistance maintained at 60W and subjects were asked to keep at 75% maximum heart rate with free pedaling rate for fifteen minutes. The data still keep record for five minutes after cycling. Two different types of music with light music and heavy metal music were tested and the tempo in two types of music is 134 beats/min. Results During the rest, the heart rate is significant higher in listening the heavy metal music than in light music. During cycling, the averaged Rf, VE, VO<sub>2</sub> and VCO<sub>2</sub> are higher in listening heavy metal music than in light music, however not reached significant difference. After exercise, the VE, VO<sub>2</sub> and VCO<sub>2</sub> recovered faster in first minute significantly when listening the heavy metal music (heavy metal music: VE=18.2%±0.1, VO<sub>2</sub>=37.9%±0.1, VCO<sub>2</sub>=43.3%±0.1; light music: VE=27.8%±0.1, VO<sub>2</sub>=36.1%±0.1, VCO<sub>2</sub>=35.5%±0.1). In the second minute after exercise, only the recovering percentage of heart rate is much significant faster in listening the heavy metal music (heavy metal music HR=22.3%±0.03, light music HR=19.8%±0.04, P=0.03). Discussion From our results, the heavy metal music may stimulate more sympathetic nervous system that could increase heart rate and respiratory system. In the recovery phase, the heavy metal also have similar stimulation outcome that could enhance recovery after exercise. In this study, the exercise intensity is not very high, the heavy metal music could inspire someone, and stimulate sympathetic nervous system. If listening heavy metal music in higher intensity exercise, it may be a pressure and would not help for exercise. Listening music could change the physiological condition during exercise, and listening the heavy metal music after exercise could recover faster. References Potteiger JA, Schroeder JM, Goff KL. (2000). Percept Mot Skills, 91, 848-854.

### EFFECTS OF A COMMUNITY-BASED EXERCISE PROGRAM IN CLINICAL BLOOD PRESSURE OF PATIENTS WITH TYPE 2 DIABETES: DIABETES EM MOVIMENTO® PILOT STUDY

Mendes, R., Sousa, N., Reis, V., Themudo Barata, J.

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Introduction One of the major complications of type 2 diabetes is systemic arterial hypertension, that leads to an increase in morbidity and mortality of diabetic patients. Regular exercise is widely recommended as a non-pharmacological strategy to control type 2 diabetes and also to control blood pressure levels and reduce cardiovascular risk. This study aims to analyze the effects of a community-based group exercise intervention in clinical blood pressure of patients with type 2 diabetes. Methods This was a longitudinal study design. Twenty-three individuals with type 2 diabetes (diagnosed at 7.43 ± 5.23 years; 12 men and 11 women; age 60.17 ± 7.85 years old; glycated hemoglobin 7.13 ± 1.40 %; fasting glucose 155.67 ± 50.51 mg/dl; body mass index 30.38 ± 4.64 kg/m<sup>2</sup>; waist circumference 105.20 ± 11.73 cm; clinical systolic blood pressure 131.35 ± 14.33 mmHg; clinical diastolic blood pressure 78.90 ± 10.04 mmHg) treated with oral antihypertensive agents (with same drugs and dosages for at least 3 months), underwent a community-based group exercise program with 23 weeks duration. Exercise sessions were held three times per week on non consecutive days (Mondays, Wednesdays and Fridays) with a duration of around 70 minutes and were supervised by exercise professionals. Sessions consist of five phases: 1) Warm up (5 min), which included brisk walking; 2) aerobic exercise (30 min), which included walking at different speeds, relay races, obstacle and stairs courses; 3) resistance exercises (20 min) performed with chairs, dumbbells, fitness balls and bodyweight exercises; 4) agility training (10 min) consisting of reduced, simplified and adapted team ball games; and 5) cool down / flexibility (5 min) through static and dynamic stretching exercises. Clinical blood pressure was determined before and after exercise program (pre and post-test). Results Exercise program dropout was 26.09 % (N = 6) and exercise adherence was 70.79 ± 19.73 %. No changes occurred in type and dosages of antihypertensive drugs between pre and post-test. Student's t test for paired samples identified significant differences in systolic blood pressure (133.00 ± 14.21 mmHg vs. 122.71 ± 11.98; t = 4.036; p = 0.001) and diastolic blood pressure (78.65 ± 10.44 mmHg vs. 68.92 ± 8.02; t = 4.278; p = 0.001) between pre and post-test. Conclusions Community-based group exercise programs are effective interventions to control blood pressure levels and cardiovascular risk in patients with type 2 diabetes. Trial funding and registration Diabetes em Movimento® is funded by Portuguese Foundation for Science and Technology with reference SFRH/BD/47733/2008 and is registered in Current Controlled Trials with reference ISRCTN09240628.

## PREVALENCE AND FACTORS ASSOCIATED WITH THE CO-OCCURRENCE OF CARDIOVASCULAR RISK BEHAVIORS IN ADOLESCENTS

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The aim of this study was to analyze the prevalence and factors associated with the co-occurrence of cardiovascular risk behaviors in adolescents. A cross-sectional study was performed with a representative sample of adolescent high school students from state public schools in Pernambuco, Brazil (n= 4,207, 14-19 years old). Data were obtained using a self-reported questionnaire. The co-occurrence of cardiovascular risk behaviors was established based on the sum of five behavioral risk factors (low physical activity, sedentary behavior, low consumption of fruits/vegetables, alcohol consumption and tobacco use). The independent variables were gender, age group, time of day attending school, school size, maternal education, occupational status, skin color, geographic region and place of residence. Data were analyzed by ordinal logistic regression with proportional odds model. Approximately 10% of adolescents were not exposed to cardiovascular risk behaviors, and 58.5% reported being exposed to at least two health risk behaviors simultaneously. It was observed a higher likelihood of co-occurrence of cardiovascular risk behaviors among adolescents in the upper age (17-19 years) category (OR= 1.17; P<0.01), with higher maternal education (OR= 1.21; P<0.01), and that reported living in the driest region of the state of Pernambuco (OR= 1.39; P<0.001). Adolescents who reported having a job (OR= 0.86; P=0.04) and residing in rural areas (OR= 0.78; P=0.001) had a lower likelihood of co-occurrence of risk behaviors. Findings suggest that the prevalence of co-occurrence of cardiovascular risk behaviors in this group is high, particularly among older adolescents, whose mothers had a higher schooling level e among those who reported having no job, residing in urban areas, and in the semiarid region.

## COMPARISON OF OXYGEN CONSUMPTION IN RATS DURING UPHILL AND DOWNHILL TREADMILL EXERCISE TESTS

Sirvent, P., Chavanelle, V., Ennequin, G., Caillaud, K., Montaurier, C., Morio, B., Boisseau, N., Richard, R.

*AME2P - EA 3533*

**Introduction** The study of the physiological adaptations of skeletal muscle in response to eccentric (ECC) contraction is based on protocols in which exercise intensities are determined relative to the concentric (CON) reference exercise (as percentage of the CON maximal oxygen consumption, or VO<sub>2</sub>max) (Lastayo et al., 2000, Lastayo et al., 2003). In order to use similar exercise protocols in rats, we compared the VO<sub>2</sub> values during uphill (CON) and downhill (ECC) running tests, using variable slopes. **Methods** VO<sub>2</sub> (using a breath-by-breath device) was measured in 15 Wistar rats during incremental treadmill running exercises (initial speed 15 cm/sec, increment of 5 cm/sec every 3 min) with different slopes: level (0%), positive (+15% incline: CON+15%) and negative (-15% incline: ECC-15%; and -30% incline: ECC-30%). **Results** The VO<sub>2</sub> plateau (VO<sub>2</sub>max) was reached in nine exercise tests (89.82±2.32 mL•kg<sup>-1</sup>•min<sup>-1</sup>; mean rat weight: 447±7 g). Similar VO<sub>2</sub> values were obtained in the ECC-30% and CON+15% running conditions at the three target speeds (15, 25 and 35 cm/sec). Conversely, VO<sub>2</sub> values were 1.5 to 2 times lower (p<0.05) in the ECC-15% than in the CON+15% condition (CON+15% VO<sub>2</sub>/ECC-15% VO<sub>2</sub> ratios of 1.86, 2.05 and 1.65 at the three target speeds, respectively). **Discussion** Thus, during ECC treadmill exercise it is necessary to double the slope (ECC-30%) to obtain similar VO<sub>2</sub> levels than during CON exercise with 15% positive incline. The CON VO<sub>2</sub>/ECC VO<sub>2</sub> ratio can be useful for designing animal research protocols particularly to study the effects of ECC and CON exercise in ageing populations or with cardiovascular and respiratory diseases. **References** LaStayo PC, Ewy GA, Pierotti DD, Johns RK, Lindstedt S (2003). *J Gerontol A Biol Sci Med Sci*, 58, 419-424. LaStayo PC, Pierotti DJ, Pifer J, Hoppeler H, Lindstedt SL (2000). *Am J Physiol Regul Integr Comp Physiol* 278, 1282-1288.

## THE RELATIONSHIP OF EXERCISE-INDUCED CARDIAC TROPONIN T RELEASE AND LEFT VENTRICLE MASS IN ADOLESCENT ATHLETES

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1: MPI (Macao, China). 2: UMAC (Macao, China). 3: LNU (Dalian, China). 4: HKBU (Hong Kong, China). **Introduction** Although regular exercise training reduces cardiovascular disease risk, recent studies have documented elevations in cardiac troponin (cTn) consistent with cardiac damage after bouts of exercise in apparently healthy adults (Shave et al., 2010) and adolescents (Nie et al., 2011). At present, the mechanism(s) and clinical significance of exercise-induced cTn release remains understood. It has been proposed that cTn release following exercise is related to, or an adjunct of the messenger cascade responsible for the physiologically hypertrophied heart (Shave et al., 2007). The objectives of the present study were to determine left ventricle mass (LVM)-associated differences in the cTn response to exercise. We hypothesize that the magnitude of cTn responses to a bout of prolonged exercise would be significantly lower in athletes with more training experience and more pronounced cardiac hypertrophy. **Methods** Cardiac troponin T (cTnT) was assessed before and 4 hours after a single 21-km run (R1) at maximal sustainable pace in eleven healthy adolescent athletes (15.3±1.3yr). LVM was examined echocardiographically before run. After one year of intense endurance training (80-120 km/wk on a 7 days/wk basis), these athletes were studied again at same run (R2), using an identical test protocol. **Results** cTnT was undetectable before R1 and R2 but was elevated after R1 (median, range: 0.06, 0.02-0.08 ng/ml) and R2 (median, range: 0.05, 0.03-0.37 ng/ml) (R1 vs. R2 P>0.05). Resting LVM was elevated after one year of training (R1 vs. R2: 177±57 vs. 205±72g, P<0.05). Post-exercise cTnT was not correlated with LVM in R1 (r=0.18, P>0.05, n=11), R2 (r=-0.01, P>0.05, n=11) and combined R1 and R2 (r=0.09, P>0.05, n=22). **Discussion** In the current study we observed that during recovery from a 21-km run cTnT was elevated in adolescent athletes and LVM was significantly increased after one year of endurance training. However, a surprising finding of the investigation is that in contrast to what we expected, no inverse relationship between cTnT release and LVM has been found in present study. This approach to longitudinal study on the relationship between exercise-induced cTnT release and LVM has not been investigated before, which adds to the novelty of the current study. These findings support the contention that exercise-induced cTnT release and cardiac hypertrophy are likely mediated by independent phenomenon. \*The study was supported by a research grant from Macao Polytechnic Institute (RP/ESEFD-01/2012). **References** Nie J, George K, Tong TK, Gaze D, Tian Y, Lin H, Shi Q (2011). *Current Medicinal Chemistry*, 18, 3452-3456. Shave R, Baggish A, George K, Wood M, Scharhag J, Whyte G, Gaze D, Thompson PD (2010). *J Am Coll Cardiol*, 56, 169-176. Shave R, George K, Gaze D (2007). *Current Medicinal Chemistry*, 14, 1427-1436.

### EFFECT OF ACUTE INTENSIVE EXERCISE ON SALIVARY ALPHA AND BETA DEFENSINS, AND SECRETORY IGA IN YOUNG MALE SUBJECTS

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**Introduction** In the field of athletics, the risk of upper respiratory tract infection (URTI) is one of the most important problems in athletes. Human neutrophil protein 1-3 (HNPI-3) and human beta-defensin 2 (hBD2) have anti-virus activity and are related to susceptibility to URTI. However, there is little information of HNPI-3 and hBD2 in response to exercise. The aim of this study was to examine the effect of acute intensive exercise on salivary HNPI-3, hBD2 and secretory immunoglobulin A (SigA). **Methods** 8 healthy young male subjects ( $23.4 \pm 0.6$  years) participated in this study. The subjects performed exercise experiment (exercise on a cycle ergometer at 75%  $\text{VO}_2\text{max}$  for 60 min) and control experiment (non-exercise). Saliva samples were collected before exercise (7:30 AM), immediately following (8:30), 1 h (9:30), 2 h (10:30), 3 h (11:30), and 24 h after the bout of exercise. The HNPI-3, hBD2 and SigA concentrations were measured by the enzyme linked immunosorbent assay (ELISA). The total protein concentration was determined by the Pierce 660nm Protein Assay. The HNPI-3, hBD2 and SigA data were expressed as relative to total protein concentration (HNPI-3/TP, hBD2/TP, SigA/TP, respectively). **Result** In the exercise experiment, salivary hBD2/TP was significantly decreased during the period from immediately following to 2 h after the exercise ( $p < 0.05$ ). Salivary SigA/TP was significantly decreased during the period from immediately following to 24 h after the exercise ( $p < 0.05$ ). Salivary HNPI-3/TP did not show significant change during the study period. Additionally, in the control experiment, salivary SigA/TP was significantly decreased at 2 h and 3 h ( $p < 0.05$ ). While HNPI-3/TP and hBD2/TP did not show significant change during the study period. **Discussion** In this study, mucosal immune system mediated by hBD2 and SigA might be impaired by acute intensive exercise. Additionally, SigA secretion might have a circadian rhythm. These findings may contribute to development of markers to oral immunity in athletes. Further study is required to determine relationship between variation in immune markers and susceptibility to URTI in athletes. **In conclusion**, salivary hBD2 and SigA secretions seem to be decreased by acute intensive exercise. **Reference** Davison G, Allgrove J, Gleeson M. (2009). *Eur J Appl Physiol.* 106(2):277-84. Usui T, Yoshikawa T, Orita K, Ueda SY, Katsura Y, Fujimoto S, Yoshimura M. (2011). *Eur J Appl Physiol.* 111(9), 2005-14 Sugama K, Suzuki K, Yoshitani K, Shiraiishi K, Kometani T. (2012). *Exerc Immunol Rev.* 18, 116-27.

### RIDING A MOTORCYCLE OR RACING A MOTORCYCLE: DIFFERENCES IN OXYGEN CONSUMPTION, HEART RATE, BLOOD LACTATE; A PILOT STUDY.

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1: University of Hawai'i at Hilo (Hilo, USA), 2: University of Rome Foro Italico (Rome, Italy), 3: University of Turin (Turin, Italy). **Introduction** Riding a motorcycle requires human motor skills (Stella et al 2002). Racing with a motorcycle requires physical efforts measured by high intensity Heart Rate (HR) and Blood Lactate (BLa) (D'Artibale et al 2008). No data are published regarding the physiological differences between an amateur rider and a regular racer. This is a pilot study aimed at comparing differences in physical load suffered by an amateur motorcyclist and a road race motorcycling rider. **Methods** An amateur motorcyclist (28 yrs, 1.72 mt, 60 Kg) and a regular licensed road racing rider (35 yrs, 1.70 mt, 68.7 Kg) volunteered for this study. A portable pulmonary gas exchange analyzer (K4b2, Cosmed) was used to collect data while participants were asked to separately ride the same bike (600cc) in the same private track (2.5 Km) at a constant comfortable pace for 40 min. HR was also recorded (Team System, Polar) while riding. A portable BLa analyzer (Accutrend, Roche) was used to investigate differences in peak BLa concentrations after riding. Ratings of perceived exertion (RPE) were recorded immediately after the ride using the original Borg scale (Borg, 1998). **Results** Amateur rode 62.4 Km at 93.7 Km/h average speed. Rider rode 87.4 Km at 131.2 Km/h (+40%) average speed. While riding, average oxygen consumption ( $\text{VO}_2$ ) was four times the baseline for the amateur (20 ml/min/Kg) and was seven times the baseline for the rider (21 ml/min/Kg). Amateur's HR was 121 bpm average (63%  $\text{HR}_{\text{max}}$ ), with a peak of 137 bpm (71%  $\text{HR}_{\text{max}}$ ). Rider's HR was 142 bpm average (77%  $\text{HR}_{\text{max}}$ ), with a peak of 161 (87%  $\text{HR}_{\text{max}}$ ). BLa peak after riding was 2.1 mmol/l for the amateur and 2.8 mmol/l for the rider. Rider's RPE values were 15% lower than amateur. **Discussion** Riding a motorcycle or racing with it requires different oxygen consumptions, unlike physical loads. Road racing motorcycling has been shown to require physical effort, whereas riding as a motorcyclist seems to require smaller effort. Previous studies showed a higher cardiac load and BLa during official competitions (D'Artibale et al 2006). The differences between amateur's performance and racer's performance could be enhanced when considering their competitive environment. Further data are needed to clarify the physiological responses to those two different intensities of riding a motorcycle. Motor sports is a field that would benefit from sports sciences and training (Klarica 2001). **References** D'Artibale E, Tessitore A, Capranica L; (2008); *JouSportSci.* D'Artibale E, Tessitore A, Tiberi M, Capranica L; (2006); 11th ECSS. Stella J, Cooke C, Sprivilis P; (2002); *EmergMedic.* Klarica AJ; (2001); *Br J Sports Med.* Borg G; (1998); *Human Kinetics.*

### ASSOCIATION BETWEEN LEFT ATRIAL FUNCTION AND EXERCISE CAPACITY IN THE VERY ELDERLY ATHLETES

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**Introduction:** Exercise training is associated with left ventricular (LV) functional changes in athlete. The previous study was suggested that the left atrial (LA) functional change in young athletes could estimate athlete's heart remodeling. Therefore, the purpose of this study was to evaluate whether LA function in very elderly athletes affected exercise capacity or not. **Methods:** Thirteen well-trained athletes and fourteen sedentary subjects were enrolled. We divided into four groups, seven very elderly athletes ( $90 \pm 5$  years, EA group), six young athletes ( $21 \pm 2$  years, YA group), six elderly sedentary ( $77 \pm 5$  years, ES group), and eight young sedentary ( $43 \pm 10$  years, YS group). All subjects underwent a cardiopulmonary exercise testing (CPX). We measured LV and LA function using ultrasound echocardiography before CPX. LV and LA volume were measured by biplane Simpson method. Systolic LV and LA longitudinal function were assessed by systolic global longitudinal strain (GLS), peak GLS rate (GLSRs), LA strain (LAS), and LAS rate (LASR) with 2D speckle tracking imaging. Diastolic longitudinal function was assessed by mitral annular velocity ( $E'$ ) with tissue Doppler imaging. The index of exercise capacity was assessed by peak oxygen uptake ( $\text{peakVO}_2$ ). **Results:**  $\text{PeakVO}_2$  in YA was significantly higher compared to other three groups ( $48.8 \pm 3.7$  vs.  $29.4 \pm 4.5$  (YS),  $19.3 \pm 4.3$  (EA),  $18.1 \pm 6.0$  (ES) ml/kg/min,  $P < 0.01$ ). However, there was no difference between EA and ES, although age in EA was older than ES.  $E'$  in young groups was higher than those in elderly groups ( $19 \pm 3$  (YA),  $13 \pm 2$  (YS) vs.  $7 \pm 2$  (EA),  $8 \pm 2$  (ES) cm/sec,  $P < 0.01$ ), however there was not significantly difference between EA and ES. LA volume index was significantly larger in athletes groups compared to sedentary groups ( $31.5 \pm 4.3$  (YA),  $34.3 \pm 10.9$  (EA) vs.  $19.1 \pm 3.3$  (YS),  $17.6 \pm 4.9$  (ES) mL/m<sup>2</sup>,  $P < 0.01$ ). LASR in ES was significantly higher than those in other three groups ( $2.7 \pm 0.8$  vs.  $1.5 \pm 0.3$  (YA),  $1.5 \pm 0.3$  (YS),  $1.1 \pm 0.5$  (EA) 1/sec,  $P < 0.01$ ). On the other hand, GLS and

GLSRs were no difference in four groups. Discussion: Normally, peakVO<sub>2</sub> was decreased with aging. However peakVO<sub>2</sub> in very elderly athletes could be maintained more young age level in this study. LA volume in athletes was larger than sedentary, additionally LASR in EA was maintained at a young LA longitudinal functional level. Then, it was suggested that LA volume and function may be an important factor to maintain the exercise capacity.

### COMPARISON OF AORTIC STIFFNESS AFTER EXERCISE BETWEEN 2 DIFFERENT EXERCISE PROTOCOLS IN ELDERLY SUBJECTS

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Introduction Age-associated change in the structure and function of arteries increases the risk of cardiovascular disease. It has been reported that moderate aerobic exercise decreases arterial stiffness in young humans (Kingwell, et al., 1997, Hefferman et al., 2007). However, it has been unclear whether the different exercise protocols influence the effect of exercise on arterial stiffness in elderly humans. The purpose of this study was to investigate the effect of exercise on aortic stiffness with 2 different exercise protocols in elderly subjects. Method Healthy elderly subjects performed a 15min of cycling exercise with 50% peak VO<sub>2</sub> (trial 1) and symptom-limited ramp-protocol exercise (trial 2). Brachial-ankle PWV (ba PWV), heart rate (HR) and blood pressure (BP) were measured at baseline, 30min, and 60min after the exercise. All measurements were performed in a quiet and air conditioned room at the same time of the day in the morning. Results **【Trial 1】** The exercise HR was 108.9 beats/min and % HR max was 69.4%. The % peak VO<sub>2</sub> was 56.6% during the exercise, and there were no significant changes in ba PWV after the exercise. **【Trial 2】** The peak HR was 131.2 beats/min and %HR max was 86.6%. The % peak VO<sub>2</sub> was 158%. The ba PWV significantly decreased at 30min after the exercise (P<0.05). On the other hand, the BP at 30 min after exercise was not different from that at baseline. Conclusion The present study showed that ba PWV significantly decreased after symptom-limited exercise, whereas there were no significant changes after moderate intensity exercise in elderly subjects. Although the underlying mechanism is still unknown, the results in the present study support that aortic stiffness could decrease as a result of aerobic exercise even in elderly subjects, however, the effects are dependent on exercise protocol References Kingwell, B. A., Berry, K. L., Cameron, J. D., Jennings, G. L., and Dart, A. M. (1997). *Am J Physiol* 273, H2186-2191. Hefferman, K. S., Jae, S. Y., Echols, G. H., Lepine, N. R., and Fernhall, B. (2007). *Med Sci Sports Exerc* 39, 842-848.

### CENTRAL BLOOD PRESSURE VERSUS PERIPHERAL BLOOD PRESSURE AT REST, INCREMENTAL EXERCISE AND RECOVERY IN A YOUNG FEMALE AND MALE COHORT

Garrett, A.1, West, D.2, Shelford, A.2, Chard, G.2, Kipps, N.2, Baber, N.2, McEniery, C.3

University of Hull1; University of Hertfordshire2; University of Cambridge3

INTRODUCTION: Arterial stiffening causes increased systolic pressure and predominantly affects pressure in the central arteries. Measurement of central blood pressure (CBP) may provide more useful information than the traditional peripheral blood pressure (PBP) measure, as a marker of hypertension. The purpose of this study was to determine CBP versus PBP in a young, female and male cohort at rest, incremental exercise and recovery. METHOD: Ethical approval was obtained for 20, white, caucasians; females (n=10; age 20.1±0.6 yrs; height 167.8±5.5 cm; body mass 66.2±12.4 kg; resting cardiac output 6.0±1.0 L; VO<sub>2</sub>peak 2.1±0.6 L.min<sup>-1</sup>) and males (n=10; age 20.4±1.9 yrs; height 179.9±5; bodymass 72.9±9.2 kg; resting cardiac output 9.2±2.9 L; VO<sub>2</sub>peak 3.1±0.6 L.min<sup>-1</sup>). Participants performed a VO<sub>2</sub>peak on a cycle ergometer. CBP, PBP, augmentation index (AIx) and pulse wave velocity (PWV) were measured at rest, during incremental exercise, exhaustion and one hour of recovery using a SphygmoCor®. A sphygmomanometer was used to measure PBP. Cardiac output was measured by CO<sub>2</sub> rebreathing (Innocor®). RESULTS: There was a difference between resting systolic central blood pressure (SCBP) and resting systolic peripheral blood pressure (SPBP) in females (102 vs 110 mmHg; p=0.001) and males (107 vs 126 mmHg; p=0.001). During exercise at 50% max heart rate there was a difference between SCBP and SPBP in females (118 vs 151 mmHg; p=0.007) and males (116 vs 139 mmHg; p=0.001). Similarly, this was reported at 30 mins recovery from maximal exercise in females (88 vs 103 mmHg; p=0.006) and males (106 vs 127 mmHg; p=0.003). DISCUSSION: The results of this study indicates that central blood pressure provides different and potentially better measures than the more established peripheral blood pressure, which is traditionally used as a marker of hypertension in a young female and male cohort. Therefore, current methods used to identify cardiovascular risk factors in young people should be revised to provide more accurate information.

15:00 - 16:00

## Mini-Orals

### PP-PM13 Health and Fitness [HF] 7

#### THE INFLUENCE OF EXTRACURRICULAR AEROBIC EXERCISE EXPERIENCE ON PSYCHOLOGICAL WELL-BEING IN MALE UNIVERSITY STUDENTS

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Introduction Psychological research has made it increasingly clear that exercise can be of tremendous benefit. In fact, aerobic exercise has been shown to improve psychological well-being (Gondoh et al., 2009). However, few studies have demonstrated the improvement of psychological well-being as a result of extracurricular exercise, particularly aerobic sports. The purpose of the present study was to examine the effect of extracurricular aerobic exercise experience on psychological well-being. Methods Subjects in the present study comprised young male university students. Subjects who regularly participated in extracurricular aerobic exercise were assigned to the athlete group (n= 50), and those who seldom participated in extracurricular aerobic exercise were assigned to the non-athlete group (n= 53). Maximal oxygen uptake (VO<sub>2</sub>max) was measured during performance of an exercise task on a bicycle ergometer. Psychological scales relating to development of identity (IDS) (Simoyama et al., 1992), self-acceptance (SAS) (Sawazaki, 1993) and depression (CES-D)

(Shima et al., 1985) were also used to assess psychological well-being. Results The athlete group had significantly higher VO<sub>2</sub>max, IDS and SAS scores than the non-athlete group. No significant difference in CES-D score was observed between the two groups. Discussion Our results suggest that extracurricular aerobic exercise experience promotes psychological well-being, particularly the formation of positive feelings. VO<sub>2</sub>max levels were higher in the athlete group than in the non-athlete group. Generally, higher VO<sub>2</sub>max levels have been known to be associated with a lower prevalence of lifestyle-related disease. Therefore, higher aerobic ability may lead to more positive feelings in everyday life. On the other hand, individuals who have a relative absence of positive feelings may not be interested in exercise. This results in a lack of exercise experience. In addition, it is thought that extracurricular aerobic exercise experience induces positive changes in the physiological mechanism underlying psychological well-being. However, the details involving this influence were unclear in this study. Therefore, clarification of this physiological mechanism should be a focus in future studies. References Gondoh Y, Sensui H, Kinomura S, Fukuda H, Fujimoto T, Masud M, Nagamatsu T, Tamaki H, Takekura H. (2009). *J Sports Med Phys Fitness*, 49, 129-135. Shimoyama S. (1992). *Japanese Journal of Educational Psychology*, 40, 121-129. Sawazaki T. (1993). *Japanese Journal of Counseling Science*, 26, 29-37. Shima S, Shikano T, Kitamura T, Asai M. (1985). *Seishin-gaku (Clinical Psychiatry)*, 27, 717-723.

## EXERCISE AT THE OFFICE: HOW TO MAINTAIN WORKING PERFORMANCE OF EMPLOYEES

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Introduction: Psychiatric diseases have reached one of the top positions for absenteeism in Europe in 2012 and are still increasing. The diagnosis Burnout with its exhaustion syndroms turns to be the most present and cost-intensive disease for national economies and health insurances. This entails tremendous economic damage in the loss of production in companies. Breaks to interrupt the working time are known to support health care and working safety. For the individual employee they also offer job satisfaction and might reduce the rate of disease. Recent studies have shown that exercise is accompanied by a decrease in (pre-) frontal cortex activity, which might be related to an increase in cognitive performance. This study examined the influence of different types of breaks on the cognitive performance and related cortical activity of office-based employees. Methods: Female and male office workers were randomly assessed into four different interventions (N= 4\*10) and one control group (N=10). Interventions were applied after a predetermined work rate of 2 hours and consisted of exercise (1) boxing on a punching bag for 3 min (2) lying in a massage chair for 20 min, (3) riding on a bicycle for 20 min (4) having a standard break for 20 min. The control group kept on working for 20 min without any break. Cognitive performance was assessed using two mental tests followed by a profile of mood state to assess individuals perceived physical, motivational and psychological state. In addition, before and after the interventions an EEG was recorded, using a three lead dry system, to explore related neurophysiological changes. Results: A significant increase could be obtained in cognitive performance from pre to post intervention after boxing compared to standard break and massage chair ( $p < .05$ ). Perceived psychological state was significantly improved after the standard break compared to all other interventions ( $p < .05$ ). Alpha-2-activity was significantly increased after boxing ( $p < .01$ ) and biking ( $p < .05$ ) compared to standard break and no break. Discussion: The positive effect of a three minute boxing intervention on cognitive performance is mirrored by an increase in perceived psychological state as well as a decrease in prefrontal cortex activity, expressed by an increase in alpha-2 activity. Although perceived psychological state was increased after the standard break (which might be due to social interactions), this is neither reflected in cortical activity nor cognitive performance. With respect to the fact that also bike activity resulted an increase in prefrontal alpha-2 activity a positive effect of exercise on neuro-cognitive performance can be stated. Further research is necessary to distinguish between effects of time and exercise preferences. Health and economic benefits may result from brief physical activity breaks and help to maintain work-place performance, job satisfaction and finally reduce the loss of production.

## RELATIONSHIP BETWEEN DAILY PHYSICAL ACTIVITY AND DAYTIME SLEEPINESS IN UNDERGRADUATE STUDENTS

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Introduction Insufficient sleep is known to be linked to mental and physical health problems, and the quality of nocturnal sleep is closely correlated with daily physical activity. However, the relationship between physical activity and magnitude of daytime sleepiness is not well known. In this study, we investigated the relationship between these 2 elements in undergraduate students. Methods A total of 1146 undergraduate students participated in this study (615 men and 531 women; age [mean  $\pm$  SD], 18.9  $\pm$  1.1 years). They were asked to answer a questionnaire to assess their life style, such as the frequency of exercise, duration of physical activity, past exercise habits, etc. Magnitude of daytime sleepiness was evaluated using the Japanese version of the Epworth Sleepiness Scale (JESS) (Takegami et al., 2009). We measured the level of physical activity in 274 students (177 men and 97 women) using an accelerometer (Lifecorder (Lc), Kenz, Nagoya, Japan). The subjects were asked to wear the Lc on the right-side waist continuously for the experimental period (median, 9 days) except while bathing. The Lc measured the daily number of steps (steps/day), 24-hour energy expenditure (kJ/day), and energy expenditure during exercise (kJ/day). To eliminate the influence of the menstrual cycle on the magnitude of daytime sleepiness, timing for evaluation using the JESS for each subject was randomly selected during the duration of accelerometer experiment. Results In all subjects, the magnitude of daytime sleepiness was significantly higher in women than in men ( $p < 0.05$ ). A significant relationship between daytime sleepiness and the indices of physical activity was observed only in women ( $r = -0.27$ ,  $p < 0.05$ ). Discussion In this study, we found that the magnitude of daytime sleepiness was higher in women than in men. Furthermore, there was a significant negative correlation between the magnitude of daytime sleepiness and physical activity level only in the female subjects. Our results suggest that for female students, improvement of daytime sleepiness will be effective for increasing physical activity, but this will not be applicable for male students. Thus, we need to use different strategies to increase the physical activity level for male and female students. References Takegami M, Suzukamo Y, Wakita T, Noguchi H, Chin K, Kadotani H, Inoue Y, Oka Y, Nakamura T, Green J, Johns MW, Fukuhara S (2009) *Sleep Med*, 10, 556-56

## THE PHYSICAL CHARACTERISTICS AND THE RELATIONSHIP BETWEEN MUSCLE QUALITY AND PHYSICAL FUNCTION IN THE COMMUNITY-DWELLING OLDEST OLD POPULATION

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Introduction The oldest old ( $\geq 85$  year-old) account for 7% of the population  $\geq 65$  year-old (4). As age-related physical changes, muscle mass and physical function decrease after 60s, as well as the increase in muscle attenuation lowers muscle quality. Previous studies

reported the correlations between muscle quality and muscle strength or aerobic performance independent of muscle thickness (MT) (1, 3). However, it is not clear the physical characteristics and the relationship between muscle quality and physical function in the oldest old population. Therefore, the present study investigated the physical characteristics based on sarcopenia criteria and the relationships among echo intensity (EI) and physical function in the community-dwelling oldest old population. Methods One hundred eight  $\geq 85$  year-old individuals (F, 58; M, 50; 88-92 year-old) participated in the present study. We measured body height, weight, lower extremity circumference, and skinfold thickness as morphological characteristics. The EI and MT of anterior thigh were measured using B-mode ultrasound as the indices of muscle quality and quantity, respectively. In addition, the participants performed hand grip strength, chair rising, open-eyes one-foot balance, and time up and go tests for physical function evaluation. Results Of the participants, 44% and 86% participants were categorized as sarcopenia based on lower extremity circumference and hand grip strength, which were reported in the European Working Group on Sarcopenia in Older People, respectively (2). Significant correlations were observed between EI and hand grip strength ( $r=-0.33$ ,  $p=0.001$ ), and chair rising ( $r=-0.21$ ,  $p=0.03$ ), and time up and go test ( $r=0.22$ ,  $p=0.02$ ), respectively. Significant partial correlations were found between EI and hand grip strength ( $r_{xy.z}=-0.21$ ,  $p=0.04$ ), and time up and go test ( $r_{xy.z}=0.22$ ,  $p=0.03$ ) after controlled by gender. In addition, significant correlation was observed between EI and MT ( $r=-0.70$ ,  $p<0.001$ ). Discussion It should require circumspection to apply the sarcopenia criteria to the oldest old population. Muscle quality assessed by EI would contribute to physical function irrespective of gender. Muscle quality would be more closely related to muscle quantity in the oldest old population compared with the relationship in the young old population ( $r=-0.33$ ) (3). References 1.Cadore EL et al. (2012) *Exp Gerontol* 47: 473-478 2.Cruz-Jentoft et al. (2010) *Age and Ageing* 39: 412-423 3.Fukumoto Y et al. (2012) *Eur J Appl Physiol* 112: 1519-1525 4.National Institutes of Health, *Why Population Aging Matters*, 2007

### QUALITY OF LIFE PERCEPTION AND EXPERIENCES IN ELDERLY LEISURE

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QUALITY OF LIFE PERCEPTION AND EXPERIENCES IN ELDERLY LEISURE Introduction Populations are aging virtually worldwide, and thus means of measuring how the elderly are living in these extra years (i.e., quality of life- QOL) is of growing importance (OMS, 2005). In addition, it is necessary to consider aspects that may be related to QOL perception by the elderly, such as leisure experiences. Therefore, the objective of this study was to analyze the relationship between elderly individuals' leisure activities and their QOL perception. Methods An exploratory descriptive investigation with a quantitative approach was carried out. A sample of 141 elderly individuals from a university extension program in Florianópolis, Brazil participated in the study. A form including information on general characteristics, a leisure experience questionnaire and QOL questionnaires from the World Health Organization (WHOQOL-BREF and WHOQOL-OLD) were used. Spearman's correlation coefficient and multiple linear regression analysis were applied. A significance level of 5% was adopted in all tests. Results According to the general evaluation (WHOQOL-BREF) and the evaluation specifically for elderly individuals (WHOQOL-OLD), the elderly individuals' QOL perception was considered good: 74.5+15.2 and 93.1+10.2, respectively. The general evaluation domains resulted in the following means: 73.7+16.1 (social relations), 70.7+12.6 (environment), 66+9.3 (psychological) and 62+9.7 (physical). The components of the specific evaluation resulted in the following means: 73+14.7 (social participation), 73+17.6 (functioning of the senses), 72.8+17.1 (intimate life), 72.3+14.1 (participation in past, present and future activities), 70.5+15.5 (autonomy) and 70.3+23.7 (death and dying). Leisure experiences are more frequent when linked with intellectual, touristic, physical, social, manual, artistic and virtual leisure interests, respectively. Except for the virtual experiences, all were significantly associated with QOL perception, with a correlation ranging from weak ( $r=0.166$ ) to moderate ( $r=0.388$ ) and a linear relation with coefficients varied from 0.04 to 1.85. Discussion Investigating QOL involves the subjective perceptions closely related with living conditions and daily experiences (Fleck, 2008). The highest frequency of leisure experiences among this sample was associated with better QOL perception, which underscores the fundamental importance of providing leisure opportunities for the elderly. References Fleck, MPA (2008). *A avaliação de qualidade de vida*. Porto Alegre: Artmed. Organização Mundial da Saúde OMS (2005). *Envelhecimento Ativo*. Brasília: Organização Pan-Americana da Saúde.

### THE CROSS-SECTIONAL STUDY OF THE RELATIONSHIPS AMONG HOUSEHOLD PHYSICAL ACTIVITY, LOCOMOTIVE PHYSICAL ACTIVITY AND METABOLIC SYNDROME RISKS FACTORS

Okumatsu, K., Aoki, M., Watanabe, S., Sato, K., Kurihara, T., Otsuka, M., Fujioka, M., Fujita, S., Hamaoka, T., Sanada, K. *Ritsumeikan University*

Although previous studies have investigated the relationship between physical activity and metabolic syndrome risk, there is no report whether household physical activity, locomotive physical activity related to metabolic syndrome risks factors. PURPOSE: The purpose of this study was to investigate whether household physical activity, locomotive physical activity, and physical inactivity time were associated with physical fitness and/or metabolic syndrome risk factors in young and elderly men. METHODS: Healthy Japanese young male ( $n=29$ ) aged 18-28 yrs and Japanese old male ( $n=19$ ) aged 60-82 yrs participated in the study. Metabolic syndrome risk factors and physical fitness level were measured. Measurements of physical fitness included Body height, weight and abdominal girth were measured in all subjects. Body composition was measured using Dual-energy X-ray absorptiometry (DEXA), and  $VO_2\max$  were measured using breathe-by breathe gas analysis. The abdominal visceral and subcutaneous fat areas were measured by magnetic resonance imaging (MRI). The household physical activity, locomotive physical activity, and physical inactivity time were determined by a tri-axial accelerometer (active style pro HJA-350IT). RESULTS: The physical inactivity time and locomotive physical activity time in young men were significantly higher than those in elderly men ( $p<0.001$ ). On the other hand, the household physical activity time in elderly men was significantly higher than that in young men ( $p<0.001$ ). The physical inactivity time was positively correlated with percent body fat in young men ( $p<0.05$ ). The locomotive physical activity (Mets  $\cdot$  h) was negatively correlated with percent of body fat ( $p<0.05$ ) and abdominal visceral fat area ( $p<0.05$ ) in young men. In addition, moderate-vigorous intensity locomotive physical activity (Met  $\cdot$  h) was negatively correlated with percent of body fat ( $p<0.05$ ). The household physical activity (Mets  $\cdot$  h) and the light intensity household physical activity (Met  $\cdot$  h) were negatively correlated with HbA1c in elderly men. CONCLUSION: These findings suggest that the increase of household physical activity and decrease of physical inactivity may have a positive influence in the maintenance of physical fitness and prevention of metabolic syndrome.

### EFFECT OF EXERCISE ON DEPRESSION LEVEL

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**Introduction** Depression can be used as a concept which can include many features from normal, temporary and momentary feeling to a symptom of an illness or a psychiatric disorder (Alper et al.,1997). The aim of this study was to search the effect of exercise on depression level in terms of men and women who do not do exercise or who do exercise for a healthy lifestyle. **Methods** Beck Depression Inventory was applied to total 605 subject between the age of 18 and 45 composed of 230 female and 375 male who do not exercise or do the exercise at different levels for health. Independent sample t and chi-square tests were used to determine the statistical differences. **Results** In our study, 22.48 percent of the persons who responded to our survey are the ones who do not do the exercise, 44.13 percent of them are the ones who exercise between 1 and 3 hours a week and 33.39 of them exercise for more than 4 hours. When the Depression scores were analysed, the average score of the ones who do not exercise is 13.18 while that of the ones who exercises a little or much is 8.93. More depressive symptoms were found in the people who do not exercise than those who do. According to the gender, no meaningful difference could be found between depression level ( $p>0.05$ ). **Discussion** Generally, the point prevalence of the depressive symptoms in the society is varying between 13 and 20 percent (Oztürk 2004). In the USA, the average Beck Depression Inventory score among university students is reported as 7.6 (Oliver and Paul 1995). When the score is between 0 and 10 in Beck Depression Inventory, it is said that depression does not exist (Cıgırkçı, 2007). In our study, the people who do not exercise have more depressive symptoms than those doing exercise. According to the result of the study, it has been observed that doing weekly exercise and lengthening the duration of it decrease the level of depression. Therefore, to decline the depression level of people and to increase their life quality, the habit of doing regular exercise should be accelerated. **References** Alper Y, Bayraktar E, Karacam O. (1997). Herkes İçin Psikiyatri. İstanbul, Era Yayınları. 10-15. Oliver JM, Paul JC. (1995) J Clin Psychol, 51:467-481. Cıgırkçı H. (2007). Sağlık Bakanlığı Bakirköy Dr. Sadi Konuk Eğitim ve Araştırma Hastanesi, İstanbul, Uzmanlık Tezi. Oztürk O. (2004). Ruh Sağlığı ve Bozuklukları. 10. baskı, Ankara, Hekimler Yayın Birliği.

### RELATIONSHIP BETWEEN SCREEN TIME, PHYSICAL ACTIVITY AND BARRIERS TO EXERCISE IN 16-17 YEARS-OLD CATALAN GIRLS.

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**Introduction:** In Spanish context TV viewing and computer use are sedentary behaviours highly prevalent in 17 years old (2.21 hours/day), on the other hand majority of the girls between 14-17 years old exercise less than two days a week (79%) (Roman, B et al., 2006). While evidence suggests that external barriers have a stronger influence than internal barriers for being physically active among the youth (Daskapan, A et al., 2006), little is known about how the amount of time spent on screen activities influences teenagers' physical activity (PA) levels and perceptions of barriers for being active. Therefore, the aim of the present study is to observe how a specific sedentary pattern prevails among 17 years old girls and relate this pattern with PA levels and perceived barriers to exercise. **Methods:** All secondary schools from Osona (Barcelona) were invited to participate in the study with 12 out of 16 responding. In total 342 girls (95% response rate) completed a survey evaluating the barriers and benefits for PA (version of barriers and benefits scale) and sitting time (Active Where? Questionnaire). Assignment to activity level group was based on time spent sitting in front of screen using tertile splits. Chi Square tests and one way ANOVA were used to analyse differences between groups. **Results:** Girls spend on average 2.8 hours during a normal weekday and 3.9 hours Saturday and Sunday in front of a screen (computer, TV and videogames). Girls in the high sedentary group ( $\geq 3$  hours week day and  $\geq 3.5$ h Saturday and Sunday) perceived significantly more barriers to PA, and were significantly less active than girls in the low sedentary group ( $p \leq 0.007$ ). A common barrier among all three groups to not engage in PA was the lack of time linked to too much school work, although this barrier was significantly more highlighted among high sedentary group girls. In addition, this group reported a lack of energy or being interested in other things as other main barriers for being physically activity. **Discussion:** This specific sedentary pattern among girls is significantly related to their levels of PA and their perceived barriers to exercise. Addressing perceptions about the demands implicit in being active would appear to be a target to address the low levels observed in Spanish girls. **References:** Roman, B., Serra, L., Ribas, L., Pérez, C., Aranceta, J. (2006). Apunts. Medicina de l'esport. Vol. 41, pp. 86-94. Daskapan, A., Handan, E., Eker, L. (2006). Journal of Sports Science and Medicine. Vol. 5, pp. 615-620.

### SITTING TIME AND MVPA OF TWO INTERNATIONAL SAMPLES. COMPARATIVE STUDY

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**Introduction:** It has been observed that time spent at university in undergraduate study is often associated with a decline in physical activity (PA) levels. University students spend large amounts of time sitting, which has been associated with numerous health risks. Sedentary behaviours and lack of PA represent separate and distinct risk factors for non-communicable diseases. This study examined PA and sitting time and its relationships according to gender and university. **Methods:** Data were collected via 2 processes, an online questionnaire from 138 (104 Females, 34 males) students from Loughborough University (Group 1), UK, and from 119 (14 females, 105 males) students at Vigo University (Group 2), Spain. PA was assessed using the IPAQ short version and converted into MET-minutes/week and sitting time data were reported as minutes/weekday. A t-test, a one-way ANOVA and ANCOVA tests examined any differences between PA and sitting time reported between genders and the influences of light activity in sitting time and MVPA. **Results:** The mean sitting time on a weekday for the two groups, Group 1 ( $M= 246.8$ ,  $SD 274.39$ ) and Group 2 ( $M= 129$ ,  $SD 190$ ), was significantly different,  $p<0.001$ . Females reported higher levels of sitting time per weekday ( $M= 235$ ,  $SD 279.6$  vs.  $M= 155.4$ ,  $SD 206.8$ ,  $p<0.001$ ). Walking time was similar for both groups,  $p>0.05$ . Levels of light activity didn't show a significant effect on the amount of time spent sitting, although it was positively associated with MVPA,  $p= 0.001$ . Group 1 showed significant higher levels of MVPA, (2858 METs-min/Week vs. 394.4 METs-min/Week,  $p< 0.001$ ). Gender differences within groups were found not to be significant ( $p >0.05$ ). **Conclusion:** It seems that sitting time worked as a compensatory behaviour to high levels of MVPA, as Walking was similar in both groups. Future interventions are needed to increase MVPA and reduce sitting time to promote a healthier lifestyle.

## THE COMPARISON OF THE HEALTH RISKS OF WOMEN AGE BETWEEN 40-49 WHO WERE ATHLETES AND WHO WERE NEVER DONE ANY SPORTS IN THEIR PAST

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Introduction: Physical activities are most important behaviour to reduce diseases and injuries and in many study supported that physical exercises can be a medicine for health (Haskell et al. 2007; Ainsworth et al, 2000; Kesaniemi et al, 2001). The purpose of this study was to evaluate of risks related to the health of women ages between 40-49 years who were active athletes in the past and who were never done any sports. Method: Eighty eight women volunteered to participate in this study. Subjects' mean±SD for age were 45.1 ±2.4 years. 42 of them were licensed athletes in the past (Group 1) and the other 46 women had no any experience in sports (Group 2). This study was a kind of cross section study and the groups were provided from 4000 adults who were registered Private Fitness Club in Istanbul. It was asked risk factors related by their health before when they started to the activities. Also family history, own diseases/injuries and consumption of cigarette and alcohol information were collected in addition to Framingham risk factors. All data results were analysed by using SPSS program (version 18.0; SPSS, Inc., Chicago, IL). Frequency analyses were done and Anova was used for calculated to differences between the groups. Results: There is no any significant differences between the average of height, weight, fat percentage, lean body weight, systolic and diastolic pressure of two groups. However, there were significant differences between sum of trunkskinfold thicknesses and sum of extremite skinfold thicknesses of groups. It was found that group 1's thicknesses were less than group 2. Additionally, total cholesterol and blood glucose average values were found higher in group 2. When it was evaluated according to the risks of disease and habits; 24.4 % of women from group 1 had no any risk, but 21.5 % of in total rate, there were 5 different risk factors were found in group 2. Lastly it were found that in group 1, 34% of women smoke cigarettes, 31.7 % drink alcohol and 41.5 % using medicine regularly; in group 2, 40.4% of women smoke cigarettes, 36.2 % drink alcohol and 66 % using medicine. Discussion: In conclusion, It was found that no any physical differences between the groups but alcohol and cigarette consumption and medicine usage therefore total risk scores were higher in a group that had physical inactivity. According to Haskell et al. 2007, participation in aerobic and muscle-strengthening physical activities provides additional health benefits and results in higher levels of physical fitness. So we recommend to adults, who wish to improve their personal fitness and further reduce their risk for chronic health conditions and mortality related to physical inactivity, should exceed the minimum recommended amount s of physical activity. References: Ainsworth, B., W. L. Haskell, M. C. White, et al. (2000). *Med. Sci. Sports Exerc.* 32(suppl.):S498–S504,13. Kesaniemi, Y. A., E. Danforth Jr., M. D. Jensen, P. G. Kopleman, P. Lefebvre, B. A. Reeder. *Med. Sci. Sport Exerc.* 33(6 Suppl.):S531–S538, 2001

## SEDENTARY TIME AND PHYSICAL ACTIVITY AFTER CHILDBIRTH

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Introduction Decreasing levels of physical activity during pregnancy (Domingues et al. 2008; Tavares et al. 2009) and after childbirth are related to morbidity and obesity increase. It's important to recommend women to increase their physical activity levels. The objective was identifying changes in leisure physical activity after intervention during pregnancy in postpartum women. Methods One historical cohort Control Group (CG) (n=112) and one Intervention Group (IG) (n=79) were follow. All women were asked about physical activity habits and socioeconomic and behavioral variables in three moments (at the end of pregnancy, 6 and 12 months after childbirth). Chasan-Taber et al. (2004) questionnaire was used to measure physical activity. Data was analyzed using linear mixed model for longitudinal unbalanced data. Results The average age of participants was 27 years (range 19-40 years). Nutritional status was 65.4% normal weight and 29.3% excess weight (BMI≥25kg/m<sup>2</sup>). Regarding physical activity, there were no significant changes in energy expenditure, domestic activities and occupational mobility between groups. Conversely, leisure physical activity were significant higher in IG (p=0.03). However, physical activity during leisure time has very little contribution of total energy expenditure. Noteworthy is the fact that the intervention group have greater time in sedentary activities (p = 0.02). Other related factors were the presence of partner (in leisure physical activity), and work (on sedentary activities, locomotion and energy expenditure). Discussion Alleged impediments to exercise in postpartum are: concern about compromising the mother-child relationship, lactation and/or financial hardship (Derbyshire et al., 2008). Thus, the physical activity patterns of women raising their babies are changed, leading to an extended period of reduced physical activity and increased sedentary activities, transforming into a sedentary lifestyle. Physical activity during leisure time may had been increased twelve months postpartum, due to lower dependency of the child and likely regular sleep with decreased breastfeeding, allowing more available time. The results indicate compensatory effect of physical activity during leisure activities with the increase of sedentary ones. The recommendation to rise physical activity during leisure time showed unsatisfactory result since it represents negligible increase in total energy expenditure and resulted in increased sedentary time. References Domingues MR, Barros AJ, Matijasevich A. (2008). *Int J Gynaecol Obstet*, 103(01), 9-15. Tavares JS et al. (2009). *Portuguese. Rev Bras Epidemiol*, 12(1), 10-19. Chasan-Taber L, Schmidt MD, Roberts DE, Hosmer D, Markenson G, Freedson PS. (2004). *Med Sci Sports Exerc*, 36(10):, 1750-60. Derbyshire E, Davies GJ, Costarelli V, Dettmar PW. (2008). *British Journal of Midwifery*, 16(1), 20-24.

## INTERRUPTING SEDENTARY TIME IN AN EIGHT HOUR WORKING DAY

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INTRODUCTION There is growing evidence that sedentary behaviour increases the risk for morbidity and mortality regardless of the time spent performing physical activity. Occupational sitting represents the major source of sedentary behaviour in adults. A mainly sedentary lifestyle leads often to a negative energy balance which is related with overweight and obesity. Office workers are of high risk for prolonged sitting and it is of interest to minimise the amount of time spent being sedentary. The aim of the present study was to investigate the energy impact of interrupting office working days through hourly physical activity interruptions. METHODS On two consecutive days eight participants (3 male / 5 female; Ø age: 25,3 ± 2,1 years; Ø BMI: 22,7 ± 1,0 kg/m<sup>2</sup>) simulated an eight hour working day. On working day one the participants did activities in sedentary posture for eight hours. On working day two sedentary time of eight hours was interrupted with hourly staircase walking breaks. Total energy expenditure, active energy expenditure and METs were measured by the SenseWear Armband. The differences in the energy expenditure of the two days were compared. RESULTS The average total energy expenditure in an eight hour working day of interrupted sedentary time was 120 cal higher than total energy expenditure of uninterrupted sedentary time (980 ± 160 cal vs. 860 ± 170 cal; p<0,05). Active energy expenditure was 160 cal higher for interrupted sedentary time

compared to uninterrupted sedentary time ( $250 \pm 50$  cal vs.  $90 \pm 70$  cal;  $p < 0.05$ ). The average Metabolic Equivalents were  $1.8 \pm 0.2$  Met on working day with hourly active breaks compared to  $1.6 \pm 0.2$  Met on working day without hourly interruptions ( $p < 0.05$ ). DISCUSSION & CONCLUSION Energy expenditure increased during an interrupted working day compared to a non-interrupted working day. When extrapolated for a full 40 hour-working week, this data shows that an individual would theoretically expend additional 610 cal per week if they climbing stairs every hour compared with consecutive sitting for the eight hour working day period. This indicates that making active breaks such as climbing stairs could result in beneficial weight control or weight loss. This could be a potential approach for health promotion workplaces.

### OBJECTIVELY MEASURED DAILY PHYSICAL ACTIVITY PATTERN AND SEDENTARY BEHAVIORS IN COMMUNITY-DWELLING OLDER ADULTS

Chen, T., Narazaki, K., Honda, T., Nofuji, U., Matsuo, E., Kumagai, S.

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Introduction Physically active lifestyle is essential in healthy aging and sedentary behavior (SED) has been recognized as a risk factor for poor health (Lee et al., 2012). Studies that used accelerometer to monitor PA in older adults were mostly performed with a small sample size of less than 50 samples (Taraldsen et al., 2012). Accurate and validated data is still lacking in older adults. The purpose of this study is to describe the PA patterns in community-dwelling older adults by using a tri-axial accelerometer (TAA). Method Participants of this study were individuals ( $n=1,747$ ) who were 65 years or older and not certified as those requiring nursing care. The PA was assessed with a TAA device (HJA-350IT; Omron Healthcare, Inc., Japan) for 7 days. 1747 Participants with valid TAA data ( $\geq 600$ min/day for  $\geq 4$  days) were included in the analysis. Mean volume of daily total PA ( $>1.5$  METs, TPA, METs.hour/day) as well as daily time spent in sedentary behavior ( $\leq 1.5$  METs; SED, min), locomotive or non-locomotive light PA (1.6 to 2.9 METs; LPA, min), locomotive or non-locomotive moderate-to-vigorous PA ( $\geq 3.0$  METs; MVPA, min) are present by gender and age groups (65~69, 70~74, 75~79, 80~). Results The TPA decreases with age ( $p$  for trend  $< 0.01$ ), while SED increased with age in both genders ( $p$  for trend  $< 0.01$ ). Significant trends were also present that locomotive LPA, locomotive MVPA, non-locomotive LPA and non-locomotive MVPA decreased with age (all  $p < 0.01$ ). Compared with women, men had less average TPA ( $p < 0.01$ ). Compared with women, men had more minutes of SED, locomotive LPA and locomotive MVPA and fewer minutes of non-locomotive LPA and non-locomotive MVPA (all  $p < 0.01$ ). In addition, non-locomotive LPA highly correlated with TPA in both genders (men,  $\rho=0.80$ ,  $p < 0.01$ ; women,  $\rho=0.81$ ,  $p < 0.01$ ) after controlling with wearing time and age. Conclusions This study provides objective physical activity data on a relatively large sample of adults aged 65 years or older. Results showed that daily physical activity decreased with increasing age and non-locomotive LPA can be the main component for the total physical activity level in older adults. Furthermore, women spend more time in non-locomotive PA and are more active than men, while men spend more time in locomotive PA and SED than women. These results allow us to further investigate how PA and SED are related to health outcomes in this cohort. References Lee JM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. (2012). Lancet. 380(9838):219-229 Taraldsen K, Chastin SP, Riphagen II, Vereijken B, Helbostad JT. (2012). Maturitas, 71(1):13-9.

### THE PATCH STUDY - A SCHOOL BASED INTERVENTION TO INCREASE PHYSICAL ACTIVITY LEVELS IN PRIMARY SCHOOL CHILDREN

Cunningham, C.1, Breslin, G.1, Murphy, M.1

*University of Ulster*

Introduction The majority of primary-school aged children in Northern Ireland do not meet current recommendations for physical activity (PA) as outlined by the Department of Health (Breslin et al., 2012). Childhood has been identified as an important period to promote active lifestyle habits. Schools offer continuous contact with children and remain the only setting in which interventions aimed at increasing daily PA can be uniformly applied. The aim of this study was to evaluate the effects of the PATCH (Physical Activities To improve Children's Health) school based physical activity intervention on PA levels, body composition and physical self perception in a group of primary school children from Northern Ireland. Methods PATCH is a multicomponent, teacher-led intervention developed to incorporate classroom based PA breaks throughout the school day and to deliver weekly theory lessons on exercise and activity. The 'PA at Home' component involved daily PA homework and monthly parental newsletters to inform parents of the benefits of PA for children's health. Before and after the intervention, participants stature and body mass were measured and BMI calculated. Bone mineral content (BMC), bone mineral density (BMD), lean body mass and fat mass were obtained from a whole body DEXA scan. Resting blood pressure was measured using an automated blood pressure monitor. Physical self perception was assessed with the Children and Youth - Physical Self Perception Profile (CYSPSP). An individually calibrated treadmill test to  $VO_{2peak}$  (pre-intervention) enabled PA intensity cut-points to be calculated for each individual. Habitual PA was measured using a tri-axial accelerometer, pre, mid, and post intervention. Results PATCH participants increased daily moderate-to-vigorous PA (MVPA) and total daily PA by 14 mins and 27 mins respectively, compared to slight decreases of 4 min daily MVPA and 6 min total daily MVPA in the control group (pre to mid-intervention). PATCH participants increased total daily PA by 24 mins pre-to-post intervention whereas controls reduced total daily PA by 21 mins. PATCH participants decreased daily sedentary time by 14 mins (pre to mid-intervention) and 10 mins pre-to-post intervention. Contrastingly, the control group decreased daily sedentary time by 1 min pre to mid-intervention with no further reduction in daily sedentary time pre-to-post intervention. Discussion These findings suggest that the PATCH intervention has the potential to increase daily MVPA and total daily PA and decrease sedentary time in a group of primary aged school children. References Breslin, G., Brennan, D., Rafferty, R., Gallagher, A.M., Hanna, D. (2012). The effect of a healthy lifestyle programme on 8-9 year olds from social disadvantage. Arch Dis Child. Jul;97(7):618-24.

15:00 - 16:00

## Mini-Orals

## PP-PM19 Health and Fitness [HF] 13

**SQUARE-STEPPING EXERCISE INCREASES REGIONAL CEREBRAL BLOOD FLOW: A NEAR-INFRARED SPECTROSCOPY STUDY**

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**Introduction:** Decline in cognitive function with aging is inevitable, and it sometimes leads to the need for long-term assistance or care. We developed a novel exercise for maintaining and enhancing physical and cognitive functions called "Square-Stepping Exercise (SSE)" (Shigematsu et al., 2008; Okura et al., 2010). This study tests the hypothesis that SSE would increase regional cerebral blood flow (rCBF). **Methods:** The subjects of the pilot study were 15 college students ( $21.7 \pm 0.5$  years old) in Japan. We used near-infrared spectroscopy (NIRO-200) to measure rCBF of the prefrontal area during normal walking and SSE. We divided the SSE into 3 patterns based on difficulty: 1) basic step, 2) challenge step, which is somewhat difficult and 3) special step which is difficult. The rCBF was measured by both changes in oxygenated hemoglobin concentration (oxy-Hb) and changes in normalized tissue hemoglobin index (nTHI). Each SSE pattern was conducted in three cycles: 1) resting for 30 seconds, 2) memorizing the SSE step pattern and 3) performing the SSE. We used a one-way repeated-measures analysis of variance. **Results:** An increasing level of square stepping difficulty positively associated with a higher level of oxy-Hb of the left brain and a higher level of nTHI in both left and right brains (Trend P values  $<0.05$ ). In the post-hoc tests, oxy-Hb of the left brain during the special step was significantly higher than during the basic step. There were significant differences in nTHI level of the left brain between walking and basic step and in nTHI level of the right brain between walking, basic or challenge steps and special step. **Conclusion:** The levels of oxy-Hb and nTHI increased with increased difficulty of the SSE pattern especially with the special step. Our data suggest that the SSE may be an effective intervention program for activating brain function. **References:** Shigematsu R, Okura T, Nakagaichi M et al. (2008). *The Journals of Gerontology: Series A*, 63(1):76-82. Okura T, Yoon JY, Sanada I et al. (2010). *Journal of Japanese Society for Dementia Care*, 9(3), 519-530.

**RELATIONSHIP BETWEEN OXIDATIVE STRESS AND EXCESS POST-EXERCISE OXYGEN CONSUMPTION IN MODERATE AEROBIC EXERCISE: FOCUSING ON THE DIFFERENCE DURATION AND ENVIRONMENTAL TEMPERATURE**

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**Introduction** Recently, lifestyle diseases and metabolic syndrome have become a social problem. Moderate aerobic exercise is expected to make an effect on prevention and improvement of those diseases. Additionally, more and more people are taking exercise in a hot environment to increase the lipid metabolism. On the other hand, some researchers say the rise in body temperature had a negative influence on body. The purpose of this study was to investigate the relationship between oxidative stress and excess post-exercise oxygen consumption (EPOC) after moderate aerobic exercise (50%VO<sub>2</sub>max). **Methods** Six trained male young volunteers took part in the study after giving a written informed consent. The subjects exercised on separate days for 30 min (30EX), 60 min (60EX), 90 min (90EX) at 20 degrees and 60 min at 32-34 degrees (60EXH) at an identical intensity of 50 % of VO<sub>2</sub>max on a bicycle ergometer. Urine samples were collected before exercise (baseline) and 1.5 hour after exercise (1.5h) for analysing urinary 8-hydroxy-2'-deoxyguanosine (8-OHdG) level as an index of oxidative stress. Cardio-respiratory data and body surface temperature were measured during and 30 min after exercise on a sitting position. The statistical analysis was performed using the following tests: Student's t-test and Pearson's correlation coefficient. **Results** The values of EPOC after each exercise was 151.4 +/- 4.6 ml/kg (30EX), 168.4 +/- 4.5 ml/kg (60EX), 193.7 +/- 10.6 ml/kg (60EXH), and 170.2 +/- 4.1 ml/kg (90EX). The values of urinary 8-OHdG level at baseline and 1.5h were 5.02 +/- 0.91 ng/kg/h and 5.83 +/- 0.47 ng/kg/h (30EX), 8.22 +/- 2.54 ng/kg/h and 10.2 +/- 1.66 ng/kg/h (60EX), 7.65 +/- 1.48 ng/kg/h and 11.3 +/- 4.09 ng/kg/h (60EXH), and 5.76 +/- 0.45 ng/kg/h and 6.71 +/- 0.63 ng/kg/h (90EX). Urinary 8-OHdG level had a low correlation with EPOC (R<sup>2</sup>=0.29). Furthermore, relative value of Urinary 8-OHdG level in 60EXH correlated significantly with EPOC (R<sup>2</sup>=0.60), but there is no definite correlation in 60EX (R<sup>2</sup>=0.08). **Conclusion** The values of 60EXH were peak of EPOC and urinary 8-OHdG level at 1.5h. Therefore, there was some sort of relationship between EPOC and oxidative stress after exercise. Furthermore, it was suggested that the higher environmental temperature, the relationship between oxygen consumption and oxidative stress became strongly.

**THE EFFECTS OF RECREATIONAL PHYSICAL ACTIVITY ON THE LABORATORY LIPID PROFILE VALUES IN DIFFERENT AGE GROUPS AND BMI CATEGORIES**

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**Introduction** Nowadays, cardiovascular diseases and their complications are part of widespread diseases in the world of advanced industrial societies. It is well-known that regular physical activity has beneficial effects on cardiovascular risk factors. We investigated the effects of 3-month of recreational type of regular aerobic physical activity done on different "fat" parameters in each BMI categories of different age groups. **Methods** The program was on a voluntary basis, regardless of age or gender anyone can participate, so the sample of the research consisted of 108 persons. The participants took part in different aerobic exercise programs for 3 months at least 3 times per week. At the beginning and at the end of the program, the participants' body composition was analysed by Inbody230 and blood samples were collected. We measured the change of relative body fat, triglycerides, total cholesterol, HDL- and LDL-cholesterol, by age groups (20-29; 30-39, 40-49, >50 years old) comparing these values to the baseline BMI (19-25, 25-30, >30 BMI groups/every age groups) values. **Statistical analysis:** Mann - Whitney U test. **Results** Body fat percentage tended to decrease in all age groups in all BMI categories, and significantly decreased in 20-29 and >50 years old groups. We observed significant decrease of the triglyceride levels

almost everywhere (exception 30-39 years old group). In the case of total cholesterol, the physical activity significantly reduced the initial high values in most categories (exception >50 years old group). It is known that the increase of HDL – cholesterol level has beneficial effects. This trend also appeared as the effect of regular physical education, except for the older age group (>50), where there was no a significant increase in HDL level. The LDL concentration decreased in every group. This reduction was significant except for the older age group (>50). Discussion All the changes in parameters of the study were favourable, so it is supposed that the effects of regular physical activity on body composition and blood lipid profile are clearly positive in every age groups. The cardiovascular risk factors can be significantly reduced by regular recreational physical activity. Support Support SROP 4.2.2-08/1-2008-0006; SROP 4.2.1./B-09-1/KNOV-210-0005; SROP 4.2.4.A/2-11-1-2012-0001 References Saaristo, T. et al. (2010): *Diabetes Care*, 33: 2146-2151. Saris, W.H. et al. (2003): *Obesity Reviews*; 4 (2): 101-114. Weintraub, W.S. et al. (2011): *Circulation*; 124: 967-990. Pate, R.R. et al. (1995): *J. Am. Med. Association*; 273 (5): 402-407.

## RELATIONSHIPS BETWEEN PHYSICAL FITNESS LEVEL AND HEALTH-RELATED QUALITY OF LIFE IN OBESE ADULTS: A PILOT STUDY.

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1: LAFAL, Dipartimento di Scienze Biomediche per la Salute, Università degli Studi di Milano (Milano, Italia) 2: Laboratorio di Fisiologia Sperimentale, Corso di Laurea in Scienze Motorie, Università Cattolica del Sacro Cuore (Milano, Italia) 3: Corso di Laurea in Scienze Motorie, Università Cattolica del Sacro Cuore (Milano, Italia) Introduction If recent epidemiologic studies suggested that higher levels of physical activity (PA), cardiorespiratory and muscular fitness may offset much of the excess of mortality risk that is associated with overweight and obesity (Blair, 2004; Fogelholm, 2010) and may counteract the adverse cardiovascular profile (Artero, 2012), only PA participation has been linked to health related quality of life (HRQoL) in obese adults (Herman, 2012). Currently, there is insufficient evidence available regarding the relationship between physical fitness level with HRQoL in this special population. Therefore, the aim of the present study was to investigate the impact of cardiorespiratory ( $\dot{V}O_2\max$ ) and muscular (iMVC) fitness on HRQoL in obese adults. Methods 10 obese adults (6 women 4 men, mean age  $27.6 \pm 6.3$  years; BMI  $39.9 \pm 5.8$  kg/m<sup>2</sup>; MVPA  $37.9 \pm 36.6$  min/day;  $\dot{V}O_2\max$   $30 \pm 6$  mL/kg/min; iMVC  $15.2 \pm 2.6$  N/kg) were involved in the study. To assess  $\dot{V}O_2\max$  and iMVC, they performed a maximal treadmill test with indirect calorimetry (Quark CPET, Cosmed, Italy) and a maximal isometric strength test using two force platforms (Twin Plates, Globus, Italy) fixed on a horizontal leg press (Technogym SpA, Gambettola, Italy). HRQoL was measured with the Short-Form 36 Health Status Survey (SF-36v2) that provided the physical (PCS) and the mental (MCS) component summary score. Results The overall average PCS and MCS scores were  $53.6 \pm 6.7$  and  $45.2 \pm 6.9$ , respectively. Regression analysis, adjusted for age and BMI, revealed that neither  $\dot{V}O_2\max$  nor iMVC were related to a higher HRQoL. Only lower BMI was associated with higher vitality, a sub-dimension of MCS (F-value 5.966;  $p < 0.05$ ). Discussion The absence of associations between  $\dot{V}O_2\max$  and iMVC with HRQoL may be due to a higher PCS score when compared with the mean reference values of a population of moderately obese subjects (reference PCS =  $45.99 \pm 12.1$ ), and, in contrast with Doll et al. (2000), a higher PCS score compared with MCS values. In accordance with Fontaine (2001), a higher BMI was associated with a lower vitality score. Future studies are needed to gain a better insight into these findings. References Artero et al., *J Cardiopulm Rehabil Prev*. 2012;32(6):351-8 Blair et al., *JAMA*. 2004 8;292(10):1232-4 Doll et al., *Obes Res*. 2000;8(2):160-70. Fogelholm, *Obes Rev*. 2010;11(3):202-21. Fontaine et al., *Obes Rev*. 2001;2(3):173-82 Herman et al., *Med Sci Sports Exerc*. 2012;44(4):625-36

## EFFECT OF WHOLE-BODY VIBRATION EXERCISE ON KNEE FUNCTION IN MIDDLE-AGED AND OLDER JAPANESE WOMEN WITH KNEE PAIN: EXAMINED BY DEGREE OF KNEE PAIN

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INTRODUCTION: Strength training is known to be an effective, conservative therapy for middle-aged and older women who suffer from knee pain associated with knee osteoarthritis. Recently, whole-body vibration (WBV) exercise has been gaining attention as a new strength training technique that is both safe and effective. The objective of this study was to investigate the effect of WBV exercise on knee extension muscle strength and power, functional mobility and self-reported knee function at each degree of pain in middle-aged and older Japanese women who suffer from knee pain. METHODS: Twenty-nine subjects who suffer from knee pain were recruited (mean age:  $62.1 \pm 5.5$  years). Using the Western Ontario and McMaster Universities Arthritis Index (WOMAC) pain score, we divided the subjects into 2 groups by knee pain: "mild" ( $n = 16$ ) with a score of  $< 3$  and "moderate/severe" ( $n = 13$ ) with a score of  $\geq 3$ . All subjects participated in WBV exercise programs 3 days/week for 8 weeks. Each session included a 10-minute warm-up period, a 25-minute period of weight-bearing strength training and a 15-minute cool-down period. The strength training exercises were designed to strengthen mainly the quadriceps (e.g. squats and lunge exercises) and other surrounding muscles. All exercises were done using POWER PLATE (POWER PLATE International, London, UK) at a frequency of 30-40 Hz and vibration amplitude of 2.5 mm. We measured isometric peak torque and isokinetic (60 deg/s) mean power of knee extension. The timed-up-and-go test and WOMAC questionnaire were used to evaluate functional mobility and self-reported knee function, respectively. RESULTS: There were no dropouts with all 29 subjects completing the study through the post-test. Participation rate was 95.3%. Peak torque and average power improved significantly in both groups (mild: 3.19 to 4.00 Nm/kg, 1.43 to 1.79 W/kg; moderate/severe: 2.72 to 3.16 Nm/kg, 1.18 to 1.38 W/kg, respectively). We observed significant shortening in the timed-up-and-go test results in both groups (mild: 5.43 to 4.81 s; moderate/severe: 6.20 to 5.43 s). WOMAC total score decreased significantly (improved knee function) in the moderate/severe knee pain group (19.5 to 14.5 points) but not in the mild knee pain group (5.1 to 4.1 points). CONCLUSIONS: An 8-week, three times per week, WBV exercise program was shown to be safe while eliciting a high participation rate in middle-aged and older Japanese women who suffer from knee pain. In addition, our data suggest that the WBV exercise program can improve lower limb muscle strength and power, functional mobility independent of degree of knee pain and self-reported knee function for moderate/severe knee pain.

**WEEKDAY AND WEEKEND PHYSICAL ACTIVITY PATTERNS OF FRENCH AND SPANISH ADOLESCENTS**

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Introduction Recent research showed significant differences in Spanish and French adolescents' physical activity (PA; Aibar et al., 2012). To develop a clearer cross-cultural understanding of these findings, the primary purpose of this study was to determine country and gender differences in moderate to vigorous physical activity (MVPA) levels during specific segments of weekdays and weekend days, and to explore the contribution of each segment to PA guidelines. Method Morpho-demographic, socio-economic and PA data were collected in a sample of 829 adolescents (45.0% Spanish; 55.2% females; 14.33±7.3 years) in two twin mid-sized European cities, Huesca (Spain) and Tarbes (France). Actigraph GT3X accelerometers were worn for seven consecutive days to assess adolescents' habitual MVPA for three segments of weekdays (school-travel-, school-, and non-school-time), and weekend days (morning-, afternoon- and night-time). Data were analysed using multilevel modelling. Results The most active segments were non-school-time (29.2±17.5 min) and school-time (25.8±14.2 min) during weekdays, and morning-time (28.2±25.8 min) on weekend days. Except for school-time, Spanish adolescents were more active ( $p < .05$ ) than French adolescents during all segments. Gender was significantly associated with MVPA across all weekday and weekend segments, with boys accumulating more MVPA than girls ( $p < .05$ ). Discussion Out-of-school time (especially weekends) appears to present the greatest potential for targeted PA interventions (Floh et al., 2006), particularly focused on girls and low active boys (Fairclough et al., 2012). Country differences highlight the need to recognize cultural contexts and settings that influence adolescents' PA. Common European-wide strategies may be insufficient to increase MVPA levels if cultural variability is not considered. References Aibar, A., Bois, J.E., Generelo, E., Zaragoza, J., Paillard, T. (2012). A cross-cultural study of adolescents' physical activity levels in France and Spain. *European Journal of Sport Science*. doi:10.1080/17461391.2012.746733. Fairclough, S.J., Beighle, A., Erwin, H., & Ridgers, N.D. (2012). School day segmented physical activity patterns of high and low active children. *BMC Public Health*, 12(1), 406-417 Flohr, J.A., Todd, M.K., & Tudor-Locke, C. (2006). Pedometer-assessed physical activity in young adolescents. *Research Quarterly for Exercise & Sport*, 77, 309-315.

**STEPS THAT COUNT! Pedometer-measured versus self-reported ambulatory physical activity in relation to current guidelines- A South African adult, employed population.**

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Background: The association between perceived and objectively measured ambulatory physical activity (PA), with particular reference to current PA guidelines, may be an important factor in determining the extent of uptake and compliance to PA. We aimed to examine this association, with reference to volume, intensity and duration of PA through self-reported and pedometer-measured data. Methods: A convenience sample (N=312, 37±9yrs), recruited from health risk screening events, completed a questionnaire that included information on PA patterns and thereafter wore a pedometer (minimum 3 days; maximum 7 days). Analyses of co-variance (ANCOVA), adjusting for age and gender were used to compare pedometer-determined volume and intensity of steps/day to meeting/not meeting guidelines, self-reported. The extent of agreement between self-reported and pedometer-measured PA was also determined through correlational analyses. Results: Average steps/day of the entire study group were 6,574±3,541; of a total of 312 participants' self-reported data, those meeting guidelines (n=63) accumulated significantly more steps/day than those not meeting guidelines (8,753±4,251 versus 6,022±3,114, respectively;  $p < 0.001$ ). A similar finding was noted when comparing aerobic steps/day in those meeting/not meeting guidelines (1,772±2,020 versus 421±1,140, respectively;  $p < 0.0001$ ). Our data identified that more than half of the group meeting guidelines, self-reported, did not meet guidelines, pedometer-determined. However, participants reporting to meet guidelines were more likely to meet PA guidelines, pedometer-measured (40%), than those that reported not to meet guidelines (8%). Conclusion: Notwithstanding the limitations of both measurement tools in estimating PA patterns, the use of pedometers as an alternative to self-reported measures or accelerometers is an area for consideration.

**INFLUENCE OF WORK EXPERIENCE ON PHYSICAL FUNCTION IN LATER LIFE**

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INTRODUCTION Some studies reported that work experience links with subjective health status in later life (Kajitani, 2011), but little is known about associations between work experience and physical function (PF) using objective performance tests. This study investigated whether work experience links with PF in later life. METHODS Our study included 564 community-dwelling older adults (73.3±5.3 years old) in Kasama City, rural Japan. We classified participants' longest work experiences into nine categories: 1) owner of a shop or small company, 2) farmer, 3) self-employed other than shop or small company owner or farmer, 4) manager of a company or public organization, 5) professional e.g. medical doctor, nurse or teacher, 6) clerical worker, 7) factory worker or driver, 8) sales or restaurant staff and 9) unemployed including housewife. For a comprehensive assessment of PF, we calculated a principal component score based on eight performance tests: 1) grip strength, 2) single-leg balance, 3) functional reach, 4) sit-to-stand, 5) timed-up-and-go, 6) habitual walk, 7) hand working and 8) choice reaction time. The principal component score (PF score) was converted into a T score (50±10). To compare PF by work experience, we used the analysis of covariance (ANCOVA) controlling for age, education, equivalent income, current working status, physical activity (physical activity scale for the elderly score) and clinical history. RESULTS The PF scores of both men and women were significantly different with regards to work experience (ANCOVA P values < 0.05). Older men who were farmers (T = 42.4±10.0) or self-employed (T = 43.3±10.4) were more likely to have a low level of PF, whereas, men who were managers (T = 52.6±8.5) or professionals (T = 52.5±9.6) were more likely to have a high level of PF. Older women who were owners (T = 40.0±12.9), managers (44.8±4.7) or farmers (T = 42.8±12.0) were more likely to have a low level of PF, whereas, women who were professionals (T = 52.7±12.0) or clerical workers (T = 55.2±12.0) were more likely to have a high level of PF. DISCUSSION We did not expect to find that men and women who worked as farmers were more likely to be physically frail since habitual physical activity at midlife links with a high level of PF in later life (Tikkanen et al., 2012). However, Fletcher et al. (2011) reported that work with a high physical burden relates to a future, self-reported unhealthy status. Our study supported this negative relationship with PF. REFERENCES Kajitani S. (2012). Meisei University *The Bulletin of Economic Studies* 43(2), 1-18. Fletcher JM et al. (2011). *Health Economics* 20(5), 553-570. Tikkanen P et al. (2012). *J Gerontol A Biol Sci Med Sci* 67(8), 905-910.

**INFLUENCE OF SEX ON STRETCHING EXERCISE -INDUCED REDUCTION IN ARTERIAL STIFFNESS**

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**Introduction:** Arterial stiffness has been identified as an independent risk factor for mortality and cardiovascular disorders. The previous research has shown that poor flexibility is associated with arterial stiffening. Stretching exercise is effective for increasing flexibility. Currently, it is unknown whether arterial stiffness is reduced after one bout of stretching exercise, and moreover whether there are sex specific responses in arterial stiffness. The purpose of this study was to compare arterial stiffness after one bout of stretching exercise between young men and women. **Methods:** Twenty four healthy adults (age  $24 \pm 1$  yrs, 11 men and 13 women) participated in this study. Brachial-ankle pulse wave velocity (baPWV) was calculated from the distance between brachial and post-tibial arteries divided by transit time. The transit time was determined from the time delay between two arterial waveforms. The baPWV was used as index of arterial stiffness. Arterial stiffness measurements were performed during the follicular phase of that individual's menstrual cycle in women. The stretching protocol was performed according the static method. The session consisted of 40 stretches for whole body at the maximum range of motion. The baPWV, systolic blood pressure, and heart rate were measured before and immediately after the stretching exercise as well as 15, 30, 45, 60 minutes after the stretching exercise. **Results:** There was no significant interaction between sex and time for baPWV. However, there were sex effect ( $P < 0.05$ ) and time effect ( $P < 0.05$ ). The baPWV was greater in men compared with women ( $P < 0.05$ ) and reduced at 45 minutes after stretching exercise ( $P < 0.05$ ). There were no significant interactions between sex and time for systolic blood pressure and heart rate. Systolic blood pressure was higher in men compared with women ( $P < 0.05$ ) and increased after stretching exercise, changed this parameter to baseline levels within 15 minutes after stretching exercise. Heart rate was similar in men and women and decreased after stretching exercise, changed this parameter to baseline levels within 30 min after stretching exercise ( $P < 0.05$ ). **CONCLUSION:** These results suggest that stretching exercise acutely decreases arterial stiffness regardless of sex.

**COMBINATION OF  $\alpha$ -GLYCEROPHOSPHOCHOLINE ( $\alpha$ -GPC) INTAKE AND AEROBIC EXERCISE IMPROVES COGNITIVE FUNCTIONS IN HEALTHY OLDER WOMEN**

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**BACKGROUND:**  $\alpha$ -Glycerophosphocholine ( $\alpha$ -GPC) contributes to the cognitive improvement of mild to moderate Alzheimer's patients (Moreno DJ, Moreno M. 2003). Additionally, habitual exercise improves the cognitive functions. However, the effect of the combination of  $\alpha$ -GPC and aerobic exercise on cognitive abilities in healthy older adults remains unclear. **PURPOSE:** The purpose of this study was to clarify whether the combination of  $\alpha$ -GPC and exercise improve cognitive functions in healthy older people, especially the short-term and the working memory. **METHODS:** 10 healthy females (60-69 yrs. old;  $M = 65.6$ ) participated in the study. They were administered at  $\alpha$ -GPC 1,000 mg once a day and performed walking training for 8-week aiming for at least 30-min training-session 3 times a week. They received the memory test (Kunimi M. 2007) before and after the intervention. The memory test is divided into the serial recall task, which measures the short-term memory, and the reverse recall task, which measures the working memory. The participants were required to remember the successively -presented four kinds of symbols ( $\circ / \Delta / \times / \square$ ), which varied from the two-symbol conditions (e.g.  $\circ / \Delta$ ) to the five-symbol conditions (e.g.  $\circ / \Delta / \times / \square / \circ$ ). **RESULTS:** The memory test showed that there was no significant difference in the serial recall task. Only the five symbol condition showed a marginally significant improvement in the accuracy rate (pre  $46.0 \pm 31.3\%$  / post  $61.6 \pm 23.9\%$ ;  $p = .096$ ). On the other hand, the reverse recall task showed a marginally significant difference in the three-symbol condition (pre  $76.7 \pm 17.3\%$  / post  $90.7 \pm 10.5\%$ ;  $p = .059$ ) and significant improvement in the four-symbol one (pre  $57.0 \pm 15.8\%$  / post  $73.5 \pm 16.3\%$ ;  $p = .031$ ) and the five-symbol one (pre  $36.8 \pm 23.5\%$  / post  $50.8 \pm 21.5\%$ ;  $p = .011$ ). **CONCLUSION:** These findings suggest that the combination of  $\alpha$ -GPC and aerobic exercise may be effective in improving the cognitive functions, especially working memory, in the healthy older women. It is known that exercise helps to improve the cognitive functions of older people, but longer period of training is usually needed (Voss, et al., 2011). In that point, the combination of  $\alpha$ -GPC and exercise makes possible more rapid improvement of the cognitive functions of older people. **REFERENCES:** (1) Moreno, D. J., Moreno M. (2003) Clin Ther. 25, 178-93. (2) Kunimi, M. (2007) Human and socio-environmental studies, 13, 203-10. (3) Voss, M., et al. (2011) J Appl Physiol. 111, 1505-13 **GRANTS:** Supported by KAKENHI of the Japan Ministry of Education, Culture, Sports, Science and Technology (MI and AY).

**EFFECT OF SUPPLEMENTATION WITH VITAMIN C AND E ON MUSCLE GROWTH AND STRENGTH INDUCED BY 12 WEEKS OF RESISTANCE EXERCISE IN ELDERLY MEN**

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**INTRODUCTION:** Supplementation with antioxidants may be beneficial to accelerate gains in lean mass during resistance exercise in elderly men, due to a reduction in oxidative stress. However, oxidative stress is also important to sufficiently activate redox-sensitive signaling pathways that regulate protein synthesis. To the authors knowledge only a few studies have looked at this issue. Thus, the aim of the present study was to investigate the effect of daily supplementation with high dosage of vitamin C and E on muscle growth and maximal strength during 12 weeks of resistance exercise in elderly men. **METHODS:** Thirty-four elderly males (60 – 81 yrs old) were randomized to either a supplemental group (antiox., 1000 mg of vitamin C and 235 mg of vitamin E per day) ( $N=17$ ) or a placebo group (placebo,  $N=17$ ). Muscle growth was assessed as changes in lean mass with Dual-energy X-ray absorptiometry and thickness of rectus femoris, vastus lateralis and arm flexors (brachialis and biceps brachii) with ultrasound imaging. Strength was measured as 1 repetition maximum (1RM) in leg press, knee extension and scott curl. All participants conducted resistance exercise 3 times a week, following an undulating periodized program: 8-10RM (1 min inter-set rest periods), between 3-5RM (2 min rest) or 13-15RM (45 sec rest). The load was weekly adjusted, and the volume increased progressively throughout the 12 weeks of resistance exercise. **RESULTS:** Median changes in total lean mass and in the legs were significantly increased in the placebo group (3.9% (95% confidence intervals 3.0-5.2); and 4.6% (3.0-5.7);, respectively) compared to antiox. (1.2% (CI 0-3.6);  $p < 0,03$  and 1.7% (1.1-3.4);  $p < 0,02$ , respectively). Similar results were shown in ultrasound images of rectus femoris, as the muscle thickness increased with 16.2% (12.8-24.1) for the placebo vs. 10.9% (9.8-13.5) for the antiox. ( $p=0.01$ ). 1RM increased in the range of 15-21% in antiox. and placebo during 12 weeks of resistance exercise ( $p < 0.001$ ), although not significantly different. Changes in lean trunk and lean arms, as well as for muscle thickness in armflexors and vastus lateralis did not differ significantly between groups. **DISCUSSION:** In response to resistance exercise both groups had a robust increase in lean mass,

muscle thickness and strength. However, supplementation with vitamin C and E did not have any positive effects on the adaptation to resistance exercise in elderly men, but seemed on the contrary to hamper muscle growth.

#### **ACTIVA: A COMMUNITY PROGRAM TO PROMOTE PHYSICAL ACTIVITY**

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**Introduction** The comprehensive plan for Physical Activity and Sport (Plan A + D) is a strategy created by the Spanish Government (The Sports Advisory Board) which has, as its objective, to guarantee the whole Spanish population universal access to high-quality and practical sport, thus helping to fight against the high levels of sedentary living and obesity and to promote active and healthy lifestyles. The aim of "Activa" is to improve physical activity through coordination between Primary Care doctors and nurses and Town Councils with the purpose of analysing the effectiveness of therapeutic physical exercise prescription from Primary Care consultations in patients with cardiovascular risk factors. **Methods** The subjects were included on the program on primary care centres by their doctor or nurse. They evaluate the criteria for inclusion and exclusion that people have. The criteria for inclusion in the program were the presence of two or more CVRF (hypertension, lipidic disorders, overweight and smoking) and sedentary lifestyle in people from 35 to 65 years old. The program "Activa" consisted of 30 sessions (10 weeks) of training on strength, flexibility and aerobic endurance, 3 days per week on circuit training. The program is designed and supervised by graduates in Sport Science and Health. The program will be coordinated by Healthcare and Social Policy and the Town Halls of the Region of Murcia. **Results** The program is currently being developed on 16 Town Halls in the Region of Murcia, where it is working in 42 Health Centers with 267 professionals (146 doctors, 107 nurses and 14 graduates in Sport Science). Actually, the program has already formed 82 physical exercise groups, with at least 15 patients in each group. **Discussion** The approach to chronic illness is currently a primary objective in society (Geneau, Stuckler, Stachenko, et al., 2010.). Primary care is the ideal place to initiate preventative strategies such as advice on physical exercise. However, the evidence base is weak and is not conclusive (Pavey, Taylor, Fox, et al., 2011). Some of the benefits of physical exercise are: helps prevent the development of hypertension, reduces childhood and adult obesity, reduces cholesterol and the risk of cardiovascular and cerebrovascular illness, reduces symptoms of depression and anxiety and improves your physical condition: resistance, strength, flexibility, agility, breathing and circulation. **References** Geneau, R., Stuckler, D., Stachenko S., Mckee, M., Ebrahim, S., Basu, S., Chockalinhm, A., Mwatsama, M., Jamal, R., Alwan, A. & Beaglehole, R. (2010). Raising the priority of preventing chronic diseases: a political process. *Lancet*, 376, 1689-1698. Pavey, T.G., Taylor, A.H., Fox, K.R., Hillsdon, M., Anokye, N., Campbell, J.L., Foster, C., Green, C., Moxham, T., Mutrie, N., Searle, J., Trueman, P. & Taylor, R.S. (2011). Effect of exercise referral schemes in primary care on physical activity and improving health outcomes: systematic review and meta-analysis. *BMJ*, 343:d6462

#### **CARDIORESPIRATORY FITNESS IS ASSOCIATED WITH INTRAMYOCARDIAL TRIGLYCERIDE IN HEALTH MEN**

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**Introduction** Previous studies have demonstrated convincing evidence that exercise capacity (maximal cardiorespiratory fitness; VO2peak) is related to health and predicted mortality in middle-aged as well as in older adults (Liu et al., 2012). It has been reported that intramyocardial triglyceride (IMTG) content is associated with lipotoxicity and contractile dysfunction. The aim of this study was to examine the relationship between VO2peak and IMTG. **Methods** We examined the relationship between exercise capacity and cardiovascular risk factors in 20 healthy male subjects (age 30.7 ± 1.6 yr; weight 67.4 ± 1.5 kg; body mass index 22.7 ± 0.4 kg/m<sup>2</sup>; means ± SE). Using a graded maximal cycle ergometric test, VO2peak and exhausted time were assessed. A 2 cm<sup>3</sup> (10 × 10 × 20 mm) volume of interest with was prudently selected to avoid blood contamination within the ventricular septum from cine dynamic images using breath-hold proton magnetic resonance spectroscopy (1H-MRS) techniques. IMTG content was calculated according to the area under curve of each spectrum from water and lipid (Hammer et al., 2008). As novel markers of arterial stiffness, cardio-ankle vascular index (CAVI) was simultaneously measured with blood pressure (Nakamura et al., 2008), and carotid intima-media thickness (IMT) using high-resolution ultrasound imaging was measured at the common carotid artery (O'Leary et al., 2002). **Results** There were no significant relationships between CAVI (r = 0.055), SBP (r = 0.147), DBP (r = 0.258) and pulse pressure (r = 0.258) values against VO2peak. We observed a significant inverse relationship for VO2peak and IMTG (r = -0.512, P for trend < .05). Moreover, VO2peak showed a negative correlation with IMT level (r = -0.584, P < 0.05). **Discussion** Although the results of this study were limited to healthy men, cardiorespiratory fitness showed a strong inverse relationship with intramyocardial fat as an ectopic fat. Moreover, VO2peak may be associated with carotid morphological aspect of the IMT as a surrogate marker for atherosclerosis, but not arterial stiffness, at least in healthy men. These findings suggest that cardiac triglyceride contents and carotid intima-media thickness may be linked to exercise capacity. **References** Hammer S, van der Meer RW, Lamb HJ, de Boer HH, Bax JJ, de Roos A, Romijn JA, Smit JW. (2008). *Am J Physiol Endocrinol Metab.* 295(3), E714-8. Liu R, Sui X, Laditka JN, Church TS, Colabianchi N, Hussey J, Blair SN. (2012) *Med Sci Sports Exerc.* 44(2), 253-9. Nakamura K, Tomaru T, Yamamura S, Miyashita Y, Shirai K, Noike H. (2008). *Circ J.* 72(4), 598-604. O'Leary DH, Polak JF. (2002). Intima-media thickness: a tool for atherosclerosis imaging and event prediction. *Am J Cardiol.* 90(10C), 18L-21L.

#### **EFFECTS OF AEROBIC EXERCISE TRAINING ON PLASMA ASYMMETRIC DIMETHYLARGININE CONCENTRATION AND CENTRAL ARTERIAL COMPLIANCE IN POSTMENOPAUSAL WOMEN**

Tanahashi, K., Akazawa, N., Miyaki, A., Choi, Y., Ra, S.G., Matsubara, T., Higashino, R., Kumagai, H., Oikawa, S., Aijisaka, R., Maeda, S.

*University of Tsukuba*

**Background:** Central arterial compliance decreases with advancing age. Reduction in Central arterial compliance with aging increases the risk of cardiovascular disease. Regular aerobic exercise has a favorable effect on vascular aging. Asymmetric dimethylarginine (ADMA) is an endogenous competitive inhibitor of nitric oxide synthase (NOS), an enzyme responsible for generation of nitric oxide (NO). Plasma concentration of ADMA increases in elderly people and in menopausal estrogen deficient women. However, it is unclear whether regular aerobic exercise decreases plasma ADMA concentration in postmenopausal women. We investigated the effects of aerobic exercise training on plasma ADMA concentration and central arterial compliance in postmenopausal women. **Methods:** Thirty postmenopausal women were divided into two groups, i.e., exercise training group (n = 20) and control group (n = 10). Subjects in the exercise

group completed 12 weeks of aerobic exercise training (65-80% of maximal heart rate, 40-60 min/day, 3-5 days/week). The subjects in the control group were instructed not to change their physical activity level for 12 weeks. Before and after the intervention, we measured plasma ADMA concentration and carotid arterial compliance in all participants. Results: The baseline plasma ADMA concentration, carotid arterial compliance, and most other key dependent variables did not significantly differ between two groups. Plasma ADMA concentration was significantly decreased in the exercise group after the intervention ( $P < 0.05$ ). In the exercise group, carotid arterial compliance was significantly increased after the exercise intervention ( $P < 0.05$ ). There was no change in the parameters tested in the control group. In addition, changes in carotid arterial compliance were correlated with changes in plasma ADMA concentration ( $r = -0.367$ ,  $P < 0.05$ ). Conclusion: We demonstrated that aerobic exercise training significantly decreased plasma ADMA concentration associated with improvement of carotid arterial compliance in postmenopausal women. These data suggest that reduction in ADMA may play an important role in the aerobic exercise training-induced increase in arterial compliance.

## 15:00 - 16:00

### Mini-Orals

#### PP-PM10 Health and Fitness [HF] 4

##### DOES A SEDENTARY LIFESTYLE MODIFY THE BODY COMPOSITION CHANGES DURING THE AGING PROCESS? A LONGITUDINAL STUDY

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Introduction: Obesity and sarcopenia are common disorders within the older population and constitutes a large and important health-related problem as they are associated with functional decline, loss of independence, morbidity and increased risk of mortality [1,2]. Aim: To evaluate the evolution of fat mass (FM) and lean mass (LM) through the aging process in a 2 years follow-up study and to clarify whether sedentary lifestyle could be affecting these changes. Methods: A total of 125 non-institutionalized elderly (37 men and 88 women; aged  $73.1 \pm 5.4$  y), members of the cohort of the multi-center EXERNET Project [3] participated in the study. Dual-energy X-ray absorptiometry was used to measure FM and LM of the whole body, trunk, upper and lower limbs in all participants. Lifestyle information was collected through personal interviews using a structured questionnaire. The variables considered in the present study were sex, age and sitting time (sedentary behavior). The evaluations were performed at baseline (2008-2009) and 2 years later (2010-2011). A 2-way repeated measures ANOVA test was performed to determine body composition changes. All the analyses were repeated taking into account the time spent sitting per day in order to test whether a sedentary behaviour could affect this variation. As no sex by time interactions were found, analyses were performed including men and women as a whole. Results: After the 2 years follow-up FM increased and LM decreased at all sites (all  $p < 0.01$ ) in the whole group. The percentage of change during the follow-up ranged from 3% to 5.5% for fat-related variables and from -1.6% to -2.1% for lean-related variables. When the sample was divided by sedentary time, those who spent sitting less than 4 h per day had no changes neither in LM at all regions nor in the FM in the arms. Conclusion: Human aging normally leads to an increase in fat mass and a decrease in lean mass. Sitting time seems to be a determinant factor in this body composition changes. Therefore, a reduction of sedentary behaviors among elderly population should be encouraged in order to guarantee a healthier body composition during the aging process. References: 1. Kopelman PG. Obesity as a medical problem. *Nature* 2000. 2. Freiburger E et al. Physical activity, exercise, and sarcopenia - future challenges. *Wien Med Wochenschr* 2011. 3. Gomez-Cabello A et al. Prevalence of overweight and obesity in non-institutionalized people aged 65 or over from Spain: the elderly EXERNET multi-centre study. *Obes Rev* 2011.

##### 10 000 DAILY STEPS TARGET FOR INFLUENCING THE CARDIOMETABOLIC RISK

Skalska, M., Bunc, V.

*Charles University*

Introduction Physical inactivity is lifestyle behavior associated with high cardiometabolic risk not least due to its contribution to weight gain. The aim of this study was to determine the effectiveness of increase of physical activity by walking for cardiometabolic risk in healthy obese women. Methods The study was carried out in 36 obese fully employed mid-age women (age  $44.1 \pm 9.7$  years). 6 months intervention was based on recommendation 10 000 steps per day. For step's monitoring was used Pedometer Omron HJ-720IT-E2. Women took part in 12 weekly sessions of cognitive behavioral therapy programme, followed by 12 weeks interactive internet support. Results Women walked  $6866 \pm 1944$  steps per day before intervention. They increased by 23% to  $8354 \pm 2112$  steps per day during the intervention ( $p < 0.0001$ ). The initial weight was  $96.5 \pm 18.6$ kg, terminal was  $89.3 \pm 19.4$ kg ( $p < 0.05$ ). The initial waist circumference was  $98.3 \pm 10.0$ cm, terminal was  $95.2 \pm 10.3$ cm ( $p < 0.0001$ ). The body fat percentage decreased from  $40.7 \pm 4.9$  to  $39.3 \pm 5.6$ % ( $p < 0.004$ ). The initial HDL cholesterol increased from  $1.3 \pm 0.4$  mmol/l to  $1.6 \pm 0.3$  mmol/l ( $p < 0.0001$ ). Discussion Exercise intervention can elicit long-term changes only in cases when it gets over certain minimum level which is given by intensity, time, frequency and form of such exercise (Bunc, 2009). A crucial factor for the volume of changes is the start level of evaluation parameters and then changes are the bigger the lower was the start position. One of the methods which has recently gained higher attention and is, of course, more often used in practice, is the evaluation of the number of steps. Here we can find the necessary volume of exercise for the needs of overall physical condition and positive influence of overweight, which is 10000 steps a day (Le Masurier et al., 2003). Changes announced by applied intervention programme were on the level which was mentioned in writing (e.g. Bouchard 2000, Brettschneider a Naul 2007). The results of our study confirm that the increase of physical activity of 23%, with constant energy intake, manifests in the weight reduction, has positive influence on cardiometabolic risk and can be achievable in daily life of obese fully employed mid-age women. References: 1. BOUCHARD, C. Physical activity and obesity. Champaign: Human Kinetics. 2000. 2. BRETTSCHEIDER, WD, NAUL, R. Obesity in Europe. Frankfurt am Main: Peter HAINER V, TOPLAK H, MITRAKOU A. Treatment Modalities of Obesity What fits whom? *Diabetes Care* 31, 2008, (Suppl. 2): 269-277. 3. BUNC V. Tělesné složení u adolescentů jako indikátor aktivního životního stylu. *Česká kinatropologie*, 2009, 13(3), 11-17. 4. LE MASURIER, G., SIDMAN, C.L., CORBIN, C.B. Accumulating 10 000 steps: Does this meet current physical activity guidelines? *RQES*, 2003, 74(4), 389-394.

## BODY COMPOSITION, BLOOD PRESSURE AND DIETARY HABITS AMONG YOUNG QATARI MALE ADULTS

Goebel, R.1, Velenczei, A.2, Alsuliman, B.1, Riahi, M.1, Bibi, K.1, Kneffel, Zs.1

1 Qatar University, Sport Science Program. 2 Qatar Foundation, Al-Shaqab

**Introduction:** Due to a rapidly changing lifestyle in Qatar, determinants of non-communicable diseases and linked levels of risk factors have risen. These facts pose a national challenge (1). Information about Qatari adults' (19-30yr.) dietary habits is essential because of the increase in the incidence and prevalence of obesity in Qataris. In 2006, the percentage of Qatari boys who are overweight and obese is 28.6%, and 7.9%, respectively (3). Aim of this study was to determine body composition, blood pressure and dietary habits of the next cohort, those 18-29 yrs old. **Methods:** 80 Qatari male students, 18-29 yrs of age, from Qatar University (QU) participated. Blood pressure (BP) was measured by Omron HEM-780, body composition (body weight and percent of body fat (BF)), were measured by OMRON BF-400. Dietary habits were evaluated using the NHANES Food Frequency Questionnaire. For data analysis, Chi-square test and univariate analyses of variance were conducted using SPSS version 20. **Results:** The mean systolic and diastolic BP was 128.6±1.42 mmHg, 73.32±1.1 mmHg, respectively. The mean arterial pressure (MAP) was 91.74±1.06 mmHg. The mean BF is 23.79±1.19%. 30.77% of the subjects were classified as overweight, 38.46% as obese. The crosstab statistical analyses yielded a difference between fast food (FF) vs. seafood (SF) consumptions ( $p=.007$ ). No statistical difference between vegetables consumption vs. pasta intake occur. However, the subjects' soda consumption was greater than fruit juices ( $p=.05$ ). The BF is expressed by an interaction between salad and SF consumption,  $p=.047$ ,  $\eta^2=.409$ , but these main effects are not qualified by a separate interaction on BF ( $p=.234$ ,  $\eta^2=.181$  vs.  $p=.34$ ,  $\eta^2=.149$ , respectively). No interaction was found between FF, SF or sweets and blood pressure values. **Conclusion:** Obesity is uniformly considered to be the most important factor in developing non-communicable diseases in Qatar (2). Our study supports the results. In our sample, the prevalence of overweight and obesity was higher compared to previously published studies. No correlation between dietary habits and MAP occurred though, due to the wide range of nutrients consumed. High caloric diets are prevalent among QU students. **References:** (1) Al-Thani, Hamad bin Jabor bin Jassim (2008). Qatar National Vision 2030: The Four Development Pillars. Retrieved on February 11, 2013 from [http://www.cna.nl.ca/Qatar/pdfs/qatar\\_vision\\_2030.pdf](http://www.cna.nl.ca/Qatar/pdfs/qatar_vision_2030.pdf). (2) Alwan, A.D. (1996). Prevention and Management of Hypertension. WHO Regional Office for Eastern Mediterranean. Retrieved on February 11, 2013 from <http://applications.emro.who.int/dsaf/dsa20.pdf> (3) Bener, A. (2006). Prevalence of obesity, overweight, and underweight in Qatari adolescents. Food and Nutrition Bulletin. 27(1): 39-45.

## FOUR-YEARS INCIDENCE OF YOUTH OVERWEIGHT-OBESE. ASSOCIATION WITH DEMOGRAPHIC AND LIFESTYLES FACTORS

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University of Santa Cruz do Sul; Federal University of the South of Brazil

**Introduction** Considering premature consequences of obesity, several studies appointed for the public health importance of understand obesity since childhood. Therefore, the aim of this study was to evaluate four-years incidence of youth overweight/obese (OW/OB) and to identify lifestyles and demographic outcomes of youth and their parents associated. **Methods** This is a longitudinal study comprised a randomized sample of 405 schoolchildren and adolescents for both genders aged 7-17 from Santa Cruz do Sul - Brazil. A previously trained research group measured baseline and 3 years after all variables at the University laboratory. Subjects were classified in OW/OB according of an international cut off point. Youth and their parent's lifestyles and demographic variables were measured by an adapted questionnaire. Cardiorespiratory fitness (CRF) was available by a nine minutes walking and run test. Subjects were categorized in CRF healthy and unhealthy zone in agreement with Brazilian parameters. **Results** The cumulative incidence of OW/OB was 23% over a period of four years. The prevalence of both OW/OB was two times more elevated on the second year compared with baseline values (OW: 16.8%-33.3%; OB: 6.7%-15.3%). By poisson regression test: CRF unhealthy youth on baseline and on the fourth year showed a higher risk for keeping and developing OW/OB (Baseline - OR: 2.03; 95% CI: 1.16; 3.55; fourth year - OR: 2.37; 95% CI: 1.52; 3.69); and, youth with mother categorized in OW/OB (OR: 2.92; 95% CI: 1.69; 5.05). Sex, age, birth weight, school localization and variation of CRF did not show significant association with develop our keep over four year on OW/OB group. **Discussion** Approximately half of our sample kept or became OW and OB over a four years period. Mother overweight/obesity and low levels of cardiorespiratory fitness seem important predictors that should be considerate for prevention and treatment of this pandemic disease. Promotion of health through modification of children and their parent's lifestyles could be an important approach. **References** Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). *BMJ*, 320(7244), 1240-1243. Freedman, D. S., Goodman, A., Contreras, O. A., DasMahapatra, P., Srinivasan, S. R., & Berenson, G. S. (2012). *Pediatrics*, 130(1), e159-166. Gaya, A. PROJETO ESPORTE BRASIL. Porto Alegre - RS. 2009. [http://www.proesp.ufrgs.br/proesp/images/pdf/MANUALDOPROESP\\_BR\\_2012.pdf](http://www.proesp.ufrgs.br/proesp/images/pdf/MANUALDOPROESP_BR_2012.pdf) Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2012). *JAMA : the journal of the American Medical Association*, 307(5), 483-490.

## THE INFLUENCE OF DIETARY BEHAVIOR AND SEDENTARY LIFESTYLE ON BLOOD PRESSURE AND BODY COMPOSITION AMONG YOUNG QATARI FEMALE ADULTS

Kneffel, Zs.1, Al-Bader, H.K.1, Bou Hassine, R.R.1, Velenczei, A.2, Goebel, R.1

1. Qatar University, 2. Qatar Foundation

**Introduction:** Obesity is emerging as a major health problem due to recent dietary habits and sedentary lifestyles in Qatar. The prevalence of, overweight, and obesity was over 23%, among adolescents girls in the country. On the other hand, the adult Qatari population has a high prevalence of hypertension (32.1%)(1,2). The aim of the study was mapping the early signs of hypertension and its connection to the dietary habits, to the inactivity level, and to the body composition of young adult Qatari females. **Methods:** 70 Qatari female students were involved from Qatar University, age between 18-29 yr. Blood pressure was measured by Omron HEM-780, body composition (body weight (BW), % of body fat (BF)), were measured by OMRON BF-400. The dietary habit was evaluated by NHANES Food Frequency Questionnaire (FFQ). To clarify the subjects actual physical activity International Physical Activity Questionnaire (IPAQ) was used. For data analyzes Chi-square test and univariate analyses of variance were used by SPSS version 20. **Results:** The systolic (BPS) and diastolic (BPD) blood pressure mean values were in the normal range (BPS 114±1.44 mmHg and BPD 64±1.16 mmHg). Mean arterial pressure (MAP) was 87.71±1.15 mmHg. Mean BF was 28.82±1.44 and 39.65% of the subjects was overweight or obese. The crosstabs shown significant difference between the seafood vs. fast food (FF) consumption, however no difference was shown between the vegetables and pastas use. In the fluid uptake, soda and 100% fruit juice drinking did not differ from each other. There were qualified by an interaction between FF consumption and total weekly sitting hours (TWH) on BF,  $p = .16$ ,  $\eta^2=.164$ , where the main effects was FF vs. TWH ( $p=.01$ ,  $\eta^2=.245$  vs.  $p=.451$ ,  $\eta^2=.012$ ), but these effects did not qualified by an interaction on MAP ( $p=.256$ ,  $\eta^2=.055$ ). **Conclusion:** Qatar puts

big effort to popularized the regular physical activity in the society to prevent the appearance of non-communicable diseases (hypertension, type-II diabetes) (3). Based on our data 37% of the measured subjects has some weight problem which seems to be generated by their regular eating behavior and with less weight the lack of regular physical activity. These factors didn't shown any interaction to the MAP values, probably because in this age group the different physiological protective mechanisms control well the systolic and diastolic pressure. References: 1. Bener A., Al-Suwaidi J., Al-Jaber K. Epidemiology of hypertension and its associated risk factors in the Qatari population. *J Hum Hypertens*, 2004, 18,529–530. 2. Bener A. Prevalence of obesity, overweight, and underweight in Qatari adolescents. *Food Nutr Bull*. 2006 27(1),39-45. 3. Qatar National Vision 2030. Retrieved from [http://www.cna.nl.ca/Qatar/pdfs/qatar\\_vision\\_2030.pdf](http://www.cna.nl.ca/Qatar/pdfs/qatar_vision_2030.pdf). 2013. Febr.11.

### THE EFFICACY OF 12 WEEKS SUPERVISED AEROBIC OR RESISTANCE TRAINING FOR OBESITY MANAGEMENT

Herring, L., Scott, A., Wagstaff, C.

*Loughborough University & University of Portsmouth*

Purpose: This randomised controlled trial (RCT) was designed to assess the effect of a structured 12-week aerobic training (AT) or resistance training (RT) programme on morbidly obese individuals as part of a multidisciplinary weight management programme. Methods: The RCT was undertaken on male & female participants aged between 24 and 68 with a body mass index (BMI) of at least 40kg•m<sup>2</sup> or at least 35kg•m<sup>2</sup> with co-morbidities. Participants were assigned to either the AT (n=12), RT (n=11) or control group (CON) (n=10). AT and RT groups undertook three structured ~60 minute moderate intensity sessions per week, two supervised gym-based and one structured home-based session for 12 weeks. Pre and post intervention, anthropometric, psychological and functional capacity measures were obtained to allow comparisons. A one-way ANOVA was applied to the data. Results: When compared to the CON both exercise interventions elicited improvements in: the incremental shuttle walk test distance [AT [Difference 207.0±123.0 metres, 68.0%, P=0.04], RT [Difference 165.0±183.3 metres, 48.8%, P=0.06], CON [Difference -14.3±38.7 metres, -6.2%]], the triceps skin fold [AT [Difference -9.29±3.33mm, -25.6%, P=0.01], RT [Difference -9.03±5.80mm, -24.9%, P=0.01], CON [Difference 0.50±3.34mm, 1.5%]], self-efficacy to regulate physical activity (P=0.005) and interest/enjoyment physical activity motive (P=0.006). The RT group displayed additional improvements compared to the CON in BMI [RT [Difference -1.02±0.91 kg•m<sup>2</sup>, -2.5%, P=0.033], AT [Difference -0.19±2.70kg•m<sup>2</sup>, -3.9%,P=0.142], CON [Difference -0.31±1.47kg•m<sup>2</sup>, -0.6%]] waist circumference (P=0.022), the competence PA motive (P=0.019), the biceps skin fold (P=0.012) and the medial calf skin fold (P=0.013). No significant differences were displayed between AT and RT. Conclusion: Physiological, functional and psychological measures improved with structured exercise in patients with a BMI of 35kg•m<sup>2</sup> or greater demonstrating RT was at least as effective as AT.

### EFFECT OF RHYTHMIC ACTIVITIES AND CHOREOGRAPHIC WORKS PROGRAM ABOUT THE QUALITY OF LIFE PERCEIVED IN OBESITY OR OVERWEIGHT

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Introduction Obesity has been provided by different ways (SEEDO, 2000) and is defined as entity where health and well-being are affected by excess of body fat (WHO, 1998). Rhythm programs have been used, for example, with elderly (Granacher et al, 2012), individuals with cancer (Aktas and Ogce, 2005) or Parkinson disease (de Breu et al, 2012). Nevertheless, application not found in these programs with overweight and obese populations. Numerous studies have a relationship with physical activity practice and the improvement of the quality of life (Horacio et al., 2009). Authors such as Muller-Pinget et al. (2012) have emphasized the importance of designing exercises that cause enjoyment and entertainment to assume a program of physical activity in overweight and obesity people. Methods The sample was composed of 32 overweight or obese (7 males and 24 females). To conduct the study, 2 groups were created into a 4 months intervention based with rhythmic and choreographic activities. First group with 9 subjects with obesity Type I (33.1±2.59BMI; 85.86±8.96K; 161±7.37cm) and the second one with Type II obesity integrated by 22 subjects (40.35±3.8BMI; 106.62±15.55K; 161.84±7.99cm). Each individual completed the Health Questionnaire SF-12 and the analyzed variables were Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Emotional, Mental Health, Physical Component Scale and Mental Component Scale. Data processing was conducted by descriptive analysis (SPSS v 20.0), by Shapiro-Wilk test and a Wilcoxon test. Results Statistically significant improvements was obtained in the obese group in type II and higher, Vitality variables (t = 1968, p <.05) and Social Functioning (t = 2227, p <.05). Discussion Perhaps, to find improvements in Obese Type I the sample and the performance time should be bigger. According to results of Mohamed et al. (2012), after 12 weeks of intervention Biodanza program for patients diagnosed with fibromyalgia, there were significant improvements in the same components, Social Functioning and Vitality. References Granacher, U., Muehlbauer, T., Bridenbaugh, S. A., Wolf, M., Roth, R., Gschwind, Y., Wolf, I., Mata, R., & Kressig, R. W. (2012). Effects of a salsa dance training on balance and strength performance in older adults. *Gerontology*, 58, 305-312. doi: 10.1159/000334814 Mohamed, K., El Yousfi, M. & López, C.J. (2012). *Revista de Transmisión del Conocimiento Educativo y de la Salud*, 5(1), 51-66. Muller-Pinget, S., Pataky, Z., Golay, A., Armand, S., & Allet, L. (2012). *Revue Medicale Suisse*, 8(334), 687-691. Sociedad Española para el Estudio de la Obesidad (SEEDO). (2000). *Medicina Clínica* (Barcelona), 115, 587-597.

### MORPHOLOGICAL CHANGES IN THE FOOT OF OBESE CHILDREN AFTER A THREE-MONTH VIGOROUS PHYSICAL ACTIVITY PROGRAMME

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Introduction Excess weight affects the anthropometric structure of the foot of children (2). Also, long-term adaptations in the foot due to exercise can lead to changes in both the arch index or in the foot morphology of young subjects (1). The aim of this study was to assess the effects of a three-month vigorous physical activity (VPA) programme on the foot morphology of children with obesity. Methods Eighteen children in an experimental group (EG) (12.5±2.0 years; BMI 28.9±3.5 kg/ m<sup>2</sup>) and 11 children in a control group (CG) (11.2±1.9 years; BMI 27.4±2.1 kg/m<sup>2</sup>) participated, all of them diagnosed as overweight or obese. The EG performed a three-month VPA programme aimed primarily to improve aerobic endurance and strength, while the CG did not train. Foot dimensions were measured with a 3D feet digitizer in static standing, and body composition was assessed with dual-energy X-ray absorptiometry, before and after the intervention. Results The EG showed significant decreases in body mass (-2.5%, P = 0.002) and body fat (-4.8%, P < 0.001) after the intervention. There were significant changes in the foot morphology in both groups, mainly in widths, resulting in an increase in all measures except arch

height, which decreased (EG: -1%,  $P = 0.657$ ; CG: -3%,  $P = 0.045$ ), indicating that the foot was made flatter. Discussion The CG showed changes in foot morphology, therefore the changes found in the EG were influenced by growth. The plantar arch should have already been established at these ages; hence the tendency to a flatter foot found in both groups could have been due to their overweight (3). Therefore, despite changes in body composition, it seems like the EG group did not revert the flattening of the foot that could lead to orthopaedic pathologies. To conclude, foot morphology should be an item to control in children with overweight and obesity involved in physical activity interventions in order to avoid future lower limb injuries. References 1. Aydog T, Tetik O, Demirel HA, Doral MN. (2005). *Br J Sports Med*, 39, e5. 2. Riddiford-Harland DL, Steele JR, Storlien LH. (2000). *Int J Obes*, 24, 541-544. 3. Villarroya MA, Esquivel JM, Tomás C, Buenafé A, Moreno L. (2008). *Int J Pediatr Obes*, 3, 39-45.

## CHANGES IN VO<sub>2</sub>MAX AFTER A MASSIVE WEIGHT LOSS INDUCED BY GASTRIC BYPASS SURGERY IN OBESE AND TYPE 2 DIABETIC PATIENTS.

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**Introduction** Morbid obesity is associated with an inactive lifestyle and impaired exercise performance, partly explained by physical discomforts and morbidities associated with overweight. Gastric bypass surgery leads to substantial weight loss, but whether obesity alters lifestyle patterns in morbidly obese is unknown. Our aim was to measure, if substantial weight loss in relation to gastric bypass surgery was associated with an enhanced level of fitness in normal glucose tolerant (NGT) and type 2 diabetic patients (DM2), before and after Roux en Y gastric bypass surgery, as an indication of a more active lifestyle following weight loss. **Methods** 8 DM2 and 15 NGT (age:  $42 \pm 1$  and  $43 \pm 1$  yrs; BMI:  $42 \pm 1$  and  $43 \pm 1$  kg/m<sup>2</sup>; weight:  $129 \pm 5$  and  $122 \pm 5$  kg respectively), were recruited. Subjects reported to the lab four times: Before any weight loss (A), after a diet induced weight loss prior to surgery (B), 4 months (C) and 1.5 years after surgery (D) ( $n = 5$  DM2 and 10 NGT). At each test day a dual Energy X-ray Absorption Scan for determination of body composition was performed, followed by an incremental bicycle test (75W warm-up 2 minutes, increase 25W/min until exhaustion) on a stationary ergometer bicycle, with continuous oxygen uptake measurement. Maximal oxygen uptake (VO<sub>2</sub>max) was determined over a 20 sec period according to the levelling off criterion. Data is presented as mean  $\pm$  SEM and 2-way ANOVA for repeated measurements was used for statistical analysis. **Results** Weight loss was similar in NGT and DM2: A-B:  $5 \pm 1$  kg and  $5 \pm 1$  kg; B-C:  $27 \pm 2$  kg and  $26 \pm 3$ ; C-D:  $11 \pm 3$  and  $10 \pm 2$  kg, respectively. VO<sub>2</sub>max per kg body weight was similar in the two groups at any given time and increased after surgery: NGT: (A:  $22 \pm 1$  vs. C:  $26 \pm 2$  or D  $33 \pm 3$  ml/min/kg, both  $p < 0.05$ ) and DM2 (A:  $20 \pm 2$  vs. C:  $26 \pm 2$  or D  $29 \pm 2$  ml/min/kg, both  $p < 0.05$ ). Absolute values of VO<sub>2</sub>max were similar in both groups and did not change between test days (NGT: A:  $2722 \pm 194$ ; B:  $2744 \pm 229$ ; C:  $2565 \pm 221$ ; D:  $2803 \pm 385$  ml/min; A vs. D:  $p = 0.92$  and DM2: A:  $2456 \pm 253$ ; B:  $2504 \pm 223$ ; C:  $2491 \pm 175$ ; D:  $2355 \pm 157$  ml/min; A vs. D:  $p = 0.61$ ). **Discussion** The substantial weight loss of more than 25 kg body weight due to diet and gastric bypass surgery increased VO<sub>2</sub>max when calculated per kg body weight. However, the absolute maximal oxygen uptake is unaltered by the massive weight loss. Thus gastric bypass surgery does not improve exercise performance or induce regular exercise habits in these previously morbidly obese patients, when they have achieved a new (lower) steady state body weight.

## BODY COMPOSITION OF HUMAN LIMBS BY USING BIA AND MRI

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**Introduction** The modern lifestyle increases the prevalence of metabolic syndrome with increasing intra-abdominal fat in both obese and non-obese individuals. An increase in adipose tissue and decrease in muscle mass may further cause to decrease in peripheral uptake of glucose and insulin resistance. Such metabolic syndrome or sarcopenia contributes to atherosclerosis, causing to reduce blood flow in the limbs, usually the legs. Due to human hands being free from locomotion, legs engage in motor activities. There are a great number of studies with body composition in whole body; however, the chronic metabolic responses or body composition of limbs have seldom been studied. In order to maintain our good health status and understand chronic metabolic responses in our body, it is important to measure and evaluate our body compositions. The bioelectrical impedance analysis (BIA) method is widely used for both clinical and practical fields; however, it is still unclear whether body composition of limbs is equivalently estimated with a whole body composition. On the other hands, magnetic resonance imaging (MRI) offers to accurately and non-invasively assess size and volume of regional muscle and fat. The aim of this study was to investigate body composition of human limbs by using BIA and MRI methods. **Methods** Twenty-two healthy young individuals volunteered and their body compositions were measured by BIA and MRI, respectively. For a measurement of BIA, the eight-contact electrode system (Inbody720, Biospace, Japan) was used. The device can measure segmental impedance at multiple frequencies of 5 body parts (arms, trunk, and legs). For a measurement of MRI, subjects were laid supine on the examination table of a 1.5-T MR system (Signa HDxt, GE Healthcare). The axial images of upper arm and thigh were acquired to measure the cross sectional areas of muscle, fat and bone. The images at the midpoint of the limbs were selected due to that the anatomical cross-sectional area (ACSA) is the largest at this point. **Result & Discussion** The percentage of the fat in upper and lower limbs measured by BIA and MRI were significantly correlated (upper limb:  $r = 0.96$ ,  $p < 0.01$ ; lower limb:  $r = 0.95$ ,  $p < 0.01$ ). However, the values measured by MRI method were larger than those measured by BIA (upper limb,  $26.0 \pm 12.1\%$  for BIA;  $32.1 \pm 14.2\%$  for MRI; lower limb  $23.1 \pm 7.8\%$  for BIA,  $25.2 \pm 11.6\%$  for MRI). The difference was more significant in upper limb as compared to lower limb. The study demonstrated a close relationship between body composition of limbs measured by BIA and MRI. It is suggested that multifrequency whole-body BIA may be useful in the estimation of the whole body and limb composition, but it may be difficult to determine the regional specificities in body composition of limbs.

## SUSTAINED BOUTS OF MODERATE-VIGOROUS PHYSICAL ACTIVITY ARE RELATED TO CARDIOVASCULAR HEALTH IN OVERWEIGHT AND OBESE JAPANESE MEN

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**Introduction:** Whereas greater physical activity (PA) is known to prevent cardiovascular disease (CVD) in overweight and obese adults, the influence of sustained or shorter bouts of PA on CVD risk factors is not well known. Global PA recommendation indicates that PA should be accrued in bouts of at least 10 min for potential health benefits. However, further research is needed to determine the health benefits of PA lasting < 10 min. The objective of this study was to investigate the relationship between moderate-vigorous PA (MVPA), measured in

bouts  $\geq 10$  and  $< 10$ min, and CVD risk factors in overweight and obese Japanese men. Methods: We analyzed a cross-sectional data of 190 men (age = 50.3 years; body mass index = 29.4 kg/m<sup>2</sup>) who underwent objective assessment of PA by a uniaxial accelerometer (Kenz Lifecorder-EX) over 2 consecutive weeks. Total MVPA, MVPA lasting  $\geq 10$  min (MVPA10+), and MVPA lasting  $< 10$  min (MVPA<10) were calculated. Multiple linear regression analysis was applied to assess contributions of different MVPA exposures to individual CVD risk factors, including measures of waist circumference, blood pressure, blood lipid, glucose, and insulin resistance. Results: Greater total MVPA and MVPA10+ were significantly associated with higher HDL cholesterol level ( $\beta = 0.23$  and  $0.29$ , respectively). In contrast, MVPA<10 showed no significant association with any CVD risk factors. Meeting PA recommendation ( $\geq 150$  min/week of MVPA10+) was related to lower waist circumference, triglycerides, insulin level, insulin resistance, and higher HDL cholesterol level (Cohen's  $d > 0.2$ ). Accumulation ( $\geq 150$  min/week) of total MVPA was not related to any CVD risk factors. Conclusions: Our cross-sectional observations confirm a positive association of MVPA with a healthier CVD risk factor profile and indicate that accruing MVPA lasting  $\geq 10$  min may favorably influence CVD risk factors. These results underscore the importance of sustained physical activity as exercise for health benefits in overweight and obese men.

### **CASE STUDY: COULD GPS TECHNOLOGY ASSIST IN DETECTING EARLY SIGNS OF OVERREACHING IN A PROFESSIONAL CRICKET PLAYER OVER A SEASON?**

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Case study: Could GPS technology assist in detecting early signs of overreaching in a professional cricket player over a season? Introduction Global positioning system (GPS) technology has been used extensively in various team sports, however, most research focused on the kinematics of players to determine the demands of a specific sport. We focused on test cricket to try and find indicators that will resonance to triggers to inform coaches of a player's physical state. This is a unique study as no other study tracked a fast bowler over a test season to measure changes in kinematics. A decline in muscle force production has been proposed as a potential marker for overreaching (Mackinnon 2008), which could be related to a reduction in speed. Knicker et al. (2011) mentioned that fatigue is related to a decline in peak velocity, along with altered kinematic components. We tested our hypotheses that the player's maximum speed will decline over the test match season. Methods A professional fast bowler was monitored for five consecutive 5-day international test matches. The player wore a SPI ProXII GPS unit (GPSports, Canberra, Australia) for a total of 147 overs during five matches. The speed of every run-up was recorded during an over (six run-ups) to calculate the average maximum speed per over. This was then used to calculate the average maximum speed per match (AveMax). Secondly the maximum run-up speed per over was recorded, and the average of the maximum speeds per over was then calculated per match for the absolute maximum speeds per over per match (AbsMax). Results A decline in the AveMax, as well as the AbsMax speed of the player over the five consecutive matches were found. Differences in AveMax between the matches were not significant ( $p=0.157$ ) ( $p>0.05$ ). AbsMax, however, showed a significant difference  $p=0.001$  ( $p<0.05$ ) and indicated variability of the maximum speeds of run-ups between matches. The number of wickets taken also declined progressively over the season. Discussion These findings seem to support our theory that accumulated fatigue during a season might be responsible for a decline in maximum power, in this case, maximum speed. This might result in a poor performance and can be detrimental to an athlete's health. If this decline in speed is a result of central or peripheral fatigue, still needs to be investigated. We propose this method used, in this study, to be an alternative method to monitor and manage an athlete's health. We can conclude that GPS is a suitable device to monitor speed of a player during a season and detect changes which might be valuable in managing a player's workload. References Mackinnon, L.T., Halson, S.L., Hooper, S.L., & Jeukendrup, A.E. (2008) Physiological bases of human performance during work and exercise. Churchill livingstone, p505-520 Knicker, A.J., Renshaw, I., Oldham, A.R., Cairns, S.P. (2011). Sports Med. 1;41(4):307-28.

### **INGESTION OF ANTIOXIDANT-RICH DATES TO CURE DELAYED ONSET MUSCLE SORENESS**

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Antioxidant-rich dates originally cultivated from middle east countries with scientific name "Phonex Dactylifera" are very common among muslims especially in fasting months. It was consumed for more than 100 years. Proven scientifically for its high antioxidant nutrients, ingestions of these dates may assist the recovery of muscle damage. The purpose of this research is to observe the effect of rich antioxidant dates intake during the recovery process following eccentric exercise. Ten healthy male subjects with no history of biceps muscle injury and not participate in specific strength training or exercises were involved in these two experimental sessions. Contralateral arms approach was used in this study. Subjects were randomly assigned to have their arms undergo treatment or control condition. The treatment session consists of exercise induce muscle damage (EIMD) to the biceps via eccentric exercise and seven days recovery monitoring where the subjects daily ingests  $\pm 10$  gram of dates fruits for seven consecutive days. The control session consists of similar EIMD protocol and seven days of recovery monitoring without ingestion of Phonex Dactylifera. The EIMD involved 6 set of exercises and each set consisting ten controlled eccentric contraction repetitions of arm (elbow flexors) with dumbbell weighted 7.5 kg. One minute rest were given between sets. Muscle injury existence were measured through four indirect muscle injury indicators that are upper arm circumference, range of motion (ROM), delayed onset muscle soreness (DOMS) and maximum strength. The indicators were measured one hour after EIMD and followed by day 1,2,3,4 and day 7 after the damage. Subjects were then rested for two weeks between two experimental sessions to avoid the effects of injury between arms. Results indicates that only upper arm circumference showed a significant difference with  $p = 0.05$ , where the control group recorded higher score in circumference. No significant differences were recorded on DOMS, ROM and maximum strength. As a conclusion, dates fruit is only effective in reducing the diameter of the swelling but not effective to lessen DOMS and other indicator of muscle damage

### **THE RELATIONSHIP BETWEEN THE 6MWT AND PSYCHOLOGICAL STATUS IN PEOPLE WITH SCHIZOPHRENIA**

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Introduction: People with schizophrenia are more sedentary than the general population, with only 25% of schizophrenics meeting the minimum recommendation for health of 150 min a week of moderate-intensity physical activity (Faulkner & Carless, 2006). In addition, 25 to 50% of mental health patients experience depressive and/or anxiety symptoms (Buckley et al., 2009). Thus, the aim of this study was to analyse the relationship between physical function and psychological status in schizophrenics. Methods: Fifty hospitalized patients from a

public mental health institution in Spain diagnosed with schizophrenia (DSM-IV criteria), and thirty matched healthy controls, were recruited using convenience sampling. Participants were assessed by the Six-Minute Walk test (6MWT) for physical function, and the DASS-21, which measures the 3 negative affective states of depression, anxiety, and stress over the past week. Results: Schizophrenics had lower levels of physical function as measured by the 6MWT ( $p < 0.001$ ) compared to healthy controls. They also showed significant higher levels of stress ( $p < 0.001$ ), anxiety ( $p < 0.001$ ), and depression ( $p < 0.001$ ). Within the schizophrenics, there was a negative correlation between the 6MWT and the levels of stress ( $p < 0.05$ ) and depression ( $p < 0.05$ ), and a tendency was found for anxiety. After controlling for possible confounding variables (age, years of illness, gender, smoking, and body mass index), a negative correlation was found for anxiety ( $p < 0.05$ ), and the significance and the power of the correlations increased for stress and depression. No correlations were found in the healthy controls. Discussion: As expected, people with schizophrenia walked lower distances in the 6MWT and had higher levels of psychological distress, compared to healthy controls. The poor performance of people with SCZ in the physical test is partially due to high sedentary levels and also other negative lifestyle habits such as a poor diet and high levels of smoking, common in this population (Faulkner & Carless, 2006). Our results confirm the need to increase physical activity in people with SCZ (Vancampfort et al. 2012), since better performance in the test correlated with better psychological status. References: Faulkner G, and Carless D. (2006). Physical activity and the process of psychiatric rehabilitation: Theoretical and methodological issues. *Psychiatric Rehabilitation Journal*, 29, 258–266. Buckley PF, Miller BJ, Lehrer DS, Castle DJ. (2009). Psychiatric comorbidities and schizophrenia. *Schizophr Bull*, 35, 383–402. Vancampfort D, Knapen J, Probst M, Scheewe T, Remans S, De Hert M. (2012). A systematic review of correlates of physical activity in patients with schizophrenia. *Acta Psychiatr Scand*, 125, 352–362.

15:00 - 16:00

## Mini-Orals

### PP-PM03 Adapted Physical Activity [AP] 3

#### BIOENERGETIC PROFILE OF SWIMMERS WITH LOCO-MOTOR DISABILITY

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Introduction Research involving swimmers with loco-motor disabilities has increased exponentially in the last decade, but little attention has been given to the bioenergetic factors that play a key role in improving sports performance. The aim of this study was to evaluate the bioenergetic variables related to swimming velocity at the individual anaerobic threshold (IAnT) and maximal oxygen uptake (VO<sub>2</sub>max) of swimmers with loco-motor disability. Methods Three male competitive swimmers (a superior limb paralysis, amputee and neuropathy impairment), mean: 24.0yrs; 71.9kg; 1.84m, in functional classes S8 and S9, according to the International Paralympic Committee performed incremental protocol in front crawl until voluntary exhaustion. Steps were repeated 200m swims, at increments of 0.05m.s<sup>-1</sup> with 30s rest intervals. Swimming velocity, ventilatory parameters, and blood lactate response ([La-]) associated to the IAnT and VO<sub>2</sub>max was determined. The IAnT was calculated by the [La-] vs velocity curve modeling method (Fernandes et al., 2011). Results The mean values associated with the intensity of IAnT and VO<sub>2</sub>max were 40.5mL.kg<sup>-1</sup>.min<sup>-1</sup>, 153.0bpm, 2.3mmol.L<sup>-1</sup>, 1.03m.s<sup>-1</sup> and 51.1mL.kg<sup>-1</sup>.min<sup>-1</sup>, 177.7bpm, 6.3 mmol.L<sup>-1</sup> and 1.15m.s<sup>-1</sup>, respectively. The percentage values of IAnT regarding VO<sub>2</sub>max were 79.9% and 89.3% in the VO<sub>2</sub> and velocity domains, respectively. Discussion The bioenergetic profile of loco-motor disability swimmers maintain a similar standard in issues associated to the physiological performance when compared with these reported for non-disability swimmers described in the literature, however, when analyzed the velocities at which the disability swimmers attained the VO<sub>2</sub>max and the IAnT, the motor disability should be recognized as a severe limiting factor to achieve high absolute swimming performances. References Fernandes RJ et al. (2011). *Int J Sports Med*, 32 (12), 940–46.

#### BODY COMPOSITION ASSESSMENT, STATUS NUTRITIONAL AND METABOLIC CHANGES IN INFECTED CHILDREN ANTI-VIRAL THERAPY

Ramalho, L., Gonçalves, E., Samur-San Martin, J., Krahenbühl, T., Barbeta, V., Bertapelli, F., Barbeta, C., Guerra-Júnior, G., Morcillo, A., Silva, M.

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Introduction: The advent of antiretroviral therapy (ART) has resulted in increased survival of children and adolescents infected with HIV. However, several adverse effects were found with the use of this therapy. Objective: To evaluate body composition nutritional status, and lipids in Brazilian children infected with HIV, effective ART and the association of these variables with lifestyle, clinical, immunological, virological and therapeutic. Methods: Cross-sectional study with 97 children HIV and 364 healthy. Body composition was measured by anthropometry. Identified the accumulation of abdominal fat by waist circumference (WC) and waist-hip ratio (WHR). Lipodystrophy was identified by clinical evaluation. The clinical and immunological categories defined by CDC. Lipid levels in the serum were defined according to the international standard. We use 24-hour Recommended Dietary Allowances, (RDA), (Recommended Dietary Allowances, 1989). Statistical analysis was performed using SPSS for Windows. Results: The prevalence of short stature in a 25.53%, 22.34% by malnutrition, lipodystrophy by 38.29% and 40.42% in lipohypertrophy in patients. Hypercholesterolemia was associated with the RDA, (OR 1.57, 1.12 to 10.22) and viral load (1.81, 1.20 - 8.70). Patients who were treated with protease inhibitor (PI) showed a higher risk of malnutrition (3.51, CI 1.07 to 11.44) and lipodystrophy (3.5, CI 1.37 to 8.95). The insulin resistance was associated with the use of IP (0.48, CI 0.02 to 0.49) and clinical category C (2.35, CI 1.05 to 31.46). Comparing HIV groups and control, WHR and WC were higher in HIV ( $p < 0.001$ ) and ( $p = 0.011$ ), respectively. HIV patients had a higher risk of short stature (5.33, CI 2.83 to 10.04), malnutrition (4.7, CI 2.44 to 9.06) and small risk of obesity and overweight (0.33, IC 0.14 to 0.78). Discussion: Pediatric patients with ART showed greater involvement in nutritional status and body composition (Buonora et al., 2008). His body and metabolic alterations were associated with the severity of the infection, such as the use of IP, an advanced stage of the disease, the difficulty of virologic control and immunosuppression. References: Recommended Dietary Allowances - 10th Edition - National Academy Press, Washington, D.C. 1989. Buonora S, Nogueira S, Pone MV, Aloé M, Oliveira

RH, Hofer C. Growth parameters in HIV-vertically-infected adolescents on antiretroviral therapy in Rio de Janeiro, Brazil. *Ann Trop Paediatr.* 2008; 28(1):59-64.

### DEVELOPMENT AND EVALUATION OF A NEW ARM CRANK ERGOMETER

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**INTRODUCTION:** An arm crank ergometer is the popular devices used in clinical exercise testing or programs of cardiac rehabilitation and training of upper limb for wheelchair users. However, it is speculated that assessment of oxygen uptake is difficult because of mixing muscle exertion of lower limb with arm cranking exercise. Therefore, we have developed a new designed device for arm cranking ergometry. The purpose of this study was to compare oxygen uptake and heart rate (HR) on a new arm ergometer with performance on a conventional arm ergometer. **CHARACTERISTICS:** The new ergometer and a seat unified by one framework. It is possible to adjust height of the seat, and distance to the ergometer in accordance with characteristics of subjects and/or purpose of the exercise. The ergometer has belts in five points (both shoulders, waist on either side and between the leg), and the subject's body is fixed by the belts when the arm cranking ergometry. **METHODS:** Nine healthy Japanese male (age  $22 \pm 3$  yr, height  $172.8 \pm 2.9$  cm, weight  $69.5 \pm 2.1$  kg) participated in arm ergometer test. The arm test began with subjects cranking (60 rpm) at a work rate of 25 watts, and the load was increased until exhaustion. On one testing day subjects performed an incremental arm test using the new ergometer (Fixed condition) while on the other day the subjects completed a same test using conventional ergometer (Control). HR, rating of perceived exertion (RPE) and oxygen uptake were measured at rest and every a minute. Data were analyzed using two-way ANOVA, and presented as mean  $\pm$  SD. **RESULTS and DISCUSSION:** Each subject finished the test using the new ergometer at early phase rather than that using conventional ergometer. Final workload in Fixed condition was lower than that of Control at exhaustion. No significant difference existed in HR between Fixed condition and Control. Oxygen intake 2 and 3 minutes before exhaustion in Fixed condition (2min: 20.9ml/kg/min, 3min: 23.4ml/kg/min) were significantly higher than that of Control (2min: 23.5ml/kg/min, 3min: 25.1ml/kg/min). However, there was no significant difference in peak oxygen uptake between the two tests (Fixed: 28.4ml/kg/min, Con: 29.1ml/kg/min). RPE in Fixed condition was reached 20 (very, very hard) earlier than Control. It is considered that the upper limbs reached the all-out state at an early stage, and it became difficult for exercise to continue. **Conclusion:** We could show that arm cranking test using an adjustable arm ergometer could be monitor heart rate and peak oxygen uptake with accuracy, and measure with shorter time than conventional method.

### PHYSICAL ACTIVITY DURING THE MONTH OF RAMADAAN FASTING

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The month of Ramadaan incorporates the fasting of Muslims for approximately 12-18 hours of the day. Because it's a month where no drink or food can be consumed during daylight, there has been a lot of speculation regarding the abstinence of exercise and physical activity during Ramadan. There have been myths with regards to a decrease in blood levels and heart function, weakening of the immunity system and syncope when exercising during Ramadan. Research has shown that fasting for 30 consecutive days without exercise results in a regression of strength and fitness. It is imperative that Muslims maintain their exercise routine during Ramadan. Persons with chronic diseases, injuries and complications Persons with the above should take caution when exercising or doing any strenuous workloads during Ramadaan. In particular, persons with Type 1 Diabetes should not exercise at all as this can hinder their glucose levels profusely. Hypoglycemia is the most common problem for Diabetics who exercise and is usually a concern for Diabetics taking insulin or oral medication. However, persons with Type 2 Diabetes can exercise at a low-intensity, but for a maximum of 35 minutes focusing predominantly on aerobic and strength training. Persons with any injuries or complications should also exercise at a low-intensity for a maximum of 30 minutes because your bodies utilise more energy during the recovery phase of injury or pain, especially when fasting. Therefore, not enough energy and glycogen stores will be retained for more than 30 minutes when exercising. In addition, persons with chronic diseases or complications are refrained from consuming medication while fasting. It is therefore difficult to manage sugar levels, cholesterol levels and blood pressure without medication during Ramadaan. Exercise can manage these as well but the above recommendations need to be adhered to when exercising during fasting. Individuals with any chronic diseases, and in particular Diabetes and Hypertension, should consult with their physician first before implementing an exercise routine during Ramadaan. When to exercise After having a moderate exercise session, you will not adequately replenish the glycogen stores that you burnt during exercise, thus resulting in weight loss and dizziness. 90 minutes before sunset would be the ideal time to train because when breaking your fast, you can supplement the energy and glycogen stores lost when exercising. **References** 1. Fallah, J. Ramadaan Fasting and Exercise Performance. *Asian J of Sports Med:* 2010; 1(3): 130 2. Maughan R. The effects of fasting on metabolism and performance. *Br J of Sports Med:* 2010; 44: 490 3. Azizi F, Siahkalah B. Ramadaan Fasting and Diabetes Mellitus. *J Iranian Medicine* 2003; 6(4): 237 – 242. 4. Whelton SP. Effect of aerobic exercise on blood pressure: a meta-analysis of randomised, controlled trials. *Annals of Int Medicine* 2002; 136(7): 493 – 503. 5. Ramadaan J. Does Fasting during Ramadaan alter body composition, blood constituents and physical performance? *Med PrincPract:* 2002; 11(2): 41-46

### THE ROLE OF SOCIAL COMPETENCE IN THE RELATIONSHIP BETWEEN SPORT INVOLVEMENT AND MOTOR PERFORMANCE IN PREADOLESCENT CHILDREN

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**Background:** Lifestyle habits in childhood are retained in adulthood, emphasizing the importance of developing strong physical activity habits among children. Children with motor impairments have an established activity deficit including lower sport participation (Cairney et al., 2006) while socially competent children are capable of having supportive friendships which aid in adopting active lifestyles (Jago et al, 2011). The inter-relationship of these factors is unknown and we examined the role that social competence (SC) plays in the relationship between motor performance (MP) and sport involvement (SI). **Methods:** We examined data from 1958 sixth grade children (50.2% males) from the Physical Health Activity Study Team study in Ontario, Canada. Sport involvement was determined using the Participation Questionnaire, MP was established with the short form of the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP), and SC using Harter's Self-Perception Scale. Multiple regression models were created by gender adjusting for BMI and SES. Odds ratios (OR) were created with z scores (<0 vs.  $\geq$ 0) used as SI and SC cut offs with BOTMP quartiles as high or low MP (reference= 3rd/4th BOTMP quartile with Harter z

score  $\geq 0$ ). Results: MP and SC are both independent predictors of SI. Children with low MP and low SC were at significantly greater risk of low SI (OR<sub>males(m)</sub>=2.8198; OR<sub>females(f)</sub>=2.4138). Children with low MP and high SC (OR<sub>m</sub>=1.0462; OR<sub>f</sub>=1.4104), or high MP and low SC (OR<sub>m</sub>=1.1226; OR<sub>f</sub>=0.9774) demonstrated no significant risk of low SI. Conclusion: Social competence plays an important role in sport participation during childhood and appears to ameliorate the risk of inactivity associated with low MP. Higher SC in children with low MP removes the risk of low sport participation for both genders. In the development of sport promotion campaigns the role of SC in enhancing sport participation should be considered. This is particularly true for children with poor MP as SC is an important contributing factor in their sport participation. References: Cairney, J., Hay, J., Faight, B.E., Corna, L.M. & Flouris, A.D. (2006a). Developmental coordination disorder, age, and play: A test of the divergence in activity-deficit with age hypothesis. *Adapted Physical Activity Quarterly*, 23, 261-276. Jago, R., Macdonald-Wallis, K., Thompson, J.L., Page, A.S., Brockman, R. & Fox, K.R. (2011). Better with a buddy: Influence of best friends on children's physical activity. *Official Journal of the American College of Sports Medicine*, 43(2), 259-265. DOI: 10.1249/MSS.0b013e3181edefaa.

### PSYCHOBIOLOGICAL ASPECTS OF THE BRAZILIAN PARALYMPIC ATHLETES IN THE LONDON 2012 PRE-PARALYMPICS PERIOD.

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Introduction The Paralympic sport has been competitiveness every year, being crucial to evaluate psychobiological aspects of Paralympic athletes. The aim of this study was to assess the psychobiological aspects of Brazilian Paralympic athletes before the London 2012 Paralympic Games. Methods 40 athletes (31 men and 9 women) participants of athletics were evaluated. The questionnaires were used to assess anxiety, mood, sleep and sleepiness, respectively: IDATE, POMS, BDI, Epworth Sleepiness Scale. Results 62% of the athletes had medium level of anxiety-trace -state and 80% of the athletes showed no propensity to depression. In the humor assessment it was found: tension-anxiety  $2.1 \pm 3.8$ ; depression  $3.3 \pm 7.3$ ; anger-hostility  $5.0 \pm 8.2$ ; vigor  $21.5 \pm 5.5$ ; fatigue  $4.3 \pm 5.0$ ; mental confusion  $-0.4 \pm 3.7$ ; total mood disturbance  $-7.3 \pm 28.0$ . Considering sleep quality, 62.5% of the athletes had good sleep, 67.5% presented sleep latency < 20 minutes and 92.5% had sleep efficiency > 85%. Mean total sleep time was  $7.3 \pm 1.2$  hours, 52.5% presented excessive daytime sleepiness and 46.3% were dissatisfied with their own sleep. Sleep latency was higher in athletes with poor sleep quality ( $p = 0.000$ ), total sleep time was shorter in athletes with poor sleep ( $p = 0.005$ ), sleep efficiency was lower in athletes with poor sleep ( $p = 0.000$ ) and total sleep time was shorter for those who had sleep efficiency < 85% ( $p = 0.01$ ). Discussion Most athletes had medium level of anxiety, which according to Halvari and Gjesme (1995) this is associated with better performance during a competition. The athletes showed positive mood states profile and this can lead to a better performance during competition (Bertollo et al., 2009). The athletes did not show propensity to depression, possibly due to the absence of injury (Smith and Milliner, 1994) or dissatisfaction (Wiese and Weiss, 1987) during the period of evaluation. To Walker and Stickgold (2005) sleep is important, if in the adequate quantity and quality, to ensure good performance, cognitive and psychomotor tasks when needed. The control of psychobiological aspects can be decisive to achieve better results in competition. The work of a multidisciplinary team can benefit athletic performance of Paralympic athletes. References Bertollo M et al (2009). *Psychol Sport Exerc*, 10(2):244-457. Halvari H, Gjesme T. (1995). *Percept Mot Skills*, 81:1059-1074. Smith AM, Milliner EK. (1994). *J Athl Train*, 29(4):337-341. Walker MP, Stickgold R. In: Postolache T. (2005). *Sports Chronobiology Clinics Sports Medicine*, 24(2):301-318. Wiese D, Weiss M. (1987). *The Sport Psychologist*, 1:318-330.

### PEAK FAT OXIDATION DURING PHYSICAL ACTIVITIES OF DAILY LIVING – A COMPARISON OF NORMAL WEIGHT AND OVERWEIGHT ADULTS

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Introduction: Physical inactivity and obesity are risk factors for numerous diseases and strategies to accomplish activity recommendations are needed. These suggest 30 minutes of physical activity per day in moderate (3-6 METs) intensity on most days of the week (Haskell et al., 2007) and can also be reached with exercise bouts throughout a normal day followed by an increase of energy expenditure (EE) and fat loss (Jeppesen and Kiens, 2012). In order to benefit from exercise, it is important from what source the body takes the energy. Fat oxidation rises until a specific maximum at moderate intensity, with further intensity fat oxidation drops again (Jeukendrup and Wallis, 2005). This study aims to find out if healthy adults can reach high fat oxidation up to a maximum (FATpeak) in physical activities of daily living (PADL). Methods: 33 subjects were divided into a normal weight (NW:  $n = 21$ , body fat  $21.6 \pm 6.1\%$ ,  $52 \pm 7$  yrs) and overweight (OW:  $n = 12$ , body fat  $33.1 \pm 6.5\%$ ,  $47 \pm 9$  yrs) group and matched according to gender, age, fat free mass (FFM) and maximal aerobic capacity (VO<sub>2</sub>max). Six PADLs, including REE, PC work, vacuuming, walking, stair stepping and cycling, were tested under controlled conditions using a portable spirometric system. Body composition was measured with Bio Impedance Analysis. Physical activity under free-living conditions was detected with a multi sensor device. Results: Both NW and OW reached FATpeak (NW: Confidence interval 95% 42.56 – 56.37% of VO<sub>2</sub>max, OW: 43.79 – 53.22% of VO<sub>2</sub>max), but showed no significant difference. In all activities except for the last activity with the highest intensity the NW consumed more carbohydrates than the OW. Multiple regressions with FATpeak as dependent variable show that VO<sub>2</sub>max, FFM and physical activity explain 75% of the variance. Conclusion: Results prove that FATpeak can be reached during physical activities of daily living under controlled conditions. Thus behavioral changes that include increased physical activity throughout the day can result in high fat oxidation rates. Furthermore activities like walking and stair stepping can help reaching physical activity recommendations. References: Haskell WL, et al. American College of Sports Medicine and American Heart Association. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 116: 9: 1081-1093, 2007. Jeppesen J and Kiens B. Regulation and limitations to fatty acid oxidation during exercise. *J.Physiol.* 590: Pt 5: 1059-1068, 2012. Jeukendrup AE and Wallis GA. Measurement of substrate oxidation during exercise by means of gas exchange measurements. *Int.J.Sports Med.* 26 Suppl 1: S28-37, 2005.

**THE HEALTH COACH PROJECT - AN INTERVENTIONAL STUDY ON HEALTH PROMOTION IN ELEMENTARY SCHOOL**

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*Department of Health Sciences*

Introduction Young school children in Sweden spend today less time taking part in physical activities, compared to what they did 15-20 years ago. Physical activity is a major health component, which can make children maintain or increase their health. Given this background new efforts to meet these inactivity problems among young children are very important. The purpose of this study is to analyze and describe a longitudinal (two years) health coach intervention, focusing on the effects and experiences of expanded physical activities in an elementary school, managed by a health coach. Methods A health coach has been employed on a part time basis in an elementary school, to increase young children's (10-12 years old) physical activity. The research team planned the health coach's activities which were based on earlier research and the theoretical model; Youth Physical Activity Promotion Model (YPAPM) (Welk, 1999). In order to make comparisons, we also selected two control schools where no health coach is employed and no health promotion activities are conducted. In the study, quantitative data has been collected on two occasions over a period of two years (2011-2013: pupils survey n=120, parents survey n=40, pupils pedometers, n=120). In addition to the quantitative data, a qualitative data collection has also been conducted on two occasions (2011: pupils & teachers interview n=30; 2013: pupils, teachers & health coach interview n=32). Results Baseline data (2011) has been collected, and the last data is being gathered under February, 2013. Preliminary analysis has indicated that the implemented health promotion activities, managed by the health coach, attract even those children who usually do not like the PE classes. More data will be analyzed and some central variables from the final data collection will be presented in comparison to baseline data. Discussion Earlier research has shown that a minimum of 60 minutes a day of physical activity are needed for young children to develop good health (Strong, et al. 2005). The regular school curriculum in Sweden is not enough to meet this conditions, and therefore it's of great importance to find new ways to activate all children during the school day. This project has investigated if and to what extent a health coach, as an extra resource in school, can make a difference concerning increased physical activity for young school children. References Strong, W.B., Malina, R.M., Blimkie, C.J.R., Daniels, S.R., Dishman, R.K., Gutin, B., Hergenroeder, A.C., ... & Trudeau, F. (2005). The Journal of Pediatrics, Volume 146, Issue 6, p. 732-737. Welk, G.J. (1999). Quest, 51, 5-23.

**15:00 - 16:00****Mini-Orals****PP-PM25 Neuromuscular Physiology [PH] 3****THE USE OF FAR INFRARED EMITTING FABRIC RESULTS IN BETTER NEUROMUSCULAR PERFORMANCE**

Souza, T.M.F., Gáspari, A.F., Guimarães, P.S., Felipe, T.I., Rodrigues, G.F.C., Souza, G.V., Chacon-Mikahil, M.P.T., Moraes, A.C.

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Introduction: The fabric made from polyamide yarn far infrared emitting (FIRE) to issue far infrared ray when it is heated (e.g. exercise condition). This far infrared ray promotes an increase in mobility of body fluids, breaking the clusters of water molecules and facilitating the clearance of nutrients and metabolic products. This could reduce the oxidative stress, fatigue and improve the performance through the increase in offer of substrate, possibly including ATP concentration, as removal of active muscle metabolic waste. Aim: To assessment the effect of FIRE garment on muscular performance in individuals submitted to muscle damage protocol on isokinetic dynamometer. Methods: Twenty-one volunteers (23.83 ± 3.19 years, 73.60 ± 11.37 kg and 1.75 ± 0.07 m), performed two maximal eccentric exercise bouts on an isokinetic dynamometer composed by 10 sets of 15 repetitions to 210°.s<sup>-1</sup> in synchronism with contact electromyography, using randomly the FIRE garment and Placebo (double blind). Were measured the knee extensor muscle Peak of Torque and Total Work compared between groups (FIRE and Placebo) by repeated measures ANOVA followed by Tukey's Post Hoc test. Results: In the measured variables it were found differences between garments in Peak of Torque (p = 0.035) and Total Work (J) in sets 1 (Placebo = 1966.0 ± 671.4; FIRE = 2275.4 ± 919.9; p = 0.028), 2 (Placebo = 1954.4 ± 779.9; FIRE = 2380.5 ± 747.1; p = 0.000) and 3 (Placebo = 2082.2 ± 845.4; FIRE = 2507.2 ± 613.1; p = 0.000). Discussion: Greater differences between garments in Total Work were found in the first sets of the protocol, when the fatigue process has lesser effect on performance. This finding show a possible action of far infrared on muscular tissue, with no relation to the increase in mobility of body fluids or reduction of acidosis (YU et al., 2006; LEUNG et al., 2011), but exerting an influence on the neuromuscular mechanisms determinants to performance (BENEDICENTI et al., 2008). Conclusion: The FIRE garment was efficient to improve the neuromuscular performance, with better results in eccentric Peak of Torque and Total Work. References: YU, S.Y.; CHIU, J.H.; YANG, S.D.; HSU, Y.C.; LUJ, W.Y.; WU, C.W. Photodermatol Photoimmunol Photomed, v.22, p.78-86, 2006. BENEDICENTI, S.; PEPE, I.M.; ANGIERO, F.; BENEDICENTI, A. Photomed Laser Surg, v.26, n.5, p.451-3, 2008. LEUNG, T.; LEE, C.; TSAI, S.; CHEN, Y.; CHAO, J. Chinese Journal of Physiology, v.54, n.4, p.247-254, 2011.

**ACHILLES TENDON LENGTH EVALUATED BY A TWO-DIMENSIONAL STRAIGHT LINE MODEL IS SERIOUSLY ERRONEOUS: USEFULNESS OF A THREE-DIMENSIONAL CURVED LINE MODEL**

Fukutani, A.1, Ema, R.1, Hirata, K.1, Hashizume, S.1, Wakahara, T.1, Kanehisa, H.2, Kawakami, Y.1

*1: Waseda university (Saitama), 2: National Institute of Fitness and Sports in Kanoya (Kagoshima)*

Introduction The Achilles tendon has a key role in the performance of human movements because it acts as a spring by storing and releasing elastic energy. In a previous study (Hoffrén et al. 2012), the Achilles tendon length change during an ankle joint movement was evaluated as the straight distance between the proximal and distal ends of the Achilles tendon in a two-dimensional (2D) plane in a three-dimensional (3D) space. However, this approach inevitably contains errors in two ways: neglecting the curvature and underestimation caused by the projection from 3D to 2D plane. The purpose of this study was to compare the Achilles tendon length change calculated by 2D straight line model (2D straight) and by 3D curve line model (3D curve). Methods Eight subjects were recruited. After confirming the location of the Achilles tendon from ultrasonographic images, markers were attached on the skin over the Achilles tendon and 3D

coordinates of markers were obtained from video camera images. The Achilles tendon length evaluated by 3D curve was expressed as the sum of distances between adjacent markers. The Achilles tendon length evaluated by 2D straight was obtained by projecting the 3D coordinates of markers onto the sagittal plane of the lower leg and taking the distance between markers attached on both the ends of the Achilles tendon. The Achilles tendon length was determined at dorsiflexion 20° (DF20) and at plantar flexion 20° (PF20), and its length change was calculated by both methods. Results The Achilles tendon length was 182.6 ± 18.6 mm at DF20 and 174.5 ± 17.2 mm at PF20 in 2D straight, and 183.7 ± 18.3 mm at DF20 and 179.6 ± 17.7 mm at PF20 in 3D curve. The extent of Achilles tendon length change calculated in 2D straight (8.1 ± 3.2 mm) was significantly larger than that calculated in 3D curve (4.1 ± 1.5 mm) ( $p < 0.05$ ). Discussion Although the Achilles tendon length was almost similar between the two methods at DF20, its length at PF20 was shorter in 2D straight than in 3D curve. This difference between two methods in PF20 caused the overestimation of Achilles tendon length change in 2D straight compared to that in 3D curve. The measurement error of approximately 4 mm in 2D straight clearly has a substantial effect in the evaluation of the Achilles tendon length change conventionally done in previous studies (e.g., 10-15 mm, Hoffrén et al. 2012). The current results call for a need to determine the Achilles tendon length by 3D curve. References Hoffrén M, Ishikawa M, Avela J, Komi PV (2012). Eur J Appl Physiol, 112(12), 4035-4043.

### CHANGES OF H-REFLEX DURING THE MENSTRUAL CYCLE PHASE

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**Introduction:**The menstrual cycle phase is phenomenon in woman-specific. A negative association between the menstrual cycle phase and muscle contraction. Muscle contraction was relationship the activity on spinal  $\alpha$ -motoneuron pool, but it was without relation to the menstrual cycle phase. The purpose of this study was to investigate the activity on spinal  $\alpha$ -motoneuron pool excitability was dependent on the menstrual cycle phase.**Methods:**The subject was a healthy Japanese female (age: 25 years) who had regular menstrual cycle phase. Three menstrual cycle phases were defined as menstrual phase (M phase), follicular phase (F phase) and luteal phase (L phase) following the changes in the basal body temperature during a month. The H-reflex was measured twice each phase. Measurement position was in prone posture. H-reflex was elicited in the SOL from the right leg by electrical stimulation with single square pulse of 1ms duration to the tibial nerve in the popliteal fossa. EMG was recorded on the middle surface of the SOL using disposable bipolar electrodes. Mmax was defined as the M-wave at the time of verifying the peak out in amplitude with the increases of stimulus intensity. All the signals were digitized the AD converter with a 10-kHz sampling frequency. The amplitude of maximal H-wave and M-wave potential was measured by obtaining H-reflex / M-wave recruitment curve and calculating Hmax / Mmax. Results & Discussion: The subject of each phase in Hmax / Mmax was showed similar value. The men of Hmax / Mmax were showed similar value in different measurement day. Thus, the Hmax/Mmax was to consider of effect sex differences. However, recruitment curve of pattern were showed the pattern differ by menstrual cycle phase. M phase was showed the Hmax in near the M-wave threshold value and then showed a steep decline of the H-wave. Meanwhile, F phase and L phase was showed the Hmax in late the M-wave threshold value. The men of recruitment curve were no difference pattern and amplitude of changes. From these, the activity on spinal  $\alpha$ -motoneuron pool was to change by menstrual cycle phase.

### RESTING PERIODS OF 1-MIN ARE TOO LONG TO INDUCE A DECREMENT OF THE MEDIAN FREQUENCY DURING AN INTERMITTENT FATIGUE PROTOCOL

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**Introduction:** Using superficial EMG, it is usual to observe how the power spectrum is displaced toward lower frequencies when muscles become fatigued (De Luca, 1997). Nevertheless, the distinct results reported in the literature could be explained by the combination of different force intensities, recovery and contraction times, muscle groups, and other non-controlled or non-reported factors (Bystrom and Kilbom, 1990). The aim of this study is to check how much recovery time is too long to induce a decrement of the median frequency during an intermittent fatigue protocol (IFP). **Methods:** 21 road racing motorcycle riders aged 29.1 ± 8.0 years performed an IFP exerting forces of different intensities respect to the maximal voluntary contraction (MVC) against a brake lever attached to a gauge connected to the Muscle-Lab system 4000e (Ergotest Innovation). The sequence of the IFP, as well as the structure that replicated the overall position when the rider is piloting a racing motorcycle coincides with Marina et al. study (2012). A ME6000 electromyography system (Mega Electronics, Kuopio, Finland) was used to register flexor digitorum superficialis (FS) and carpi radialis (CR) median frequency (MF). The MF was normalized with the basal measure (NMF). The NMFs measured from the 30% MVCs (NMF30), preceded by 5 s recovery period, were compared to the ones obtained from the 50% MVC (NMF50), preceded by 1 min rest. A 2x2x2 Anova of repeated measures was used to compare the NMF values between the beginning and the end of the IFP, and to study potential interactions with the two muscles (Carpi radialis -CR- and flexor superficialis digitorum -FS-) and the two intensities that are led by very distant recovery periods (5 s rest for NMF30 and 1 min for NMF50). Results Whereas at the beginning of the IFP we observed bigger CR' NMF30 than CR' NMF50, the opposite was observed at the end of the IFP. In both muscles, NMF30 decreased significantly during the IFP whereas the opposite or maintenance was observed with NMF50 after 1 min rest. Conclusion Our results suggest that 1-min-resting period can be enough to avoid fatigue from the previous contractions using voluntary contractions and IFP. This suggestion is in accordance to previous studies (Kleine et al., 2000; Kamimura and Ikuta, 2001). References: Bystrom, SE., Kilbom, A. (1990). Eur J Appl Physiol 60, 457-466. De Luca, CJ. (1997). J Appl Biomech, 13, 135-163. Kamimura, T., Ikuta, Y. (2001). J Rehabil Med, 33, 225-229. Marina, M., Torrado, P., Busquets, A., Rios, JG., Angulo-Barroso, R. (2012). J Electromyogr Kinesiol. Kleine, BU., Schumann, N. P., Stegeman, D. F., Scholle, H. C. (2000). Clin Neurophysiol, 111, 686-693.

### CORRELATION BETWEEN HANDGRIP STRENGTH AND PARKINSON DISEASE RELATED DISABILITY AND IMPAIRMENT.

Silva, M., Vieira, A., Santos, T., Vidal, S., Silva, M., Tolentino, G., Clael, S., Miranda, A., Sousa, J., Oliveira, R.

Univesidade de Brasilia

**Introduction:** Parkinson Disease is a neurodegenerative condition characterized by substantia nigra dopaminergic neurons death (BRAAK et al., 2003). Searching for a better clinical and functional evaluation of the PD population, it was developed the Unified Parkinson Disease Rating Scale (UPDRS) (MOVEMENT DISORDERS SOCIETY, 2003). On the other hand, this instrument doesn't contemplate the mus-

cular strength on a specific way. A literature review by Cano-de-La-Cuerda et al. (2003) showed that this physical valence is deficient in PD subjects. Thus, instruments that measure muscular strength are necessary on a comprehensive approach. Purpose: To correlate handgrip strength and PD-related disability and impairment. Methods: Activities of daily living and motor exam was evaluated by UPDRS sections II and III, respectively. Handgrip strength was evaluated by a Jamar® hand hydraulic dynamometer. Variable correlation was made through Pearson coefficients of the level of significance set at  $p \leq 0.05$ . Results: Inverse correlations were founded between handgrip strength and UPDRS 2 ( $r = -0.7$ ;  $p = 0.009$ ) and UPDRS 3 ( $r = -0.72$ ;  $p = 0.01$ ). Discussion: The inverse proportional correlation between handgrip strength and II and III UPDRS sections happened by the fact that handgrip strength is a global motor aspect, as activities of daily living and main motor exam tasks. So, the handgrip strength shows to be an efficient and comprehensive tool for the clinical and functional characterization of individual with PD.

## MUSCULAR POWER IS NOT EFFECT DURING MENSTRUAL CYCLE PHASES

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**Introduction** Knowledge about acute decreases in strength during menstrual cycle remains equivocal. Besides variation of muscles strength, others studies also have been done to investigate variation of sprint capacity, aerobic capacity and aerobic endurance in any specific menstrual cycle phase. However, there are no data about muscular power. Therefore, the aim of this study was to verify the effects of menstrual cycle phase (MCP) upon lower limb isokinetic power and vertical jump performance in female soccer players. **Methods** Seventeen female soccer players athletes with regular menstrual cycles volunteered to participate in the study (age:  $22.35 \pm 6.42$ ; height  $165.3 \pm 7.8$ ; weight:  $61.8 \pm 7.7$ ). The phases of the menstrual cycle (luteal and follicular), was determined by monitoring for 3 consecutive months. Isokinetic muscular test, squat jump test and countermovement jump test were measured in 2 consecutive menstrual cycles in the follicular phase and in the luteal phase. Knee flexors and extensors isokinetic power for both lower limbs were measured at  $300^\circ/s$ . Results Mean values for dominant and non dominant isokinetic flexors power were not different from luteal and follicular phase ( $p = 0.89$  and  $p = 0.58$ , respectively). Dominant and non dominant isokinetic extensors power were not different too. Both vertical jump tests, also failed to show significant difference between menstrual cycle phases ( $p = 0.64$  and  $p = 0.61$  for squat jump and countermovement jump, respectively). **Discussion** Results from these studies showed no difference in muscular power between luteal and follicular menstrual cycle phase, neither in isokinetic muscular power, nor in jump tests that depends on muscular power. These results suggested that the changes in female steroid hormones during their menstrual cycle did not affect muscular power. However, these findings were limited to isokinetic power evaluation and jump test measured at 2 different times, and further research examining these variables at multiple times and using other measures of neuromuscular function is needed. **References** Montgomery MM, Shultz SJ, *Journal of Athletic Training* 2010;45 (6):586–593. Tsampoukos A, Peckham EA, James R, Nevill ME, *Eur J Appl Physiol*. 2010 Jul;109(4):659–67 Sarwar R, Niclos BB, *Rutherford OMJ Physiol*. 1996 May 15;493 ( Pt 1):267–72. Bambaiechi E, Reilly T, Cable NT, Giacomoni M. *Chronobiol Int*. 2004 Jul;21(4-5):645–60.

## INFLUENCE OF AGING ON FOOT GRIP FORCE

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**[Introduction]** A deterioration of skeletal muscle function is the main consequence of aging. The impairment of neuromuscular function in lower limbs may affect functional movement of daily living and cause a fall after stumbling in elderly individuals (Yamauchi et al. 2009, 2010). Because foot bears body weight as it carry the body through daily activities, it plays an integrative role in controlling the posture and movements. There are numerous studies on muscle functions of lower limbs; however, no studies have demonstrated how foot grip force affects with aging. Therefore, the present study was to investigate the influence of aging on maximum isometric foot grip force generation. **[Methods]** Nineteen healthy young ( $21.1 \pm 1.8$  years old) and 18 healthy elderly ( $66.3 \pm 6.9$  years old) individuals were measured the maximum foot grip force on the dynamometer. For the measurement of maximum isometric foot grip force, subjects exerted force with maximum effort for ~3 seconds on a foot grip dynamometer in either sitting or standing position. Measurements were repeated three times with at least one-minute rest period between bouts, and the highest value among the measurements was used. **[Results and Discussion]** Foot grip forces in the sitting position was significantly lower in elderly than young individuals; however, its in the standing position was not significantly different between elderly and young individuals. The present results indicate that the ability to generate foot grip force in standing position was somehow compensated to maintain higher force in elderly individuals. **[References]** Yamauchi J et al. *Journal of Biomechanics* 42: 2151–2157, 2009. Yamauchi J et al. *Gerontology* 56(2): 167–174, 2010.

## SEX DIFFERENCES IN MUSCULAR AND NEUROMUSCULAR FUNCTION FOLLOWING A DOWNHILL RUNNING TASK

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**Introduction** Increased relative risk of non-contact anterior cruciate ligament (ACL) injury has been attributed to numerous biomechanical, anatomical and neuromuscular factors with females 4 times more likely to suffer a non-contact ACL injury compared with males. The aim of this study was to examine the effects of a fatigue task on sex differences of the functional Hamstring / Quadriceps ratio (FH/Q ratio) and electromechanical (EMD). **Methods** One hundred and ten healthy males ( $n = 55$  age  $29 \pm 5$  yrs) and females ( $n = 55$  age  $27 \pm 6$  yrs) were recruited from the university population. Isokinetic concentric (CON) and eccentric (ECC) torque of the hamstrings and quadriceps were determined in a prone position at 60, 120 and  $240^\circ/s$  with the hip flexed at  $10^\circ$ . Range of movement of the knee joint was  $90^\circ$  with  $0^\circ$  determined as full volitional extension. The FH/Q ratio was determined at 15, 30,  $45^\circ$  and where peak torque (PT) was achieved for each movement velocity. Surface electromyography was recorded from the semitendinosus (ST), semimembranosus (SM) and biceps femoris (BF) of the dominant limb using an 8-channel DelSys EMG telemetry system during the eccentric actions. The electromechanical delay (EMD) was determined as the time delay between the onset of muscle activation (change in activation of  $+15 \mu V$ ) and onset of torque production (9.6 Nm) according to the procedures described by Zhou et al (1995). Each participant performed a 40 min intermittent downhill running protocol consisting of  $5 \times 8$  min bouts on a  $-10\%$  decline at 80% Heart rate max, with 2 min standing rest between each bout. **Results** Irrespective of sex, joint angle or angular velocity, the FH/Q ratio was significantly lower and EMD of hamstring muscles was significantly longer post-fatigue compared to pre-fatigue. Significant interactions between sex and time for the FH/Q ratio and EMD of hamstring muscles were found. The interactions showed a significantly lower FH/Q ratio and significantly longer EMD post fatigue in

females compared to males. Discussion These data suggest that functional stability of the knee is reduced when fatigue is present as both muscular (FH/Q) and neuromuscular (EMD) function is impaired. The impact of fatigue is significantly greater in females compared to males and this may in part contribute to the greater relative risk of non-contact knee injury in females. These data reinforce the need for appropriate pre-habilitation programmes for both males and females to reduce the risk of injury. However, most current conditioning programmes for injury prevention do not focus on fatigue resistance to reduce the impairment to muscular and neuromuscular function and thus there is a need to re-develop injury prevention programmes to focus conditioning on fatigue resistance.

### SEX-RELATED CHANGES IN FORCE AND MUSCULOTENDINOUS ARCHITECTURE FOLLOWING PASSIVE STRETCH

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**INTRODUCTION** Strength is contingent upon the effective transfer of force from the contractile element of skeletal muscle to passive tendinous structures. Men are typically stronger than women in part because of larger muscle mass, cross-sectional area, and shorter, less compliant tendons (Kubo et al., 2003; Bryant et al. 2008). Stretch may minimize sex-related force differences by attenuating musculotendinous compliance in women. The purpose of this study was to determine whether passive stretch differentially affects maximal voluntary force (MVC) production and musculotendinous architecture in men and women. It was hypothesized that stretch would lessen slack length of the musculotendinous unit in women reducing sex-related strength differences. **METHODS** A 5s plantar flexion MVC was performed prior to, and following, a two minute maximal dorsiflexion stretch. The ankle was positioned at 15° plantar flexion in a custom foot plate attached to the Biodex Dynamometer for each MVC. Passive stretch was achieved by rotating the ankle joint to each subject's maximal stretch (~30° dorsiflexion). An ultrasound probe (GE Logiq E9) was fastened over the plantar flexors at the musculotendinous junction of the medial gastrocnemius and the Achilles tendon. Supramaximal square wave stimuli (200µs pulse width, 66-217mA) were administered prior to, during, and immediately after each MVC. Surface EMG of the agonists and antagonist were recorded. **RESULTS** Voluntary activation (98% vs. 95%) and strength ( $\Delta$ 33%) were higher in men than women and did not change following stretch. Normalized surface EMG of the MVC for the agonists (%M-wave) and antagonist (%MVC) did not differ between men and women. In women ( $\Delta$ 33%), but not men, tendon length increased following stretch. Relaxed fibre length was greater in men than women post-stretch (30%). **DISCUSSION** Contrary to the hypothesis, passive stretch did not affect the difference in strength between men and women. Greater tendon length in women and longer relaxed fibre lengths in men suggest that the absorption of passive stretch was isolated to contractile tissue in men and non-contractile tissue in women. Results demonstrate changes in muscle and tendon following passive stretch are sex-specific and may function to maintain maximal isometric force.

### THE INFLUENCE OF AGE AND MATURATION ON RELATIVE LEG STIFFNESS IN FEMALE YOUTH SOCCER PLAYERS

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**Introduction** Leg stiffness has been associated with both jumping and running performance in youth athletes as well as associated with injury risk/prevention. Data from boys suggests that leg stiffness increases with age and maturation, however, there are no comparative data on girls. Given the relative increase in ACL risk in females compared to males understanding the age and maturation related changes in leg stiffness is important. The aim of this study was to determine the intra and intersession reliability of determining leg stiffness using a mobile contact mat with female youths, and to explore the influence of maturation on leg stiffness. **Methods** 32 healthy female youth players from 3 age groups (U13, U15 U17y) attached to an FA women's super league football club were recruited for this study. Participants were split into three maturation groups based on estimated maturity offset: Group 1:  $-0.27 \pm 0.56$  (n=11), Group 2:  $1.38 \pm 0.64$  (n=11) and Group 3:  $3.14 \pm 0.49$  (n=10). Participants completed a familiarisation and two testing sessions, requiring four sets of 20 sub-maximal hops at 2.5Hz. Relative leg stiffness (normalised for body mass and leg length) was determined on each test occasion. Reliability statistics included independent sample t-tests, intraclass correlation coefficient and coefficient of variation (CV). To explore maturation effects, a group one-way repeated measures analysis of variance (ANOVA) was conducted. **Results** The contact mat was found to be a reliable method to determine leg stiffness in female youth both between control trials and within trials (CV = 9.5%). A significant main effect for maturation was observed with group 3 demonstrating significantly lower relative leg stiffness than either group 1 or 2 ( $36.6 \pm 6.6$  Vs  $44.6 \pm 5.5$  and  $46.4 \pm 8.8$  respectively). There were no significant differences in leg stiffness between group 1 and 2. **Discussion** The mobile contact mat was deemed a reliable measure of relative leg stiffness in youth female footballers both within and between test sessions. In contrast to data from male youths we did not find a significant increase in leg stiffness with maturation. Our data identified a lower leg stiffness in more mature girls. This reduced stiffness may be due to traditional football training de-sensitising supra-spinal feed forward input and short latency stretch reflexes that are required to regulate greater levels of leg stiffness. However further research is require including non-training control groups to explore the influence of traditional football training on relative leg stiffness.

### POST ACTIVATION POTENTIATION OF THE PLANTAR FLEXORS AT DIFFERENT KNEE ANGLES

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**Introduction** Post activation potentiation refers to the enhanced contractile muscle properties seen after a conditioning maximal voluntary muscle action (MVC) (1). In tasks such as sprint start and jumping, propulsive force is achieved by both the slow twitch Soleus muscle and the fast twitch Gastrocnemius. The contribution of each muscle to plantar flexor torque varies with knee angle (2). To understand how post activation potentiation affects performance in such tasks post activation potentiation of plantar flexors should be compared between different knee joint angles. **Purpose** To investigate differences in post activation potentiation of the plantar flexors between an extended and a flexed knee position. **Methods** Nine power athletes participated in the study. Twitches were evoked by supramaximal stimulation of the tibial nerve in the popliteal fossa before and repeatedly after a 6s conditioning plantar flexor MVC, with the subject lying first prone with an extended knee and then (after 15 min rest) in four point kneeling position, with the knees and hips flexed at 90 degrees. **Results** At 5s after MVC, PT was potentiated by (mean $\pm$ SD)  $67 \pm 18\%$  in the straight versus  $40 \pm 24\%$  in the flexed knee. At 5s after MVC, RTD was potentiated by  $94 \pm 26\%$  in the straight versus  $64 \pm 41\%$  in the flexed knee position. PT and RTD remained potentiated for an equal duration irrespective of knee position. At 5s after MVC, HRT was decreased by  $19 \pm 5.5\%$  in the flexed knee position but increased by  $4 \pm 24.4\%$  in the straight knee position. **Discussion** The finding that RT and RTD were potentiated more in the extended knee than the flexed knee

position suggests that post activation potentiation likely has greater influence on RTD and strength of the plantar flexors in tasks where the knee is extended. Since the duration of potentiation was similar between position, a few minutes of rest after a conditioning MVC the plantar flexors are equally potentiated in both positions. Furthermore, the findings lend support to the notion that post activation potentiation enhances performance of fast twitch muscles more than slow twitch muscles, since in the flexed knee position there is lesser involvement of the gastrocnemii muscles. This study was financially supported by The Swedish Center for Sports Research. Paulo Gago wishes to thank Gymnastik- och idrottshögskolan (GIH) and Fundação para a Ciência e Tecnologia (FCT), Portugal for the Ph.D. Grant SFRH/BD/79184/2011. 1. Hodgson et al., *Sports Med* 2005;35:585-95. 2. Cresswell et al., *Exp Brain Res* 1995;105:283-90.

## FACTORS INFLUENCING MAXIMUM ROM AT THE ANKLE JOINT: DIFFERENT RESULTS FROM CROSS-SECTIONAL VS. LONGITUDINAL STUDIES

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**Introduction** The ability to move through large joint ranges of motion (ROM) is important for the successful performance of activities of daily living and athletic tasks, however the factors affecting ROM are not currently known. Two common approaches to studying these factors are to: (1) compare neuromuscular differences between 'flexible' and 'inflexible' subjects, and (2) determine which neuromuscular factors change temporally with ROM. We have compared the results obtained by these two approaches. **Methods** In study one, 21 healthy men were divided into two groups (flexible, n=11; inflexible, n=10) based on their maximum dorsiflexion ROM (median = 46 deg) measured on an isokinetic dynamometer with the knee straight. Muscle and tendon lengths, passive muscle and tendon stiffness, fascicle length, angle, strain (lengthening) and rotation, peak passive torque (i.e. stretch tolerance), gastrocnemius and soleus EMG records, and H wave amplitudes (maximum and at 10% Mmax) were measured using dual-transducer ultrasound, isokinetic dynamometry, EMG and tibial nerve stimulation procedures. In study two, these measures were obtained in 12 subjects who performed twice daily straight-leg plantarflexion stretches for 3 weeks and 9 subjects who acted as non-stretching controls. Five additional subjects were tested for fascicle length, strain and rotation only, in order to improve statistical power. **Results** In study one, subjects with a greater ROM (flexible) tolerated a greater peak passive torque (48.6%) and exhibited greater fascicle rotation during stretch to 30 deg dorsiflexion (9.7 vs. 5.9%) than inflexible subjects; there was a greater tendon length at stretch termination only due to the greater loads tolerated. There were no differences in H-reflex magnitudes, EMG maximum amplitudes or EMG at stretch termination, but there was a moderate correlation between the angle of EMG onset and maximum ROM ( $r=0.60$ ,  $p<0.05$ ). There were no other between-group differences. In study two, subjects who performed stretching training showed an increased peak passive torque (28.1%), greater fascicle strain measured to 30 deg (27.2%), lower muscle stiffness (-18.0%) without change in tendon stiffness, and a depression of the H reflex measured in plantarflexed and neutral joint positions only. **Discussion** In both studies, the ability to tolerate stretch appeared to be a key factor influencing maximum ROM. However, the later onset of EMG and greater fascicle rotation appeared to be characteristics of more flexible subjects, whilst reductions in fascicle and muscle stiffness were associated with improvements in flexibility with training. Thus, the neuromuscular factors that contribute to between-subject variability in flexibility are largely different to those that are associated with improvements in flexibility with training.

## THE TRUNK MUSCLE STRENGTH AND MUSCLE VOLUME OF BALLET DANCERS

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**Introduction** Previous studies have indicated that better balance control in dancers than in control groups (Mouchnino et al., 1992, Crottes et al., 1996, Golomer et al., 1997). However, functional characteristics of trunk muscle for dancers have not been fully elucidated. So the purpose of this study was to investigate isometric isokinetic muscle strength during trunk flexion and extension and their relations to trunk muscle volume for Japanese female ballet dancers. **Methods** Subjects were seven female dancers with ballet training more than ten years as the dance students group and four professional ballet dancers as the professional dance group and nine female university students as the control group. Control subjects had no experience of any dance training and no regular exercise in past three years. This study was divided into two testing. For evaluating muscle volume of the trunk, MRI images were prepared using a 1.5 T MRI scanner (TOSHIBA EXCELART Vantage). Contiguous transverse images with 1.0cm slice thickness were obtained from the seventh thoracic vertebra to the hip joint. Cross sectional area were digitized for psoas major muscle, abdominal rectus muscle, erector spinae muscle, external oblique muscle, and quadratus lumborum muscle. For evaluating isometric and isokinetic muscle strength during trunk flexion and extension, subjects performed trunk flexion and extension on the isokinetic dynamometer (Biodex) at 60 deg./sec, 120deg./sec and 180deg./sec. **Results** There was no significant difference in all trunk muscles among three groups. The peak torque for trunk extension at 60 and 180deg./sec were significantly higher in the professional dance group compared to the controls. Significant higher peak torques were found in both dance groups during trunk flexion at 120 and 180deg./sec compared to the controls. Professional dance group showed significant greater torque/CSA compared to the control during trunk extension at 180deg./sec. For trunk flexion, significant higher peak torque/CSA was found at 120 and 180deg./sec. **Discussion** From the results of this study, it is indicated that ballet dancers would have high strength of the trunk muscles especially for faster isokinetic conditions, although there was no significant difference in muscle volume of the trunk by MRI images. It is also speculated that greater torque of trunk muscle might induced by physiological factors.

## IDENTIFICATION OF MULTI-DIRECTIONAL POSTURAL CONTROL IN HUMANS

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**Introduction** Human bipedal standing is inherently unstable. So even during quiet standing, we must constantly regulate multiple joint torques by controlling a large number of muscles coordinately to keep the body stability. To achieve such complex bipedal standing effectively, it is thought that muscle synergies, which are modular organization formed by muscles activated in synchrony, are contribute to postural control (Torres-Oviedo and Ting, 2007). In this study, we investigated multi-directional postural control from the viewpoint of muscle synergies. **Methods** Five healthy males participated in this study. The subject stood on a force plate with four postural configurations: normal stance, narrow stance, and parallel stance (right foot anterior and left foot anterior). During the tasks, the foot center of pressure (COP) position was measured. Each subject was instructed to gradually shift their position of COP from the original position to the target point by leaning his body around the ankle joint and then to hold the COP position for 10 s. The targets were placed in 12 direc-

tions, which were equally distributed in 30° increments to cover the entire horizontal plane (Imagawa et al., 2013). Surface electromyography (EMG) was recorded from 10 muscles, and raw EMG data were rectified and averaged across 10 s period for each muscle and direction. From them, we generated EMG data matrix, which consisted of 10 muscles × 12 directions for each stances. Then, we extracted muscle synergies and their activation for each direction from the EMG data matrix using nonnegative matrix factorization (NMF) (Lee and Seung, 2001). Results The principal synergies mainly contribute to the fluctuations of anterior-posterior direction, which are mainly composed of soleus, medial gastrocnemius, and tibialis anterior. The synergies activated for medial-lateral postural adjustment were also observed by varying stance configurations, which were dominant for gluteus medius and fibularis longus. Discussion Present results suggest that the synergies were connected to postural strategies (Horak and Nashner, 1986), for example, anterior-posterior “ankle” strategy. Human postural control is low-dimensionally achieved by the contribution of synergies which is related to regulation of each joint torque. References Imagawa H, Hagio S, Kouzaki M. (2013) J Electromyogr Kinesiol, in Press Lee DD, Seung HS. (2001) Adv Neural Info Proc Syst 13: 556–562 Horak FB, Nashner LM. (1986) J Neurophysiol 55: 1369–1381 Torres-Oviedo G, Ting LH. (2007) J Neurophysiol 98:2144–2156

**15:00 - 16:00**

## Mini-Orals

### PP-PM70 Training and Testing [TT] 5

#### **DETERMINANTS OF ACCELERATION AND MAXIMUM SPEED PHASE OF REPEATED SPRINT ABILITY IN SOCCER PLAYERS: A CROSS-SECTIONAL STUDY**

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**Introduction** Despite the increasing knowledge and interest in the associations of repeated sprint ability (RSA) with anaerobic and aerobic power measures, there is little information about the physical fitness determinants of the acceleration and maximum speed phase of an RSA test. The aim of this study was to examine the anthropometric and physiological factors that influence the acceleration (0-10 m) and maximum speed phases (10-20 m) of an RSA test. **Methods** Thirty-six soccer players were tested for height, body mass, body fat (BF), sit-and-reach test, squat jump (SJ) and countermovement jump (CMJ), Wingate anaerobic test (WAnT), maximal aerobic running speed (MAS), 20 m sprint time and a 10×20 m RSA test. A stepwise regression analysis was performed to investigate variables that predict RSA. **Results** The comparison between groups with different levels of RSA revealed that players with higher RSA had better scores in physical fitness than their counterparts with lower RSA (MAS +1.1 km.h<sup>-1</sup>, +7.1%; SJ +4.5 cm, +14.2%; mean power in WAnT +0.4 W.kg<sup>-1</sup>, +4.6%; 20 m sprint -0.13 s, -4.1%; p<0.05). Sprint time at 0-20 m (Sprint), 0-10 m (Sprint0-10) and 10-20 m (Sprint10-20) were predictor variables of eight out of nine RSA dependent variables. Sprint was the best predictor variable of best time (BT) and mean time (MT), Sprint0-10 time the best predictor of BT0-10 and MT0-10, and Sprint10-20 time the best predictor of BT10-20, MT10-20 and performance decrement at 10-20 m (PD10-20). BF was predictor variable of BT, MT, BT0-10, MT0-10 and performance decrement (PD0-10). MAS was predictor variable of MT, PD0-10, BT10-20 and MT10-20. Other predictor variables included age, CMJ, mean and peak power in WAnT. Very large multiple correlation coefficients were found in the models of BT, MT, BT0-10, MT0-10, BT10-20 and MT10-20, large in the model of PD10-20, and moderate in the models of PD and PD0-10. While Sprint0-10 and Sprint10-20 had similar correlations with BT and MT (0.57

#### **COMPARATIVE MULTIPLE SENSOR APPROACH FOR POWER CALCULATION IN LOADED SQUAT JUMP AND POWER CLEAN**

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**Introduction** Power output is a critical component of athletic performance (McGuigan et al., 2012); therefore, strength and conditioning specialists are nowadays employed to help athletes increase the power-generating capacity in specific motor tasks. Due to the widespread need to assess power output in common strength training exercises, the development and validation of various assessment approaches has led to studies aimed at identifying the external optimal load (OL) to maximize power output (Cormie et al., 2007). The aim of this study was to compare conventionally used linear position transducer and force plate based methods with a new methodology for calculation of peak power (PP) and average power (AP) output in conjunction with the load-power relationship. **Methods** Nineteen male elite athletes performed loaded squat jump (LSJ) and power clean (PC) with different external loads to determine the load/power relationship. Nine methods were used simultaneously in data collection: vertical ground reaction force (VGRF), ground reaction force (GRF) i.e. vertical, antero-posterior and medio-lateral reaction force components, 1 linear encoder (1Encoder), 1 linear position transducer (1LPT), 1LPT and VGRF (1LPT+VGRF), 2 linear position transducers (2LPTs), 2LPTs and VGRF (2LPTs+VGRF), 5 linear position transducers (5LPTs), 5LPTs and GRF (5LPTs+GRF; novel method). Power output was calculated for each lift according to the sensor or sensors simultaneously used and the results were compared. **Results** Power output calculated separately with LPTs and GRF method differed significantly from combined methods such as 1LPT+VGRF, 2LPTs+VGRF, and 5LPTs+GRF (novel method). The optimal load in LSJ and PC with respect to PP output was identified at loads between 30 and 50% of their body mass (bm), respectively; and with respect to AP output equal to loads between 85 and 75% of bm, respectively. **Discussion** This study indicates that test methodology influences the results of the power output and the load-power relationship in LSJ and PC exercises. The results of this study suggest the possibility that the combined methods provide a better representation of muscle power generation during dynamic movements involving the non-linear trajectories of the barbell than kinematic or kinetic methods alone. **References** Cormie, P., McBride, J. M., & McCaulley, G. O. (2007). J Appl Biomech, 23(2), 103-118. McGuigan. (2012). Strength and Power Assessment Protocols. Physiological Tests for Elite Athletes (2nd ed., pp. 207-230). Stanningly Leeds, United Kingdom: Human Kinetics.

## STRENGTH TRAINING PERIODISATION AND PERFORMANCE DEVELOPMENT OF AN ELITE JUDO ATHLETE DURING AN ENTIRE OLYMPIC TRAINING CYCLE

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**Introduction** Long-term individual training and testing data of elite judo athletes are rarely published. The main objectives of this work were to monitor the strength training periodisation and the performance diagnostic data of an elite judo athlete during an entire Olympic cycle. **Methods** Based on a regular macrocycle quarterly periodisation the strength training of a male elite judoka (junior world champion 2010; 5th European Championship 2012) was monitored during the Olympic cycle of 2008-2012. The following nonspecific strength training exercises with free weight barbells and machines were used: Snatch/Sn; Clean and Jerk/CJ; Back Squat/BS, Barbell Bench Press/BP, Barbell Bench Pull/BBP, Knee Flexion Curl/KF; Barbell Elbow Curl/B, High Pulley Triceps Extension/T, Lat Pull Down/LP. Training volume was quantified as described by Stone et al. (1982) and varied (maxima to minima) as follows: Sn/396-98, CJ/396-98, Sq/420-84, BP/BBP/KF/B/T/LP/800-120, respectively. Intensity was 50-90% of 1 RM and the weekly duration of strength exercises ranged from 240-300 minutes. Using an isokinetic dynamometer isometric MVC of the knee extensors and flexors and the shoulder internal and external rotators were assessed at the beginning and the end of the yearly winter training period. An incremental laboratory treadmill running test including measurements of VO<sub>2</sub>-kinetics and lactate accumulation was performed at these yearly testing days. **Results** During the 4-years period, the following 1 RPM increases of the exercises were detected: Sq: 50%; BP: 16%; BBP: 28%; KF: 22%; B: 33%; T: 33% and LP: 37%. MVC knee extension moments increased of about 25% and MVC knee flexion moments showed enhancements between 20% and 30% according to body side. MVC of the internal and external shoulder rotators showed large enhancements of about 50% and 60%, respectively. Body weight increases peaked at 11% during the period. Treadmill test performance remained relatively stable during the period and displayed running speeds of 15-16 km/h at the individual anaerobic threshold, maximum speeds of 20 km/h and maximum VO<sub>2</sub>-uptake values of slightly above 60 ml/kg/min. **Discussion** This work presents the training and testing values of an elite judoka during an Olympic cycle. Despite profound gains in absolute strength and without special focus on aerobic training at any time of the period, the athlete's aerobic and anaerobic performance values remained stable at a relatively high level. These data might underline the importance of special genetic and individual talent factors in elite athletic performance. **References** Stone, M, O'Bryant, H, Garhammer, J, McMillan, J, Rozenek, R. (1982). Journal of the National Strength and Conditioning Association, 4, 36-39.

## USEFULNESS OF THE THREE-DIMENSIONAL MOTION ANALYSIS IN KICK START OF SWIMMING

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**Introduction** Kick start (KS) is the starting technique which swimmers set up their rear leg on a back plate of the starting platform. It is reported that KS can achieve higher performance than the traditional start in the start phase. However, the detailed characteristics of KS movement has not been clarified because the two-dimensional motion analysis (Two-DMA) was used in previous studies. Since the KS involves trunk twisting movements, three-dimensional motion analysis (Three-DMA) is more appropriate for analyzing the KS movement. Therefore, the aim of this study was to gain new KS's data by using the Three-DMA through the comparison with Two-DMA, in order to clarify the movement characteristics of the KS. **Method** Six male university swimmers were asked to perform the KS. The movement of the KS was taken by three digital video cameras on each subject. The real coordinates of captured anatomical landmarks were calculated by Three-DMA using the DLT method. In this study, we defined the two joint angles as the 2D angle (angle on the sagittal plane) and the 3D angle (angle in 3D space). **Result** Average value of each time segment in the movement of the lower limbs were as follows: the time in which knee angle starts extending;  $0.18 \pm 0.03$ s, leaving the starting platform;  $0.65 \pm 0.08$ s as to the rear leg and the time in which knee angle starts flexing;  $0.28 \pm 0.08$ s, starts extending;  $0.60 \pm 0.07$ s, leaving the starting platform;  $0.77 \pm 0.08$ s as to the front leg. In most subjects, the trunk twist angle was soared after the slight decrease in the block phase. In the lower limb movement, the 2D angle and the 3D angle showed a very high positive correlation ( $r = .938$  or more,  $p < 0.01$ ). **Discussion** In the block phase of KS, the knee angle of the rear leg extended without flexion, but the knee angle of the front leg extended rapidly after flexion. And the trunk twist angle was also soared after the slight decrease in the block phase of KS. This results suggest that stretch-shortening cycle (SSC) occurred in the knee extensor of the front leg and the trunk rotator. Bosco et al. (1982) reported that the utilization of the SSC enhanced the performance over that of the pure concentric contraction. Therefore, it was considered that the KS is superior to the usual starting technique in performance of start phase because of the utilization of SSC. It was suggested that Two-DMA can obtain same results in the lower limb movement as Three-DMA, because the 2D angle and the 3D angle showed a very high positive correlation in the lower limb movement. **Reference** Bosco C, Tarkka I, Komi PV (1982) International Journal of Sports Medicine, 3(3):137-140

## THE EVALUATION OF REPRODUCIBILITY OF BALLET LEG POSITION IN ELITE JUNIOR AND SENIOR SYNCHRONIZED SWIMMERS

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**Introduction** Synchronized swimming is a competitive sport, which is judged based on synchrony between music and the movements of each swimmer. Synchronized swimming competition includes a figure session and a routine session. All specified 200 figures are constituted from movements of the leg, such as hip extension-flexion movements, in particular, the ballet leg positions (from a back layout position to raise a leg and to keep the hip flexion angle at 90°) that account for 40% of the figures. Therefore, precise control of hip flexion angle is important for synchronized swimmers. The purpose of this study was to examine the evaluation of reproducibility of ballet leg position in elite junior and senior synchronized swimmers. In addition, the relationship between these positions and the physical performance characteristics of synchronized swimmers were also determined. **Methods** A total of 24 elite female synchronized swimmers participated in this study. The participants were divided into the following 2 groups: junior group ( $n = 15$ ; age,  $11.5 \pm 1.5$  years) and senior group ( $n = 9$ ; age,  $17.7 \pm 2.6$  years). The participants performed the ballet leg positions in water and on dry land. The indicators of ballet leg positions, namely, (1) repositioning error (RE) of hip flexion angle and (2) maximal moving distance of the greater trochanter of the femur, were evaluated using an image analyzing system with high-speed underwater video cameras. The indicators of physical performance tests were (1) sculling on double ballet leg position, (2) range of hip motion, and (3) abdominal muscle endurance. **Results** RE for ballet leg position in water was  $3.2 \pm 1.7^\circ$  and  $7.2 \pm 4.3^\circ$  in the senior and junior groups, respectively. RE for ballet leg position on dry land was  $2.9 \pm 3.0^\circ$  and  $5.0 \pm 3.5^\circ$  in the senior and junior groups, respectively. The physical performance tests of sculling, range of hip mo-

tion, and abdominal muscle endurance was greater in the senior group. Conclusions These findings showed that compared to the junior group, the senior group showed better reproducibility of ballet leg position in water. In conclusion, this study suggested that the precise reproducibility of ballet leg position in water correlated with the physical performance characteristics of synchronized swimming, and that sculling, range of hip motion, and abdominal muscle endurance seem to be important indicators. Reference Yamamura, C., et al. (1999). Physical characteristics of well-trained synchronized swimmers in relation to performance scores. *Int J Sports med*, 20 (4):246-251.

### **EFFECTS OF 18-WEEKS IN-SEASON HEAVY RESISTANCE AND HIGH-INTENSITY TRAINING ON THROWING VELOCITY, STRENGTH, JUMPING AND MAXIMAL SPRINT SWIM PERFORMANCE OF ELITE MALE WATER POLO PLAYERS**

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*UNIVERSITY PABLO DE OLAVIDE*

**Introduction** Water polo (WP) is a sport that places high strength and high-intensity as well as endurance demands on the athlete, with a predominance of sprint swimming and wrestling. The importance of non-swimming activities (e.g., throwing, passing, and wrestling) which account for around 69% of playing time has been previously highlighted (D'Auria 2008; Smith 1998). Competitive performance in WP depends not only on strength, but also on the ability to exert force at the speed required by this discipline. In addition to technical and tactical skills it has been argued that muscular strength and power are the most important factors that give a clear advantage in elite competitions (Smith 1998). Elite WP players who supplemented their normal in-season WP training with an 18-week program of bi-weekly heavy resistance and high-intensity oriented exercises would enhance their muscular strength without compromising other qualities critical to WP performance. **Methods** This study was designed to assess the effects of 18 weeks of bi-weekly (36 sessions) strength and high-intensity training in-season on muscular strength performance of elite WP players. The participants were randomly allocated to undergo an additional program of strength and high-intensity training or only receive usual in-water training. 20-m maximal sprint swim, maximal dynamic strength (1RM) for upper (bench press (BP) and lower (full squat (FS) body, countermovement jump and throwing velocity were measured before and after training. **Results** Baseline-training results showed no significant differences between the groups in any of the variables tested. No improvement was found in the control group, however, meaningful improvement was found in all variables in the experimental group: CMJ (2.38 cm, 6.9%, Effect Size (ES)=0.48), BP (9.06 kg, 10.53%, ES=0.66), FS (11.06 kg, 14.21%, ES=0.67), throwing velocity (1.76 km/h, 2.76%, ES=0.25) and 20-m maximal sprint swim (-0.26 sec, 2.25%, ES=0.29). **Discussion** Specific resistance and high-intensity training in-season enhances the strength output of both upper and lower-body, whether assessed by jumping (6.90%) or swim sprinting (2.25%), 1 RM-BP (10.53%) and FS (14.21%) test, or throwing velocity (2.76%). Other studies have examined the influence of strength training and jump height on overhead throwing velocity of elite WP players (Bloomfield et al 1990; McCluskey et al 2010), but this is the first study to examine gains of jumping and swim sprinting performance, using resistance and high-intensity exercises such as the bench press, military press and pull-ups for the upper-body and full-squat and plyometric exercises for the lower-body. Therefore, we propose modifications to current training methodology for WP players to include strength and high-intensity training for athlete preparation in this sport. **References** D'Auria S, Gabbett, T (2008). *Int J Sports Phys Perfor* 3: 305-319. Smith HK. (1998). *Sports Med* 26: 317-334. Bloomfield J, Blanksby B (1990). *Aust J Sci Med Sport*, 22: 63-7. McCluskey L, Lynskey S (2010). *J Sci Med Sport* 13: 236-240.

### **EFFECTS OF IN-SEASON LOWER BODY HEAVY RESISTANCE AND HIGH-INTENSITY TRAINING ON PERFORMANCE OF ELITE FEMALE WATER POLO PLAYERS**

Ramos Veliz, R., Requena, B., Saez de Villareal, E.

*UNIVERSITY PABLO DE OLAVIDE*

**Introduction** Until 2000, women's water polo (WP) was not an Olympic event, and information on the physical characteristics and the physiological demands of elite female WP players was limited. WP is a sport that places high physiological demands on players (aquatic environment and intermittent nature of the game) (Mujika et al, 2006). To technical and tactical skills it has been argued that muscular strength and power are the most important factors that give a clear advantage in elite competitions (Smith 1998). Elite female WP players who supplement their normal in-season WP training with a 16-week program of bi-weekly heavy resistance and high-intensity oriented exercises for the lower body would enhance muscular strength without compromising other factors critical to WP performance. **Methods** We examined the effect of 16 weeks of lower body strength and high-intensity training on key sport performance measures of elite female players. Twenty-one players were randomly assigned to 2 groups; control group (C) who did in-water training only and a lower body strength group (LBS), who performed strength and high-intensity training sessions (twice per week) in addition to the same in-water training. In water training was conducted five days per week for a total of sixteen weeks. 20-m maximal sprint swim (MSS), lower body strength during 1RM full-squat (FS), countermovement jump (CMJ) and throwing velocity (ThV) was measured before and after the training. **Results** Pre-training results showed no meaningful differences between the groups in any of the variables tested. After sixteen weeks no meaningful improvement was found in any of the variables measured in the C group, however, meaningful improvement was found in the LBS group: CMJ (2.48 cm, 8.66%, Effect Size (ES)=0.85), FS (12.78 kg, 25.11%, ES=2.41), ThV (3.55 km/h, 6.73%, ES=3.22). **Discussion** Elite female WP players can enhance muscle strength and jumping ability by undertaking a 16 week in-season program of strength and high-intensity oriented training involving exercises for lower body (FS, split and loaded and unloaded jump exercises). Such benefits can be realised from only two short training sessions per week during competitive season. Previous authors have found a similar benefit of strength and power oriented training in other sports (McCluskey et al, 2010), but this is the first study involving elite female WP players. It is recommended that WP coaches implement during competitive season strength and high-intensity training to enhance the performance of their players. The outcomes may help coaches and sport scientists formulate better guidelines and recommendations for athlete assessment and selection, training prescription and monitoring and preparation for competition. **References** Mujika I, McFadden G (2006) *Int J Sports Phys Perfor* 1: 27-39. Smith HK (1998). *Sports Med* 1998; 26: 317-334. McCluskey L, Lynskey S (2010) *J Sci Med Sport* 13: 236-240.

### **PHYSICAL FITNESS IN MALE TEAM HANDBALL PLAYERS FROM TEAMS WITH DIFFERENT RANKING**

Nikolaidis, P.T.1, Ingebrigtsen, J.2

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**Introduction** Although the physical fitness profile of team handball players according to age, sex and playing position is well documented, there is little information about the components of physical fitness that differentiate players according to their level. Therefore, the aim of this study was to examine possible discriminant physical and physiological characteristics between male team handball players from

elite teams with different league rankings. Methods Participants included players from three teams, A, B and C, which competed in the first league of the Greek championship during the season 2011-2012. Team A finished first, B came second and C came eighth out of eleven clubs. Teams A and B also participated in European Cups, and team A won the European Challenge Cup. The players (n=44) were examined for stature, body mass, percentage body fat, fat free mass (FFM) and performed a sit-and-reach test, physical working capacity in heart rate 170 bpm, squat jump, countermovement jump without and with arm-swing, 30-s Bosco test, handgrip strength test, Force-velocity test and Wingate anaerobic test (WAnT). Results Players from teams A and B were taller (6.1 and 9.2 cm,  $p \leq 0.001$ ), and had higher amount of FFM (6.4 and 5.3 kg,  $p \leq 0.05$ ) compared to those of the lower ranked team (C). Players from team A performed better than players from team C in mean power (0.5 W.kg<sup>-1</sup>,  $p \leq 0.05$ ) during the WAnT, squat jump (5.5 cm,  $p \leq 0.05$ ), countermovement jump without arm-swing (5.5 cm,  $p \leq 0.05$ ) and with arm-swing (6.0 cm,  $p \leq 0.05$ ), and in the 30 sec Bosco test (5.8 W.kg<sup>-1</sup>,  $p \leq 0.01$ ). Also, team A players outperformed team B in the Bosco test (7.8 W.kg<sup>-1</sup>,  $p \leq 0.01$ ). Overall, players from the best ranked team performed better than the lowest ranked team on WAnT, vertical jumps and the Bosco test. Stepwise discriminant analysis showed that stature and mean power during the Bosco test were the most important characteristics in team handball players, accounting for 54.6% of the variance in team ranking. Conclusions For the first time, mean power output (W.kg<sup>-1</sup>) in a 30 sec Bosco test and WAnT, were shown to differentiate between players from higher ranked and lower ranked male elite handball teams. Also, vertical jump performances were better among the players on the best team. Furthermore, higher stature and amount of FFM were found in players from the higher ranked teams. This could indicate that both physiological and physical characteristics can be useful for differentiating between elite male team handball players.

### EFFECTS OF 9 WEEKS OF WHOLE BODY VIBRATION VS. UNSTABLE SURFACE TRAINING ON BALANCE IN POSTMENOPAUSAL WOMEN

Del Cerro, N., Alcaraz, P.E., Marín-Cascales, E., Rubio, J.A.

*UCAM (Murcia)*

Introduction One of the biggest expenses in the health services is caused by hospitalization and intervention of injuries resulting from falls in older people. Thus, it emerges the need to create training protocols focused on one of the main factors that cause falls: loss of balance that leads to functional instability. Therefore, the aim of this study was to study different protocols for improving balance in older people. Methods We conducted a quasi-experimental design intra- and inter-subject with a control group of 39 sedentary postmenopausal women ( $58.8 \pm 1.6$  years,  $73.5 \pm 8.9$  kg,  $1.56 \pm 0.06$  m). The participants were divided according to their BMD at three experimental groups and control group (G4). The experimental groups performed an incremental training, WBV (G1), unstable surface (G2) and floor (G3), for 9 weeks 3 sessions/week. All participants maintained a static position of semi-squat and every 6 times (1-0-5, 100bpm) performed ankle plantar flexion. At the beginning and end of the process static balance was assessed (Romberg test) with and without unstable surface, and dynamic balance (Stepping test) using a force platform. Results Only significant differences were observed between the groups G3 and G4. For static balance, the projection area was reduced without surface in the Romberg test, with values of 0.034 between pre-test and post-test. Concerning the dynamic balance, there were significant differences in the minimum contact time in the Stepping Test, 0.047 between pre-test and post-test. Discussion A decrease in the projection area in static balance (Romberg test without surface) is related to an improvement of the functional stability of the subject, and therefore more effective postural control to any disturbance before the fall (1; 3). Reducing the minimum contact time in dynamic balance (Stepping test) is related to the speed of walk and a more reactive step, and an improved ability to recover any disturbance of the postural stability (2; 4). Therefore, the motor pattern performed during training is indicated as a preventative exercise for fall risk when performed without unstable surface. References 1. Agrawal, Y., Carey, J., Santina, C. Della, S., Michael C., & Minor, L. (2009). American Medical Association. 2. Bendall, MJ, Bassey, EJ, & Pearson, MB. (1989). Age Ageing, 18. 3. Karlsson, A, & Frykberg, G. (2000). Clin Biomech (Bristol, Avon), 15. 4. Lord, S., & Fitzpatrick, R. (2001). J Gerontol A Biol Sci Med Sci, 56(10), M627-632

### A COMPARISON OF THE PHYSIOLOGICAL, PHYSICAL AND TECHNICAL DEMANDS DURING BATTLEZONE, TRADITIONAL CRICKET TRAINING AND ONE-DAY CRICKET MATCHES

Vickery, W., Dascombe, B., Duffield, R.

*University of Newcastle; University of Newcastle; University of Technology Sydney*

Introduction Current research suggests that small-sided games allow players to simultaneously develop decision-making and technical ability, along with metabolic conditioning, whilst simulating match conditions (Gabbett et al., 2009). Recently, small-sided games (Battlezone) have been suggested as an alternative to cricket net-based training (Renshaw et al., 2010). However, it is unknown if either training method replicates match demands. This study aimed to compare position-specific physiological, physical and technical demands of Battlezone, traditional cricket training and One-Day matches. Methods Eleven (age:  $22.2 \pm 3.3$  yr, height:  $1.82 \pm 0.06$  m, body mass:  $80.4 \pm 9.8$  kg) amateur, male cricket players completed four Battlezone and four traditional cricket training sessions within respective playing positions with measures of heart rate, blood lactate concentration, rating of perceived exertion and movement patterns taken. Retrospective video analysis was performed to code for technical outcomes. Following this, similar data was collected from 42 amateur ( $23.5 \pm 4.7$  yr,  $1.81 \pm 0.07$  m,  $81.4 \pm 11.4$  kg), male cricket players during One-Day matches. To compare the difference within each playing position between the different formats, one-way repeated measures analysis of variance with Fisher's LSD post hoc ( $p < 0.05$ ) tests were used. Results Main effects were present ( $p < 0.05$ ) between Battlezone, traditional cricket training and One-Day matches within each playing position for physiological, physical and technical measures. Battlezone and traditional cricket training invoked significantly ( $p < 0.05$ ) greater physiological, physical and technical demands within each playing position compared to One-Day matches. Discussion It appears that across all playing positions the physiological, physical and technical demands of Battlezone and traditional cricket training are suitable for replicating the demands of a One-Day match in amateur players. For batsmen, the loads imposed on players during Battlezone greatly exceed that of a match. In regards to the other playing positions, it appears a similar match-appropriate load can be gained from either Battlezone or traditional cricket training. References Gabbett, T., Jenkins, D., & Abernethy, B. (2009). Game-based training for improving skill and physical fitness in team sport athletes. Int J Sports Sci Coach, 4, 273-283. Renshaw, I., Chappell, G., Fitzgerald, D., Davison, J., & McFadyen, B. (2010). The Battle Zone: Constraint-Led Coaching in Action. In M. Portus (Eds), Conf Sci Med and Coach Cricket (pp. 181-184).

## HEMOGLOBIN MASS ADDS TO THE PREDICTIVE VALUE OF BODY WEIGHT FOR MAXIMAL OXYGEN UPTAKE IN INTERNATIONAL LEVEL ELITE ATHLETES.

Jørgensen, S.

*Team Danmark*

**INTRODUCTION** In elite athletes, frequent determination of maximal oxygen consumption (VO<sub>2</sub>max) normalized to body weight (BW) is used in analyses of physical capacity during careers and seasons. The test is physically demanding and time consuming. Manipulations of tHb clearly affect VO<sub>2</sub>max and performance. Thus, we investigated if a relative simple measurement of total hemoglobin mass (tHb) in combination with gender and BW would be of predictive value for VO<sub>2</sub>max. **METHODS** In 6 female and 10 male Danish international level elite athletes maximal oxygen uptake was determined using an incremental running test to exhaustion. Within ±XX days, total hemoglobin mass was determined by 2 min carbon monoxide rebreathing. Multiple linear regression with backward elimination was performed using VO<sub>2</sub> max as the dependent variable (SPSS v. 20). The following possible predictor variables were included: gender; BW; height; tHb. Further, it was investigated if VO<sub>2</sub> normalized to BW could be predicted from tHb normalized to BW in combination with gender. The level of significance was set at P<0.05. **RESULTS** VO<sub>2</sub>max was 4.42±0.88 [3.01; 5.82] l x min<sup>-1</sup> (mean±SD [Range]), BW was 72.3±9.4 [54.7; 86.2] kg, blood volume was 6.16±1.29 [4.41;8.19] l and tHb was 827±168 [549;1064] ml. VO<sub>2</sub>max was strongly associated (P<0.001) with BW (R<sup>2</sup>=0.80) with an additional predictive value of tHb (P<0.001) resulting in a model where R<sup>2</sup> reached 0.91. Gender and height did not contribute to the model. The resulting predictive equation was VO<sub>2</sub>max = BW x 0.052 + tHb x 0.002 -1.389. In prediction of VO<sub>2</sub>max normalized to body weight (VO<sub>2</sub>max<sub>rel</sub>) tHb was of predictive value (R<sup>2</sup>=0.68; P<0.001) whereas gender and height was not. The resulting predictive equation was VO<sub>2</sub>max<sub>rel</sub> = 0.031 x tHb + 35.311. **CONCLUSION** The expected strong association between absolute VO<sub>2</sub>max and BW was confirmed. Adding tHb as a predictor variable increased R<sup>2</sup> an additional 11%. This demonstrates that tHb determination is a feasible way to improve VO<sub>2</sub>max estimations without the need for stressing and time demanding testing. The prediction of relative maximal oxygen uptake from normalized tHb was less precise. Future studies should address if the suggested relationship between body weight and tHb can be verified in a larger population of elite athletes. It should also be addressed if seasonal and career variations in VO<sub>2</sub>max is associated with fluctuations in total hemoglobin mass. Do not insert authors here

## BIOMECHANICAL STUDY OF THE EFFECT OF DURATION ON CATCHING AND THROWING MOTION IN THE FIELDING PRACTICE OF BASEBALL

Goro, M., Takashi, K., Keita, A., Kenta, N., Takeshi, U.

*Hiroshima University*

**Introduction:** The change of catching and throwing motion during a long term fielding practice was investigated. **Methods:** One collegiate baseball player participated in a fielding practice in the position of shortstop. One set of the fielding practice lasted for 5 minutes at intervals of 17 seconds, and 10 sets were continuously done. Rest periods between each set were 1 minute. The fielding actions of the subject were recorded by 4 high-speed cameras. Then, after calculating the coordinates of 13 anatomical landmarks and the center of the ball, each parameter of catching and throwing motion were calculated by the three-dimensional motion analysis. The accuracy of the throw was evaluated with the target. **Results:** The accuracy of the throw did not change within the increase in the number of attempts, but the ball velocity significantly decreased (p<0.01). In the catching situation, the knee joint angle of the pivot leg and the step size increased (p<0.01, p<0.05, respectively). In the throwing situation, the shoulder abduction angle, the amount of change of forward trunk tilt and the horizontal mobility speed of waist middle point decreased (p<0.05, p<0.05, p<0.01, respectively). The amount of change of shoulder horizontal adduction and abduction angle increased (p<0.01). The hip joint angle of the step leg at the moment of ball release had the highest correlation with the ball velocity (r=-0.579, p<0.01). **Discussion:** In the catching situation, the catching form with "high waist" was prevented by compensating the decrease in the knee angle with the extension of the step size. In the throwing situation, the number of attempts in this study significantly decreased the ball velocity due to the decrease in the amount of change of the forward trunk tilt, just as same as the result in 5~6 innings pitching done by Murray et al. (2001). Escamilla et al. (2007) also observed the decrease in the forward trunk tilt of the pitcher during the last innings in a game. It was considered that the decrease in the muscular power of leg due to the fatigue caused the decrease in the physical mobility speed toward the direction of the target. It was considered that this fatigue wrecked the interlocking of each segment, and the amount of change of the shoulder horizontal adduction and abduction angle increased as the compensation movement. This movement may become the mechanism of the pathogenesis of disorder. Escamilla RF, Barrentine SW, Fleisig GS, Zheng N, Takata N, Kingsley D, Andrews JR (2007) *Am J Sports Med*, 35, 23-33. Murray TA, Cook TD, Werner SL, Schlegel TF, Hawkins RJ (2001) *Am J Sports Med*, 29, 137-142.

**15:00 - 16:00**

## Mini-Orals

### PP-PM76 Training and Testing [TT] 11

#### SCREENING OF MOTOR PROFICIENCY IN CHILDREN

Fors, E., Ekblom, M.

*The Swedish School of Sport and Health Sciences*

Children with Developmental Coordination Disorder (DCD) have poor motor proficiency unrelated to intellectual or neurological diseases. The most cited prevalence among schoolchildren is 5 - 6%. DCD greatly affects school work, social relations and self-esteem as children incorrectly risks being seen as clumsy and awkward by the environment. Still, many countries are lacking a national screening policy for DCD. To detect children with motor problems and provide adequate support, valid and functional testing and screening methods designed to reflect the linguistic and cultural differences are needed. Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07) is an international survey tool specifically designed to identify children with DCD, which is based on the parents' perception of their own child's motor skills relative to peers. **Purpose** The aim of this study was to evaluate whether a Swedish version of DCDQ'07 can serve as a

screening instrument for detection of children with DCD in Sweden by examining how the classification of DCD via DCDQ'07 is consistent with the classification of DCD via the motor skills test Movement ABC. Method In conjunction with a larger study a Swedish version of DCDQ'07 sent to 4000 randomly selected families in the area of Stockholm. Forty families were contacted. Thirty-four children (8.5 ± 0.6 years) completed the quantitative portion of the Movement ABC chosen as the standard for motor skills. The recommended limits for DCDQ'07 were applied (56/57 for 9 and 10 years). Receiver-operator characteristic curve (ROC graph) was used to identify positive criterion for DCDQ'07. Spearman's Rho was used to test associations between variables. Significance level  $p < 0.05$ . Results A sensitivity of 80%, specificity of 67% and positive predicted value (PPV) of 50% was achieved at cut of values of 56/57. Kappa was just under 0.4. Significant correlations were found between Movement ABC and total score of DCDQ'07 ( $r = -0.61$ ) and between the subcomponents of DCDQ'07 and all subtasks of the Movement ABC except one. Discussion The study showed that the Swedish version of DCDQ'07 exhibits an acceptable validity and can be recommended as one of several steps for early detection of DCD among schoolchildren 8-10 years of age. Cut of values between 48 and 57 are recommended, depending on whether the survey is used in clinical environments or population studies. In populations with known high prevalence of motor problems even lower cut of values should be considered. Perceived and actual motor performance is highly related to the child's school performance and participation in physical activity and thus health. To prevent children with motor problems from developing secondary problems early identification via motor skills screenings such as DCDQ'07 and Movement ABC are necessary. The project was financed and supported by the Promobilia Foundation in Sweden.

### OXYGEN UPTAKE KINETICS AROUND MAXIMAL LACTATE STEADY STATE VELOCITY IN SWIMMING

Almeida, T., Espada, M., Reis, J., Vleck, V., Alves, F.

*Faculty of Human Kinetics, Technical University of Lisbon*

Introduction The upper boundary for the heavy intensity domain is defined as the highest exercise intensity in which oxygen uptake (VO<sub>2</sub>) can be maintained at an elevated but steady-state level. In severe intensity exercise, maximal oxygen uptake (VO<sub>2max</sub>) is attained and signals the imminent termination of exercise (Burnley & Jones 2007). Maximal lactate steady state velocity (MLSSv) is considered to be the best predictor of endurance performance, indicates an exercise-intensity above which the metabolism changes qualitatively (Beneke et al., 2000). VO<sub>2</sub> kinetics provides information related to efficiency and conditioning of several integrated systems (Reis et al., 2012). The purpose of this study was to analyze VO<sub>2</sub> kinetics response around MLSSv in swimming. Methods Twelve male swimmers completed an incremental test composed by 5x250 and 1x200 m front crawl for VO<sub>2max</sub> and the velocity associated to VO<sub>2max</sub> (VVO<sub>2max</sub>) determination. For MLSSv estimation, subjects performed, in random order and different days, 30-min at constant velocity at 87.5, 90 and 92.5% of VVO<sub>2max</sub>. In two complementary days, four 6-min bouts were performed separated by one hour of passive rest between each repetition at 97.5% and 102.5% of MLSSv (two bouts each day). All tests were completed with aquatrainer swimming snorkel®. Results Time delay (td) and time constant (tp) of the primary phase were not significantly different (respectively 10.6 ± 3.8 Vs. 11.0 ± 3.2 s and 19.5 ± 6.8 Vs. 17.7 ± 8.0 s) below and above MLSSv. Contrarily, the amplitude of the primary phase (Ap) was significantly different at infra and supra MLSSv (2931.9 ± 445.6 Vs. 3152.9 ± 406.2 ml.min<sup>-1</sup>). Two swimmers revealed relevant slow component (A'(sc)) at 97.5% (average 31.2 ± 5.6 ml.min<sup>-1</sup>) and seven at 102.5% of MLSSv (average 41.4 ± 21.4 ml.min<sup>-1</sup>). T-test revealed that end-exercise VO<sub>2</sub> at 102.5% MLSSv (3666.8 ± 371.7 ml.min<sup>-1</sup>) was not different from VO<sub>2max</sub> (3767.7 ± 483.9 ml.min<sup>-1</sup>). Discussion VO<sub>2</sub> kinetics seems to be a useful tool to be applied in swimming to diminish the tests used to access MLSSv. Although the designated gold standard indicates an exercise intensity above which metabolism changes qualitatively, td and tp were not significantly different at 97.5 and 102.5% MLSSv. On the other hand, Ap and end-exercise VO<sub>2</sub> values below and above MLSSv were significantly different and end-exercise VO<sub>2</sub> evidenced at supra MLSSv signaled the heralding of the imminent termination of exercise, confirming that MLSSv represents the boundary of the heavy intensity domain. References Beneke, R., Hutler, M., Leithauser, R.M. (2000). *Med Sci Sports Exerc*; 32: 1135-1139. Burnley, M. & Jones, A.M. (2007). *Eur J Sport Sci*; 2: 63-79. Reis, J.F., Alves, F.B., Bruno, P.M., Vleck, V., Millet, G.P. (2012); *J Sci Med Sport*. 15(1): 58-63.

### RELATIONSHIP OF FORCE METRICS WITH SWIMMING PERFORMANCE IN AGE-GROUP SWIMMERS

Amaro, N., Marinho, D.A., Batalha, N., Morouço, P.

*Polytechnic Institute of Leiria*

Introduction In competitive swimming, performance relies in the good combination of force and technique. The relative contribution of each of these components is still a controversial issue. Therefore, the aim of this study was to verify if force metrics obtained through tethered swimming can be explanatory of free swimming performance. Methods 22 age-group swimmers (male n=14, age: 14.6±1.2years of age, body mass: 53.1±9.0kg, height: 1.66±0.1m; female n=8, age: 13.9±2.1years of age, body mass: 46.3±9.2kg, height: 1.57±0.1m) took part in the study. Each participant performed a 30 s maximal front crawl tethered swimming test (described in detail by Morouço et al., 2011). After normality assumption checked, force metrics (average force – Favg; maximum force – Fmax; and impulse of force – Fimp) were correlated with 50m in-water maximal bout performance (t50). Results Both in male and female swimmers Favg presented strong negative correlations with t50 ( $r = -0.81$  and  $r = -0.95$ ;  $p < 0.01$ , respectively). For the male group, both Fmax and Fimp obtained moderate negative associations with t50 ( $r = -0.63$  and  $r = -0.57$ ;  $p < 0.05$ , respectively). In female swimmers, both Fmax and Fimp attained strong negative relationships with t50 ( $r = -0.91$  and  $r = -0.85$ ;  $p < 0.01$ , respectively). Discussion The higher force metric associated with t50 was Favg for both groups, in accordance with Taylor et al. (2001). These authors stated that only average force was a reliable parameter to estimate swimming performance in age-group swimmers. However, if propulsion occurs along the whole propulsive phase of the stroke cycle (Marinho et al., 2011), integral of force with respect to time should be considered. The lower relationship of Fimp with t50 may suggest that this cohort of swimmers have lack of technique leading to a poor ability to extend the propulsive capacity during stroke. The impulse of force assessment, and respective association with swimming performance, is a feasible methodology to analyze the balance between force and technique in age-group swimmers. References Marinho D, Silva A, Reis V, Barbosa T, Vilas-Boas J, Alves F, Machado L, Rouboa A (2011). *J Appl Biom*, 27(1), 74-80. Morouço P, Keskinen K, Vilas-Boas J, Fernandes R (2011). *J Appl Biom*, 27(2), 161-169. Taylor S, Lees A, Stratton G, MacLaren D (2001). *J Sports Sci*, 19, 12-13.

### RUNNING PATTERNS IN ELITE YOUTH FOOTBALL USING GPS DATA

Bowen, L., Case, A., Taberner, M., Wilson, C., Ross, F., Li, F.X.

*University of Birmingham*

Introduction Bearing the importance of sprinting in football, many studies have looked into its characteristics, particularly regarding positional variations. Furthermore, default commercially available GPS systems' outcomes tend to classify a sprint as anything over a certain

speed and a set time, usually one second (Li & Dallaway, 2012). However, there is lack of research analysing the movement patterns pre and post-sprint. In addition, to our best knowledge, changes of direction within a sprint have not been systematically analysed. Therefore, using raw GPS data, this study aims to identify these patterns in elite youth footballers. We hypothesise that there will be substantial differences in the variables tested for gender, age and level. Method Data from 36 elite male footballers (age range 16-21 years) across the current season will be included in the analysis (completed by April). For each player, time-motion analyses are performed using a global positioning system (10Hz) during 5-10 league and cup games. All data above 2m/s are included. Measures consist of maximum speed, average speed, duration and distance in each speed zone and in total across 5 positions: central defenders, external defenders, central midfielders, external midfielders and forwards. Sprints are calculated from the start of acceleration to the end of deceleration. Changes of direction within a sprint are also analysed to determine at what speed most changes of direction occur. Mixed design ANOVA were performed with alpha level set at .05. Results Currently, the majority of the data has been collected and exported from the GPS system. A bespoke program has been created to analyse the data. A small sample from one central midfield player shows a Maximum speed 7.5m/s; average speed 4.5 m/s; distance covered overall 71.2m, in acceleration 36.6m, in sprint 6.2m, in deceleration 28.4; duration overall 13.1s, in acceleration 6.1s, in sprint 1.9s, in deceleration 5.2s. Discussion This is the first study to examine the sprint patterns in more detail, from the beginning of the acceleration to the end of the deceleration. The results will provide coaches information on the optimal sprint training for players in different positions, in terms of distance, duration and acceleration/deceleration time. Additionally, it is rare that football players start sprinting from a standing start within a game, so in order to increase transfer between training and matches, pre and post movement patterns should be taken in to account. References Li, F-X & Dallaway, N (2012). Comparison of a team sport global positioning system (GPS) and a video based motion tracking system in an elite competitive football environment, ECSS conference, Bruges.

### **DEVELOPMENT OF THE ESTIMATE OF COMPUTER ASSISTANCE PROGRAM FOR CHECKMARK POSITION BY DIFFERENT BEND RADIUS OF CURVATURE OF DIFFERENT LANES IN 4X100M RELAY**

Hsu, T.Y., Ko, B.J., Luo, C.C.

*National Taichung University of Education*

**Introduction** The set of the checkmark position is affected by the speeds of the incoming and outgoing runners. The speed is divided into two parts, namely the linear speed and the bend speed. According to the scientific theory, the bend speed is affected by the bend radius of curvature and the linear speed, but all three takeover zones cover the bend part, and the different lane has the different bend radius of curvature. Therefore, the bend radius of curvature is recognized as an important factor that may affect the set of the checkmark position, and will be also an important uncontrollable condition that will affect the baton exchange. This study aims to discuss the effect of radius of curvature on the checkmark in different lanes of 4x100m relay and offer appropriate suggestion of checkmark according to the speed of different runners. **Methods** The objects of research were sixteen outstanding players of senior high school and college who had accepted the long-term training in 4x100m relay. The research obtained the interval time of checkmark calculation of each runner in 130m to calculate the interval speed by SPM100. Experimental checkmark was calculated from the interval speed of incoming runner in last 30m and the starting speed of outgoing runner in 30m. Traditional checkmark was the original used distance. The grades were analyzed and tested for significance via paired-sample t-test ( $\alpha = .05$ ). **Results** The grades of experimental checkmark were better than the grades of traditional checkmark ( $p < .05$ ). Therefore, the estimate of computer assistance program for checkmark position by the different bend radius of curvature of different lanes in 4x100 m relay could be applied to the real competitions which can provide the runners and coaches as prompt references, which expect to reduce the possibility of mistakes of baton exchange and let relay process more easily completed. **Discussion** The forecast formula of bend speed developed by Greene in 1985 could be used in present PU track, thus we can apply it to substitute the actual measurement. In 4x100 m relay, some grades of traditional checkmark were better than the grades of experimental checkmark, we found the inferior grade of certain runner caused the decrease of the whole grades. One reason might be that setting the takeover zone in the end resulted in the pressure of outgoing runner easily. Another reason might be the differences between the checkmark and the original habit. **References** Campbell, K.M., Kram, P. R., Chang, Y. H. (1999). Human Maneuverability on Curves. *The Berkeley McNair Research Journal*, 21-32. Chang, Y. H., Campbell, K., and Kram, R. (2001). Running speed on the curve is limited by the inside leg. *Proceedings of the 25th Annual Meeting of the American Society of Biomechanics*, 435-436. Green, P. R. (1985). Running on flat turns: experiments, theory, and applications. *Journal of Biomechanical engineering*, 107, 96-102.

### **THE ADVENTURE RACING ATHLETE: A PHYSIOLOGICAL PROFILE**

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**Introduction:** The aim of this study was anthropometric and physiological characterisation of male and female adventure racing athletes (ARs), and also to compare top and bottom finishers in the Adventure Racing World Championship (ARWC) 2006. **Methods:** The physiological profile was developed from oxygen uptake during submaximal and maximal exercise on treadmill, cycle- and kayakergometers. The characterisation study included 15 male and 9 female ARs. Additional anthropometric measurements were obtained from 128 participants in the ARWC. **Results:** The anthropometrics for male ARs were: [mean (95% confidence interval)] age 33 (32-34) years, height 180 (179-181) cm, body mass (BM) 79.4 (78.1-80.7) kg, body fat 17.1 (16.5-17.7) % of BM. Corresponding values for female ARs were: age 31 (30-32) years, height 165 (163-167) cm, BM 61.6 (59.8-63.4) kg, body fat 24.7 (23.6-25.8) % of BM. The men's peak oxygen uptakes were: running 5.02 (4.82-5.22), cycling 4.99 (4.80-5.18), and kayaking 4.05 (3.84-4.26) L·min<sup>-1</sup>. Corresponding values for the women were: running 3.26 (3.02-3.50), cycling 3.27 (3.05-3.47), and kayaking 2.59 (2.34-2.84) L·min<sup>-1</sup>. The characterized ARs had fractional utilisation in the order: running > cycling > kayaking (best trained in running), indicating that a shift in training regime in favour of kayak training could result in better overall performance. Top male finishers in the ARWC were taller, heavier, had a higher BMI and a trend towards higher body fat than bottom finishers, while there were no such differences among the women. The ARs display a distinct profile, in both anthropometric and physiological aspects, which differs from the specialist athletes'. The ARs have to balance a wide variety of demands, such as sufficient endogenous storage of fat and high ability to carry, against sustained ability to run and perform other BM related tasks.

### BIOPHYSICAL EVALUATION OF A YOUNG SWIMMER ALONG A TRAINING MACROCYCLE

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**Introduction:** Swimming performance development is based on a complex training process, involving a combination of several variables. Concurrently, it is necessary to monitor training during both the preparatory and competitive periods, once its efficiency is determined by the evaluation of the swimmer's capabilities and needs. Our aim was to observe (and give feedbacks about) the evolution of relevant swimming determinants and performance during the winter macrocycle of the current training season. **Methods:** One international level male juvenile swimmer (15yrs, 1.75m, 64.3kg and 7 units/week training frequency), performed a 7x200m front crawl incremental protocol until exhaustion (0.05m/s increments and 30s intervals, cf. Fernandes et al., 2008) in the final of the general preparatory (6 weeks), specific preparatory (6 weeks) and competitive (3 weeks) training periods. The corresponding averaged training volume and relative intensity values were: 32500, 38063 and 28283m/week, and 75, 77 and 78%, respectively. The anaerobic threshold (vAnT) was calculated by the blood lactate concentration ([La-]) vs velocity curve modeling method. Oxygen consumption (VO<sub>2</sub>) and heart rate (HR) values were obtained during the recovery periods using a portable gas analyzer (Cosmed, Italy). Stroke rate (SR) was registered by a Seiko base 3 chronofrequencemeter and stroke length (SL) was obtained by the ratio between v and SR. Swimming performance was obtained by maximal 200 and 800m front crawl tests. **Results:** Longitudinal data (in the consecutive 3 training periods) were: (i) [La-]AnT: 3.37, 1.80 and 2.30mmol/l and vAnT: 1.38, 1.38 and 1.40 m/s; (ii) [La-]max: 7.6, 8.6, 10.2mmol/l, VO<sub>2</sub>max: 41.4, 52.4, 59.1ml/kg/min, HRmax: 195, 198 and 196 b/min, vVO<sub>2</sub>max: 1.48, 1.54 and 1.59m/s, SRmax: 39.8, 41.1 and 41.0cycles/min and SLmax: 2.61, 2.69 and 2.63m/cycle; 200m: 147, 146, 144s and 800m: 586, 557 and 527s. **Discussion:** As expected, aerobic capacity related parameters, i.e., [La-]AnT and vAnT evolved along the training macrocycle (despite a stabilization in the specific preparatory period), reflexing in a better performance at the 800m test. Furthermore, it is known that after a cycle of "basic" (i.e. aerobic) training, coaches implement a cycle focusing on more intense training areas, particularly developing the swimmers aerobic power, with evident higher values of [La-]max, VO<sub>2</sub>max and vVO<sub>2</sub>max. Nevertheless, the swimmer's SR and SL seem to regress in the competitive period, evidencing eventual biomechanical and coordinative deficiencies in the final stage of the training process. **References:** Fernandes R et al (2008). *Int J Sports Med*, 29(2). **Acknowledgements:** PTDC/DES/101224/2008 (FCOMP-01-0124-FEDER-009577)

### HEART RATE VARIABILITY IN MEN SUBJECTED TO 30-HOURS OF EXERCISE AND SLEEP DEPRIVATION

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**Introduction** Heart rate variability (HRV) is considered to be a factor determining condition of the heart, especially its fatigue and possible overtraining. The aim of the present study was to evaluate the heart rate variability at rest in subjects submitted to prolonged exercise combined with complete sleep deprivation using simple, commercially available tool. **Methods** Heart rate variability was assessed in 11 endurance trained men before (trial B) and immediately after (trial A) 30 hours of prolonged exercise (simulated adventure race) combined with complete sleep deprivation using infrared sensor fitted in BioCardio Mouse (Poland). For evaluation of HRV PNN50 and RMSSD factors were chosen. **Results** Significantly lower values of HRV were observed after 30 hours of prolonged exercise (simulated adventure race) combined with complete sleep deprivation. In trial B PNN50 was 18.3±2.0 vs. 10.6±2.3 in trial A, p<0.001 and RMSSD was 515.7±81.4 vs. 708.6±70.1, p<0.05, respectively. **Discussion** Simple and cheap BioCardio Mouse delivered consistent and reliable results of several factors determining HRV. Automatically generated reports are easy to follow and raw results can easily be used in everyday monitoring of athletes, whereas description and recommendations in extreme case of present study were completely inadequate. Prolonged, 30-hour physical activity combined with total sleep deprivation produced decreased HRV which results from the shift in parasympathetic to sympathetic activity balance.

### DISCRIMINATING CHARACTERISTICS OF UNDER-17 MALE HOCKEY PLAYERS

Pereira, J.1, Vaz, V.1, Valente-dos-Santos, J.1, Cupido-dos-Santos, A.1, Figueiredo, A.J.1, Soles-Goncalves, R.2, Areceres, A.3, Elferink-Gemser, M.4, Malina, R.5, Coelho-e-Silva, M.1

1: FCDEF-UC (Coimbra, Portugal), 2: School of Health and Technology (Coimbra, Portugal), 3: INEF (Coruna, Spain), 4: University of Groningen (The Netherlands), 5: University of Texas (Austin, USA)

**INTRODUCTION:** The objectives of this study were twofold: (i) to profile the experience, size, adiposity and biological maturity characteristics and functional performances of U-17 Portuguese male roller hockey players using both field and laboratory tests; and (ii) to evaluate the contributions of these variables to the discrimination of players by competitive level (international versus local). **METHODS:** Characteristics of 32 international and 41 local U-17 (14.5-16.5 years) roller hockey players were considered in the context of training history, body size, skeletal maturation, and several laboratory (peak O<sub>2</sub>, isokinetic strength of knee extensors and flexors, wingate test) and field performance tests (25-m dash, jumps, sit-ups, 2-kg ball throw, PACER). **RESULTS:** More international (42%) than local (22%) players were advanced in maturity status. International players had slightly less hockey experience (years), but had more practice sessions and match time (minutes) during the season. Local players were shorter and attained better performance in the 25-m dash, while international players performed better in sit-ups, ball throw and 20-m shuttle run. The fatigue index derived from the Wingate anaerobic test was higher among local players, while peak torques of knee extension and flexion were greater in international players. Stepwise discriminant function correctly classified 85% of players by competitive level based on grip strength, ratio of eccentric and concentric knee extension, number of training sessions, playing time and fatigue index. **CONCLUSION:** An interaction between isokinetic strength, anaerobic fitness and training plus game time seemed relevant factors in discriminating international from local level players and by inference in the selection and development of youth roller hockey players.

## PROGRESSIVE RESISTANCE TRAINING AND PROTEIN SUPPLEMENTATION INCREASES PHYSICAL FUNCTION IN INSTITUTIONALIZED ELDERLY

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*University of Vienna*

Introduction Von Haehling et al. [1] showed that 5-13% of 60- to 70-year-old and 11-50% of people over 80 years are affected by sarcopenia. Recent observations proved that resistance training is effective up to old age to mitigate the effects of sarcopenia [2,3]. However, most of the studies applied resistance training performed on weight machines which is not practicable for most of seniors. Therefore, we aimed to capture the effect of resistance training using therabands and own body weight on muscle strength and function in elderly institutionalized persons. Additionally, the effect of dietary supplementation enriched with branched chain amino acids was examined. Methods The population of this randomized, observer-blind, controlled intervention study consisted of healthy untrained men (n=14) and women (n=103) aged  $83 \pm 6.0$  years. They were distributed randomly but stratified by sex to one of 3 groups [Cognitive training (CT), resistance training (RT), RT+supplement (RTS)]. Supervised RT was performed twice a week. The supplement (FortiFit, Nutricia) was distributed every morning as well as after training. CT was based on activities with coordinative or cognitive tasks. Pre, during (after 3m) and post (6m) intervention functional tests for strength as well as aerobic capacity were assessed. Tests include isokinetic torque measurements of knee extensors - and flexors, isometric handgrip strength, chair-rise test, maximum walking speed and 6min walking test. Repeated measures ANOVA was used for analysis of group-, time- and interaction effects. Results Baseline values didn't differ in any of the functional parameters. The attendance to training sessions was  $71 \pm 26.5\%$  and did not differ between groups ( $p>0.05$ ). We observed a group-, time- and interaction effect in the chair rise test. The RT improved by 17.2% and 20.1%, the RTS by 7.3% and 16.4% after 3 and 6 months whereas CT did not show improvements. Significant time but not group or interaction effects were detected for isokinetic torque measurements, walking speed and 6 min walking test. Discussion Six months of progressive resistance training with own body weight and therabands is able to improve physical function of the lower limbs as shown by chair rise test. Protein supplementation did not lead to further enhancements. Interestingly, many of the other parameters improved over time regardless of group implying that different types of supervised training and the potential social aspects can lead to improvements in fitness parameters in institutionalized elderly. References [1] von Haehling, S, et al. (2010). J Cachex Sarcopenia Muscle, 1(2), 129-133 [2] Peterson, MD, et al. (2010). Ageing Res Rev, 9(3), 226-237 [3] Rabelo, HT, et al. (2011). J Strength Cond Res, 25(8), 2298-303

## THE EFFECT OF MATURITY ON FUNCTIONAL MOVEMENT SCREEN™ SCORE IN YOUNG SOCCER PLAYERS

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Introduction Knowledge of movement competency in junior athletes informs athletic development and recruitment. The functional movement screen (FMS) is a reliable tool that is used to assess and grade fundamental human movement (Frohm et al., 2012). The aim of this study was to examine the effect of maturity on FMS score in young soccer players. Methods Participants were 914 junior, male soccer players (age 9 – 16 years) from English Football League clubs. Each player was assessed on the FMS by an experienced practitioner. The FMS is a series of 7 tests, each scored 0-3 on a categorical scale, whereby an individual with perfect execution on each test would score a maximum 21. Players were awarded a score that was the sum of all 7 tests (FMS<sub>T</sub>). Age from peak height velocity was estimated from anthropometric measures (Mirwald et al., 2002). Players were subsequently grouped as pre- (n = 665) and post- (n = 249) peak height velocity (PHV). To identify where differences in FMS<sub>T</sub> score existed between groups we separated the screen into 3 parts: FMS<sub>m</sub> (3 movement tests), FMS<sub>f</sub> (2 flexibility tests) and FMS<sub>s</sub> (2 stability tests). Data were modelled using ordinal logistic regression to derive estimates of the probability of having a score  $\geq 14$  for FMS<sub>T</sub>,  $\geq 6$  for FMS<sub>m</sub>, and  $\geq 4$  for FMS<sub>f</sub> and FMS<sub>s</sub>. These cut-points are equivalent to scoring a '2' on each test - 'satisfactory' performance. Results The median (interquartile range) for FMS<sub>T</sub> was 12 (10 to 13). For FMS<sub>T</sub> the predicted probability for a score  $\geq 14$  was: Pre-PHV = 0.15; Post-PHV = 0.40 [Difference = 0.25 (95% confidence interval, 0.20 to 0.30)]. In FMS<sub>m</sub> the predicted probability of a score of  $\geq 6$  was: Pre-PHV = 0.24; Post-PHV = 0.41 [Difference = 0.17 (0.11 to 0.23)]. In FMS<sub>f</sub> the predicted probability of a score of  $\geq 4$  was: Pre-PHV = 0.69; Post-PHV = 0.79 [Difference = 0.10 (0.04 to 0.16)]. In FMS<sub>s</sub> the predicted probability of a score of  $\geq 4$  was: Pre-PHV = 0.10; Post-PHV = 0.48 [Difference = 0.38 (0.32 to 0.44)]. Discussion Maturity status had a substantial effect on functional movement screen performance, with players who were post-PHV being more likely to achieve at least a satisfactory performance than those pre-PHV. Maturity affected the total score and all three sub-components, with the largest effect on stability. Coaches using the FMS to evaluate movement competency of their junior players should take maturity status into account when interpreting results. Frohm A, Heijne A, Kowalski J, Svensson P, Myklebust G.(2012). Scand J Med Sci Sports 22, 306-15 Mirwald RL, Baxter-Jones AD, Bailey DA, Beunen GP. (2002). Med Sci Sports Exerc 34, 689-694

## TRAINING IN THE FASTED STATE DOES NOT IMPROVE PERFORMANCE OR FAT OXIDATION IN MILD LEVEL ATHLETES COMPARED TO TRAINING IN THE FED STATE, BUT INCREASES VO<sub>2</sub>MAX

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Introduction Training in a fasted state is practiced by many athletes in endurance to improve their performances through increased fat oxidation and spared muscle glycogen. To this day, the demonstrations of these metabolic effects have been unconvincing and performances not significantly modified. One hypothesis is that carbohydrate supplementation during the post-training measurements precluded increased fat oxidation to occur. Thus, we assessed here the effects of endurance training in a fasted state on performance, oxygen uptake and substrate oxidation without carbohydrate supply. Methods Sixteen young healthy male and mild level athletes ( $21.1 \pm 2.3$  y; maximal oxygen uptake or VO<sub>2</sub>max =  $56.3 \pm 3.8$  mL/min/kg) trained on a treadmill during 6 weeks, 3 sessions/week planned on 3 different days, consisting in 2 continuous sessions (40 min at 70% of VO<sub>2</sub>max) and 1 intermittent session (40 min with 8 sets of 2 min at 85 % of VO<sub>2</sub>max). One group trained in a fasted state (FAST, n=8) and one group in a fed state (FED, n=8). Before and after the training period, 4 variables of interest were measured in the fed state: substrate oxidation during a 60 min-steady state exercise at 60 % of VO<sub>2</sub>max, the 3000 m-time trial performance that followed the steady-state, the intensity eliciting the highest fat oxidation (FATmax) and VO<sub>2</sub>max. Results The substrate oxidation during the 60 min steady-state exercise was not altered by training or by the nutritional status. Time to complete the 3000 m trial decreased not differently in FED and FAST (-63 and -108 s, respectively,  $p<0.001$ ). FATmax tended to increase with training ( $p=0.058$ ) without difference between FED or FAST. VO<sub>2</sub>max increased only in FAST ( $56.9$  vs  $61.6$  mL.kg<sup>-1</sup>.min<sup>-1</sup>, +8.1 %,  $p=0.019$ ) although speed at VO<sub>2</sub>max increased by 9 % ( $p<0.001$ ) without difference between groups. Discussion In this study, training

in a fasted state failed to improve fat oxidation, endurance performance or intensity of maximal fat oxidation although tests were conducted without carbohydrate supplementation. Only maximal oxygen uptake was still increased in these mild level athletes when they trained in the fasted but not in the fed state, suggesting a power of training in the fasted state to enhance already high  $\text{VO}_2\text{max}$ . In conclusion, the demonstration of an effect of training in a fasted state on performance is still needed.

### THE EFFECTS OF AEROBIC AND COMBINED AEROBIC AND RESISTANCE EXERCISE TRAINING ON PHYSICAL FITNESS IN YOUNG WOMEN

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1: UE (Évora, Portugal), 2: CIDESD (Portugal)

**Introduction** There is a lack of studies evaluating the effects of combining different types of exercise in young women. Therefore, the purpose of this study was to evaluate the effects of aerobic training alone or combined with strength training on the physical fitness of young women. **Methods** Sixty-five women (18–28 years old), who were not engaged in any exercise program for at least one year, were randomly assigned to an aerobic training group, a combined training group, or a control group. The aerobic training consisted of indoor cycling sessions and the combined training consisted of indoor cycling and resistance exercise in the first and second half of each session, respectively. Both aerobic and combined exercise programs lasted 8 weeks with a periodicity of 3 sessions of 45 min per week. Assessments were conducted before and after the 8-week intervention period on muscular strength, body composition, bone mineral density and cardiorespiratory fitness. Total fat and bone mineral density (lumbar spine and femoral neck) were determined by dual-energy x-ray absorptiometry (DEXA Hologic QR). Knee and elbow extensor and flexor concentric strength were measured with an isokinetic dynamometer (Biodex System 3) using protocols with angular velocities of  $60^\circ\cdot\text{s}^{-1}$  (3 reps) and  $180^\circ\cdot\text{s}^{-1}$  (20 reps). The YMCA cycle ergometer test was used to estimate  $\text{VO}_2\text{max}$ . Data were analysed using repeated measures ANOVA with Bonferroni post-hoc analysis (level of significance was set at  $p < 0.05$ ). **Results** Knee strength increased significantly for the combined exercise group following training. The post-hoc analysis showed that the combined training group improved in comparison to the aerobic training group in knee flexion peak torque (PT) ( $p = 0.024$ ) and knee flexion PT/body weight ( $p = 0.046$ ) at an angular speed of  $60^\circ\cdot\text{s}^{-1}$ . Significant positive changes of the combined training group in comparison with the control group were also found in knee extension PT ( $p = 0.013$ ), knee flexion PT ( $p = 0.002$ ) and knee flexion PT/body weight ( $p = 0.014$ ) at an angular speed of  $180^\circ\cdot\text{s}^{-1}$ . Finally, after the 8-week training period and also for the evaluation at  $180^\circ\cdot\text{s}^{-1}$ , the combined training group showed better scores than the indoor cycling group in knee flexion PT/body weight ( $p = 0.014$ ). No significant changes were found at follow-up for measures of cardiorespiratory fitness, body composition and bone mineral density. **Discussion** Our results show that 8 weeks of combined training can improve the knee muscular strength of young women. Nevertheless, no other differences were found between groups in measures of physical fitness. Future studies should examine if prolonged training periods would lead to more noticeable differences on the effects of combined and indoor cycling training programs.

15:00 - 16:00

## Mini-Orals

### PP-PM82 Training and Testing [TT] 17

#### SEASONAL CHANGES IN BODY COMPOSITION OF A PROFESSIONAL BASKETBALL TEAM IN TURKEY

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**Introduction** There is a growing interest in improving the performance of athletes. Many of the activities are focused on increasing the physical fitness of athletes with taking into consideration the assessment of their nutritional status and body composition (Rodríguez et al., 2009). Specific athletic events require different body types and weight for maximal performance. Physical abilities are important for basketball players to achieve higher levels of performance. To evaluate these physical abilities, the anthropometric measurements, parameters of the body composition such as the body fat percentage (% fat), fat mass (FM) and fat-free mass (FFM) are often used (Apostolidis et al., 2003). Changes in body composition during a season or in response to specific training and nutrition programs are important for assessment of the athletic performance (Harley et al., 2011; Sallet et al., 2005). The aim of this study is to evaluate the professional basketball players' seasonal body composition changes and present an average data. **Methods** Anthropometric measurements were collected from the players of a first division Turkish basketball team (TBL). Fifteen players (27.3±5 years, 195.7±10.1 cm, and 99.2±11.5 kg) were evaluated by using a bioelectrical impedance analyser (Tanita, BC-418, Japan). First measurements were taken prior to the beginning of the practices and the second ones were noted 18 weeks later in the season. Changes in the body composition of these players during the season were analysed. **Results** A significant decrease in fat mass (2.1 kg,  $p < 0.05$ ) and a significant change in body fat percentage (% 2.24,  $p < 0.05$ ) was measured. Although there is no statistically significant difference in fat-free body mass, a tendency toward a slight increase in FFM was observed (1.05 kg,  $p = 0.29$ ). It is also presented that the average body fat percentage is  $12.63 \pm 4.04$  for the basketball players of a professional Turkish team. **Discussion** Although it is clear that the athletes' body composition and anthropometry will not remain static, but may alter according to the quantity, intensity and type of activity undertaken (Kamble et al., 2012), we believe that the present study provides a valuable baseline data for further investigation of the anthropometry of professional athletes. **References** Rodríguez NR, Di Marco NM, Langley S (2009). *Med Sci Sports Exerc.* 41(3): 709-731 Apostolidis N, Nassis GP, Bolatoglou T, Geladas ND (2003). *J. Sports Med. Phys. Fitness*, 43: 157–163. Harley JA, Hind K, O'hara JP (2011). *J Strength Cond Res.* 25(4): 1024-1029 Sallet P, Perrier D, Ferret JM, Vitelli V, Baverel G (2005). *J. Sports Med. Phys. Fitness*, 45: 291–294. Kamble P, Daulatabad VS, Bajilnt PS (2012). *Biol Med Res.* 3(1): 1404-1406

### LONGITUDINAL PREDICTORS OF AEROBIC PERFORMANCE IN ADOLESCENT SOCCER PLAYERS

Duarte, J.1, Valente-dos-Santos, J.1, Pereira, J.1, Simões, F.1, Rebelo-Gonçalves, R.1, Severino, V.1, Figueiredo, A.1, Elferink-Gemser, M.1, Malina, R.M.2, Coelho-e-Silva, M.1

*University of Coimbra, Portugal*

Background: The importance of aerobic performance in youth soccer is well established. The aim of the present study was to evaluate the contributions of chronological age (CA), skeletal age (SA), body size, and training to the longitudinal development of aerobic performance in youth male soccer players aged 10 to 18 years. Methods: Players (n=83) were annually followed up during 5 years, resulting in an average of 4.4 observations per player. Decimal CA was calculated, and SA, stature, body weight, and aerobic performance were measured once per year. Fat-free mass (FFM) was estimated from age- and gender-specific anthropometric formulas, and annual volume training was recorded. After testing for multicollinearity, multilevel regression modeling was used to analyze the longitudinal data aligned by CA and SA (Model 1 and 2, respectively) and to develop aerobic performance scores. Results: The following equations provide estimations of the aerobic performance for young soccer players:  $\hat{y}$ (Model 1 [deviance from the null model =388.50;  $P<0.01$ ]) =  $57.75+9.06\times\text{centered CA}-0.57\times\text{centered CA}^2+0.03\times\text{annual volume training}$  and  $\hat{y}$ (Model 2 [deviance from the null model= 327.98;  $P<0.01$ ]) =  $13.03+4.04\times\text{centered SA}-0.12\times\text{centered SA}^2+0.99\times\text{FFM}+0.03\times\text{annual volume training}$ . Conclusions: The development of aerobic performance in young soccer players was found to be significantly related to CA, biological development, and volume of training.

### SPEED AND GRADE INCREMENT DURING CARDIOPULMONARY TREADMILL TESTING: IMPACT ON EXERCISE PRESCRIPTION

Belli, K.C.1,2, Figueiredo, P.1,2, Stein, R.1,2, Ribeiro, J.P.1,2 (in memoriam)

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Introduction: Ventilatory thresholds (VT) have been used as reference for exercise prescription (EP). We test the hypothesis that EP, based on VT determined by treadmill cardiopulmonary exercise testing (CPET), could be influenced by the emphasis in speed or grade of the treadmill. Methods: Nine healthy individuals underwent two CPET, followed by two sessions of submaximal exercise, both in randomized order. The protocol based on speed increments (SP) increased the speed in 0.1 to 0.3 Km/h every 15s. The protocol mainly based on grade increments (GP) increased the grade in 1% every 30s and 0.1Km/h every 45s. Each submaximal session lasted 40min, at the intensity corresponding to heart rate (HR) between 1st and 2nd VT. Results: The SP resulted in higher 1st ( $27.5\pm 2.3$  vs  $24.9\pm 1.9$  ml/kg.min;  $p=0.001$ ) and 2nd ( $32.4\pm 2.9$  vs  $29.7\pm 2.1$  ml/kg.min;  $p=0.017$ ) VT, and had no difference on maximal oxygen uptake. The target HR for EP was higher in the SP ( $169\pm 9$  vs  $156\pm 8$  bpm;  $p<0.001$ ). Blood lactate was higher during the submaximal session prescribed with SP ( $6.2\pm 1.6$  vs  $4.6\pm 1.9$  mmol/l;  $p<0.001$ ) remaining stable over the session. Discussion: The oxygen uptake (VO<sub>2</sub>) and HR at VT were higher in the SP when compared to the GP (7% and 8%, respectively). Previous studies have shown that the detection of VT was independent of the rate of increment in power output on cycle ergometer (Ribeiro et al, 1986; Davis et al, 1982; McLellan, 1985). When the treadmill was utilized the results were dependent of the type of increment. One possible explanation for lower VT on the GP is activation of a larger muscle mass with increments in grade (Wall-Scheffler et al, 2010). It is associated with larger oxygen deficit (Sloniger et al, 1997) and larger glycogen depletion (Costill et al, 1974). The GP used in the present study probably resulted in the activation of a larger muscle mass, larger glycogen utilization, and earlier blood lactate accumulation, resulting in a lower VO<sub>2</sub> at 1st and 2nd VT. The EP based on SP modified the target HR between 1st and 2nd VT, and resulted in higher blood lactate on submaximal sessions (8% for heart rate and 2 mmol/l for blood lactate). References: Ribeiro JP, Yang J, Adams RP, Kuca B, Knuttgen HG. (1986). *Braz J Med Biol Res* 19, 109-117. Davis JA, Whipp BJ, Lamarra N, Huntsman DJ, Frank MH, Wasserman K. (1982). *Med Sci Sports Exerc* 14, 339-343. McLellan TM (1985). *Int J Sports Med* 6, 30-35. Wall-Scheffler CM, Chumanov E, Steudel-Numbers K, Heiderscheit B. (2010). *Am J Phys Anthropol* 143, 601-611. Sloniger MA, Cureton KJ, Prior BM, Evans EM. (1997). *J Appl Physiol* 83, 262-269. Costill DL, Jansson E, Gollnick PD, Saltin B. (1974). *Acta Physiol Scand* 91,475-481.

### COMPARISON ON ENERGY EXPENDITURE, HEART RATE, AND RATING OF PERCEIVED EXERTION ACCORDING TO VARIOUS BEGINNING SET POINTS OF TARGET EXERCISE INTENSITY WHILE EXERCISING

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Introduction In general, we always exercise with exercise intensity based on the target HR which was made by HRR. However, there is no standard principle about when we should set the beginning of target HR. If we let the clients exercise without specific settings about this, they don't know about how much exercise volume they had have, and whether they are doing it with accuracy. Therefore, the aim of this study is to compare the differences on energy expenditure, heart rate, and rating of perceived exertion according to various beginning set points of target exercise intensity during aerobic treadmill exercise. Methods 13 healthy university-aged male students volunteered to participate in this research. They determined their 70%HR<sub>max</sub> as target exercise intensity with using HRR, individually. And then, they have performed 30min treadmill aerobic exercise repeatedly. The research design consisted of 3-exercise trails according to approaching points(after 5min,10min and 20min of main exercise) of target HR. It were measured the energy expenditure(EE) and heart rate(HR) with heart check device(Polar, RS800CX), rate of perceived exertion(RPE) with Borg CR10 Scales(1-10), and body composition factors with In body(Biospace, 3.0). Statistical analysis was completed using one-way repeated ANOVA. Results In case of setting at 5min after main exercise, there were the highest values on EE, HR, and RPE among others(10min, 20min). There were significant difference on energy expenditure (TEE), heart rate(THR, MHR, PHR) ( $p<.001$ ,  $p<.01$ ,  $p<.001$ ,  $p<.01$ , respectively), and rating of perceived exertion (MRPE, PRPE) ( $p<.001$ ,  $p<.001$ , respectively), except RHR. Discussion It was reconfirmed that there was a similar trend among TEE, MHR and MRPE (Borg, G. et al., 1983; Borg, G.A.V. 1998) in all of three trials of exercise. There was different on exercise volume according to setting the beginning point of target HR while exercising. Especially, in case of setting the target HR at the finish point while exercising, it was produced the least energy expenditure and performed the most easy among others. Therefore, when we let the clients training the exercise program, we have to set appropriately the beginning point of the target HR based on their physical fitness level and their purpose of exercise (Peter Hofmann et al., 2011). References Borg, G. et al.(1983). *Med. Sci. Sports Exerc.*, 15 (6), p. 523-528. Borg, G.A.V.(1998). Champaign, IL: Human Kinetics. Peter Hofmann, Gerhard Tschakert( 2011). *Cardiology Research and Practice* Vol. :10. 1-10.

### INFLUENCE OF EXERCISE TYPE ON GROSS EFFICIENCY: ELLIPTICAL TRAINER VS CYCLING TRAINER

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*Oxylane Research*

**Introduction** The elliptical trainer is known as a good mean to develop physical fitness. The increase of energy expenditure when compared to that of a classical cycling trainer can be attributed to the additional use of arms (Mier & Feito, 2006). It is well known that upper limbs are less efficient than lower limbs (Eston & Brodie, 1986). However, there is no information in the literature concerning the efficiency of pedalling on an elliptical trainer. The aim of the present study is to compare metabolic cost and gross efficiency for two different trainers, elliptical and cycling. **Methods** Fourteen subjects (7 men, 7 women) were tested on the elliptical trainer (ET) and the cycling trainer (CT) during two different exercise sessions. Both trainers use magnetic resistance and were previously calibrated on a specific torque/cadence system. For each exercise session, an initial 5 min measurement was taken at rest then a 5 min warm-up protocol was followed prior to exercise. Subjects pedaled at 9 different power outputs (3 resistance levels x 3 cadences) for 3 min each. To avoid fatigue effects, the exercise was split in 3 bouts of 9 min with 3 min rest periods. A Fitmate Pro (Cosmed) recorded oxygen consumption (VO<sub>2</sub>) and heart rate (HR), whereas respiratory exchange ratio was estimated according to Nieman et al (2007). Gross efficiency (GE) was calculated as the ratio between mechanical energy output and human energy expenditure during the last 30 sec of each 3 min period at a different power output. Maximal aerobic power (MAP) was estimated for each subject in both trainer through a linear regression between HR, VO<sub>2</sub> and power output. Results MAP was significantly greater in CT (237±88W) compared to ET (151±51W). Significant positive correlations were found between power output and VO<sub>2</sub> in both CT (r=0.93) and ET conditions (r=0.97). Regarding the large variability in MAP, GE was significantly correlated to the percentage of MAP (r=0.75 in CT and r=0.69 in ET). Logarithmic relationships were found with  $GE=5.9*\ln(\%MAP)+24.5$  in CT condition and  $GE=3.9*\ln(\%MAP)+14.3$  in ET condition. Maximal GE reached at 100% of MAP corresponded to the second coefficient, 24.5% in CT and 14.3% in ET. **Discussion** The originality of the present study was to investigate different metabolic demand of two type of exercise using the relative power output in each condition (%MAP). The results confirmed that metabolic cost of ET was greater than CT at similar %MAP. Gross efficiency was greatly impaired in ET condition. This could be explained through the additional use of arms and the upright position during ET. **References** Eston RG, Brodie DA. (1986). *Br J Sports Med* 20(1):4-6. Mier CM, Feito Y. (2006). *Res Q Exerc Sport* 77(4):507-513. Nieman DC, LaSasso H, Austin MD, Pearce S, McInnis T, Unick J. (2007). *Res Sports Med*, 15:67-75.

### THE RELATIVE AGE EFFECT AND THE INFLUENCE OF THE LEVEL OF PERFORMANCE OF PHYSICAL MOTOR SKILLS ON IT IN ALPINE SKIING

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**Introduction** The relative age effect (RAE) was recently shown to be present in international alpine skiing for top elite athletes (Müller et al., 2012; Baker et al., 2012). The causes for it still remain unclear and it is unknown at which age category it starts to exist. As a result, the aims of this study were (1) to test the presence of RAE depending on gender and age in young alpine ski racers and (2) to test the influence of the level of performance of physical motor skills on the RAE. **Methods** We investigated 989 participants of the entrance exams of three Austrian ski boarding schools, examined their birth dates and tested three different physical fitness abilities. Chi<sup>2</sup>-tests were used to assess differences between the observed and the expected birth-quarter-distributions, in which an even distribution was assumed. For evaluating the influence of the level of performance of the physical motor skills on the RAE, multivariate, univariate and parameter-free univariate analyses of variance were used. Results A highly significant difference from an equal distribution was shown for the overall sample ( $\chi^2=25.4$ ;  $p<0.001^{**}$ ) and for both male ( $\chi^2=13.8$ ;  $p=0.003^{**}$ ) and female athletes ( $\chi^2=12.9$ ;  $p=0.005^{**}$ ), without a significant gender specific difference. For testing age specific differences, the participants of the entrance exams were divided into two groups: children (9-10 years; n=541) and adolescents (14-15 years; n=448). Both groups showed a significant (children:  $\chi^2=11.0$ ;  $p=0.012^{**}$ ) or a highly significant difference between the expected and the observed birth quarter distribution (adolescents:  $\chi^2=19.9$ ;  $p<0.001^{**}$ ), without age specific differences. The analyses of variance did not show significant differences, which means that the level of physical motor skills does not influence the RAE. **Discussion** Obviously, the RAE in alpine skiing exists from an early age. The results of our study indicate that the level of physical motor skills does not influence the RAE. Therefore, changes in the talent-selection- and talent-development-system are imperative (Lames et al., 2008). Since the level of physical motor skills does not influence the RAE, the causes for it have to be pursued elsewhere. The assessment of the biological age within the talent-selection-systems could be a possible solution. **References** Lames M, Augste C, Dreckmann C, Görsdorf K, Schimanski M. (2008). *Leistungssport*, 38, 4-9. Baker J, Janning C, Wong H, Cobley S, Schorer J. (2012). *Eur J Sport Sci*, doi: 10.1080/17461391.2012.671369. Müller L, Raschner C, Kornexl E, Hildebrandt C, Bacik M, Kröll J, Müller E. (2012). *Leistungssport*, 42, 5-12.

### RESISTED SPRINT EFFECTS OF THREE DIFFERENT LOADS ACCOUNTING FOR 5%, 12.5% AND 20% OF BODY MASS ON ACCELERATION, VERTICAL JUMP, LOADED VERTICAL JUMP, AND FULL SQUAT.

Bachero-Mena, B., González-Badillo, J.J.

*Pablo de Olavide University*

**Introduction** The optimal resisted load for sprint training has not been established yet, but a resistance reducing the athlete's velocity by more than 10% from unloaded sprinting would entail substantial changes in the athlete's sprinting mechanics (1). The aim of this study was to examine the effects of sled resisted sprint training during 7 weeks with three different loads both on acceleration and strength variables. **Methods** Nineteen young male subjects were divided into three sled loads training groups according to a % of body mass (BM): low load (LL: 5% BM), medium load (ML: 12.5% BM) and high load group (20% BM). During 7 weeks (2 sessions/week), these followed the same training program consisting in sprint accelerations with pull sled. The three loads used caused a mean velocity loss of 5.6%, 10% and 15.5%, respectively as compared to unloaded sprinting. The subjects performed sprint tests (40m) and strength tests (CMJ, JS, and full squat) before and after the 7-week training period. Results Statistical improvements were observed on 20m and 30m for the HL group, and on 40m for the three groups. Likewise, the partial times 10-40m and 20-40m for the LL group, and the partial times 20-30m and 20-40m for the ML group, were improved. Regarding the strength tests, CMJ and full squat for the ML and HL groups, and jump squat (JS) for HL group were improved. **Discussion** Some studies have investigated the effect of resisted sprint training. However, different reasons such as a higher training volume (3) or the use of parallel strength and soccer training sessions (2) make it difficult to directly compare the results of these studies with ours. Sprinting tests results suggest that the improved 40m performance of the HL group is due to a better acceleration phase up to 30m; however, improvements in both LL and ML groups on 40m are fundamentally due to a better

maximum speed phase. The results show that depending on the magnitude of load we use, the effects will be attained in different phases of 40 metres acceleration run. Moreover, sprint resisted training with ML and HL improves vertical jump and leg strength in moderately trained subjects. References 1. Clark KP, Stearne DJ, Walts CT, and Miller AD. The longitudinal effects of resisted sprint training using weighted sleds vs. weighted vests. *J. Strength Cond Res* 24: 3287-3295, 2010. 2. Spinks CD, Murphy AJ, Spinks WL, and Lockie RG. The effects of resisted sprint training on acceleration performance and kinematics in soccer, rugby union, and Australian football players. *J. Strength Cond Res* 21: 77-85, 2007. 3. Zafeiridis A, Saraslanidis P, Manou V, Ioakimidis P, Dipla K, and Kellis S. The effects of resisted sled-pulling sprint training on acceleration and maximum speed performance. *J. Sports Med Phys Fitness* 45: 284-290, 2005.

### RELATIONSHIP BETWEEN SPORTS INJURY AND LANDING STEP PATTERN IN MALE LONG-DISTANCE RUNNERS

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Recently, the running form of long-distance runners has been analyzed to prevent sports injuries and to improve performance. The purpose of this study was to investigate the relationship between the incidence of sports injury and the pattern of landing step. We included 23 Japanese collegiate long-distance runners as subjects. A video analysis system was used to check the forms of their lower legs during the landing phase. The duration to first incidence of injury (DFI) for each runner from March 1, 2011, to February 29, 2012, were obtained through structured interviews. On the basis of the video data of the feet during the landing phase, the subjects were divided into 2 groups, i.e., separate step type (SST) and overlap step type (OST) groups. Mean DFI for the SST group ( $254.5 \pm 29.5$  days) was higher than that for the OST group ( $177.5 \pm 35.7$  days). In other words, the incidence of sports injury was lower in the SST group than in the OST group (Kaplan–Meier survival curves and log-rank test;  $p = 0.046$ ). It was suggested that step types during the landing phase influenced the incidence of injury in long-distance runners.

### ALLOMETRIC SCALING OF PEAK OXYGEN UPTAKE IN UNDER-17 MALE ROLLER HOCKEY PLAYERS

Pereira, J.R.1, Vaz, V.1, Valente-dos-Santos, J.1, Duarte, J.1, Simões, F.1, Rebelo-Gonçalves, R.1, Severino, V.1, Cupido-dos-Santos, A.1, Elferink-Gemser, M.T.2, Malina, R.M.3, Coelho-e-Silva, M.J.1

1: FCDEF-UC (Coimbra, Portugal), 2: UMCG, University of Groningen (The Netherlands), 3: University of Texas (Austin, USA)

Background: Peak oxygen uptake (peak VO<sub>2</sub>) is routinely expressed in liters per minute and also by unit of body mass (ml/kg/min) despite theoretical and statistical limitations of using ratios. Allometric modeling is an effective approach for partitioning body-size effects in a performance variable. Methods: The current study examined the relationships among chronological age (CA), skeletal age (SA), total body and appendicular size descriptors with peak VO<sub>2</sub> in male adolescent roller hockey players. Seventy three Portuguese, highly trained male athletes (CA:  $15.4 \pm 0.6$  years; SA:  $16.4 \pm 1.5$  years; stature:  $169.9 \pm 6.9$  cm; body mass:  $63.7 \pm 10.7$  kg; thigh volume:  $4.8 \pm 1.0$  L) performed an incremental maximal test on a motorized treadmill. Results: Exponents for body size descriptors were 2.15 for stature ( $R^2=0.30$ ;  $P<0.01$ ) and 0.55 for thigh volume ( $R^2=0.46$ ;  $P<0.01$ ). The combination of stature or thigh volume with CA or SA and with CA<sup>2</sup> or SA<sup>2</sup> increased the explained variance in peak VO<sub>2</sub> ( $R^2$  ranged 0.30-0.55). The allometric model combining more than one body size descriptor (i.e., stature and thigh volume) in addition to SA and CA<sup>2</sup> was not significant. Conclusions: Results suggested that thigh volume and skeletal age are the main contributors to explain inter-individual variability in aerobic fitness.

### HEART RATE AND GRADED MAXIMAL TEST VALUES TO DETERMINE POSITIONAL RUGBY UNION GAME INTENSITIES OF ADOLESCENT BOYS

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Heart rate and Graded Maximal Test Values to Determine Positional Rugby Union Game Intensities of Adolescent Boys Introduction The positional demands of high school rugby union games need to be quantified so that appropriate conditioning programs can be compiled (Hartwig et al., 2008). Therefore, the purposes of this study were firstly, to determine the significant positional differences in the heart rate and standard incremental maximal oxygen uptake test values of u/15 high school rugby players and secondly, to determine the significant positional differences in the intensities of u/15 high school rugby union games when making use of heart rates and standard incremental maximal oxygen uptake test values. Methods Twenty-four u/15 rugby union players from a high school in the Potchefstroom area of the North-West Province, South Africa performed standard incremental running tests to the point of exhaustion in the periods between rugby games, to determine the individual heart rate (HR) intensity zones: (1) low intensity zone or LIZ (below ventilatory threshold (VT)); (2) moderate intensity zone or MIZ (between VT and respiratory compensation point (RCP)) and (3) high intensity zone or HIZ (above RCP). Players' HR values were then recorded during several rugby games and categorised according to the HR intensity zones. Descriptive statistics and an independent test were used to describe and determine significant differences between the two positional groups. Results Results of the standard incremental running test showed that the backs obtained a significantly higher average HR at the VT and HRs for the LIZ and MIZ as well as significantly lower average VO<sub>2</sub> at RCP compared to the forwards. With regard to the match analysis related results, forwards and backs spent the highest percentage of match time in the MIZ (60.3% and 57.5%). Forwards spent less time in the LIZ (12.5% versus 26.4%) and more time in the HIZ compared to the backs (27.4% and 17.6%). The average length of each intensity bout were 33 s (forwards) and 51 s (backs) for the LIZ; 70 sec (forwards) and 60 sec (backs) for the MIZ; and 39 s (forwards) and 37 s (backs) for the HIZ. Despite these differences, only total time and relative total time spent in the LIZ obtained significantly lower values for the forwards compared to the backs. Discussion Results of this study seem to suggest that the positional specific intensities of u/15 high school rugby union games can be determined and compared by making use of HRs and standard graded maximal oxygen uptake test values. Furthermore, results showed that the physical match demands of high school backline play are less than the demands of front-line play. References Hartwig TB, Naughton G, Searl J. 2008. Defining the volume and intensity of sport participation in adolescent rugby union players. *Int. J. Sports Physiol. Perform*, 3, 94-106.

## THE COMPARISON OF ARM-LEG AND AGILITY PERFORMANCES OF YOUNG ELITE WRESTLERS WITH ELITE SOCCER PLAYERS

Memiş, U.A., Ayan, S., Yapıcı, H., Ünver, R., Doğan, A.A., Kutlu, M.

*Bulent Ecevit University*

Introduction Wrestling and soccer are highly popular sports that need very markedly different strength from each other. It is well known that speed, strength, endurance, flexibility, balance and agility affect performance in both team and individual sports in which aerobic and anaerobic systems are used consecutively (Calbert et al., 2003). Especially, agility is one of the key elements an athlete must have in order to be successful in competitions (Little, 2007). In recent days strength and power have been assessed by comparing body composition of an athlete and his performance (Wozniak et al., 2006). The aim of this research was comparing agility, anaerobic strength and capacities (arm-leg) of elite wrestlers who compete in Turkish National Team with elite soccer players who compete in professional and amateur soccer teams in Kirikkale. Methods Elite Turkish National Greco-Roman young wrestlers (n=48) and elite professional and amateur (at least 7 years) (n=40) soccer players in Kirikkale participated in this study. Illinois agility run test and Wingate anaerobic (leg and arm) test were conducted. Statistically independent t test was used to assess the comparison. Results Elite Greco-Roman young wrestlers' (N=48) ages were 19±1 years, heights were 172±8.4 cm, weights were 77±18 kg, and professional and amateur soccer players' (N=40) ages were 20±2 years, heights were 178±6 cm, and weights were 73±8 kg. Discussion Significant differences were found between elite wrestlers and soccer players' body weights, heights, percentages of body fat, body mass indexes, anaerobic capacities (leg-arm) and agility scores (p<0.05). No significant differences were found in athletes' ages with sport ages (p<0.05). Results revealed that anaerobic performances and capacities of wrestlers were higher than soccer players. Agility scores of soccer players were found significantly better (p<0.05). Wrestlers were also found more successful in Wingate (cycling) strength test. That result emphasized the importance of test selection and effects of different work out styles (Sands et al., 2004). It is thought that the findings which revealed wrestlers arm and leg anaerobic strength and capacities were higher than those of soccer players, was because of the effects of strength and power trainings specific to wrestling. Findings which showed agility scores of soccer players were higher than wrestlers also suggested that agility trainings of soccer players must be better. Moreover, it is thought that differences in body composition affected sports performance. References 1. SANDS WA, MCNEAL JR, OCHI MT, URBANEK MJ, JEMNI M., STONE MH. (2004). Journal of Strength and Conditioning Research; 18: 810-815. 2. CALBET AL., DE PAZ JA., GARATACHEA N., DE VACA SC, CHAVARREN J. (2003). Journal of Applied Physiology; 94: 668-676. 3. WOZNIAK EH., LUTOSAWSKA G., KOSMOL A., ZUZIAK S. (2006). Human Movement, 7(2), 147-152. 4. LITTLE T., WILLIAMS A.G.J. (2007). Strength Cond. Res. 21(2):367-371-373.

15:00 - 16:00

### Mini-Orals

#### PP-PM85 Training and Testing [TT] 20

##### ANTHROPOMETRIC CHARACTERISTICS OF ELITE MONOFIN SWIMMERS: A FIRST APPROACH

Tampaki, M., Theos, A., Kaloupsis, S., Maridaki, M.

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Introduction Anthropometric characteristics play an important role in performance of swimmers (Saavedra et al., 2010; Strzala et al., 2009). The purpose of the present study was to investigate the anthropometric characteristics of Greek competitive monofin swimmers. Methods Fifteen elite male monofin swimmers, age 20.3 ± 3.5 yrs, all members of the Greek fin swimming national team participated in this study. Anthropometric characteristics such as body mass, body height, the circumferences of the limbs and the thicknesses of skinfolds at the pectoral, mid-axilla, triceps, subscapular, abdominal, suprailiac, front thigh, and medial calf sites were measured. All skinfold thicknesses and circumferences of the limbs were measured on the right side of the body. Based on these data, body mass index (BMI), percent body fat, fat mass, skeletal muscle mass and somatotype (endomorph, mesomorph, ectomorph) were calculated. Results are presented as mean ± SD. Results Mean body mass was 75.6 ± 6.3 kg, body height 178.6 ± 2.9 cm, body mass index 23.7 ± 1.6 kg/m<sup>2</sup>, percent body fat 16.3 ± 5.3 %, estimated fat mass 12.5 ± 4.5 kg and estimated skeletal muscle mass 63.1 ± 5.1 kg. The mean of skinfold thicknesses were: pectoral 6.8 ± 1.8 mm, biceps 7.8 ± 3.3 mm, axilla 8.3 ± 2.4 mm, triceps 12.4 ± 5.5 mm, subscapular 10.5 ± 2.3 mm, suprailiac 10.1 ± 4 mm, abdominal 14.9 ± 4.8 mm, suprailiac mm, thigh 15.3 ± 5.8 mm, calf 12.1 ± 4.7 mm. The mean of somatotype (endomorph, mesomorph, ectomorph) was 2.7 – 5.9 – 2.6. Conclusion The results of the present study suggest that elite male monofin swimmers are more mesomorphic than endomorphic and ectomorphic. References Strzala, M., Tyka, A. (2009). Medicina Sportiva 13, 99-107. Saavedra, J.M., Escalante, Y., Rodriguez, F.A. (2010). Pediatric Exercise Science, 22, 135-151.

##### PERFORMANCE AND PHYSIOLOGICAL CHANGES AFTER COMBINED REPEAT SPRINT TRAINING AND SODIUM BICARBONATE SUPPLEMENTATION

Varley, M.C., McKenna, M.J., Anderson, M.J., Stepto, N.K., Aughey, R.J.

*Victoria University*

Introduction A variety of training strategies have been used to enhance sprint performance. Four weeks of repeat sprint training (RST) can improve acceleration and peak and mean sprint velocity. Cellular potassium (K<sup>+</sup>) efflux during muscle contraction may impair membrane excitability and contribute to fatigue. Sodium bicarbonate (NaHCO<sub>3</sub>) ingestion improves K<sup>+</sup> regulation during exercise and may improve repeat sprint exercise (RSE) performance. This study investigated whether chronic NaHCO<sub>3</sub> ingestion during 4 weeks of RST would result in greater improvements in RSE performance and improved K<sup>+</sup> regulation compared to placebo ingestion. Methods Fourteen healthy participants were randomly assigned to experimental (EXP, NaHCO<sub>3</sub> ingestion before RSE) or placebo (CON, calcium carbonate ingestion before RSE) groups. Both groups performed a baseline RSE (3 sets of five, 4-s sprints on a non-motorised treadmill, 25 s rest between sprints and 4.5 min rest between sets). The EXP and CON groups completed twelve RST sessions ingesting either NaHCO<sub>3</sub> or placebo before each session, respectively. Both groups then completed RSE post-training in which they ingested the placebo before exercise.

Performance (acceleration, peak and mean velocity) was recorded in all sessions. Venous blood was sampled before, during and after RSE in all sessions and analysed for venous [K+] ([K+]<sub>v</sub>). Results Following four weeks of RST the CON group had small improvements across all sets in acceleration (6.6 – 7.7%; Effect Size (ES) 0.32 – 0.37) and peak and mean velocity (4.0 – 6.3%; ES 0.33 – 0.51 and 3.8 – 5.8; ES 0.31 – 0.47, respectively). The EXP group had small improvements in acceleration in set 1 and 2 (4.8 – 5.4%; ES 0.20 – 0.22) and peak and mean velocity in set 2 (3.6%; ES 0.24 and 3.8%; ES 0.25). Following four weeks of training there was an increase in [K+]<sub>v</sub> during exercise (P=0.006) however [K+]<sub>v</sub> did not differ between groups. Discussion Repeat sprint training induced small improvements in acceleration and velocity, but these improvements were not enhanced with the addition of NaHCO<sub>3</sub> ingestion. Therefore, whilst RST is recommended to improve acceleration and velocity, the concomitant ingestion of NaHCO<sub>3</sub> is unnecessary. The increase in [K+]<sub>v</sub> following training was unexpected and associated with an improvement in performance. The small rise in [K+]<sub>v</sub> during RSE suggests this variable is unlikely to exert a critical role in fatigue during extremely short maximal sprint efforts.

### RECOVERY KINETICS DURING A 3-DAY FLOORBALL TOURNAMENT

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Introduction During tournaments, team sport athletes are exposed to high physical loads due to a large number of games played within a few days. To perform well and prevent injuries, recovery in between these games is crucial. To monitor the recovery kinetics the Total Quality of Recovery (TQR) is suggested as a practical and useful tool (Kentta et al, 1998). The purpose of this study was to explore the feasibility and sensitivity of the TQR as a recovery monitoring tool during a 3-day floorball tournament. Methods Eleven elite Dutch female floorball athletes (age:24.3±4.8, length:171.5±9.1, weight:67.6±8.1) participated in a 3-day tournament. Their recovery was monitored with the TQR scale (6-20) (Kentta et al, 1998). All athletes were asked to rate their recovery each morning and every two hours including: 1 hour prior to the game (pre-game), immediately after the game (post-game) and 2 hours post-game. Comparisons were made for the TQR at the beginning and end of the tournament as well as pre- vs. post-game. Results A significant (p<0.05) lower TQR was recorded at the end of the tournament (M=13.2,SD= 1.9) compared to the beginning of the tournament (M=14.8,SD= 1.8). On the first day the pre-game TQR (M=14.6,SD= 2.1) was significantly (p<0.01) higher compared to the TQR two hours post-game (M=12.8,SD= 2.3). The second day the TQR pre-game (M=14.7,SD= 1.3) was significantly (p<0.05) higher compared to post-game (M=13.6,SD= 1.6) and two hours post-game (M=13.8,SD= 1.2). On the last day the TQR pre-game (M=14.5,SD=1.2) was significantly (p<0.05) higher compared to six (M=13.2,SD= 1.8) and eight hours (M=13.2,SD= 1.9) after the game. Discussion The TQR scale seems feasible and sensitive to monitor recovery kinetics in general. Besides, the TQR shows clear individual patterns. On average, recovery seems to go back to pre-game values after two hours the first and second day, while on the third day the recovery is still lower eight hours post- game. However the time of day at which the games were played were different. Earlier research used the TQR in soccer around a regular competition game looking at pre- and post-game and 24-hours post-game or in longer intervals showing higher TQR pre-game compared to post-game just as compared to 24-hours post-game (Kinugasa et al, 2009, Nedelec et al, 2012). More research is needed in recovery kinetics around tournaments and should take into account the time of the day at which the game is played. Besides, recovery-enhancing strategies should be developed to optimize recovery kinetics. References Kentta G., Hassmen P.(1998) *Sports Med*,26(1):1-16. Kinugasa T., Kilding, A.E. (2009) *J Strength Cond Res*, 23(5):1402-1407 Nedelec M., McCall A., Berthoin S., Dupont G. (2012) Thesis.

### THE EVALUATION OF BLOOD LACTATE RECOVERY PROCESS USING AN EXPONENTIAL REGRESSION MODEL

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Introduction Most athletes know that recovery process after high intensity exercise is important to improve sports performance. In our previous study, gas exchange parameters were fitted using exponential regression model (Sasaki and Tsunoda, 2006). Blood lactate concentrations reflect the balance between lactate production and clearance. Failure of oxidative mechanisms can affect both production and clearance of lactate. (Barrie Phypers, et al., 2006). In this study, we applied an exponential regression model to evaluation of blood lactate recovery process after high intensity exercise. The purpose of this study was to clarify the relationship between the gas exchange parameters and blood lactate parameters. Methods Incremental metabolic test: 21 athletes (8 females, 13 males, VO<sub>2</sub>Max: 63.8±8.6 (ml/min/kg)) voluntarily participated in this study. Subjects voluntarily participated in stepwise incremental metabolic test. This test contained 3 min resting, approximately 20 min exercise (Cycling or Running), and 10 min recovery resting. All subjects performed exercise until exhaustion. Gas exchange parameters (VO<sub>2</sub>, VCO<sub>2</sub>, VE and HR) were sampled at 30 sec interval. Blood Lactate was sampled at 3 min interval after exercise (0, 3, 6, 9 and 12 min). An exponential regression model was fitted to each parameter. Exponential regression model:  $F(t) = (A - C) * \exp(-t / B) + C$ , A: Initial amplitude at end of exercise in an exponential function, B: Time-constant (time taken to reach 63% of the final amplitude), C: Final amplitude in an exponential function. Regression analysis was performed, between blood lactate parameters and Gas exchange parameters. Results The responses in all parameters during recovery fitted exponential models highly (e.g. mean value of regression coefficient of Blood Lactate was 0.93). Mean values of time-constant of Blood lactate were about 20-30 times larger than gas exchange parameters (VO<sub>2</sub>: 64.3±16.4, VCO<sub>2</sub>: 101.2±20.6, VE: 109.6± 29.8, HR: 101.1± 27.2, and La: 1881.1±1646.2). The maximum blood lactate at exhaustion was explained by the linear regression equation using time-constant of HR. ( $Y = 0.061 * X + 6.98$ ,  $r = 0.564$ ,  $p < 0.01$ ). Y: Blood lactate (mmol/l), X: time-constant of HR (sec). And, time-constant of Blood lactate was associated with RQ ratio at exhaustion ( $Y = 4738.9 * X - 3822.4$ ,  $r = 0.461$ ,  $r = 0.461$ ,  $p < 0.01$ ). Y: time-constant of Blood lactate (sec), X: RQ ratio (VCO<sub>2</sub>/VO<sub>2</sub>). Discussion The higher concentration of blood lactate caused the slower recovery of heart rate after exercise. RQ is the ratio of CO<sub>2</sub> produced to O<sub>2</sub> consumed. The higher production of CO<sub>2</sub> at exhaustion caused the slower recovery of blood lactate after exercise. References Sasaki, T., and Tsunoda, K. (2006), The estimation of oxygen consumption from heart rate using an exponential equation, *Hokkaido J. Phys. Educ, Hlth, Sports Sci.* 41:27-35 Barrie, Phypers, and JM, Tom, Pierce (2006), Lactate physiology in health and disease, *Continn Educ Anaesth Crit Care Pain* (2006) 6 (3): 128-132.

### TIME COURSE ALTERATIONS IN PHYSIOLOGICAL AND BIOCHEMICAL PARAMETERS DURING 2 WEEKS OF HIGH ALTITUDE TRAINING IN CROSS-COUNTRY SKIERS

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**Introduction** Although it has been reported results of pre-post high altitude acclimatization (Dill & Adams, 1971; Levine & Stray-Gundersen, 1997), it has not well been demonstrated that how the endurance athletes adapt to high altitude environment during high altitude training. The purpose of this study was to investigate the time course alterations in physiological and biochemical parameters during 2 weeks of high altitude training in cross-country skiers. **Methods** Collegiate cross-country skiing athletes (8 males, 6 females, 20 ± 1.0 yrs.) were participated. They lived 1 day before exposed to high altitude at sea level for collecting control data and lived and trained for 14 days at 2,200 m above sea level. Resting heart rate (HR), HR, arterial blood oxygen saturation and blood lactate during 3 minutes submaximal cycling exercise at a constant load corresponding to their each 70% HRmax, salivary amylase, urine specific gravity and subjective feeling of physical condition were measured at every morning. Erythropoietin (EPO), red blood cell, hemoglobin (Hb) and ferritin were measured just before altitude training and 48 hours and 14 days after sojourn at 2,200 m. Salivary cortisol and feeling profile were measured at day 2, 8 and 14. 5,000 m running performance test at sea level as an index of endurance performance was conducted pre and post altitude training. One way repeated measure of variance was used for the statistical evaluation. **Results** Supine and standing HR significantly increased at day 2 (vs control) and, after that, gradually decreased during acclimatization process of 2 weeks of high altitude training. Particularly, supine HR was significantly decreased at day 12 (vs. day 2). Likewise, salivary cortisol was significantly increased at day 2 (vs. con) and, after that, significantly decreased at day 14 (vs. day 2 and 8). The other measurements at the every morning were positive changed similarly resting HR. EPO was significantly increased after 48 h at 2,200 m (vs. before altitude training) and significantly returned to the same level with sea level at day 14. Hb was significantly increased day 14 (vs. con, day 2). However, no significant changes were found in other hematological parameters. 5,000 m running time was significantly improved after high altitude training. **Conclusion** This study suggested that it needs for at least 2 weeks to acclimatize to high altitude environment (2,200 m) during high altitude training in cross-country skiers. **References** Dill DB and Adams WC. (1971). *J Appl Physiol*, 30(6), 854-859. Levine BD and Stray-Gundersen J. (1997). *J Appl Physiol*, 83(1), 102-112.

### RECOVERY FROM REPEATED ON-COURT TENNIS SESSIONS; COMBINING COLD WATER IMMERSION, COMPRESSION AND SLEEP HYGIENE INTERVENTIONS.

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**Introduction** The use of interventions such as cold water immersion (CWI) and compression garments (CG) to assist recovery are popular; while the role of sleep to also aid athlete recovery remains an integral, but rarely researched area. Similarly, combining recovery techniques into a mixed-method protocol, and the application to the prolonged and repeated demands of tennis has not been reported. The current study investigated the effects of combining CWI, CG and a sleep hygiene protocol on physical, physiological and perceptual recovery following on-court tennis sessions. **Methods** In a cross-over design, 8 male high-performance tennis players completed two sessions a day of on-court tennis drill training and match-play, followed by a recovery or control condition. Recovery interventions included a mixture of 15min CWI, 3h of full-body CG and a sleep hygiene protocol performed that night (earlier into bed, reduced ambient light, cool room temperature and sleep eye-masks). Conversely, the control condition involved 15min post-session stretching and self-regulated sleeping patterns. Technical performance (stroke count and error rates), physical performance (accelerometry, counter-movement jump), physiological (heart rate, blood lactate) and perceptual (mood, exertion and soreness) measures were recorded from each on-court session. Measures of sleep quantity and quality were determined via actimetry measures each night. A two-way ANOVA and effect size analyses were used to compare respective conditions. **Results** While stroke and error rates did not differ in the drill session ( $P > 0.05$ ;  $d < 0.20$ ), a large effect for increased time-in-play and stroke-volume were evident in match-play following the recovery interventions ( $P > 0.05$ ;  $d > 0.90$ ). Although accelerometry values did not differ between conditions, ( $P > 0.05$ ;  $d < 0.20$ ), a large effect for CMJ improvement was evident before match-play with recovery ( $P > 0.05$ ;  $d = 0.90$ ). Further, CWI and CG resulted in faster post-session reductions in heart rate and lactate and reduced perceived soreness ( $P < 0.05$ ;  $d > 1.00$ ). Finally, the sleep protocol increased sleep quantity ( $P > 0.05$ ;  $d > 2.00$ ) and also maintained lower perceived soreness and fatigue the next day ( $P < 0.05$ ;  $d > 2.00$ ). **Discussion** Given the increased soreness and fatigue resultant from two tennis sessions a day, post-session mixed-method recovery interventions (CWI and CG) increased time in play and lower-body power and reduced perceived soreness. Further, a sleep hygiene protocol increased sleep quantity and assisted the reduction of perceived soreness. Mixed-method recovery interventions may also be applicable to other athletes required to perform and recover for twice daily sessions.

### THE EFFECTS OF DIFFERENT TRAINING INTENSITIES ON PHYSIOLOGICAL RESPONSES WHEN TRAINING DURATION IS INDIVIDUALISED

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**Introduction** Numerous studies have compared high intensity training (HIT) to moderate intensity training (MOD), with findings suggesting HIT provides similar or greater physiological benefits. These studies have used standardised training times to set the training interventions. Consequently, the individual differences in one's ability to train at the same relative intensity for variable durations have been ignored. The aim of this study was to compare the physiological effects between MOD and HIT when training durations are individualised. **Methods** The study population consisted of sedentary or recreationally active (training <4h wk) male and female participants ( $n=12$ ; mean ± standard deviation (SD) 29 ± 9 yr; 72 ± 14 kg; 171 ± 9 cm) randomly assigned to either the MOD ( $n=5$ ;  $VO_{2max} = 3.14 \pm 1.01$  l min<sup>-1</sup>) or HIT ( $n=7$ ;  $VO_{2max} = 2.78 \pm 0.49$  l min<sup>-1</sup>) training group. Before and after 4-wks of supervised training we measured  $VO_{2max}$ , maximal aerobic power (MAP), time-to-exhaustion (TTE) and gross efficiency (GE). Training consisted of supervised cycling 4times/wk for 4-wks. The MOD group exercised at 60% MAP for the duration completed in the pre-training time-to-exhaustion test. This consisted of 5 min blocks with 1 min passive rest until the target training duration was complete. The HIT group exercised at 100% MAP with 2 min active (25% MAP) and 1 min passive rest. Participants were encouraged to complete the maximal number of repetitions in the first training session. All participants were encouraged to complete an extra block/repetition after every two training sessions. The effects of training were analysed using a two-way mixed ANOVA (time; training group). All values are reported as the mean ± SD. The level of significance was set at

$P < 0.05$ . Results Average training time per week ( $\approx 2$ h vs. 4.5h) was substantially lower in the HIT compared to the MOD group. TTE ( $+60 \pm 3$  vs.  $50 \pm 35$  %); MAP ( $+10 \pm 7$  vs.  $11 \pm 5$ %) and  $VO_{2max}$  ( $+10.5 \pm 7.5$  vs.  $12.5 \pm 6.7$ %) increased significantly in the MOD and HIT exercising groups following 4-wks of training (main effects;  $P < 0.05$ ). There were no significant changes in GE for either group or time ( $P < 0.05$ ). Discussion No differences are found between MOD and HIT when training duration is individualised at different intensities, despite differences in training volume. These findings further support the contention that HIT is a time-efficient strategy, inducing physiological improvements that are comparable to MOD.

### **STRENGTH OR ENDURANCE FIRST?: EFFECTS OF COMBINED SESSIONS ON ECONOMY AND BIOMECHANICS OF RUNNING**

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**Introduction** Strength is recognized as a necessary component of training for endurance runners but because of the divergent responses and adaptations to strength and endurance training (Hickson 1980), training needs to be carefully planned. As part of an optimal training regimen, or to save time, recreational and elite athletes may perform strength (S) and endurance (E) in the same combined session, but which should be performed first when focusing running performance? **Methods** Recreationally endurance trained men and women ( $M=12$ ,  $W=10$ ) and ( $36 \pm 8$  years) completed two combined loadings: E followed by S (ES) and S followed by E (SE). S focused on the leg extensors, while E consisted of 60min moderate intensity steady-state running. Maximal bilateral isometric force (MVC) and muscle activation (EMG) were measured Pre-Mid-Post ES and SE. Running economy was measured at the beginning and after E. Biomechanical characteristics of running were measured at the beginning, during, and after both E sessions. **Results** A significant decrease in MVC was observed at mid in men after E of ES ( $p < 0.01$ ), while a significant decrease in MVC was observed in both men and women at mid after S of SE ( $p < 0.05$ ). MVC was significantly decreased in men and women at post in both conditions ( $p < 0.05$ ) and men showed a significant decrease in EMG post SE ( $p < 0.05$ ). Running economy was decreased significantly at the beginning of E after S when compared to E performed before S (4 and 3% in men and women, respectively). In men, stride-length shortened significantly ( $p < 0.05$ ) in both ES and SE, but running speed, and stride-rate were statistically unaltered. Braking time was unaltered and push-off time increased slightly, but total contact time remained statistically unaltered in both ES and SE. In women, stride-length, running speed and stride-rate were statistically unaltered while a slight increase in braking time and decrease in push-off time were observed and total contact time remained statistically unaltered in both ES and SE. **Discussion** Performing S immediately prior to E may decrease neuromuscular performance of maximal strength and muscle activation and led to decrements in running economy and selected biomechanical characteristics of running. These findings in combination with our previous study (Taipale & Häkkinen 2013), suggests that performing E prior to S may be better for recreational endurance runners if the main focus of the specific combined training session is on optimizing running performance. **References** Hickson (1980) *Eur J Appl Physiol.* 45:255-263. Taipale & Häkkinen (2013) *PLOS ONE*

### **DIFFERENCES ON VERTICAL JUMPING, SPRINT VELOCITY AND RSA AMONG ELITE SENIOR AND TEEN BASKETBALL PLAYERS**

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**Introduction** The speed in short sprints, the height in vertical jump and the ability to repeat such efforts are key in basketball (Buchheit, Bishop, & Girard, 2012). However, the differences in these variables between elite senior and teen basketball players are poorly studied. **Purpose** Analyze the differences in the vertical jump, 35-meter sprint, the repeated sprint ability (RAST) and loss of vertical jump among professional and teen basketball players. **Methods** **Sample** The sample consists of two top-level basketball teams. Group A consists of professional basketball players ( $N = 11$ , age =  $24.2 \pm 5.5$  years) and group B consists of elite, teen basketball players from the same club ( $N = 9$ , age =  $15, 2 \pm 0.4$  years). **Variables** The variables analyzed were: Vertical jump height (cm), 35m sprint time (s), vertical jump loss (%), loss of speed in the RAST (%), average power of RAST (W), maximum power of RAST (W) and RAST fatigue index (W / s). **Instrumental** Optojump Infrared Platform (Microgate, Italy) and photoelectric cells Racetime 2 (Microgate, Italy). **Procedure** After a 5 minute warm up, the players performed the tests as follows: (1) counter-movement jump (CMJ) with free arms, (2) repeated sprint test RAST, (3) CMJ with free arms. **Statistical Analysis** T test for independent samples was used, using the IBM SPSS Statistics 20 software. **Results** There were no significant differences in any of the variables studied, except in the average ( $+168W$ ,  $t = 3.8$ ,  $p = 0.003$ ) and maximum power ( $+219,4 W$ ,  $t = 3.2$ ,  $p = 0.005$ ) produced in the RAST, with group A being significantly more powerful than the group B. **Conclusion** Our data indicate that elite teen basketball players have similar values of CMJ, sprint velocity and ability to repeat those efforts than professional players, while these have significantly higher power levels. These results suggest that to reach the highest competitive level in basketball is not necessary to obtain higher values than those achieved in adolescence, but the key would be to maintain the same levels while significantly increasing the body size and weight and muscle power. **References** Buchheit, M., Bishop, D., & Girard, O. (2012). Should We be Recommending Repeated Sprints to Improve Repeated-Sprint Performance? *Sports Medicine*, 42 (2), 169-173.

### **PHYSIOLOGICAL RESPONSES IN REFERENCE TO SURFACE AND IMMERSION IN FIN SWIMMING: A PILOT STUDY**

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**Introduction** Fin swimming is a sport that takes place on the surface of water as well as underwater, with the aid of a fin. Repeated efforts, due to different stops between them, provoke different physiological responses in the muscle (McCartney, 1986; Spiet et al., 1989; Gaitanos et al., 1993; Bogdanis et al., 1995). The aim was to compare two different conditions, swimming immersion and surface, in physiological responses. **Methods** The sample of this study consisted of 8 athletes of competitive level of fin swimming, aged:  $19.0 \pm 1.92$  years, height:  $172.5 \pm 3.59$  cm and weight:  $67.0 \pm 11.15$  kg. The participants swam with maximum intensity 6x100m with two different ways, immersion and surface. The stop between each 100m was 1min. After each experimental condition, lactic acid, oxygen saturation and heart rate were measured. **Results** The results of Manova analysis showed that there are no statistical significant differences between the two conditions of fin swimming in all measured variables. **Discussion** In the present study it was noted that swimming on the surface in comparison to immersion, does not present significant differences according to physiological responses. This fact gives the motive for further research in fin swimming with bigger sample and other variables, such as  $VO_{2max}$ , that may affect performance in this

specific sport. References Bogdanis GC, Nevill ME, Boobis LH, Lakomy HKA, Nevill A. (1995). *J Phys*, 482 (2), 467-480. Gaitanos GE, Williams C, Boobis LH, Brooks S. (1993). *J Appl Phys*, 75, 712-719. McCartney N, Spiet LL, Heigenhauser GJF, Kowalchuk JM, Sutton JR, Jones N. (1986). *J Appl Phys*, 60(4), 1164-1169. Spiet LL, Lindinger MI, McKelvie RS, Heigenhauser GJF, Jones NL. (1989). *J Appl Phys*, 66(1), 8-13.

### THE RHYTHM OF PLAY IN COMPETITION. A PROPOSAL TO CONTROL THE TRAINING LOAD IN ELITE RUGBY SEVENS

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**Introduction** The concept of rhythm of play is based on the frequency of alternation between the team role with the ball possession or team role as opposition, in relation to the number of the actions taking place on each role time unit. In this study we set two aims: (i) determine the influence of the rhythm of play in competition at the final score, (ii) propose the rhythm of play in competition as a control of training load on the Spanish team of rugby sevens. **Method** To focus our analysis, we build the following equations: - Rhythm of play = (no possession units + no opposition units) x no total actions / total time ball in play. - Rhythm of possession = no possession units x no possession actions / total time possession role. - Rhythm of opposition = no opposition units x no opposition actions / total time opposition role. **Statistical analysis** based on the multiple linear regression model allows us to analyze the first aim of the study, considering the rhythm of play, rhythm of possession and rhythm of opposition as independent variables, and the points difference at the final score as dependant variable. To analyze the second objective of the study used descriptive statistics (means  $\pm$  standard deviations). **Results** In the determination of the influence of the rhythm of play, rhythm of possession and rhythm of opposition has obtained a statistically significant model  $F(11,3) = 6.639$ ,  $p = 0.015$ . in which the independent variables explained 61% of the variability ( $R^2_{corrected} = 0.606$ ) and the independent variables that violate the null hypothesis are rhythm of possession ( $\beta_{standard} = 1.819$ ,  $t = 4.184$ ,  $p = 0.003$ ) and rhythm of play ( $\beta_{standard} = -1.463$ ,  $t = 3.286$ ,  $p = 0.011$ ). In the observed tournament Spanish team has a rhythm of play of 6.5. The rhythm of possession was 4.5 (11.5  $\pm$  1.9 possession units, of 25.9s  $\pm$  5.2s each one, with 10.1  $\pm$  2.0 possession actions and 57.1s  $\pm$  6.8s pause time); and the rhythm of opposition was 1.7 (11  $\pm$  1.9 opposition units, 20s  $\pm$  1.4s each one, with 3.3  $\pm$  1.2 opposition actions and 57.1s  $\pm$  6.8s, and pause time). **Discussion** The high influence of the rhythm of play, rhythm of possession and rhythm of opposition on the final score gives this proposal a consistency of very high suitability. To control the training load, are multiple options: increasing or decreasing the number of actions to perform in each role time unit; increasing or decreasing the length of role time units, increasing or decreasing the pause time. The best option will depend on the characteristics of the style of play technical staff want to implement. **References** Solé, J. (2002) *Endurance training in team sports, Master of high performance in team sports*. INEFC-Byomedic. Barcelona. Vaz, L.; Carreras, D. & Kraak, W. (2012). Analysis of the effect of alternating home and away field advantage during the Six nations Rugby Championship. *International J of Performance Analysis in Sport*, 12, 594-608.

### RELATIONSHIP BETWEEN RUNNING VELOCITY AND SUBJECTIVE SENSATION.

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**Introduction** It has been reported that the stimulation to the foot has important, and barefoot activity has been noted in recent years. In addition, it came to be observed that the children running with barefoot on the school yard. However, we did not understand about the sprinting conditions faster in barefoot and shoes. For this reason, it is considered that it is important to clarify which is about the way leaders can run faster in education. The purpose of this study, it was decided to make the questionnaire and the 50m dash in order to clarify the relationship between the subjective sensation and the running velocity, and comparison of running velocity of barefoot and in shoes. **Methods** Subjects were 133 students (84 males and 49 females) at a university of physical education. Measurements were questionnaire and 50m dash. Measurements were made twice with subjects running a 50m dash barefoot and in shoes. Measurements were made one week apart. Running time was measured every 10m. In the analysis, we calculated the average running velocity and the interval running velocity. The average running velocity was calculated by dividing by the time taken in the distance measured points. The interval running velocity was calculated by dividing by the time taken the distance of each interval. In addition, a questionnaire was completed before and after the measurement. **Results** Both males and females had a significantly faster average running velocity barefoot than in shoes. Both males and females had a significantly faster interval running velocity from 0-10m and from 30-40m barefoot than in shoes. In males, there was a relationship between subjective sensation and faster sprinting condition. There was no such relationship in females. **Discussion** These results revealed that barefoot sprinting is faster because the acceleration at the start. This could have affected the sprint velocity at all measured points. Subjective sensation may be an effective way to select sprinting conditions. **References** Shunichi T. (2007). 50m running with shoes and barefoot-from the viewpoint of running time, running velocity and swing-back velocity of driving leg immediately before foot contact on the ground-. *Doshisha Journal of Health and Sport Sciences*, 45, 37-54. D.E.Lieberman, M.Venkadesan, W.A.Werbel, A.I.Daudo, S.D.Andrea, I.S.Davis, R.O.Mang Eni, and Y.Pitsiladis. (2010). Foot strike pattern and collision force in habitually barefoot versus shod runners. *Nature*, 463(28). 531-536.

### PERFORMANCE ANALYSIS OF ELITE GROUP RHYTHMIC GYMNASTICS

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The aimed was to analyze, anthropometric characteristics, body composition, age at menarche, training hours volume, sport activity initiation and years of practice of Elite Rhythmic Gymnastics gymnasts and analyze according to the competition performance, the content of the competition routines contributing to high level RG gymnasts and RG group's performance characterization. We studied 84 group gymnasts' characteristics who participated in Portimão 2009 and 2010 RG World Cups, and the 126 group competition routines content from 28 countries that participated at 4 World Cups in Portimão (2007 to 2010). For the gymnasts characteristics analysis\* we calculated body mass index, body fat and lean body mass, the last two estimated from skinfolds thicknesses and circumferences. Age at menarche, age of RG training initiation, years of practice and training volume (daily and weekly) was recorded using a questionnaire. For the routines content analysis, all body and specific groups elements\*\* and apparatus elements\*\*\* recorded on the official forms provided in competitions were analyzed. It was clear that anthropometric characteristics, body composition and age at menarche were not relevant in success competition explanation. However, we concluded that those characteristics were similar for the high level performance gymnasts. The high number of training hours per week (about 42 hours) explained 42% of competition success. Early initiation in RG (6 yrs old) and the high number of years of practice are significantly relevant to achieve the excellence level in RG groups. The age at menarche ob-

served in gymnasts was significantly more delayed in older gymnasts probably due a higher number of years training gymnastics prior to the menarche onset. It was possible to conclude that competition routines content follow a pattern consistent with the high level sports performance. This pattern includes: high number and complexity in exchange difficulties; balance difficulties mostly performed with high amplitude movements and performed on different supports in a dynamic way; jump difficulties mainly performed with rotation; rotation difficulties performed mostly with high technical complexity; higher use of throws criteria (explaining 6% of competition success) than the catches criteria; high use of collaborations with loss of visual contact with the apparatus during its flight explaining 16.5% of competition success. \*Ávila-Carvalho, L., Klentrou, P., Palomero, M. d. L., & Lebre, E. (2012). Body composition profile of Elite Group Rhythmic Gymnasts. *Science of Gymnastics Journal*, 4(1), 21-32. \*\* Ávila-Carvalho, L., Klentrou, P., Palomero, M. d. L., & Lebre, E. (2012). Analysis of the Technical Content of Elite Rhythmic Gymnastics Group Routines. *The Open Sports Sciences Journal*, 5, 146-153. \*\*\* Ávila-Carvalho, L., Klentrou, P., & Lebre, E. (2012). Handling, Throws, Catches and Collaborations in Elite Group Rhythmic Gymnastics. *Science of Gymnastics Journal*, 4(3), 37-47.

### **DIFFERENCES IN PHYSIOLOGICAL CHARACTERISTICS BETWEEN YOUNG GIRLS PARTICIPATING IN TENNIS AND GYMNASTICS**

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**Introduction** Tennis is a demanding sport because it requires speed, agility, explosive power and aerobic conditioning along with the ability to react and anticipate quickly (Barber-Westin et al., 2010). Gymnastics training develops strength, flexibility, concentration, balance, grace and speed (Carric et al., 2007). The purpose of the present study was to investigate differences in physiological characteristics of young girls participating in different sports. **Methods** A total of thirty eight girls (14 tennis players and 24 gymnasts, age:  $13.5 \pm 0.2$  yrs, weight:  $49.8 \pm 1.7$  kg, height:  $155.7 \pm 1.6$  cm) that had a training experience of more than three years participated in this study. Flexibility (sit and reach test), arm strength (handgrip) and agility (agility T-test) were measured. Differences between the groups were analyzed using t-test. Results are presented as mean  $\pm$  SE. Results In the dominant hand tennis players performed better than gymnasts ( $24.8 \pm 0.9$  kg vs.  $15.5 \pm 1.6$  kg,  $p < 0.001$  respectively) and so did in the non dominant hand ( $21.6 \pm 0.9$  kg vs.  $14.4 \pm 1.3$  kg,  $p < 0.001$  respectively). Dominant and non dominant hand differed also in tennis players ( $p < 0.05$ ) while there was no difference in gymnasts ( $p = 0.59$ ). Significant difference was also observed in agility (Tennis players:  $12.6 \pm 0.8$  sec vs. Gymnasts:  $13.6 \pm 0.3$  sec,  $p < 0.05$ ). On the other hand gymnasts performed better than tennis players in flexibility ( $29.3 \pm 1.5$  cm vs.  $20.6 \pm 1.6$  cm,  $p < 0.001$  respectively). **Discussion** The results of the present study show that tennis seems to improve arm strength, especially the strength of the dominant hand, and agility while gymnastics seems to promote flexibility in girls with the same training experience. **References** Barber-Westin SD., Hermeto A. and Noyes F. (2010). *J Strength Cond Res*, 24(9), 2372-2382. Carric F., Oggero E., Paganocco G., Brock B., Arian T. (2007). *Disabil Rehabil*, 29(24), 1881-1889.

### **EDUCATION TO SEE. AN INQUIRY INTO THE PERFORMANCE IN YOUNG FEMALE VOLLEYBALL ATHLETES.**

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**Introduction** The eye allows encoding and receiving information about movement: it also allows knowing the environment, including space and three-dimensional parameters: therefore it plays a key role in posture. Thus, there is a strong connection between the latter, the visual system and movement. Therefore, the aim of this study was to highlight, through electronic stabilometry in static mode, a correlation, whether or not statistically significant, of any possibility of influencing in an immediate manner the proprioceptive reflexes that link an athlete's extrinsic eye muscles and posture. **Methods** The study was conducted on 18 female volleyball athletes. These were subjected to a Lang test of dominant eye and of hypo-convergence. Then to a stabilometric measurement in upright stance with open and closed eyes both in the cabin and in the open field. After that, to exercises of evocation of the convergence reflexes at close range, with the use of a micro-magnet, and from a distance, using a stereo trainer device. We eventually proceeded to a comparison between the stabilometric recordings in the cabin and in the open field. **Results** There were no statistically significant differences between recordings in the cabin and in the open field. The difference is statistically significant ( $p < .001$ ), however, on behalf of the condition in the open field in the length parameter, which indicates a greater stability of athletes. **Discussion.** The sporting gesture is mostly influenced by the Tonic Postural System, although there are many other factors that contribute to its success. The data confirm that the volleyball athletes are accustomed to an assessment of their surroundings and have a good stability due to the frequent handling of balance or unsteady conditions. **References** Zupan M, Wile A. (2011). *Training & conditioning*, 21(2),11-15. Roll J.P. (1997), *Sauramps médical Montpellier*, 13-16. Graham B. Erickson. (2007), *Sports Performance*. Elsevier, Missouri, U.S.A.

**15:00 - 16:00**

## **Mini-Orals**

### **PP-BN07 Biomechanics [BM] 7**

#### **FORCE PLATFORM VS CONTACT MAT IN THE ASSESSEMENT OF VERTICAL JUMP IN VOLLEYBALL PLAYERS.**

Borràs, X., Balius, X., Drobnic, F.

*Universitat de Vic*

**FORCE PLATFORM VS CONTACT MAT IN THE ASSESSEMENT OF VERTICAL JUMP IN VOLLEYBALL PLAYERS.** Borràs, X.1, 2, Balius, X.2, Drobnic, F.2 1: Uvic (Spain), 2: GIRSANE. CAR (Spain) **Introduction** Vertical jump test is commonly used in volleyball to assess different force manifestations of the lower extremity. Contact mat (CM) and force platform (FP) are two devices used for the assessment (Bosco et al, 1983; Vanrenterghem et al, 2004). Both are considered reliable in recording vertical jump height (Moir et al, 2009; Harman et al, 1990) and show a high correlation coefficient (Roig et al, 2008). With this study we want to give a help to trainers to choose between devices, knowing their advantages and disadvantages. **Methods** Sixteen male, of the Spanish National volleyball team, performed a vertical jump test

consisting of squat jump (SJ), countermovement jump (CMJ), CMJ with arms (CMJa) and spike Jump (SPJ). Jumps were recorded simultaneously in a FP (Kistler) and a CM (ErgoJump System). Results Vertical jump height were calculated by means of flight time (FT) in CM (SJ 41.3cm, CMJ 47cm, CMJa 56.5cm, SPJ 68.6cm) and FP (SJ 39.1cm, CMJ 46.7cm, CMJa 55.9cm) and by means of velocity of take off (V) also in the FP (SJ 36.4cm, CMJ 43cm, CMJa 51.1cm). Correlation coefficient between devices is high (R(FT) 0.998; R(V) 0.970). Discussion CM has a higher portability even compared with the FP brands considered portable and has a lower cost than the FP. The CM allows the assessment all the jumps used in volleyball; FP does not permit the measurement of the SPJ due to reduced dimensions. CM results are immediate while FR data usually needs to be processed before giving height. Power is calculated from force in FP while CM uses prediction equations. Devices show a high correlation coefficient, however, caution has to be taken when comparing heights. CM data is higher than FP values regardless the method used. The flight time method, used in CM, overestimates height (Garcia-Lopez et al, 2005) consequence of the different body position when taking off and landing (Aguado and Gonzalez, 1995). With the FP this problem can be avoided. FP allows to distinguish between the maximum SJ (SJV 38.1•4.6cm) and the "valid" SJ (minimum countermovement). 25% of the experienced players couldn't avoid a small countermovement after 3 attempts. Those jumps were considered valid and make evident the difficulty to differentiate correct SJ. References Aguado X, Gonzalez JL (1995). RED, 9, 17-23. Bosco C, Mognoni P, Luhtanen P. (1983). Eur J Appl Physiol, 51, 357-364. Garcia-López J, Peleteiro J, Rodríguez-Marroyo JA et al (2005). Int J Sports Med, 26, 924-302. Harman EA, Rosenstein MT, Frykman PN, et al (1990). Med Sci Sport Ex, 22 (6), 825-833. Moir GL, Garcia A, Dwyer GB (2009) Int J Sports Physiol Perform 4 (3), 317-330. Roig A, Borràs X, Drobnic F, et al (2008). Arch Med Dep, XXV (128), 520. Vanrenterghem J, Lees A, Lenoir M, et al (2004). Hum Mov Sci, 22, 713-727.

### DOES THE POSITION OF BALL CONTACT EXERT A DIFFERENCE ON THE RESULT OF INSIDE SOCCER TRAPPING?

Tahara, R.

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Introduction In soccer, it could be said that trapping, in which the ball is stopped using the inside of the foot, is the most frequently used skill. However, little research has been devoted to ball trapping. The purpose of this study was to clarify that the factor determined the success of inside soccer trapping changes with the position of ball contact. Methods Six experienced male collegiate soccer players and six unskilled players were asked to perform inside trapping 10 consecutive times with the following task. The subjects controlled the ball in front of the foot. The ball kicked at random speeds 7m away from the experimental subjects. The motion of the whole body during trapping was recorded using two high-speed video cameras. And distances between trapping foot and supporting leg (= ball contact position) were determined. The ball was recorded with another camera set on the right side, and the spin rate of the ball was calculated by the method of Jinji et al (2006). Paired t-test and Pearson's product-moment correlation coefficients were used for the statistical processing. The criterion for statistical significance was  $p < 0.05$  for all analyses. Results About the mean ball velocities for after ball impact, experienced players' velocities ( $1.2 \pm 2.5$  m/s) were significant lower than unskilled players' ( $3.5 \pm 4.5$  m/s). About ball contact positions, the experienced players ( $0.25 \pm 0.12$  m) had stopped the ball in the position away from the unskilled players ( $0.07 \pm 0.24$  m). The experienced players ( $70.8 \pm 43.8$  rpm) applied many backspins to the ball rather than the unskilled players ( $-10.2 \pm 70.1$  rpm). There were significant correlations among ball velocity after trapping, ball contact position and ball spin rate. Discussion Since the ball velocity after trapping was low, it can be said that ball control is good at experienced players. In the experienced players, the ball contact position was in front, and there was also much number of backspin rates. Moreover, there were correlations between ball velocity after trapping and spin rate, ball contact position respectively. These results suggested that contact to the ball in front of supporting leg increase the backspin rate, and reduce the velocity of the ball. It was considered that abduction of the hip joint has been made easier by the forward position of the ball contact, and it produces buffer action toward ball impact (Tahara et al., 2012) and the movement to put a backspin. References Jinji, T., and Sakurai, S. (2006) Sports Biomechanics, Vol.5(2), 197-214. Tahara, R., Shimonagata, S., Taguchi, M. (2012) The 30th Conference of the ISBS Proceedngs, Vol.4, pp.303-306.

### THE ANALYSIS OF MUSCLE ACTIVITY PATTERN IN PEDALING MOTION AT THE SUBJECTIVELY APPRECIATED SADDLE HEIGHT OF A SKILLED CYCLIST

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Introduction In the setting of mechanical components of a cycle road racer, the saddle height has been considered as the most significant factor to set the other components, because cyclists commonly use binding pedals and shoes to efficiently convert their physical power to the propulsion force of a bicycle. This study aims to evaluate the saddle height based on the statistical analysis of the muscle activity patterns of lower limb of a skilled cyclist. Methods The experimental environment was composed of a cycle ergometer, an electromyography, and a computer, in which the lab-made saddle height control device has been mounted at the saddle part of the ergometer. SEMG signals of lower limb muscles during pedaling motion are used to estimate the activity patterns. The relationship between the the muscle activity patterns and the subjective evaluation against the saddle height of a skilled cyclist was investigated. Results A skilled cyclist clearly recognized the small changes of saddle height that declined by 3mm from 680mm to 650mm. In the results of principal component analysis (PCA) applied to the muscle activity data, the PCA scores concentrated near zero point at the saddle height subjectively appreciated by the skilled cyclist. Discussion The authors have been considering that the subjective evaluation were based on the empirical rule of activating muscles in pedaling motion amassed through longtime training. Then the pedaling motion performed at the saddle height subjectively appreciated, satisfied his motion perceptions empirically constructed. Since the skilled cyclist pedals by keeping balance well the muscle's activity among muscles to avoid the development of regional fatigue, the muscle activity patterns became featureless at the saddle height subjectively appreciated by the skilled cyclist.

### STRIKE INDEX AND SPATIOTEMPORAL PARAMETERS AT DIFFERENT RUNNING VELOCITIES

Mann, R., Malisoux, L., Urhausen, A., Meijer, K., Statham, A., Brunner, R., Gette, P., Theisen, D.

*CRP-Santé*

Introduction When running, higher speed can be achieved by increasing stride length (SL), stride frequency (SF) or both. Increasing SL can lead to overstriding, which has been associated with higher braking forces and elevated injury risk [1]. Adopting a rearfoot strike (RFS) also generates greater impact forces compared to a forefoot strike (FFS) during running [2]. Strike pattern can be measured by the strike index (SI), i.e. the point of contact on the foot sole as a percentage of total sole length. A lower SI value means a more pronounced RFS

pattern. We aimed to explore changes in SI and spatiotemporal parameters under increasing running speed, hypothesising a decrease in SI and an increase in SL. Methods Participants were recreational runners selected from a convenience sample, all having performed an incremental, maximal exercise test on a treadmill. The incline was set to 0° and velocity was increased by 0.5 m/s every 3min. 38 participants (41±9 y, 1.77±0.08m and 77.1±11.5kg) were selected on the basis that they ran at 2.5, 3.0, 3.5 and 4.0 m/s. They were equipped with the Runalyser (TNO Eindhoven, The Netherlands), a pressure-sensitive insole device designed to measure pressure patterns and temporal parameters during running. Intra-subject changes in SI, contact time (CT), flight time (FT), stride time (ST), duty factor (DF, CT/ST), stride length (SL) and stride frequency (SF) were compared using repeated measures analyses of variance. Statistical significance was accepted at  $p < 0.05$ . Results The following significant ( $p < 0.001$ ) decreases were found when running speed increased from 2.5-4.0 m/s: SI [33.4-29.6%], CT [283-231ms], ST [749-693ms] and DF [37.8-33.7%]. SL [1.87-2.77m] and SF [80.3-86.9 strides/min] increased significantly ( $p < 0.001$ ), whereas FT [467-462ms] displayed no significant change ( $p = 0.261$ ). Discussion As hypothesised, runners increased SL with higher running speed, in spite of a significantly higher SF. This resulted in a more pronounced RFS pattern as indicated by the reduction in SI. As a consequence, greater running speeds will increase the risk of overstriding, thereby promoting injury risk through higher braking forces [1]. In how far SI, SL and SF are related to injury remains to be established. References 1. Lohman EB, 3rd, Balan Sackiriyas KS, Swen RW. Physical therapy in sport : official journal of the Association of Chartered Physiotherapists in Sports Medicine. 2011;12(4):151-63. 2. Lieberman DE, Venkadesan M, Werbel WA, Daoud AI, D'Andrea S, Davis IS, et al. Nature. 2010;463:531-6.

### EFFECTS OF ELASTIC TAPING ON PLYOMETRIC JUMPING PERFORMANCE IN KOREAN COLLEGE MALE STUDENTS

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Introduction Some of the recent research focused on applying elastic taping on a body to improve the jumping performance. The results, however, hardly confirm any positive influence the elastic taping may have on the performance (Lin, Huang & Huang, 2011; Murray, 2000). Therefore, the aim of this study is to investigate the effects of knee joint elastic taping on performance and kinematic of lower limbs in plyometric jump. Method Ten healthy college male students were selected and their 3D motion captures were sampled by infrared cameras. The participants were subjected to jump on the force platform with and without the Kinesio tape applied to both knee joints. Vertical ground reaction force (VGFR), center of mass (CoM) of total body, and range of motion (RoM) of the ankle, knee and hip joint were analyzed in the two conditions respectively. A paired t-test was conducted to compare the two groups. This research is based on the raw data from Shin(2013). Result Although there were no statistically significant differences in variables such as peak VGFR, range of CoM, height of CoM, peak velocity of CoM between the two conditions ( $p > 0.05$ ), the variables obtained from the condition with taping produced an increase. Both of the peak times of vertical displacement and of vertical velocity of CoM yielded the differences between the two conditions ( $p > 0.05$ ). There were no statistically significant differences in RoMs of 3D motion of joints between the two conditions ( $p > 0.05$ ), but the group with taping showed an increase except RoM of ab/adduction of hip joint. Discussion and Conclusion In this research, there were no statistically significant differences when the taping is applied to knee joints, but most variables in this research showed a consistent increase in the condition with taping. For instance, amplitude of VGFR was greater after taping. With regards of CoM, range, height, and peak velocity increased to 4.2%, 1% and 1.3%, respectively whereas peak times of height and velocity between two groups showed little change. The magnitudes of RoMs of ankle, knee, and hip joint also showed a little bit of increase in the three dimensional planes with a maximal increase of 3.7° in the flexion/extension of knee joint. Therefore, this research showed the latent positive effects the application of elastic taping has on the enhancement of the performance such as an explosive jumping task. Reference Fu, T. C., Wong, A. M. K., Pei, Y. C., Wu, K. P., Chou, S. W., Lin, Y. C. (2008). Effect of Kinesio taping on muscle strength in athletes—A pilot study. *Journal of Science and Medicine in Sport*, 11, 198—201. Murray, H. (2000). Kinesio Taping Muscle Strength and ROM after ACL Repair. *Journal of Orthopedic and Sports Physical Therapy*, 30, 1. Shin, J. M.(2013). Effects of taping on performance and lower extremities motion in plyometric vertical jumping. *Journal of sport and leisure studies*, unpublished paper.

### THE 3D KINEMATIC EFFICIENCY OF USAIN BOLT'S SPRINTING STRIDE

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Introduction The efficiency of sprinting velocity depend on the optimal proportion of starting phase, acceleration phase, maximal velocity phase and deceleration phase. Maximal velocity is one of the most important factors of sprint (Coh and Dolenc, 2008) and in 100m race it is mostly maintained from 60 m to 90 m. Biomechanical parameters of sprinting performance made on elite sprinters are important for the scientists and coaches. This study is conducted to obtain 3D kinematic parameters of sprinting strides of the top level male sprinter during the 100 m race. Methods The video acquisition was done in competition conditions during the 100 m race in Zagreb, Croatia (IAAF World Challenge Zagreb 2011). The subject of this study was Usain Bolt (height 196 cm; weight 86 kg) a world record holder on 100m and 200m (9.58 sec and 19.19 sec). Three miniDV digital cameras (Sony HDR-HC9E) operating at 50 frames per second filmed space on track between 65 m and 75 m. The space was defined by the cube (180cmx180cmx180cm) placed on track and filmed after the competition. 3D kinematic data calculations were done with APAS (Ariel Dynamics Inc., San Diego, CA) using a 15-segment model of sprinter's body (Dempster, 1955). Results Usain Bolt won this competition with 9.85 sec. His stride lengths of sprinting cycle left-right-left contact (from 63.42 m to 68.92 m of 100 m track) were 278.41 cm and 272.81 cm. The heights of the center of mass (CM) at touchdown (TD), amortization (AM) and takeoff (TO) during left foot support phase were 111.76 cm, 111.62 cm and 115.99 cm. The heights of CM during right foot support phase were 114.63 cm (TD), 113.31 cm (AM) and 115.04 cm (TO). The heights of CM during flight phases were 119.20 cm and 118.51 cm. The AM angles were 144.15° (left) and 131.71° (right). The horizontal projection of CM in braking phase was 21.42 cm on left foot and 14.56 cm on the right foot. In the propulsion phase the projection of CM was 65.36 cm and 65.68 cm. An average horizontal velocity of CM during observed strides was 12.36 m/sec which is 44.50 km/h. Discussion The efficiency and economic of Usain Bolts sprinting performance are confirmed by the 3D kinematic parameters. It can be noticed extremely small vertical CM oscillation during support and flight phases. The horizontal distance between toe and projection of CM at the instant of TD is also very small which helps to minimize velocity loss in the braking phase. The only disproportion is noticed at AM angle values where right knee AM angle is lower than left leg. References Bruggemann GP, Glad B (1990). Scientific Research Project the Games, of the XXIVth Olympiad-Seul 1988, International Athletic Foundation. Coh M, Dolenc A (2008). Faculty of Sport, Institute of Kinesiology, Ljubljana. Dempster WT (1955). Wright-Peterson Air Force Base, Ohio.

## THE INFLUENCE OF HILL'S FORCE-VELOCITY RELATION ON MUSCLE STRESS DURING EXERCISES WITH CONSTANT LOAD AND VELOCITY

Thaller, S., Penasso, H.

*University of Graz*

**Introduction** It is often assumed that by following a fixed protocol for exercise movements (e.g. performing a movement at a given constant velocity with a certain percentage of the 1RM or the maximal isometric force) equal stress is exerted to muscles of different individuals. However, there is a strong dependence on the individual Hill parameters of the muscles involved. Aim of this simulation study is to quantify the differences in muscle activation (MA) for a movement on a vertical leg press taking into account the individual shape of the force-velocity relation of the muscle. **Methods** To show the differences in MA we simulated two knee extension movements on a vertical leg press with two constant velocities  $k_1 = 0.55$  m/s and  $k_2 = 0.8$  m/s. A load corresponding to 70% of the isometric force was first accelerated with a maximal voluntary contraction to reach the velocity-value  $k_{1,2}$  as fast as possible. Then the velocity was kept constant and thus the load was pushed with constant force equal to the weight. We used a model with arbitrary but fixed Hill parameters (cf. Siebert et al., 2007; Thaller et al., 2010) and computed the contraction velocity (CV) as a function of time. Via Hill's force-velocity relation we got the corresponding muscle force for a fully activated muscle. In addition, we calculated the actual muscle force as a function of time according to the constant external force applied to the leg press. Comparing these two forces we got the percentage of MA during the movement in dependence of the force-velocity relation of the muscle involved. **Results** The maximal CV for  $k_1$  and  $k_2$  was 0.24 m/s and 0.36 m/s, respectively. The muscle force first increased, then decreased already during the acceleration phase. The MA started at 70%, went up to 96.3% and 98.2%, then decreased to 32.7% and 49.1% and again increased to 33.6% and 61.3%, respectively. **Discussion** Although both movements were performed at the same submaximal level of 70%, the percentage of MA ranged between more than 90% and less than 40% during the movement. This was not only due to the fact that the knee angle changed and therefore less muscle force for pushing was needed at the end of the movement but also due to the individual force-velocity relations of the muscles. The behaviour of the MA as a function of time crucially depends on the Hill parameters of the muscle. If the optimal contraction velocity ( $v = 0.19$  m/s in this case) is exceeded during the movement, the percentage of MA increases again. Therefore, for assessing the amount of active motor units the individual shape of the force-velocity relation of the muscles involved has to be considered. **References** Siebert T, Sust M, Thaller S, Tilp M, Wagner H. (2007). *Hum Mov Sci.*, 26, 320-341. Thaller S, Tilp M, Sust M. (2010). *Math Comp Model Dyn Syst.*, 16(05), 417-429.

## INDIVIDUALS WITH CURVY OR STRAIGHT LUMBAR SPINES EXHIBIT DIFFERENT MOTION PATTERNS WHEN LIFTING A BOX

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**Introduction:** We have recently used active shape modelling (ASM) to show that the lumbar spine has an intrinsic shape (I) which is maintained throughout flexion and extension. We earlier showed that when the shoulders are axially loaded straighter than average spines tend to straighten while curvier spines curve further (2). The affect of intrinsic shape on dynamic motion and load-bearing is unknown, but could have implications in sport and manual handling occupations where the incidence of low back pain is high despite training and lifting guidelines. **Methods:** This study investigated the effects of different intrinsic shapes on the natural motion patterns of 30 healthy adults during lifting. The lumbar spine was imaged in standing using a positional magnetic resonance imager (Fonar 0.6T Upright). ASM, a statistical model that uses principal components analysis, was used to identify and quantify 'modes' of variation in the shape of the lumbar spine (L1-S1). The main mode of shape variation (M1) describing the overall lumbar curvature was used to group participants into 'curvy' (lordotic) or 'straight' spines by their deviation from the mean shape (M1=0). Three dimensional motion capture (Vicon MX, Oxford Metrics) was used to examine how participants lifted a weighted box (6-15 kg, participant selected) without instruction. **Results:** Straighter spines exhibited higher knee flexion angles ( $r = 0.4$ ,  $P = 0.03$ ) typical of a 'squat' style of lifting. Peak knee flexion negatively correlated with measures of lumbar flexion ( $r = -0.5$  to  $-0.86$ ,  $P < 0.01$ ) and with forward pelvic tilt ( $r = -0.81$ ,  $P < 0.001$ ). Furthermore, in a comparison of the two extreme ends of spinal shape ( $\geq \pm 1$ SD from mean;  $n=8$ ) individuals with straighter spines had significantly higher peak knee flexion ( $U=0$ ,  $P=0.04$ ) and appeared to maintain their lumbo-pelvic posture for a greater proportion of the lift. Curvier spines tended to have more lumbar flexion ( $r=-0.79$ ,  $P=0.02$ ). **Discussion:** These results indicate that individuals with a greater than average lumbar curvature naturally tend to adopt a stooped posture when lifting a load, while those with a straighter lordosis primarily lift by bending at the knees with less flexion of the back. Although further analysis of other shape modes and internal lumbar forces is required, these novel results suggest that the intrinsic shape of the spine affects how we naturally move to pick up a load. This has implications for individualizing lifting guidelines and screening in sports and manual occupations in an attempt to reduce injury risk. **References:** 1. Meakin JR, et al. (2009). *J Anat*, 215, 206-211. 2. Meakin JR, et al. (2007). *J Biomech*, 40 (Supp 2), S270.

## KINEMATICS OF ATHLETE'S CENTER OF MASS IN SPRINTING AT VARIOUS FOOT ABDUCTION IN FIRST FOOT STRIKE

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**Introduction** The features interaction of foot and ground mostly determine efficiency of high speed run (Bates, 1983; Lee & Piazza, 2009). But now there aren't justified recommendations about optimal of foot abduction in first foot strike in sprinting. So the aim of this study was comparison of kinematic characteristics of athlete's center of mass (CM) in sprinting with forward and outward toes position. **Methods** Four male sprinters were tested for this study (age  $19.3 \pm 2.0$  years, body mass  $71.5 \pm 8.5$  kg, height  $182.8 \pm 7.2$  cm, 100 metres best  $11,23 \pm 0,25$  s). Every participants had two attempts in 50 metres maximal speed running: first attempts with comfortable foot position in first foot strike and second attempts with toes forward. 3-D video analysis (Qualisys, 6 cameras ProReflex with the frame rate 120 Hz) was used for evaluating kinematic characteristics of athlete's CM. The data were filtered with the 2nd order of lowpass filter (10Hz). Were analyzed kinematic characteristics of athlete's CM from takeoff moment of one leg to takeoff moment of other leg. Videotaping performed on 38-42 metres of distance. One-way analysis of variance was used to examine statistical differences of data. **Results** Value of foot angle in first attempt was significantly large than in second attempt ( $19.9 \pm 5.9^\circ$  and  $10.9 \pm 4.4^\circ$ ,  $p < 0.05$ ). However no significant differences ( $p > 0.05$ ) of following characteristics between run with both first foot strike techniques were found: average velocity of CM ( $9.30 \pm 0.35$  and  $9.12 \pm 0.20$  m/s), ground contact time ( $0.098 \pm 0.008$  and  $0.100 \pm 0.007$  s), flight time ( $0.146 \pm 0.014$  and  $0.152 \pm 0.015$  s), horizontal displacement of CM in direction of moving during ground contact time ( $0.83 \pm 0.09$  and  $0.84 \pm 0.08$  m) and during flight time ( $1.27 \pm 0.11$  and  $1.29 \pm 0.11$  m), vertical displacement of CM during ground contact time ( $0.02 \pm 0.00$  and  $0.02 \pm 0.00$  m) and during flight time ( $0.04 \pm 0.01$  and

0.04±0.02 m). Discussion Results of present study haven't shown what foot position toes forward or outward in the first foot strike in maximal speed run is better. Horizontal velocity of CM not increased significantly after decrease of foot angle. At the same time not all participants of this study really completed their task to turn toes forward. It is shown that foot position in first foot strike is strong skill and planting foot with zero angle (neutral position) can be reason of larger changes of kinematic characteristics of CM than in present study. References Bates, BT (1983). Foot function in running: researcher to coach. Proceedings of I International Symposium on Biomechanics in Sports. San Diego, USA, 293-303. Lee, SS & Piazza, SJ (2009). Built for speed: musculoskeletal structure and sprinting ability. *J Exp Biol*, 212(22), 3700-3707.

### NEURAL AND MECHANICAL ADAPTATIONS OF RHYTHMIC MULTI-JOINT COORDINATION DUE TO EXTERNAL INTER-ACTION TORQUE

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Rhythmic multi-joint coordination is influenced by the two constraints typical for multi-segmental coordination: interaction torque and multi-joint muscles (muscles that cross two or more joints). Interaction torque emerges in virtually all multi-joint tasks and the neural control also needs to be adjusted to the presence of multi-joint muscles. The effects of interaction torque and multi-joint muscles in multi-joint coordination are hard to discern. Typically, previous research has been focused on only one constraint, while trying to control the effect of another constraint on the studied coordination. In order to address the exclusive role of multi-joint muscles in rhythmic coordination, it is necessary to exclude the influence of natural interaction torque. The aim of the study was to explore how CNS adapts to artificially imposed interaction torques, by looking specifically into behaviour of elbow muscles during rhythmic multi-joint tasks. Elbow joint system with 2 independent degrees of freedom (DOF) of flexion-extension (FE) and supination-pronation (SP) was selected because of negligible influence of natural interaction torque (IT) and suitability to apply IT artificially using a robot motor arm. Subjects (8) were asked to produce in-phase movement pattern (simultaneous flexion-supination followed by extension-pronation), while an external IT was imposed at 90 degrees out of phase (i.e. the supination lagging relative to flexion). Five levels of IT were applied while EMG was recorded from 4 muscles (biceps, triceps, brachioradialis and pronator teres). Onset and half-relaxation time of linear enveloped EMG were analysed to quantify the time shift and the duration of EMG signal for different IT levels. A sine wave of muscular torque produced in the absence of IT and a sine wave of external IT were used to calculate the pattern of net muscle torques exerted in the presence of external IT (i.e. predicted net muscular torques). The results showed that EMG activity was correlated with the predicted net muscular torques. The onset of EMG activity shifted earlier with an increase in the level of IT. Namely, the phenomenon matched with the shift of the predicted net muscular torques, reflecting therefore flexibility of the CNS to adapt to resistive IT while preserving the instructed kinematics. Conversely, the activity pattern of multi-joint muscles (i.e. biceps and triceps) remained unaffected, which was probably enabled by the adaptation of the activity of single-joint muscles. In conclusion, this approach (a system with both a negligible own IT and a possibility to apply additional external IT) offers the way to test multi-joint muscles irrespective of IT which could be important for future rehabilitation purposes.

### 3D PATH OF THE BODY CENTRE OF MASS AND PROPULSIVE MUSCLES LENGTH CHANGE WHEN PEDALLING: RECUMBENT VS. UPRIGHT BICYCLE.

Telli, R., Seminati, E., Minetti, A.E.

*università degli studi di milano*

Introduction: Recumbent bike (RB) is a high performance human powered vehicle allowing man to reach speeds in excess of 130 km/h principally due to aerodynamic drag reduction (Wilson 2004). The change in posture of the rider moves the body centre of mass (BCoM) in a lower position compared to normal bicycle (NB) and also could lead the propulsive muscles to work at different lengths. Here we compared RB and NB at different cadences in terms of muscle length changes, 3D BCoM trajectory, internal and 'eventually additional' external mechanical work (EAEMW). Methods: Four subjects performed one minute of pedalling at different RPM (50, 70, 90, 105) on both bicycles placed on rolls. Lower limbs muscles lengths were estimated with the musculoskeletal modelling software OpenSim 2.4, from 3D kinematic data sampled at 100 Hz with an 8-camera motion capture system (VICON MX, Oxford, UK). 35 reflective markers were placed on subjects body landmark (Plug-In-Gate model) with two additional markers placed in correspondence of the greater trochanter for the evaluation of BCoM position and EAEMW. Results: In RB, when compared to NB, some muscles work nearer their optimal muscle length (from 1 to 12% nearer in RB among NB), while others farther (from 3% to 13%). The advantaged muscles (propulsive signed with P) are: biceps femoris longus (P), rectus femoris (P), vastus lateralis intermedius and medial (P), biceps femoris brevis (P), iliacus (P), psoas (P), semitendinosus (P), tibialis anterior (P), sartorius (P). The disadvantaged muscles: semimembranosus (P), soleus (P), lateral and medial gastrocnemius (P). BCoM 3D trajectory follows an elliptical profile in the sagittal plane (as reported by Minetti 2011), with different major axis inclinations for the two bicycles, but also shows some lateral displacement, the range of which increases with pedalling frequency. Mechanical internal work increased as a power function of pedalling cadence, for both bicycles, while EAEMW was always higher for RB. Discussion: Comparison between the two bikes shows some differences: the EAEMW is higher in RB (+42.13%), while the internal work is slightly lower (-11.63%) (probably due to a different BCoM trajectory), in line with the progressive reduction of internal work in cycling evolution shown by Minetti and collaborators (Minetti et al. 2010). Propulsive muscles in RB work either in a nearer or a farther part of optimal muscle length, likely balancing out the advantage/disadvantage due to the force-length relationships. References Minetti AE. (2011). *Eur J Appl Physiol*, 111, 323-329. Minetti AE, Pinkerton J and Zamparo P. (2001). *Proc. R. Soc. B*, 268: 1351-1360. Wilson DG (2004). *Bycycling Science*. Cambridge, MA: MIT Press, 188.

**15:00 - 16:00****Mini-Orals****PP-BN12 Coaching [CO] 3****RELATIONS BETWEEN LEGS-ONLY AND FULL STROKE SWIMMING IN VARIOUS SWIMMING STYLES**

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**Introduction** Some researchers consider that the role of legs in swimming is negligible, especially in front crawl. Most of the research has concentrated on front crawl or breaststroke styles. The purpose of this study was to investigate the relationship between swimming speed achieved using full stroke, and swimming speed achieved using legs-only, in four different swimming styles. **Methods** Sixty-eight well conditioned male swimmers aged 16-18 participated in this study. The subject swam "all-out" 25 m and 100 m distances four times, using each of the four styles (crawl, backstroke, breaststroke and butterfly) starting from the water. Each of the swimming styles was performed on the same day (25 m + 100 m) with a 15 minutes rest period. Two days later, the procedure continued by legs-only swimming, all styles on the same day with 15 minute rest periods. **Results** The statistical analyses were performed using Statistica 10.0. The mean full stroke swimming times (in seconds) were: 100 m crawl = 59.13±3.46, 100 m backstroke = 69.13± 6.04, 100 m breaststroke = 77.65±5.27 and 100 m butterfly = 69.68±6.71. Mean times for 25 meter swims were: 25 m crawl = 13.54±0.60, 25 m backstroke = 15.92±1.11, 25 m breaststroke = 18.49±1.23 and 25 m butterfly = 15.27±1.17. Times for legs-only swimming were: 25 m crawl = 19.50±1.88, 25 m backstroke = 19.99±2.66, 25 m breaststroke = 22.28±1.49 and 25 m butterfly = 20.27±2.47. The results indicated that correlation coefficients between legs-only swimming times and full stroke swimming times across various distances are similar. When comparing different styles it can be noticed that front crawl has the lowest correlation coefficients (0.40 and 0.38 for 100 meters and 25 meters, respectively). The highest correlation coefficient was observed for breaststroke (0.55 and 0.71 for 100 meters and 25 meters, respectively). For butterfly style, the correlation coefficients were 0.59 and 0.54 for 100 meters and 25 meters, respectively) and for backstroke 0.47 and 0.46 for 100 meters and 25 meters, respectively. **Discussion** The results showed that legs-only swimming may be a good indicator of full stroke swimming speed for butterfly and breaststroke styles. In front crawl and backstroke, this influence is less pronounced. Relationships in different swimming distances are similar. **References** Deschodt VJ, Arsac LM, Rouard AH.. (1999). *Eur J Appl Physiol Occup Physiol*. Mehmet ÖZ, Bahtiyar Ö. (2009). *Serbian Journal of Sport Science*. Shahbazi MM. (2006). *Proceedings; . XXIV ISBS 71-4*. Shahbazi MM. (2007). *Proceedings; . XXV ISBS 208-11*. Shahbazi MM. (2008). *Proceedings; . XXVI ISBS 58-61*.

**HOW SPORT COACHES IDENTIFY AND DEVELOP TALENT IN CHILDREN AND YOUTH**

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**Introduction** Sport coaches' thinking about talent is likely to influence how children and adolescents who participate in leisure sport activity-programs are stimulated (Gagné, 2000). The coaches' thinking may reflect socio-cultural assumptions which can be more or less in discrepancy with research-based knowledge. Therefore, the aim of this study is twofold: (i) to establish research-based knowledge of the criteria used by coaches when identifying the talented child or young person, and (ii) to provide for knowledge and greater understanding of how talent is developed and stimulated in qualified ways. **Methods** Exploratory Interviews (semi-structured) with the research participants (sport coaches) were based on an interview guide designed to ensure both comparability and completeness, using a similar approach as Martindale et al. (2006), adjusted to our study. Six experienced sport coaches were selected, from swimming, gymnastics, and football resp., all training 10- to 15-year old boys and girls. **Results** Three themes emerged: (1) Personal characteristics/psychological factors; (2) Body characteristics; and (3) Social characteristics. The coaches emphasize (1a) talented youth learns things fast; is willing to learn and train; is motivated; (1b) the significance of the coach as a motivator, care person, conversation partner, and role model; and parental support; (2) bodily conditions; (3) the importance of comprehensiveness; variation; motivational climate; and safety, growth, and challenge. **Discussion** Our findings support that the concept and understanding of talent are compound (Abbott & Collins, 2004). The significance of the coach as a motivator and the motivational climate correspond with empirical research based on achievement goal theory and self-determination theory (Duda, 2001; Deci & Ryan, 2000). Our research was limited to coaches' statements. **References** Abbott, A., Collins, D (2004). Eliminating the dichotomy between theory and practice in talent identification and development: considering the role of psychology. *Journal of Sport Sciences*, 22, 395- 408. Deci, E. L., Ryan, R. M. (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11, 227-268. Duda, J. L. (2001). Achievement Goal Research in Sport: Pushing the Boundaries and Clarifying Some Misunderstandings. In: Roberts, G. C. (Eds.), *Advances in Motivation in Sport and Exercise*; chapter 5 (p129-182). Gagné, F. (2000). Understanding the complete choreography of talent development through DMGT-based analysis. In: K.A. Heller (aut.). *International handbook of giftedness and talent*. 2nd ed. Oxford, UK: Elsevier Science Ltd (p. 67-79). Martindale, R., Collins, D., Abraham, A. (2006). *Talent development: Elite coach perspective*. Napier University, School of Life Sciences. Edinburgh, UK.

**THE PARENTAL SUPPORT IN THE CAREER OF BRAZILIAN GYMNASTS PARTICIPATING IN THE OLYMPIC GAMES <1980-2004>: THE GYMNAST'S VIEW**

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**THE PARENTAL SUPPORT IN THE CAREER OF BRAZILIAN GYMNASTS PARTICIPATING IN THE OLYMPIC GAMES (1980-2004): THE GYMNAST'S VIEW** **Introduction** This abstract is part of a wider research made about the sports career of all the women Brazilian gymnasts participating of Olympic Games in Artistic Gymnastics, from 1980 to 2004, which objective was to register and analyze this process of formation (Schiavon, 2009). In this poster, we will analyze the parental support in the career of gymnasts. This aspect has been highlighted, many times, as determinant in the preparation of the athletes (Ewing et al, 2002; Cummings, Davies and Campbell, 2000). **Method** In this qualitative research it was used the Oral History method (as there is no available data about some aspects of the modality in Brazil), with

the techniques of "oral testimonials" and crossed analysis (Thompson, 2002), and non-structured interviews (Laville and Dionne, 1999). The selection criteria was: Brazilian gymnasts participating in the Olympic Games till 2004 (GAF). Subjects: 10 gymnasts (100% of the universe), since the first Brazilian participation in Olympic Games in 1980. Results and Discussion It was found that all gymnasts had significant parental support, their families offered a stable structure so they could concentrate on training. The family was often decisive in the process, especially in relation to motivation to continue their daily training and also stimulating them at crucial moments, most important life of a child / athlete. And eight out of the ten gymnasts mentions their parents as the people who know most about their sporting careers, demonstrating complicity and support. From the high incidence of positive aspects in relation to family support, it is possible to conclude that this was an important aspect in the formation of gymnasts, especially because of the peculiarities of the modality (early onset, injuries, risks etc.); and that should be considered, mediated and encouraged by the coaches. References Cummings EM, Davies PT, Campbell SB. (2000). Developmental psychopathology and family process: theory, research and clinical implications. New York: Guilford. Laville C, Dionne J. (1999). A construção do saber: manual de metodologia da pesquisa em ciências humanas. Artes Médicas Sul, Porto Alegre. Ewing ME et al. The role of sports in youth development. In: Gatz M, Messner MA, Ball-Rokeach SJ. (2002). Paradoxes of Youth and Sport. Suny Press, Albany, 31-48. Schiavon LM. (2009). Ginástica artística feminina e história oral: a formação desportiva de atletas brasileiras participantes de Jogos Olímpicos (1980-2004). Doctoral dissertation, Campinas, São Paulo, Brazil: State University of Campinas. Thompson P. (2002). História oral: a voz do passado. 3 ed. Paz e Terra, Rio de Janeiro.

## A STUDY ON THE ADVANTAGES AND DISADVANTAGES OF STUDENT ATHLETES AS FEMALE STUDENTS

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**Introduction** The purpose of this study was to understand the difficulties female students had as student athletes. For that purpose, the study set the following research questions: first, what kind of advantages and disadvantages do female students have by doing sports in terms of exercise and instructor? Secondly, what kind of advantages and disadvantages do female students have according to the gender of instructor? **Methodology** The subjects include 140 female students at physical education middle and high schools in G and J Province. Research tool was an open-ended questionnaire. As for data gathering, questionnaires were distributed to the students, who were asked to fill them out. Their answers were classified by item, encoded, and put to inductive category analysis for data analysis. **Results** First, the advantage of being a student athlete as a female student most cited by the respondents was the positive perception of body changes, which was followed by the positive perception of oneself and others. As for disadvantages, the respondents had a relatively high negative perception of their body changes and appearances. Secondly, as for their advantages and disadvantages as female students according to the gender of instructor, many mentioned good sport instructions and more consideration for female students as the advantages of having a male instructor. On the other hand, they experienced such disadvantages as male instructors being difficult to talk to and being unable to understand women. The advantages of female instructors include understanding female students based on good knowledge of women and further having sympathy for them. However, over familiarity with women also had negative aspects as the respondents mentioned privacy violation and excessive meddling as the disadvantages of having a female instructor. **Discussion** In short, the vulnerability of female student athletes due to their female features or physical strength, body changes, and physiological phenomena have negative effects on their athletic life. Student athlete interest in the body and appearance is a type of self-management (Seong Min-gyeong and Jang Yeon-jip, 2006) and can have positive influences on an athlete's satisfaction and performance (Jin Myeong-su, 2012). It is thus required to instruct female students not to have excessive interest in their appearances and, at the same time, form a positive perception of themselves. The research findings also confirm that female student athletes have a considerable amount of difficulty according to the gender of instructor. An instructor has the biggest influence on young student athletes and can cause changes to them (Im Ji-hun, 2008), which means that field instructors need to have a serious contemplation over what to teach them and how to deal with them.

## COACHING AT SWEDISH RIDING SCHOOLS - FROM MILITARY PRACTICE TO A SPORT FOR GIRLS

Thorell, G.

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**Introduction** Equestrian sport in Sweden has a long tradition within the military academy until the end of 1960s, when the equestrian sport became formed by civilians and an increasing number of women began to be educated to riding instructors (Hedenborg, 2009). Today almost 500 riding schools provide education in riding and horse caring and play an important role as a leisure activity, especially among young girls. In Sweden, sport and leisure activities for children are supported by the government and that is why education at riding schools are not exclusively for the wealthy as in many other countries (Forsberg & Tebelius, 2011). Coaching and pedagogics in equestrian sport have traditionally been formed by military commands and instructions, so the aim of this study is to explore riding instructors' experience and perceptions about coaching at riding schools and if there has become a change due to the shift from military to girls. **Methods** A constructivist grounded theory method have been use to collect and analyzed the data material from interviews with ten riding instructors with more than ten years of experience at their riding school. The constructivist approach of grounded theory is based on the scientists who produce knowledge based on the interpretation of the informants' actions and behavior (Charmaz, 2009). Thus, the result can be seen as an interpreted portrait of the studied world, not an exact picture of it. **Results** The result shows that the way to perform the lessons and the language are very much the same as the military tradition but the riding instructors considered that there has been a pedagogical change over time. Today they stressed the importance of listening to the pupils and create new activity besides the traditional riding lessons. **Discussion** This main result is explained by impact of the changing market conditions and increased competition from other sports and interest that the riding instructors adapt their way of coaching. In conclusion this generates a new way of coaching at riding schools with a more individual and social focused form of coaching which shows that there is a development ongoing in Equestrian sport. **References** Charmaz, K. (2009) Shifting the Grounds. J. M. Morse, P. Noerager Stern & J. Corbin (Eds). Developing grounded theory: The second generation. Left Coast Press Inc. Forsberg, L & Tebelius, U. (2011). The riding school as a site for gender identity construction among Swedish teenage girls. World Leisure Journal, 53:1, pp 42-56. Hedenborg, S. (2009). Unknown Soldiers and Very Pretty Ladies: Challenges to the Social Order of Sports in Post-War Sweden. Sport in History. Vol 29, No 4, April 2009, pp 601-622.

## PREPARING AN EXPEDITION - PERFORMING IN UNCERTAIN ENVIRONMENTS

Fernando, C., Lopes, H., Vicente, A.

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**INTRODUCTION** When preparing and organizing an expedition it is important to understand how the performance of the participants will be influenced by the conditions in which they will have to act and take decisions. This work continues previous studies (Fernando et al., 2010) with cold, mud and dust, and how these conditions influence decisions, even very simple decisions. To easier compare the results we kept, as possible, the same methodology. Uncertain conditions are present in several sport environments, mainly in Open Spaces Sports and in Environments Adaptation Sports. **METHODS** To a sample of 20 people aging between 21 and 25 years, we presented on a paper a test of 60 arithmetical operations (additions, subtractions, divisions and multiplications), with numbers equal or inferior to 5, distributed randomly. Participants should perform these arithmetical operations with two sorts of objectives: 1- first of all to make no mistakes; 2- to do it as quickly as possible. But in one of the situations participants also have to be aware of a ball in the top of a table that can never fall down. The sample was divided in two groups of 10 and 10, randomly. One group, group A, answered to the test, always the same test, first comfortably sitting at a table, indoors, and then, second, the same test but with a ball on a table at 1 meter distance and having the information that if the ball moves they have to prevent it from touching the floor (it never happens but they don't know) – priority to the test. The other group, group B, did the same situation but in the reverse order. So after doing the second test (with the ball) they had half an hour rest and then answered the same test in the same comfortable situation indoors. We've measured the time of each participant and the total of errors committed by all the members of each group. **RESULTS** Group A - the average time in uncertain conditions was 15% higher than indoors in comfortable conditions. Results showed a much wider distribution in the uncertain conditions situation (with the ball). While in indoors conditions there were practically no errors (less than 3.5% of the total), in uncertain conditions there were 12% of errors. Group B - the average time in uncertain conditions was 19% higher than in the situation with the ball. Results showed a much wider distribution in uncertain conditions (with the ball). While in the situation without the ball there were practically no errors (less than 2% of the total), in uncertain conditions there were 15% of errors. **DISCUSSION** Performance was influenced by uncertain conditions so we must know what to expect and the influence it can have in the activities. This knowledge is an essential tool to organize and plan an expedition because it allows us to define the limits within which this type of activity can occur in order to preserve the safety of sportsmen and ensure their ability to respond to happenings. **REFERENCES** Fernando, C., Vicente, A., Lopes, H. & Almada, F. (2010). 15th ECSS, pp.473-474.

## SOMATOTYPE IN RUNNERS AND PARTICIPANTS IN ADVENTURE RAIDS

Perez Ruiz, J.A., Escaño Lopez, H.

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**INTRODUCTION:** Adventure raids it's a newfangled sport which increased the number of licenses since 1993, year of the founding of the Federation, 975 licenses, at 2011, 18,324 licenses. (Memory 2011, CSD, "<http://www.csd.gob.es/csd/estaticos/asoc-fed/historico-de-licencias.pdf>") It is defined as a multidisciplinary competition designed to test the ability of resistance, navigation and survival of the team in complete autonomy. The teams must complete an extensive orientation tour, in the shortest time possible, overcoming natural difficulties, which are on their way, using only their own forces, without receiving aid, or use motorized means. (FEDO, 2011). The different stages are: career, mountain biking and canoeing. Special tests are normally declines or vertical ascents (abseiling, climbing, Tyrolean traverse, archery, ...). The profile of the participant in raids is varied. In terms of gender we find a 84.2% correspond to men and 15.8% to women. (Baena Extremera. A, 2008) In regard to the age, it reveals that the predominant groups are 20 to 30 years (51.8%) and 31 to 40 years (41.9%) (Baena Extremera. A, 2008) The analysis of athletic performance is an area of Sport Sciences is dependant for the investigation of the current performance of sports or performance in training, in the specific context where it develops (O'Donoghue, 2010). This must be set the factors influencing the performance of objectively determining the selection criteria, which include anthropometric variables. (Bompa, 1987; Kutsar, 1992; Kunst y Florescu, 1971, cited in Bompa, 1987) From decades ago, different studies have made sufficiently clear that anthropometric profile is a very important target for sporting success factor. (Rocha, 1975, cited in Esparza y col., 1993) The study of body composition provides us valuable information about the structure of an athlete at a particular time of the season and on the effect of the training. (Battistini y col., 1996; Villa y col., 2000; Withers y col., 1997; Gambarara y col., 1994). **METHOD:** The measurements will be carried out in adventure Raids Extremadura League competitors. Taking as shown in 20 competitors from different categories and gender. The measuring instruments used to conduct the assessment are skinfold or compass of skinfold thickness, thickness gauges and metal tape. The measurements were carried out in the same place, by the same explorer following all corrections by the Spanish group of Kinanthropometry. (Esparza y col., 1993) The evaluation will take place at the end of the day's competition. Weight, age, and size-related data will be collected through a sociodemographic questionnaire. Anthropometric measures to take are: skin folds (triceps, bicipital, subscapular, suprailliac), perimeter (biceps flexed and leg) and diameters (femur biepicondylar and humerus biepicondylar). The technical measurement error considered as good is set at a maximum of 5% for the folds and a maximum of 3% for diameters and perimeters. (Sillero Quintana M., 2004) ere

15:00 - 16:00

## Mini-Orals

## PP-SH05 Physical Education and Pedagogics [PP] 3

**MENTORING CONVERSATIONS IN PHYSICAL EDUCATION- CONTENT AND PROCESSES IN FIELD WORK IN INITIAL TEACHER EDUCATION**

Næsheim-Bjørkvik, G., Helgevold, N., Østrem, S.

*University of Stavanger*

**Introduction** This presentation reports from a study of mentoring conversations in student teachers' field work within initial teacher education (ITE). We ask what affordances can be depicted when studying mentor conversations in Physical education field work. What is at the core in such conversations and how do the mentors and students talk about physical education in question? What do student teachers possibly learn by taking part in such conversations? **Methods** This study is a part of a larger project on students learning, TasS (Teachers as Students) 2012 – 2014, at the University of Stavanger, Norway. The primary objective of this project is to develop a research-based approach to enhance students' teaching in ways that promote pupils' learning and inclusion. Data collection has included focus group interviews with student teachers, mentoring conversations and lessons led by student teachers, all video-recorded. This presentation is based on 12 video recordings related to pre- and post-supervision and lessons led by students in physical education. We have developed a system for observing and quantifying activities in mentoring conversations. Also the observed categories are recorded in a binary form, stating what is "absent" or "present" during the period of observation, a tool that made it possible to get an overview of a complex material. **Results** Our system of observing has made it possible to compare activities and content in mentoring conversations across student groups, mentoring teachers and subjects. It has also been a starting point for more qualitative analyses. Findings show great variation between how these mentoring conversations are developing (what form of conversations; dialogue – monologue, instruction – co-production, information seeking – reasoning), and also to what is spoken about (pupil oriented, subject oriented, task oriented, general pedagogic oriented conversations). At the core of these conversations task oriented topics are dominating, while pupil oriented and subject oriented references are scarce. Attention is focused on student teachers' "doings", and little awareness of pupils' learning can be depicted. Never the less conversations show variations. **Discussion** Our analyses has made it possible to gain insight into students' knowledge of teaching Physical Education. There is reason to suggest that mentoring will not necessarily serve as scaffolds in students' professional development. The interplay between students and mentors and their use of tools seem to be crucial. In the poster presentation variations between conversations related to this interplay will be further discussed. **References** Gibson, J. (1979). *The Ecological Approach to Visual perception*, Boston : Houghton Mifflin Stone, C.A. (1998) *What is missing in the metaphor of scaffolding?* I D. Faulkner, K. Littleton og M. Woodhead (red.) *Learning relationships in the classroom*. London and New York: Routledge Vygotsky, Lev S. 1999. *Thought and language*. Cambridge, MA: The MIT Press.

**MINIMAL GUIDANCE LEARNING FOR PHYSICAL EDUCATION IN A SCOTTISH SECONDARY SCHOOL**

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**Introduction** It has been recognised, that a traditional, linear model of teaching may not necessarily be the most effective in physical education scenarios, where game-play and understanding are as important as the learning of specific skills. However, attempts to alter approaches to teaching are not always forthcoming or well reported. This paper reports on a small-scale teaching intervention, which implemented a minimally guided teaching approach to a six-week handball activity block. **Methods** Two classes of equal age and ability were used in the intervention, based around a handball teaching block. One class followed a normal curriculum, using a traditional teacher-led teaching approach. The other class was given a task brief, and although supervised, was given no assistance from the class teacher. After the six-week block, the classes competed against each other under normal supervision. Teachers provided qualitative analysis of performance, and a small focus group with pupils was completed after the teaching block. **Discussion** During the first session of the intervention, students were provided with access to computer terminals, and used the internet to research the regulations and skills required for handball. During the teaching block, the intervention class teacher noted that participants were continuing to use the internet and other media sources, to develop their understanding of the game. It was also noted that this was not something usually done by students in relation to other sports. Teachers observing the final session of the block reported that individuals from the intervention group demonstrated greater teamwork, organisation and apparent tactical awareness than those in the control group, with no apparent difference in technical skill ability. Students involved in the project reported that although initially they found the task difficult because of the lack of direction, as they became more familiar with the game, they expressed feelings of excitement that they were able to dictate their own learning, and organise their own practice sessions. They also reported that they drew on skills and knowledge from other sports, in order to improve their handball gameplay, which they did not usually contemplate following a teacher-led approach. In this way, the students were able to develop a deeper understanding of the game, demonstrating some criticality in considering, selecting and modifying appropriate concepts from other team games. This case study indicates that a heavily student focused, minimally guided approach may be an effective tool in the development of student ability in some team games.

**CORRELATES OF PHYSICAL ACTIVITY IN PRESCHOOL CHILDREN**

Roettger, K.1, Grimminger, E.1, Kreuser, F.1, Assländer, L.1, Korsten-Reck, U.2, Gollhofer, A.1

*University of Freiburg*

**Introduction:** Physical activity (PA) is important for preschool children's health including their weight status and motor and psycho-social development. PA behaviors are already established in preschool years and track from early childhood into adolescence (Herman et al. 2009). To create well fitted future interventions and public health programs, factors associated with physical activity have to be analyzed. The present study sought to identify multidimensional correlates of preschool children's physical activity. **Methods:** In N=117 preschool children PA was measured over 7 days using accelerometry. Proxy-report diary and physical-activity and spare-time questionnaire were

completed by parents. Anthropometrical data (weight, height, BMI) and socioeconomic data were obtained. Timetables and curricula of two different models of child-care were analyzed. Multi-regression-models were used to identify constructs potentially associated with preschool children's physical activity. Results: Correlates of physical activity were found across all the domains of the potential factors and varied between week and weekend days. On weekday the kind of child-care (open concept vs. desk based), and socio-economic status (SES) had influence on PA. Desk-based teaching versus an open concept in child-care leads to more inactivity ( $p < 0.05$ ) and children with lower SES were more passive in the afternoon if cared at home ( $p < 0.05$ ). A variance of 88% was explained through the regression model ( $R^2 = 0.88$ ) using the PA on weekend as dependant variable. The highest influence on PA on weekend was given by the BMI of the child, the number of brothers and sisters, TV-consumption of parents and child and the family state and income of both parents. Children with a lower BMI, more brothers and sisters, less TV-consumption and with married parents were more active. Additionally the factors high income of the father and lower income of the mother had also a significant influence on PA on weekend. Discussion: PA-affordance seems to be supported by a kind of "traditional higher SES" family background, meaning one adult responsible for promoting PA in context with other children and responsible for observing screen time at home. In child-care "open concepts" with caregivers skilled in PA should be preferred for enhancing PA (Reilly 2010). Herman, K. M., Craig, C. L., Gauvin, L., & Katzmarzyk, P. T. (2009). Tracking of obesity and physical activity from childhood to adulthood: the Physical Activity Longitudinal Study. *International journal of pediatric obesity*, 4(4), 281-8. Reilly, J. J. (2010). Low levels of objectively measured physical activity in preschoolers in child care. *Medicine and science in sports and exercise*, 42(3), 502-7.

### THE IMPLEMENTATION OF PROBLEM BASED LEARNING STYLES TO TEACH THE COACH-ATHLETE RELATIONSHIPS TO UNDERGRADUATE SPORT AND EXERCISE SCIENCE STUDENTS

Rossato, C.J.L.

*Canterbury Christ Church University*

**Introduction** The central components of problem based learning consist of students working in groups to provide a possible solution and that the focus is on the process of problem resolution as well as the actual solution (Savin-Baden, 2003). A meta-analysis by Dochy et al (2003) found that there was a significant and positive effect on student's skills when using problem based learning styles, and that students engage with slightly less knowledge but retain more knowledge and elaborate more on information than those taught traditionally. There was also a positive effect on student skills that was immediate and lasting. **Methods** This study attempted to explore whether problem based learning styles are suited to lecturing Coach-Athlete relationships. Sixty four (39% female, M age=22.64, SD=2.02 and 61% male, M age=24.30. SD=4.86) students attended a lecture on the topic of Coach-Athlete relationships, a problem based learning task was implemented using images of a coach showing a hostile approach and another image of a coach using a friendly approach. These images were used to initiate discussions about the potential problems the scenarios could elicit. At the end of the session students filled out an evaluation sheet regarding their thoughts about the session's ability to aid learning and whether they felt it was preferred over a traditional style of lecturing as well as their enjoyment of the session. **Results** Eight one percent ( $n=52$ ) of participants found the task helpful to aid learning, 65% ( $n=42$ ) participants indicated that using this style of lecture could aid learning more than a traditional approach and 73% ( $n=47$ ) participants enjoyed the task. **Discussion** It maybe useful to use problem based learning styles in lecture sessions to engage students with the topic area of Coach-Athlete relationships. Problem based learning could also be used to help develop transferable skills for those students who want to pursue a career in coaching. Skills such as problem solving and working within a team in a Coach-Athlete environment are invaluable as communication plays an important part in the Coach-Athlete relationship (Philippe and Seiler, 2006). **References** Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003) ' Effects of problem based learning: A meta-analysis. ', *Learning and Instruction*, 13 pp. 533-568 Philippe, R.A. & Seiler, R. (2006) Closeness, co-orientation and complementarity in coach-athlete relationships: What male swimmers say about their male coaches. *Psychology of Sport and Exercise*, 7, 159-171 Savin-Baden, M. (2003) 'Disciplinary differences or modes of curriculum practice? Who promised to deliver what in problem-based learning?' *Biochemistry and Molecular Biology Education*, 31 (5), pp. 338-343

### ANALYSIS ABOUT THE CONCEPTUAL RELATION BETWEEN SPORT AND GYMNASTICS FOR ALL

Toledo, E., Schiavon, L.M., Paoliello, E.

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**ANALYSIS ABOUT THE CONCEPTUAL RELATION BETWEEN SPORT AND GYMNASTICS FOR ALL** **Introduction** Brazil has expanded, in the last decade, the publications, events and practices of Gymnastics for All (GFA), which can be seen through many indicators, including the artistic and academic production of the six editions of the International Forum of General Gymnastics (FIGG). In this context, we aim to expand our research about the concept of GFA, and their approaches and detachments with the concepts of sport. **Method** This research is characterized as bibliographical and documentary, using the technique of data interpretation (Gil, 2007). Database: Scielo Sport (articles) and CAPES portal (theses and dissertations), with the following keywords: sport, general gymnastics and gymnastics for all. In addition, all Brazilian books that were specific about GFA (4) and all the annals from FIGG (6) that were available in Gimnica Virtual Library, have been researched. **Results and Discussion** Three clear concepts on GFA were found in: Gallardo e Souza (1992 apud Souza, 1997), Santos e Santos (2001) e Ayoub (2003), which comprise it respectively as: manifestation of body culture, gymnastic field and corporal practice. There are not, in any of them, approaches with the classic concept of sport. Some Brazilian authors hold that detachment, to emphasize the cultural, inclusive, creative and autonomous aspects of GFA (Paoliello, 2008; Toledo, 2005), in the opposite direction of a competitive logic and of a gesture standardization, a characteristic of the modern sport. However, that understanding differs, in some ways, from other countries, among them are :Germany (Hartmann, 2003); Japan (Tatsuo, 2012), Hong Kong (Cheung, 2012), that shows the need for further discussions on a national and international level. **References** Ayoub E. (2003). *Ginástica Geral e Educação Física Escolar*. Unicamp. Capes. Chueng S Y. (2012) *General Gymnastics in Hong Kong*. In: *Anais VI FIGG*. 39-44. Gil AC. (2007). *Métodos e técnicas de pesquisa social*. 5a. ed. Atlas. Gimnica – Biblioteca Virtual de Ginástica, Hartmann H. (2003) *General Gymnastics – the conception and its prospects for the future development in our modern world of sports*. In: *Anais II FIGG*. 21-28. Paoliello E (org). (2008). *Ginástica Geral: experiências e reflexões*. Phorte. Santos JCE, Santos NGM. (1999). *História da Ginástica Geral no Brasil*. JCE dos Santos. Scielo. Souza EPM. (1997). *Ginástica Geral: um campo de conhecimento da Educação Física*. Doctoral dissertation, Campinas, São Paulo, Brazil: State University of Campinas. Tatsuo A. (2012) *General Gymnastics in Nippon Sport Science University (NITTAIDAI)*. In: *Anais VI FIGG*. 58-63. Toledo E. (2005). *A Ginástica Geral e a Pedagogia da Autonomia*. In: *Anais do III FIGG*, 73-77.

**TAXONOMIC AND COMPARATIVE STUDY OF MOTOR PLAY. HOMO LUDENS AND TRANSCULTURALITY**

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Introduction Play is not a simple human expression of culture, is the main factor for humanity structuring processes (Huizinga, 2000). The culture 'is playing' and finds its essence inside the human play. The man, the most social animal in the world, built himself as a Homo sapiens and faber due to its fun nature. Thus, play takes part in the development process of all societies and draws its history and its personality. Several studies have focused on motor play to describe the how homo ludens express its profile (Henricks, 2008; Pellegrini, 2009; Roopnarine, 2012; Corsaro, 2012). Hence, the main aim of the study was to analyze the internal structure of plays practised by different cultures from Europe, Africa and Center-South America. Methods 546 traditional motor games were analyzed using the COMET taxonomic model (Bantulă, 2012). The distribution of games per country was Catalonia (210), Colombia (101), Morocco (81), Peru (61) and Dominican Republic (93). The model takes into account the presence and the absence of the following factors: teammates and opponents, competition, external materials and space. Results The main finding of the analysis was the coincidence in the nature of the game concept through the different cultures. We could observe that 90% of cases were sociomotor games, 75% were without teammates, 70% were with opponents and 80% were competitive games. Thus, the profile of the recreational behaviour of cultures describes a sociomotor game played without teammates, against opponents in a competition. Besides, the use of external material is an important factor of this profile. From 33% to 66% of the different game catalogues of the different cultures reflects the use of external materials. Furthermore, the use of external materials is linked with sociomotor game (from 70% to 90% of games with opponent uses external materials). On the other hand, the cooperative play was the recreational manifestations with less external materials use (Catalonia 1%, Colombia 10% Morocco 4%, Peru 0% and Dominican Republic 2%). Discussion The important degree of coincidence observed in the different play culture of the countries analyzed contributes to idea that humans play in a similar manner. According to Huizinga (2000), Homo ludens keep a certain isomorphic and transversal behaviour through the different cultures. This finding contributes to the idea that we can study the different cultural manifestations from a transversal point of view. References Bantulă, J. (2012). [Traditional motor play: taxonomic and comparative study], LAP LAMBERT Academic Publishing GmbH & Co. KG. Corsaro, W. (2012) *Am J Play*, 4:4, 488-504. Hendricks, T.S. (2008) *Am J Play*, 1 (2), 157-180. Huizinga, J. (2000). *Homo ludens*. Alianza Editorial. Pellegrini, A.D. (2009) *The Role of Play in Human Development*. Oxford University Press. Roopnarine, J.L. (2012) *Int J Play*, 1 (3), 228-230.

**MY CONFESSION: NARRATIVE OF A TENNIS COACH**

Kim, J.

*Andong National University*

Introduction The purpose of this study is to analyze my experiences as a tennis athlete and a coach via life history research and narrative method. For this research questions are three. First, what influence do the experiences as an athlete have on the student athlete's life? Second, does tennis coach's contextual life improve him as a professional? Third, what suggestions does the understanding of my experiences make to tennis education context, particularly in relation to athletes and coaches' society? Methods It is not too much to say that tennis accounts for 99% of my life because most of my experiences are tennis related as far as I can remember. Data collected from the third grade in elementary school when I started tennis to a 28-year-old tennis coach were arranged in 'student athlete period' and 'coaching period' respectively. Data consist of self-stories as a coach, the conversations with my students when training, memos with other coaches, pictures and books, were 80 pages, revised and edited over ten times. Data analysis was inductive method. The revision and complement was accomplished by mixing domain analysis and taxonomic analysis. Results and Discussion The results of this study were as follows. First, my abilities as a coach were found. Coach is an educator, not simply a trainer who only controls and demands from his athletes. Second, physical punishment and the verbal abuse should be eliminated when coaching because athletes have been treated only as exercise machines with such violence. Third, the coach as an occupation was found. Will the student athlete be a good coach if he only performs well in matches? It is often the case that the student athlete does not attend classes and only does exercise. Is it proper that the performance is the only requirement for applying to the coach? It is necessary to regard a coach as an educator who teaches and respects students. Therefore, coach as an educator should reflect upon himself and his practices. This study is based on my experience as an athlete and a coach, serves as a useful introduction to anybody who is interested in improving coaching skills and who is inclined to know himself as a coach. The fact that this self-study and makes the life history of a tennis coach meaningful deserves our full attention. References Clandinin, D.J. & Connelly, F.M. (2000). *Narrative inquiry: Experience and story in qualitative research*. San Francisco: Jossey-Bass Publishers. Kim, J. (2007). *Coach Odyssey*. Seoul: Rainbowbooks. McCharles, B. (2010). *Life history of women coaching*. Doctor of Philosophy, University of Toronto. Polkinghorne, D. E. (1998). *Narrative knowing and the human sciences*. Albany, NY: State University of New York Press. Randolph, S. (2011). *Life history of expert wheelchair and standing basketball coach*. Doctor of Philosophy. The University of Alabama.

**DEVELOPING COACING PEDAGOGY: TEACHING MODEL BASED INSTRUCTION**

Kim, J.

*Andong National University*

Introduction The aim of this paper is explored Sport Education Model (SEM) approach as one means through which this neglect can be addressed, and the goal of coaching integration can be realised. Methods SEM was introduced to a final year class of 19 undergraduate students during a two-hour weekly session over the course of a 15 week semester. This article was to construct and evaluate pedagogical teaching method drawn from tenets of both action research and 'communities of practice' as a means through which the practice-theory gap can be somewhat addressed. The unit in question involved students being introduced to a particular theoretical position with the expectation that they would integrate that theory into their practice in the upcoming week. The students then shared their experiences in structured discussion groups during the following class. Data on student learning were gathered both through on-going observations and focus groups interviews with researcher and students at the end of the unit. Each interview was attended by three or four students and lasted approximately 90 minutes. The data were carefully sifted through by author to identify common themes as inductively analysed. Results In respect of the unit's learning outcomes, the students encouragingly reported that it had 'opened [their] eyes to something new' (Jihey) and that it provided an explicit opportunity to use some theoretical knowledge 'for the first time really, in a practical situation' (Inhwa). There was also some evidence that the students had begun to think differently about coaching as a result of their SEM experience, in addition to developing a better appreciation of the inherent complexity of coaching which relates to the many interrelated

knowledge needed to excel at the activity (Jones et al., 2012). There was also greater recognition of the structural constraints upon coaches' role fulfillment and the subsequent limits of their agency. Problems, however, were also encountered, centering principally on the use of peer assessment and the perceived ambiguity in a couple of the presented scenarios. Discussion Findings revealed that the students were generally stimulated by and, hence, generally positive about the pedagogical approach experienced. This was specifically in terms of better ordering the knowledge they had as well as developing new insights about coaching practice. In conclusion, although it carries the possibility to make some defensive and dismissive, we believe that SEM also possesses the potential to help coaches towards the higher goals of transferable knowledge, considered flexibility, critical reflection and lifelong learning--qualities which recent research suggests comprise effective, holistic coaching practice (Cassidy, 2010; Robert, 2010). Although not unproblematically, the staff were also positive about the unit; citing better and more continuous student engagement as a result of it.

### **ASSESSMENT TOOL FOR PREDICTING THE HEALTHY FITNESS LEVELS IN STUDENTS THROUGH THE BMI AND COURSE-NAVETTE**

Nebot, V., Ros, C., Martín, J., Valverde, T., Bermejo, J.L., Santamaría, R.

*Universidad Católica de Valencia*

**INTRODUCTION** Body Mass Index (BMI) and Course-Navette test (CN), included in the Eurofit battery (Jiménez, A., 2007), are two accessible, reproducible and non-invasive tools available for any teacher. Its use allows the prediction or estimation of the fitness levels in school populations, as the one shown in this study. Furthermore, these resources allow to reach specific goals when planning the Physical Education lessons. The aim of this study is provide a tool for teachers and students for predicting some reference values on their current health status. **METHODS** 46 students, 29 male and 17 female, (expressed on average (standard deviation), 17.0 (0.5) years; 64 (2.1) male weight and 54.17 (1.83) female weight; 1.71 (5.3) male stature and 1.61 (4.2) female stature). All of them completed a questionnaire about extracurricular Physical Activity Habits (PAH), number of days of practice and its duration. The fitness levels were assessed through the CN. The BMI values were obtained following the ISAK protocol. **RESULTS** BMI was higher in male (BMI male:  $21.9 \pm 2.9$  vs. BMI female:  $20.9 \pm 2.7$ ). Also, the mean CN Period (P) and extracurricular PAH percentage values were higher in male (P male:  $8.5 \pm 1.7$  vs. P female:  $4.5 \pm 0.7$ ; PAH male: 78.61 vs. PAH female: 58.8). Results showed a moderate correlation between the BMI and the fitness levels in male ( $r = -0.46$ ), not being significant in female. **DISCUSSION** The assessment tool, applied to a population that does not show a complex morphology disposable in this type of study, as suggested by Molina et al. (2007), presented in the case of male, a correlation between the BMI and the results of the CN ( $r = -0.46$ ). This test is considered as first priority for health within the EUROFIT (Jiménez, A., 2007). These results support the study of Vela et al (2007), who define the BMI as a good fitness indicator given its high correlation with the percentage of body fat ( $r = 0.80$ ). To conclude, this study allows a more effective self-assessment method to design a specific plan, such as a fitness maintenance or improvement, which considers the students' personal needs. **REFERENCES** • Jiménez, A. (2007) La valoración de la aptitud física y su relación con la salud. *Journal of Human Sport*. Vol: 2. Págs. 53 – 57. En línea en: [http://rua.ua.es/dspace/bitstream/10045/898/4/JHSE\\_2\\_2\\_4.pdf](http://rua.ua.es/dspace/bitstream/10045/898/4/JHSE_2_2_4.pdf) • Molina-García, J., Castillo, I., Pablos, C., Queral, A. La práctica de deporte y la adiposidad corporal en una muestra de universitarios. *Apunts Educación Física y Deporte*. 3er trimestre 2007 (23-30). En línea en: [http://articulos-apunts.editec.com/89/es/089\\_023-030ES.pdf](http://articulos-apunts.editec.com/89/es/089_023-030ES.pdf) • Vela, A.; Aguayo, A.; Rica, I.; González, T.; Palmero, A.; Jiménez, P., y Martul, P. (2007). Evaluación clínica del niño obeso. *Rev. Esp. Obes.*, 5 (4), 226-235

### **ENHANCING TEAM WORK COMPETENCE THROUGH SELF AND PEER ASSESSMENT AS PART OF A PHYSICAL ACTIVITY AND SPORTS SCIENCE DEGREE**

Lavega, P., Lasierra, G., Planas, A., Sáez de Ocáriz, U., Salas, C., Ticó, J.

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**Introduction** One of the proposals of The European Higher Education Area indicates that students should be actively involved in their own learning. Team work competence is not only a very important skill, not only in relation to knowledge for students' personal development but also as preparation for their future employment (Noonan & Duncan, 2005). The aim of the present study was to analyse students' self and peer assessment, as well as the assessment of teachers, regarding four of 4 dimensions of team work competence required by our degree course in physical activity and sports science. **Methods** Participants: 117 first-year students (Mage = 20.15 years [SD 3.28], 26 [18.46%] women, 91 men [81.53%]) on the degree in physical activity and sports science (INEFC, University of Lleida) and 6 teachers. The students had to solve a problem in teams of four. Self and peer assessment of team work competence was performed and assessed by means of rubrics. **Statistical analysis:** In order to assess the four dimensions of team work competence we took the mean of the ratings given by the student and his/her three classmates. The Student's t test was used to compare means for the dependent variables. A repeated measures analysis of variance (ANOVA) was applied. **Results** The differences between self and peer assessments were only statistically significant for one dimension (Identity) of team work competence ( $t = 1.99$ ;  $p = .048$ ; 95% CI [0.0027 - 0.6156]). The results also revealed significant differences between the ratings given by teachers and both self and peer assessments by students ( $F = 38.89$ ;  $p < .0005$ ). **Discussion** A significant difference was only observed in relation to the 'Identity' dimension of team work competence, where self-assessments were better than those given by peers. This finding is consistent with previous studies which have also reported that students tend to overestimate their own performance (Lindblom-Ylänne, Pihlajamäki, & Kotkas, 2006). The finding that teacher ratings were lower than those of students is in line with previous research in this regard (Noonan, & Duncan, 2005). The use of the rubrics favoured the self-regulation of learning, thereby aiding the teaching and learning process in relation to team work competence. These kinds of positive outcome have been previously reported by other authors (Butler, & Hodge, 2001). **References** Butler, S A. & Hodge, S. R. (2001). Enhancing student trust through peer assessment in physical education. *Physical Educator*, 58(1), 30-42. Lindblom-Ylänne, S., Pihlajamäki, H., & Kotkas, T. (2006). Self-, peer- and teacher-assessment of student essays. *Active Learning in Higher Education*, 7(1), 51-62. doi: 10.1177/1469787406061148 Noonan, B. y Duncan R. C. (2005). Peer and Self-Assessment in High Schools. *Practical Assessment, Research & Evaluation*, 10(17) 1-18.

### **LEVEL OF PHYSICAL ACTIVITY AMONG CHILDREN IN KINDERGARTEN:**

Weydahl, A., Stokke, A.

*Finnmark University College*

**Introduction** Kindergartens in Norway aim to ensure that all children have their physical activity needs met, and that they experience physical achievement. These factors are claimed to be important for learning, good habits and good health. Guidelines from NASPE

(Education, 2009) points out that preschoolers should be active for at least 60 minutes a day. The scientific research on physical activity among children is limited. According to international research only fifty percent of children are physically active for one hour a day or more (Tucker, 2008). Therefore, the aim of this study was to investigate the level of physical activity among children in Norway and compare different methods for describing level of physical activity. Methods Six kindergartens and 42 children in the north of Norway were involved in the study. Kindergarten staff filled out a questionnaire about the children's activity level at the end of a day of observation, while researchers observed one child throughout the entire day. The children wore a Polar Team2 monitor (Heart rate, HR) and Actigraph GT3X accelerometer (AC) during the observation. Results 16 children did not want to use the equipment. Only 14 children (6 boys and 8 girls) wore the registration equipment for more than 4 hrs (ACmedian: 421 min; HRmedian: 353min). The median age for boys was 38 months, for girls 47 months. HR- and AC-measures showed that the children's activity level through the day was above the recommended 60 min activity. Boys were more active than girls: median activity time boys: 209 min vs. girls 183 min. The same results are found in the staff's questionnaires and the HR-values. Boys are evaluated as more active than girls and their mean HR during the recorded period is higher. The researchers' observation results were "moderate activity", while the post-day evaluations from staff-members showed that they evaluated the activity level in the same child differently. Discussion The children were followed only one day during the fall. The study shows that there is no problem to get children to meet the recommended activity level in kindergartens if the physical environment allows for it. In the kindergartens that we observed the children were allowed to be outside for many hours playing. Observation, mean of the staffs' "end-of-day- evaluations" and monitoring activity level using HR and AC gave the same results. References Education, N. N. A. f. S. a. P. (2009). Active Start: A Statement of Physical Activity Guidelines for Children From Birth to Age 5, 2nd Edition. Retrieved Feb 1st, 2013, from <http://www.aahperd.org/naspe/standards/nationalGuidelines/ActiveStart.cfm> Tucker, P. (2008). The physical activity levels of pre-school-aged children: A systematic review. *Early Childhood Research Quarterly*, 23(4), 547-558.

### RELATIVE AGE EFFECT IN PHYSICAL EDUCATION: BORN TOO LATE TO GET AN A

Aune, T.K., Dalen, T.

*Nord Trøndelag University College*

Introduction In the beginning of the 1900 century it was described that young people with eminent performance had a tendency to be born early in their year of birth (Kassel, 1929), and subsequent studies have documented the relative age effect (RAE) in both sport (i.e. Musch & Grondin, 2001) and the educational system (Cobley et al., 2009). The students marks in Norwegian physical education (PE) is an evaluation of different competence aims based on the PE curriculum, and there is a distinct difference in the competence aims in secondary school (SS) vs upper secondary school (USS) (Norwegian Ministry of Education and Research, 2012). On the other hand the variability in maturation is larger in SS, whereas the last year of USS the students normally are fully grown. The present study examined PE attainments in Norwegian adolescents in order to identify eventually RAE. Method The study is based on final marks in PE from in the last year of secondary school (15-16 year) (n=1154) and upper secondary school (18-19 year) (n=1010). Month of birth and marks were classified in quartiles, and the mean of the marks for the respective quartiles were calculated. Also the binominal distribution for the mark 6 and 2 were calculated. The marks is ranged with numbers from 1-6, were 6 is the best. Results The results showed a decrease in the mean of the marks for the respective quartiles ( $p < 0.05$ ) for both boys and girls. The binominal distribution showed a higher number of students born in the first two quartiles getting mark 6 ( $p < 0.05$ ), while there were a higher number of student born in the last two quartiles getting mark 2 ( $p < 0.05$ ). Discussion RAE is documented in the present study for the last year of both SS and USS despite of differences in competence aims for SS compared to USS according to the Norwegian PE curriculum. This indicates that traditional ratings of sport performance are commonly used when evaluating attainment in PE in Norwegian samples. Early maturation and physical capacity seem to favor children's attainment in PE at last year for both SS and USS even that it should not be monitored according to the curriculum. References Cobley, S., McKenna, J., Baker, J., & Wattie, N. (2009). How pervasive are relative age effects in secondary school education? *Journal of Educational Psychology*, 101, 520-528. Kassel, C. (1929). The birth month of genius. *The Open Court*, 63(11), 677-695 Musch, J., & Grondin, S. (2001). Unequal competition as an impediment to personal development: A review of the relative age effect in sport. *Developmental Review*, 21, 147-167. Norwegian Ministry of Education and research (2012). Curriculum for Physical education. <http://www.udir.no/Regelverk/Rundskriv/2012/Udir82012-Infomasjon-om-endoringer-i-faget-kroppsoving-i-grunnskolen-og-videregaende-opplaring/>

**15:00 - 16:00**

### Mini-Orals

#### PP-SH10 Psychology [PS] 3

### EXAMINING THE RELATIONSHIP BETWEEN MINDFULNESS AND PAIN CATASTROPHIZING IN RUNNERS

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Sullivan (2008) suggested that persons experiencing or anticipating pain may avoid painful activities (e.g., high intensity training) and may quit high intensity training when the going gets tough. Recent research has shown that pain catastrophizing can influence the pain experience. Catastrophizing is a process where individuals magnify pain, ruminate on pain, and feel helpless to cope with pain. It is evident that athletes experience catastrophic thinking in relation to pain (Sullivan et al., 2000) and athletes who catastrophize may miss out on potentially useful training regimens (e.g., high intensity training). Researchers have not examined relationships between catastrophizing and other variables that may reveal ways of reducing catastrophic thinking in athletes. Mindfulness, a non-judgmental focus of one's attention on the experience that occurs in the present moment, may be important for reducing perceived pain and may help attenuate catastrophizing. We propose that runners high in dispositional mindfulness will have lower pain catastrophizing. We recruited 228 runners from online running forums, the British Miler's Club email list, and through running clubs in the UK. We asked runners to complete the Pain Catastrophizing Scale, a 13-item measure of catastrophic thinking associated with pain, and the Mindful Attention Awareness Scale, a 15-item measure of individual differences in the frequency of mindful states over time. The PCS yields a total score and three subscale scores assessing rumination, magnification, and helplessness. The MAAS yields a total score, with high scores

reflecting high levels of dispositional mindfulness. Following screening for missing data, normality, and internal reliability, we conducted a 1-tailed Pearson's correlation between the MAAS total score and the PCS subscales and total score. Results revealed significant relationships between MAAS total and PCS total ( $r = -.384$ ,  $p < .01$ ), MAAS and helplessness ( $r = -.395$ ,  $p < .01$ ), MAAS and magnification ( $r = -.325$ ,  $p < .01$ ) and MAAS and rumination ( $r = -.295$ ,  $p < .01$ ). The relationships between mindfulness and pain catastrophizing correspond with findings from clinical studies (e.g., Schutze et al., 2010) and provide preliminary evidence that low mindfulness might be a precursor to pain catastrophizing in athletes, although it is impossible to make causal connections from correlational research. Sullivan, M. J. L. (2008). Toward a biopsychomotor conceptualisation of pain. *Clinical Journal of Pain*, 24, 281 - 290 Sullivan, M. J. L. et al. (2000). Catastrophizing and pain perception in sports participants. *Journal of Applied Sport Psychology*, 12, 151-167 Schutze, R. et al. (2010). Low mindfulness predicts pain catastrophizing in a fear avoidance model of chronic pain. *Pain*, 148, 120-127

### INTERMITTENT HYPOXIC TRAINING IMPROVES QUALITY OF LIFE AND SLEEP QUALITY IN THE INACTIVE ELDERLY

Törpel, A., Hamacher, D., Peter, B., Schega, L.

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**Introduction** Physical exercise has a positive effect on quality of life (QoL) including sleep quality (SQ) (Reid et al., 2010). Intermittent hypoxia promotes first, the proliferation of endogenous neuroprogenitors which leads to an increased number of newborn neurons and second, the expression of brain-derived-neurotrophic factor (BDNF) in the adult hippocampus (Zhu et al., 2010). BDNF expression provokes an anti-depressive effect (Dreimüller et al., 2012) which is positively correlated to subjective QoL. An intervention, coupling intermittent hypoxic training together with physical activity may, therefore, lead to higher improvement of QoL and SQ as compared to an intervention that just includes physical training. **Method** 34 elderly physically inactive people were included in the study and randomly assigned to a control group (CG) or intervention group (IG). During 6 weeks (3 times / 1 hour / week), CG was supplied with a placebo air mixture and IG undertook an intermittent hypoxic training regulated by the same oxygen saturation in the blood (SpO<sub>2</sub>) in each subject. After that, both groups underwent the same strength-endurance exercise programme. QoL was determined with the Medical Outcomes Study Short-Form 36-Item Health Survey (SF12) and SQ has been tested with the Pittsburgh Sleep Quality Index (PSQI) prior and after the intervention. **Result** Regarding QoL, we observed that an interaction effect just failed to become statistically significant ( $F(1.00, 25.00) = 3.96$ ;  $p = .058$ ) in the Mental Component Summary (SF12). However, in SQ an interaction effect has been found ( $F(1.00, 30.00) = 5.89$ ;  $p = .026$ ) which is based on a significant effect in PSQI only in IG ( $t(14) = 2.11$ ;  $p = .011$ ). **Discussion** The current study evaluated the effect of an additional hypoxic training prior to physical intervention. The data of our study suggest that an intermittent hypoxia combined with physical exercise augments the positive effects of exercise on SQ in elderly physically inactive humans. We assume that the hypoxic stimulus was possibly not strong enough to affect QoL in our subjects. Furthermore, it is insufficiently clarified whether the observed result through hypoxic training is caused by physiological adaptation effects or through neurological adaptations. Therefore, further research is recommended. **References** Reid KJ, Baron KG, Lu B, Naylor E, Wolfe L, Zee PC. (2010). *Sleep Med*, 11, 934-40. Zhu XH, Yan HC, Zhang J, Qu HD, Qiu XS, Chen L, Li SJ, Cao X, Bean JC, Chen LH, Qin XH, Liu JH, Bai XC, Mei L, Gao TM. (2010). *J. Neurosci*, 30, 12653-12663. Dreimüller N, Schlicht KF, Wagner S, Peetz D, Borysenko L, Hiemke C, Lieb K, Tadić A. (2012). *Neuropharmacol*, 62, 264-9.

### INTERMITTENT HYPOXIC TRAINING AFFECTS COGNITIVE PERFORMANCE IN THE ELDERLY

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**Introduction** Physical exercise has a positive effect on cognitive performance (Etner et al., 1997). One reason for this might be the upregulation of brain-derived-neurotrophic factor (BDNF) which improves brain plasticity (Knaepen et al., 2010). Furthermore, intermittent hypoxic training promotes first, the proliferation of endogenous neuroprogenitors which leads to an increased number of newborn neurons and second, the expression of BDNF in the adult hippocampus (Zhu et al., 2010). Therefore, intermittent hypoxia may support synaptic plasticity, process of learning. Hence, intermittent hypoxia might also lead to improved cognitive functioning. This study aims to evaluate to what extent physical activity with a preceded intermittent hypoxic training is more effective than just a strength-endurance programme on measures of cognitive performance in the physically inactive elderly. **Method** Thirty-four elderly physically inactive people who successfully passed a medical exam by a medical doctor and who were between 60 and 70 years of age were randomly assigned to a control group or intervention group. Contrarily to the control group, which was supplied with a placebo air mixture, the intervention group was supplied with an intermittent hypoxic training prior to a strength-endurance exercise programme. The cognitive performance of individuals was examined using the d2-test (measuring attention) and the Number Combination Test (measuring cognitive processing speed) both before and after the exercise programme. **Result** We observed a time x group effect in the performance of the d2-test ( $F(1.00, 32.00) = 4.65$ ;  $p = .034$ ) which is based on a significant improvement over time in the intervention group ( $p = .001$ ). Regarding the Number Combination Test, we did not find any interaction effect ( $F(1.00, 32.00) = 0.21$ ;  $p = 0.649$ ). **Discussion** To the best of our knowledge, the current study provides the first data set indicating that an additional intermittent hypoxic training combined with physical exercise augments the positive effects on cognitive performance in elderly physically inactive humans. This result might be caused by an increased expression of BDNF. From an application stand point, the authors carefully speculate that due to the possible effect which increases cognitive performance, intermittent hypoxia might also be an effective preventive measure for elderly people e.g. prone to diseases like dementia. To strengthen that statement, further research is strongly recommended. **References** Etner JL, Salazar W, Landers DM, Petruzzello SJ, Han M, Nowell P. (1997). *JSEP*, 19, 249-277. Knaepen K, Goekint M, Heyman EM, Meeusen R. (2010). *Sports Med*, 40, 765-801. Zhu XH, Yan HC, Zhang J, Qu HD, Qiu XS, Chen L, Li SJ, Cao X, Bean JC, Chen LH, Qin XH, Liu JH, Bai XC, Mei L, Gao TM. (2010). *J. Neurosci*, 30, 12653-12663.

### THE EFFECT OF PHYSICAL EXERCISE IN HYPOXIA CONDITION IMPROVES MOOD

Lemos, V.A.1,2, Bittar, I.G.L.2, Caris, A.V.1, Silva, E.A.1,2, Rosa, J.P.P.1,2, Santos, R.V.T.2,3, Lira, F.S.1,2, Antunes, H.K.M.2,3, Tufik, S.1,2, De Mello, M.T.1,2

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**Introduction** Although hypoxia condition worsens mood, after the performance of exercise there is an improvement of mood in normoxia condition. However, it was never evaluated the effect of acute exercise, in hypoxia condition, on mood. Thus, the aim of this study was to evaluate the influence of acute exercise on mood state in a condition of hypoxia equivalent to 4500-m for 29 hours. **Methods** Thirty-eight healthy men were enrolled in this study, randomly divided into four groups: (Hypoxia  $n = 10$ , Normoxia  $n = 10$ , Exercise in Normoxia  $n =$

10 and Exercise in Hypoxia  $n = 8$ ). The mean values were: age (years) - ( $23 \pm 8$ ), body mass (kg) - ( $71 \pm 7$ ), height (m) - ( $1.76 \pm 0$ ), BMI ( $\text{kg}/\text{m}^2$ ) - ( $22 \pm 9$ ) and  $\text{VO}_2$  peak ( $\text{ml}/\text{kg}/\text{min}$ ) - ( $47 \pm 4.2$ ). Mood was assessed using the Brunel Mood Scale (Rohlf's et al., 2008), applied on the first day in all groups and reapplied on the second following day, shortly after the exercise session of 60 minutes, 50% of  $\text{VO}_2$  peak ( $\text{ml} / \text{kg} / \text{min}$ ). The groups Hypoxia and Exercise in Hypoxia were exposed in hypoxic condition in Colorado Altitude Training™/12 CAT-Air Unit). The comparisons were performed using ANOVA for repeated measures followed by the Tukey Post Hoc and the level of significance was set at  $p \leq 5\%$ . Results There was a significant improvement in tension ( $p = 0.001$ ) and anger ( $p = 0.001$ ) in the hypoxia exercise group when compared with hypoxia group. In the hypoxia group it was observed significant worsening in tension ( $p = 0.013$ ), anger ( $p = 0.002$ ), fatigue ( $p = 0.008$ ) and vigor ( $p = 0.05$ ) compared with normoxic group. The normoxia group and exercise in normoxia did not differ significantly. Discussion These results are similar to experimental conditions performed at sea level (Herring and O'Connor, 2009). Our results show that even in hypoxia condition, which worsens the mood (Lemos et al., 2012), the exercise can reverse this undesirable effect. This association might be explained due to an increased in serotonin levels, once it can modulate mood (Strüder and Weicker, 2001). Thus, we suggest that physical exercise performed in hypoxia condition can improve the mood state; however more studies are need to better understand the mechanism involved. References De Aquino Lemos V, Antunes HKM, Dos Santos RVT, Lira FS, Tufik S, De Mello MT. (2012). Psychophysiology, 9,1298-306. Herring MP, O'Connor PJ. (2009). J Sports Sci, 7, 701-9. Rohlf's MPCL, Rotta MT, Luft BDC, Andrade A, Krebs JR, Carvalho T. A. (2008). Rev Bras Med Esporte, 11, 176-181. Strüder HK, Weicker H. (2001). Part I. Int J Sports Med, 22, 467-81.

### WORKING MEMORY CAPACITY AND PROPENSITY FOR CONSCIOUS MOTOR PROCESSING IN AN INHIBITION TASK

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Introduction It is known that people differ in their propensity to consciously monitor and control automated movements (also known as "reinvestment"), particularly under pressure or when extensive preparation time is available (e.g., Masters & Maxwell, 2008). While reinvestment generally leads to inferior performance, a high propensity for conscious movement control might be an advantage in a task that requires inhibition. The aim of this study was to investigate the interaction between propensity to consciously control movements (i.e., movement specific reinvestment) and working memory capacity (WMC) when executive supervision of a normally automated task is required. Methods Participants were asked to coordinate a bimanual movement task (index finger movements in the horizontal plane) in an anti-phase movement pattern during a baseline and a distraction condition. They were instructed to keep in rhythm with a metronome while preventing transition from anti-phase to in-phase as the frequency increased. A visual search task was added in a distraction condition and participants were asked to do their best in both tasks. We assessed participant's WMC via the Automated Working Memory Assessment (Alloway, 2007) and administered the Movement Specific Reinvestment Scale questionnaire (MSRS, see Masters & Maxwell, 2008) Results Low scores on the MSRS were associated with better overall performance of the task, although this difference was not significant ( $p = .061$ , partial eta squared = .203). A significant interaction was evident between condition and visual WMC group ( $p < .05$ ). Participants with high visual WMC scores performed worse in the distraction condition compared to the pressure condition. They also performed worse on the secondary task compared to participants with low visual WMC. Discussion A high propensity to consciously control movements was not shown to be beneficial for performance of tasks requiring the inhibition of automated movements. One possible explanation for our findings is that control of finger movements was unlikely to have been supported by underlying declarative knowledge, which is essential for reinvestment. High visual WMC was associated with decreased performance of both tasks in the distraction condition, suggesting that participants with high visual working memory abilities may have utilized visual feedback in the inhibition task more than participants with low visual working memory capacity. References Alloway, T. A. (2007). Automated Working Memory Assessment. London, UK: Pearson Assessment. Masters, R. S. W., & Maxwell, J. P. (2008). The theory of reinvestment. International Review of Sport and Exercise Psychology, 1(2), 160-183.

### ATHLETE'S INTERNAL TASKS AND THEIR EXPRESSIONS OF BODY. -CASE STUDY OF PSYCHOLOGICAL SUPPORT WITH JAPANESE ELITE ATHLETE -

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Introduction The purpose of this study is to illuminate athlete's psychological maturity from a viewpoint of their internal tasks and their expression of body. In Japan, there are two ways to approach psychological support concerning sports and physical activities. These are called Sports Counseling (SpC), and Sports Mental Training (SMT). In this presentation, we introduce a matter which rose from clinical practices of SpC, and discuss athlete's expressions of body through practical cases. Those who practice SpC often experience difficulties in providing support to athletes using approaches like psycho-skill training, which only concerns consciousness and behaviors. They state that we need to pay attention to their inner world or internal tasks which lurk in athletes' seeking psychological support. Especially, the more athletes' performance levels grows, the more confronted they must be with their internal tasks, which are expressed through their performance; their expression of their own body (Nakagomi, 2004; Takeda, 2011). Methods We examined athletes who voluntarily received personal psychological consultation. Materials used in the analysis were the verbatim records of conversations that took place during private sessions. The clinical approach using the case study method was used to analyze the materials. Case & Discussion Case A (Female in her 20's) sought psycho-support after a struggle with movements of her sport. She mentioned that in a certain action, at the later part of the movements, she felt clumsy to the extent where she had to stop. Certified Sport Counselor interviewed with her to get information about her internal task, and identified her task was acquisition of the sense of independence. When her performance changed to higher level, the attitude of people around her also changed, and she stated that was the time she began to question her own existence as an athlete. At a competition, she felt numb in her right leg, and said the experience was a wonder. At a later competition, she achieved her personal best. Psychological sessions were ended when the change in her attitude towards her sport brought performance stability. We approached the case from a psychodynamics perspective, and concluded that the internal task of an athlete was expressed as external changes and through their performance /body. Reference Nakagomi S. (2004) Asuri-to no Shinri rinsho. Douwashoin. Nakagomi S (2004) Clinical Sports Psychology – Sport Counseling for Athletes (In Japanese) Takeda D. (2011) Psychological Characteristics of Elite Athletes from a Psychodynamics Perspective through Expressions of their Body. Asian Conference on Sport Science 2011-Ten Years of Progress in Sports Sciences Proceedings, 70-76.

## PREVENTIVE AND RISK FACTORS FOR BODY DISSATISFACTION IN PORTUGUESE ADOLESCENTS

Coelho, E., Fonseca, S., Pinto, G., Mourão-Carvalho, I.

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**Introduction:** The aim of this study was to determine the prevalence of body image dissatisfaction and associate factors in adolescents, separately for females and males. **Methods:** A cross-sectional study including 529 adolescents (53.7% male and 46.3% female) aged 10 to 18 years ( $13.32 \pm 1.59$ ) was done. Body image was assessed using Collins's body image silhouettes and estimated body image dissatisfaction. Height and weight were measure and Cole et al.'s cutoffs were used to define obesity. Lifestyle, socioeconomic status and demographic characteristics of participants were obtained through a constructed questionnaire. Univariate and multiple logistic regression analyses were used. **Results:** The prevalence of body dissatisfaction was 58%. Significant associations were found between body dissatisfaction and gender ( $p < 0.00$ ) and prevalence of obesity ( $p < 0.00$ ). Multivariate logistic regression revealed that the following variables were associated with body dissatisfaction: obesity (OR=6.94; IC95%: 3.86-12.49), more than 4 days by week of sport activities (OR=0.52; IC95%: 0.32-0.84), see tv more than 2 hours by day (OR=2.22; IC95%: 1.25-3.94; OR=2.28; IC95%: 1.35-3.84). Among male adolescents, the variables that had a significant association were obesity (OR=6.46; IC95%: 3.26-12.81) and see tv more than 2 hours by day (OR=2.50; IC95%: 1.13-5.53; OR=3.34; IC95%: 1.57-7.11). Obesity was the only variable that had a significant association with body dissatisfaction (OR=12.55; IC95%: 2.92-53.99) among female adolescents. **Conclusions:** Obesity and hours spending watching tv are risk factors of body dissatisfaction, while sport practice is a preventive factor. It is necessary to considered different interventions for men and women to reduce body image dissatisfaction

## THE RELATIONSHIPS BETWEEN BURNOUT, HEALTH DISORDERS AND PERCEIVED HEALTH IN YOUNG FOOTBALLERS

Castillo, I., Fabra, P., Ródenas, L., García-Merita, M., González, L., Balaguer, I.

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Little research in sport has previously studied the effects of burnout on the perceived health of young athletes, although some works have shown the relationship between different dimensions of burnout and physical and psychological health disorders in youths (Reinboth & Duda, 2004). This study pursue two objectives: (1) to analyze the relationship between burnout, health disorders (somatic and psychological), and perceived health in young footballers and (2) to explore the mediational role of health disorders between burnout and perceived health. 725 young male footballers from the Valencian Community Football Federation (Spain) between 11 and 13 years old ( $M = 12.6 \pm .54$  years) completed the Spanish versions of the Athlete Burnout Questionnaire (Raedeke & Smith, 2001) and some items from the Inventory of Health Behaviour in School Children (HBSC; Wold, 1995). Five simple regressions and two hierarchical regressions analyses were performed. The results reported that burnout was a positive predictor of somatic ( $\beta=0.23$ ) and psychological ( $\beta=0.22$ ) disturbances and both health alterations were, in turn, negative predictors of perceived health ( $\beta=-0.21$  and  $\beta=-0.19$ , respectively). In addition, following Baron and Kenny (1986), the regression analysis performed with predictor variable (burnout), mediating variables (somatic and psychic disturbances, separately) and the criterion variable (perceived health), indicated that health disorders, both somatic and psychic, acted as a partial mediators between the burnout and perceived health, with a beta coefficient of burnout significantly reduced by the inclusion of the both mediator variables ( $z=-3.83$ ,  $p < 0.01$ ;  $z=-3.52$ ,  $p < 0.01$ , respectively, according to the Sobel test). The results emphasize the risk of experiencing burnout in sport for the general health of footballers, both regarding symptoms as well as their perception. Research funded by Ministerio de Ciencia e Innovación (DEP2009-12748), Spain. References Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51, 1173-1182. Raedeke, T. D., & Smith, A. L. (2001). Development and preliminary validation of an athlete burnout measure. *Journal of Sport and Exercise Psychology*, 23 (4), 281-306. Reinboth, M., & Duda, J. L. (2004). The Motivational Climate, Perceived Ability, and Athletes' Psychological and Physical Well-Being. *The Sport Psychologist*, 18, 237-251. Wold, B. (1995). Health Behaviour in School Children: A WHO Cross-National Survey. Resource Package of Questions 1993-94. Norway: University of Bergen.

## MUSCLE DYSMORPHIA AND EATING DISORDERS: WEIGHTLIFTERS

González-Marfí, I., Papathomas, A.

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**Introduction** Muscle dysmorphia is characterised by a pathologically distorted perception of muscularity. Those who experience the condition perceive themselves to be significantly less muscular than reality and duly develop increased body dissatisfaction and an obsessive preoccupation with muscle development. Although numerous scholars have speculated on the link between muscle dysmorphia and eating disorders, few studies have explored this relationship empirically (Murray, Maguire, Russell & Touyz, 2011; Murray et al., 2012). The aim of this study was to explore muscle dysmorphia symptoms in weightlifters and assess the impact of an eating disorder on the severity of these symptoms. **Methods** We recruited a large sample of 442 weightlifters (285 male and 157 female) from ten Spanish gymnasiums. Ages ranged from 18 to 63 years ( $M=30.92$ ). Each participant completed a demographic questionnaire composed of 10 items and the Escala de Satisfacción Muscular (ESM; González-Marfí, Fernández, Contreras and, Mayville, 2012). The ESM is a validated 19-item scale designed to assess muscle dysmorphia symptoms. **Results** 4.8% of participants self-reported previously suffering with an eating disorder. We applied an ANOVA to compare ESM scores between the eating disorder group and the non-eating disorder group. This analysis showed significant differences ( $p < .05$ ) for all ESM factors except "Injury". The post-hoc analysis showed weightlifters who had experienced an eating disorder demonstrated higher mean scores for the "bodybuilding dependence", "muscular dissatisfaction", "substance use" and "checking behaviours". **Discussion** This study provides provisional evidence for a relationship between muscle dysmorphia and eating disorders. Given weightlifters with eating disorder experiences demonstrated accentuated muscle dysmorphia symptoms, some degree of shared pathology may be at work. Further research is needed to better understand the complex interplay between these two conditions (Murray et al., 2012). References González-Marfí I, Fernández JG, Contreras OR, Mayville SB. (2012). Validation of a Spanish version of the Muscle Appearance Satisfaction Scale: Escala de Satisfacción Muscular. *Body Image* 9, 517-523. Murray SB, Maguire S, Russell J, Touyz SW. (2011). The emotional regulatory features of bulimic episodes and compulsive exercise in muscle dysmorphia: A case report. *Europ Eating Disord*, doi:10.1002/erv.1088. Murray SB, Rieger E, Hildebrandt T, Karlov L, Russell J, Boon E, Dawson R, Touyz W. (2012). A comparison of eating, exercise, shape, and weight related symptomatology in males with muscle dysmorphia and anorexia nervosa. *Body Image*, 9, 193-207.

## THE EFFECTS OF DIFFERENT TRAINING VOLUME OF RESISTANCE EXERCISE ON COGNITIVE FUNCTIONS IN SEDENTARY YOUNG MEN

Ho, J.Y., Kuo, T.Y., Liu, K.L., Tsai, Y.J., Zeng, Y.S., Kao, S.C., Huang, C.W., Hung, T.M.

*National Taiwan Normal University*

**Introduction** Although regular aerobic exercise has been shown to improve cognitive functions (Kramer et al., 2006), little is known about the effects of resistance exercise, particularly the influence of training volume, on cognitive functions. Therefore, this study aimed to examine the effects of 1 set versus 3 sets of resistance exercises on cognitive performance in sedentary young men. **Methods** Twelve healthy sedentary young men (age  $21.6 \pm 1.7$  yrs, height  $171.7 \pm 5.3$  cm, weight  $68.1 \pm 13.2$  kg) were recruited and participated in three experimental trials in a counter-balanced order separated by one week: (1) performed single set of resistance exercises (SS); (2) performed multiple sets of resistance exercises (MS); (3) rest (Control). The whole body workout consisted of 7 different resistance exercises performed at 10 repetition maximum with 2 minutes of rest between sets and exercises. Cognitive functions were assessed by task switching paradigms with two conditions before exercise and 30 minutes after exercise. The pure task condition required repeated performance on a single task; the mixed-task condition required participants to change rapidly between two different tasks. Task performance measures of reaction times (RTs) were collected and analyzed. Results RTs of pure task significantly decreased in SS and MS after exercise ( $478.8 \pm 47.2$  to  $451.1 \pm 53.5$  ms and  $469.3 \pm 50.7$  to  $448.4 \pm 53.0$  ms, respectively) while RTs remained similar in Control. In addition, RTs of pure task were significantly shorter in MS when compared to Control ( $448.4 \pm 53.0$  vs  $472.3 \pm 59.1$  ms). Within the mixed-task condition, non-switch RTs were shorter in SS and MS but not in Control after exercise and there was no significant interaction for switch RTs. Furthermore, results showed no differences in switch cost (i.e., difference in RTs between non-switch and switch) on RTs for all three trials before and after exercise. **Discussion/Conclusion** Task switching paradigms have been used extensively to evaluate executive control functions such as working memory, inhibition, and mental flexibility (Monsell, 2003). Our findings indicate that greater training volume of resistance exercise enhances cognitive functioning in a simpler cognitive task. However, when the cognitive tasks require greater amounts of executive control, training volume of resistance exercise may not play an important role in improving cognitive functions in sedentary young men. **References** Kramer AF. et al. (2006). *J Appl Physiol*, 101, 1237-1242. Monsell, S. (2003). *Trends Cogn Sci*, 7, 134-140.

## PREVALENCE OF EATING DISORDERS AND PSYCHOLOGICAL PARAMETERS IN ELITE FEMALE GYMNASTS: THEIR RELATION TO BODY IMAGE AND BODY MASS INDEX

Theodorakou, K., Donti, O.

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**Introduction** There is strong evidence that participation in aesthetic sports, like gymnastics, is an important risk factor for developing eating disorders, particularly in the case of female athletes (Sundgot-Borgen & Torstveit 2004). Previous studies indicated that psychological factors such as anxiety, self-esteem, and disturbed body image are implicated in the etiology of eating disorders (Biro et al., 2006). The purpose of the current study was to examine the relation between the prevalence of eating disorders and trait anxiety, self-esteem, body image and body mass index in elite gymnasts. **Methods** Participants Thirty gymnasts (16 rhythmic and 14 artistic), members of the Greek national team, aged 15-21 years with considerable competitive experience ( $10.70 \pm 2.20$  years) participated in this study. Study design Participants completed the following questionnaires: the Eating Attitudes Test (EAT-26), the State-Trait Anxiety Inventory (STAI), Rosenberg's Self-Esteem Scale (RSE), Body Cathexis and Body Image scales. Results Nine gymnasts had a total score above 20 in EAT-26. Canonical correlation analysis revealed that age and body mass index highly correlated with bulimia and food preoccupation and oral control while trait anxiety and self-esteem had a medium correlation with dieting. **Discussion** Results revealed that 30% of the gymnasts demonstrated disordered eating attitudes, (EAT-26 > 20) underlining the need for sport specialists to ensure gymnasts' well being. Despite previous studies suggesting that body image dissatisfaction and psychological parameters are critical factors for eating disturbances, in this study, body image did not correlate with the subscales of EAT-26 and trait anxiety and self-esteem had a low correlation with only one subscale (dieting). In contrast, age and body mass index highly correlated with the subscales of EAT-26 (bulimia and food preoccupation and oral control) thus being in line with recent research (De Bruin, Oudejans & Bakker, 2007) suggesting that in the context of aesthetic sports long-term training and competitive demands for thinness may affect differently gymnasts' body image and eating disturbances. **References** Biro, F.M., Striegel-Moore, R.H., Franko, D.L., Padgett, J., Bean, J.A. (2006). Self-esteem in adolescent females. *Journal of Adolescent Health*, 39, 507-510. De Bruin, A.P., Oudejans, R.D., Bakker. F.C. (2007). Dieting and body image in aesthetic sports: A comparison of Dutch female gymnasts and non-aesthetic sport participants. *Psychology of Sport and Exercise*, 8(4), 507-620. Sundgot-Borgen, J., Torstveit, M.K. (2004). Prevalence of eating disorders in elite athletes is higher than in the general population. *Clinical Journal of Sport Medicine*, 14 (1), 25-32.

## PROBABILISTIC DETERMINATION OF OPTIMAL PERFORMANCE ZONES ACROSS FOUR DIFFERENT PSYCHOMOTOR TASKS

Thin, A.G., Ellis, R.M., Warnock, D.

*Heriot-Watt University*

**Introduction** Physiological activation has long been known to be a major determinant of psychomotor performance (Yerkes & Dodson, 1908). While a number of different models of performance have subsequently been developed, none are readily quantifiable. More recently Kamata et al. (2002) developed a probabilistic estimation method to quantify the Individual Zone of Optimal Function (IZOF) model proposed by Hanin (2000). By utilising all available information their approach generates estimates of the likelihood of optimal performance at a given level of activation. The aim of this study was to compare IZOFs for a group of subjects across four different psychomotor tasks varying in type and difficulty. It was hypothesised that the IZOFs would be higher for less demanding tasks. **Methods** Ten subjects (4 male) mean ( $\pm$ SD) age  $20.7 \pm 1.1$  years, height  $1.73 \pm 0.11$  m, body mass  $69.8 \pm 9.9$  kg were recruited. The tasks used were one- and two-handed turning and placing tasks adapted from the Minnesota Dexterity test and two motor racing simulation tasks (F1 2012, Sony Playstation) using easy and hard tracks. Activation was assessed both by heart rate (HR) and galvanic skin response (GSR) recorded continuously and self-reported arousal and pleasure scores at regular intervals (Edmonds et al., 2006). Performance was assessed by elapsed time at specified points during and at the end of each trial. Subjects performed the tasks on separate occasions in a randomised order. Repeated measures ANOVA were used to compare IZOFs between tasks. Results Mean HR ( $\pm$ SEM) at the mid-point of the IZOFs were  $95.5 \pm 3.0$  and  $101.9 \pm 5.0$  bpm for the one- and two-handed turning and placing tasks respectively and were significantly higher compared to the easy ( $83.0 \pm 2.6$  bpm) and hard ( $81.7 \pm 3.3$  bpm) racing tasks ( $p < 0.05$ ). There were no significant differences between

mean GSR or for mean arousal and pleasure scores. Discussion The mean HR for the turning and placing tasks was around 16 bpm higher compared with the driving tasks. Part of this difference (5-10 bpm) can be attributed to the turning tasks being designed to be performed in a standing position whereas the subjects were seated for the driving tasks (MacWilliam, 1933). The absence of any observed differences in the other measures suggests that are not sufficiently responsive to be of use to distinguish between performance levels. In conclusion, the probabilistic approach to determining IZOFs would appear to have significant potential for quantifying the relationship between physiological activation and psychomotor performance, but further work is needed to develop appropriate experimental paradigms and measures. References Edmonds WA, Mann DTY, Tenenbaum G, Janelle CM (2006). *Sport Psych* 20, 40-57. Hanin YL (2000). *Emotions in Sport. Human Kinetics, Champaign.* Kamata A, Tenenbaum G, Hanin YL (2002). *J Sport Exer Psych* 24(2), 189-202. MacWilliam JA (1933). *Exp Physiol* 23(1), 1-33. Yerkes RM, Dodson JD (1908). *J Comp Neurol Psychol* 18(5), 459-482.

## 15:00 - 16:00

### Mini-Orals

#### PP-SH14 Psychology [PS] 7

##### VISUAL BEHAVIORS OF PENALTY KICKERS IN A REAL-PLAY SITUATION

Nagano, T.

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**Introduction** Penalty kicks is decisive role in important competitions such as the World Cup. In previous studies that skilled goalkeepers use more effective visual search strategies than less skilled counterparts has been widely researched. Meanwhile, only a few studies have investigated visual behaviors of penalty kickers (e.g., Nagano et al., 2006; van der Kamp, 2006; Wood & Wilson, 2010). In the first study of penalty kickers, Kuhn (1988) identified two kicking strategies, which were termed keeper-dependent (KD) and keeper-independent (KI). The aim of this study was to investigate visual search behavior of kicker using a KD strategy and KI strategy in a real-play situation. **Methods** Twenty male university footballers volunteered to take part in this study. Participants were fitted with an eye-mark recorder EMR-9 (Inac Image Technology, Inc., Tokyo, Japan) to record the gaze while kicking. Each participant took 5 practice kicks in a "real-play" situation with an experienced goalkeeper, followed by the 20 kicks for a test trial; half of the trials were KD strategy and the other half were KI strategy. An externally positioned digital video camera was located behind of the participants. This view allowed the whole area of the penalty kick to be visible for subsequent analyses. **Results & Discussion** The shooting performances (the number of scoring a goal) for KD strategy were lower than for KI strategy. Regardless of kicking strategies, the number of fixations for high scorers was lower than low scorers. The last fixation durations for KD strategy on the ball were shorter than for KI. Regardless of kicking strategy, last fixation duration for high scorers on the ball were longer than for low scorers. These results suggest that the shooting performance was affected by visual behaviors of a kicker. **Conclusion** We measured the eye movements of penalty kickers in a real-play situation. The visual behaviors of kickers affect the performance. More research is required to understand "how" and "when" penalty kickers decide on their strategy and the direction. **References** Nagano, T. et al. (2006). *Perceptual & Motor Skills*, 102(1): 147-156. van der Kamp, J. (2006). *Journal of Sports Sciences*, 24(5): 467-477. Wood, G., & Wilson, M.R. (2010). *Journal of Sports Sciences*, 28(9): 937-946. Kuhn, W. (1988). *Science and football*, 489-492.

##### PETTLEP IMAGERY AND SHOOTING ACCURACY IN FOOTBALL: AN EXAMINATION OF DOMINANT AND NON-DOMINANT FOOT PERFORMANCE.

Grills, A., Wakefield, C.

*Myerscough College & Liverpool Hope University*

**Introduction** Imagery has been shown to be beneficial in enhancing the performance of many motor skills. PETTLEP imagery (Holmes & Collins, 2001) provides guidelines on how imagery should be conducted to increase the behavioural matching (Wakefield, Smith, Moran, & Holmes, in press) between imagery and physical execution of a task, thus enhancing the performance increment. The present study investigated the impact of dominant foot PETTLEP imagery on dominant and non-dominant foot shooting performance. **Methods** Twenty three male academy football players (Mean age = 18.26 years, SD = 1.01) were assigned to one of three intervention groups: PETTLEP imagery (dominant foot, video assisted); physical practice group (dominant foot); and a control group (stretching task). The interventions were carried out twice per week for 6 weeks. Pre and post testing consisted of 10 shots at a goal with both dominant and non-dominant feet. Participants took ten shots at goal from a marker which was central to the goal and 20.12metres out from the goal line. The goal was divided into appropriate sections based on the design of Smith, Wright, Allsopp & Westhead (2007), with the sections reflecting the difficulty of the shot. Total scores were collated and taken as a performance measure. **Results** A repeated measures ANOVA for non-dominant foot revealed no significant main effect,  $F(1,20)=.68$ ,  $p=.79$ , and no significant interaction,  $F(2,20)=.026$ ,  $p=.974$ . A repeated measures ANOVA for dominant foot revealed a significant main effect,  $F(1,20)=6.13$ ,  $p=.022$ , and a significant interaction,  $F(2,20)=3.57$ ,  $p=.047$ . Post hoc tests revealed that the PETTLEP imagery group improved significantly from pre test to post test ( $p<.05$ ). No further significant changes were observed. **Discussion** The results indicate that PETTLEP imagery of the dominant foot is not transferable to the performance of non-dominant foot shooting within football. This lack of transferability lends support to the importance of individualising PETTLEP interventions. The results do however suggest that PETTLEP imagery can have positive impact on dominant foot football shooting performance, compared to physical practice and a control task. This is coherent with previous research conducted (Finn, Grills & Bell, 2011; Wakefield & Smith 2011; Wright & Smith, 2009). Future research is needed in order to realise the implications on performance that this use of imagery can have on coaches, athletes and sports practitioners. **References** Finn, J., Grills, A., Bell, D. (2011). In B. Drust, T. Reilly & A. M. Williams (Eds.), *International Research in Science and Soccer*, 143-154. Padstow; Routledge. Holmes, P. & Collins, D. (2001). *J of App Sp Psych*, 13, 60-83. Smith, D., Wright, C., Allsopp, A., Westhead, H. (2007). *J A Sp Psych*, 19, 80-92. Wakefield, C., Smith, D., Moran, A. & Holmes, P. (in press). *Int Review of Sp and Ex Psych*, 1, 1-17. Wakefield, C., Smith, D. (2011). *The Sport Psychologist*, 25(3), 305-320. Wright, C. & Smith, D. (2009). *Int J of Sp and Ex Psych*, 7(1), 18-31.

## MUTUAL INTELLIGIBILITY AMONG FOOTBALL OFFICIALS DURING MATCH

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Introduction: Rix (2005) adopts a non-normative perspective and methodology in order to understand referee's activity in naturalistic context. The concept of judgment act highlights the synthetic cognition of the referee: he shows to - and imposes on - players what is acceptable. More, the referee judgment does not consist in an application of rules to a reality. The rules are a resource. But the referee is a member of a team of officials: the collective functioning of refereeing on pitch has never been studied. Understanding the organizing role of the prescriptions regarding the task partition (official directives, training recommendations...) is not sufficient to grasp the coordination of the individual unfolding activities. So we investigate the mutual intelligibility (Salembier & al., 2004) among officials in order to determine the way each official contributes to produce judgment acts and what operational procedures enable this contribution in match. Method: After 3 professional football games, researcher conducted individual self-confrontation interviews with: the referee, 2 assistant and the replacement referees (n=12). Using video recording of game allows each participant to relate to a particular lived-experience in his match. Researcher confronted the team members' respective perspective concerning: (1) their own actions and radio communications; (2) the perception of other teammates' actions and radio communications. Results: Assistant and replacement referees develop awareness about: - The referee information needs in situ. They focus on the body indications of doubts the referee shows to make judgments acts. It enables them to provide information for the referee judgment act process at the right moment. - The tolerance threshold of the referee for the intensity of the opponents' physical confrontation. Thus they construct a threshold which is compatible with the referee's. By taking into account (or not) the information addressed to him to produce judgment acts the referee validates (or not) - tacitly or explicitly- the relevance of the information delivered by his colleagues. Discussion: The construction of mutual intelligibility of game situations is shaped by two interactive procedures: (1) the awareness towards referee activity that the assistant and replacement referees construct; (2) the episodes of regulation in which the referee validates information relevance (Poizat & al., 2009). From their perspective each official acts on pitch in order to contribute to judgment act process. This contribution requires officials' own understandings of the game to be compatible with each other: partly shared and partly specific. References: Poizat G, Bourbousson J, Saury J, & Sève C (2009). *IJSEP*, 7(4), 465-487. Rix G. (2005). *Science & Motricité*, 56(3), 109-124. Salembier P, & Zouinar, M (2004). *@ctivités*, 1(2), 64-85.

## PASSION MOTIVES IN OFFICIATING FOOTBALL: DIFFERENCES BETWEEN NORWEGIAN ELITE AND NON-ELITE REFEREES?

Johansen, B.T., Haugen, T.

*University of Agder*

Introduction Johansen & Bjørnstad (2011) found in their study of motives for officiating football among non-elite referees in lower leagues passion as one of three main categories; fitness motives (31 %), passion motives (25 %), and social motives (25 %). One may ask: Do elite football referees see officiating as a passionate activity? Philippe, Vallerand, Andriananrisoa, & Brunel (2009) concluded in their study that elite referees are highly passionate about their officiating. The aim of this study was to compare the role of passion for officiating football between Norwegian elite and non-elite referees. Methods This cross-sectional study was conducted as a part of the "Norwegian Elite Referees in football"-study. A total of 83 (participating rate: 84.7 %) top-ranked referees (73 males and 10 females) from age 20 to 46 (mean age 33.3 years) completed a web based questionnaire (SurveyXact). The referees were asked to report randomly three main reasons or motives for officiating football. The data was analyzed and results were obtained by bracketing, intuiting, and describing the different motives reported and organized into categories of description (Marton, 1995). The different categories of description that emerged were studied and regrouped by two colleagues. Results A total of 249 different motives for being a referee reported were bracketed and grouped, and three main categories emerged; passion motives, 61 % (e.g., simply love football, enjoyment, mental fulfillment, coping of stress), social motives, 26 %, fitness motives, 13 %. A second analysis of the category passion motives revealed two main categories of passion; activity related passion (e.g., enjoyable, excitement, incredible fun), and performance related passion (e.g., handling stressful situations, feeling of success, leadership fulfillment). Discussion Norwegian elite referees are in some extent more passionate in their refereeing than non-elite referees reporting the importance of enjoyment and excitement in officiating. Moreover, several elite referees underlined that they simply love officiating football, and they find conducting this activity incredibly fun and it gives them valuable training in handling stressful situations in their professional occupations and in their lives in general. References Johansen, B.T. & Bjørnstad, J.O. (2011). Motives for being a referee in football (soccer). Proceedings for the 16th Annual Congress of the ECSS, 6th - 9th July, Liverpool-UK, 97-98. Marton F. (1995). *Cognosco ergo sum*. *Nordisk Pedagogik* [Nordic Pedagogy], 15, 165-180. Philippe, F. L., Vallerand, R. J., Andriananrisoa, J., & Brunel, P. (2009). Passion in referees: Examining their affective and cognitive experiences in sport situations. *Journal of Sport & Exercise Psychology*, 31, 77-96.

## AWARDING PENALTIES IN SOCCER: DOES TEAM SUCCESS INFLUENCE THE REFEREE?

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Introduction The fundamental role of the soccer referee is to be an impartial leader of the game, who does not favor one team over the other. Nevertheless, Sutter & Kochen (2004) found in their study that referees are significant more likely to award a penalty to the home team, suggesting that referees are subconsciously influenced by noise created by the home crowd. Social influence theory (i.e., Mucchi Faina, 1996) pinpoint that conformity to the majority is only one of various types of social influences. The aim of this study was to examine the social influence of ability by investigating if team success influences the referee in potential penalty situations in professional Norwegian soccer. Method All 16 teams in the Norwegian Premier League (NPL) 2012 were divided into three categories based on recent success; 2 "highly successful" teams, 3 "some successful" teams, and 11 "less successful" teams. Based on objective match reports in which a team were pre-categorized as "highly successful" had played against a lower categorized team, or two teams in same category had played each other, were examined. Video clips from potential penalties situations identified in the reports (n=98) were edited to reduce potential biases by hiding elements like time, score, sound, order and referees decision. The situations were evaluated individually by an expert panel of three male NPL referees, and their decisions compared to the actual decisions made in game. Results Of the 55 situations including teams in same success category, the expert panel awarded mean number of 28 penalties, while the actual game referees awarded 22 penalties (79% of the expert panel). Of the 22 situations where a highly successful team attacked, the expert panel awarded 9.7 penalties, while the game referees awarded 11 penalties (114 %). Of the 21 situations where a successful team's opponent attacked, the expert panel awarded 7 penalties, while the game referees awarded 1 penalty (14%). Discussion In the games between two teams

rated as equal successful, the actual game referees awarded 79% of the mean number of penalties identified by an expert panel. This difference may be explained by a greater possibility to identify an offence when a situation is seen on video from different angles, zoomed in and in slow motion. However, when a highly successful team attacked, referees in games awarded 114% of penalties identified by the expert panel, while the referees in games only awarded 14% when their opponent attacked. This may indicate that the actual game referees were biased by team success in potential penalty situations in the NPL 2012. References Mucchi Faina, A. (1996). *L'influenza sociale* [Social influence]. Bologna: Il Mulino. Sutter, M., & Kocher, M. G. (2004). Favouritism of agents - The case of referees' home bias. *Journal of Economic Psychology*, 28, 461-469.

### **ENACTIVE ACCOUNT OF IN SITU MOBILIZATION: THE CASE OF VOLLEYBALL PLAYERS STRONGLY COMMITTED**

Recope, M., Rix-Lievre, G., Boyer, S., Laurin-Landry, D.

*Clermont University*

Introduction: Many studies based on cognitive framework focus on expertise-related differences in sport performance, none on criteria that would be common to the practice of some novices and experts. The defensive mobilization, a key aspect in volleyball (Selinger & Ackermann-Blount, 1987), seems to be one. Our enactive based study, conceiving cognition as a 'teleological constraint' (Weber & Varela, 2002; Laurent & Ripoll, 2009), aims to understand what underlies it. Method: We investigate 12 players regularly and strongly committed, with different levels of expertise (from beginner to highly skilled). Games were filmed and self-confrontation interview were realized. We bring primacy to various types of regularities identifiable about the action as it unfolds in situ. Analysis connects three kinds of regularities, related to: typical behaviors; discriminating circumstances of the game in which they are manifested; feelings and meanings expressed about these behaviors and circumstances. Results: Regularities pointed that there is a common convergence among these various players mobilized, between all of their discriminatory behavior (instantly oriented facing the ball, frequently manifest ready position, instantaneous spurts before giving up sometimes, extended attempts to contact the ball sometimes until fall or impact, frustration manifested when defensive failure occurs); and between these and feelings signified (defensive requirement been generalized, time and space always ever reported to the defending possibility, not reflected and impulsive rushes, prevalence of the defensive need on the bodily discomfort, pleasure felt in defensive success, dissatisfaction about inactive defending partners). Discussion: Despite their different expertise levels, players strongly committed in defense have in common an intrinsic teleology directed by their sensibility to the rally break. While this is at stake for them along the game, their domain of relevant interaction (Weber & Varela, 2002) is large: extremely attentive, they try to anticipate events, to be well positioned to save the ball and to avoid the rally's breaking. This phenomenological assumption about proper world is consistent with Lazarus proposals on appraisal and commitment (2001). We claim the necessity to investigate such dimension to better understand sport performance. References: Laurent E, Ripoll H (2009). In Araújo, Ripoll & Raab, Perspectives on Cognition and Action in Sport, 133-146. Nova Publishers, New York. Lazarus R S (2001). In Scherer, Schorr & Johnstone, Appraisal processes in emotion, 37-67. Oxford University Press, Oxford. Selinger A, Ackermann-Blount J (1987). Power volleyball. St. Martin's Press, New York. Weber A, Varela F (2002). *Phenomenology and the Cognitive Sciences*, 1, 97-125.

### **ARE THE STAGES OF CHANGE FOR SWIMMING & AQUATIC EXERCISE PROS & CONS QUALITATIVE DISTINCT? : AN ANALYSIS USING A PRECONTEMPLATION STAGE UNIVERSITY STUDENTS OF DECISION BALANCE**

Nishida, J.

*Gunma University*

Introduction Various studies conducted in and out of Japan have indicated the effects of swimming and doing aquatic exercises on the mind and the body. Berger and Owen (1983) examined the effects of swimming and aquatic exercises on transient feelings of university students and suggested that there were significant changes in their feelings, such as depression, anger, energy, and emotional stability. However, the number of university students that swim is 10.6%. The characteristics of university students that do not swim, or do other aquatic exercises were investigated from the perspective of decisional balance in behavior change theory. In a qualitative study, the perceptions regarding the pros and cons of doing these exercises to participants in the precontemplation stage were examined and compared with perceptions of participants in the maintenance stage. Methods Participants were required to recall past experiences of swimming and doing aquatic exercises and to describe three positive and negative things that might have been caused by them. Following Nishida (2011), participants were also required to make self-evaluations about behavior change stages related to swimming and aquatic exercises, with the exception of those conducted as university classes. Results The results indicated certain keywords and among the keywords, those with a frequency of 3 or more were extracted and categorized. The following 10 categories reflected descriptions of participants in the precontemplation stage regarding pros (N=593, 91.0%): improving health and physical strength, dietary effects, increasing muscle strength, stress reduction, improved aerobic capacity, comfort and enjoyment, gross movement, improved swimming, appropriate physical load, and healing effects. The following seven categories reflected the contents of description of participants in the precontemplation stage regarding the cons of swimming (N=535, 82.1%): changing clothes and preparation, physical damage, tiredness and exhaustion, danger, time required, expenses, and exposing the body. Discussion Categories indicated by participants in the maintenance stage were considered to be perceptions of pros of those doing these exercises for an extended period. Such participants considered that their health and physical strength improved, personal development was promoted, opportunities for meeting other people were increased, and life was enriched. On the other hand, participants in the precontemplation stage considered increased muscle strength and improved swimming ability as the main pros. References Berger, B. G. & Owen, D. R. (1983). Mood alteration with swimming- Swimmers really do 'feel better'. *Psychosomatic Medicine*, 45: 425-433. Nishida, J. (2011). Assessment of the pros and cons of swimming & water exercise among university student: Development and validation of a decisional balance scale. *Japan Journal for Health, Physical Education, Recreation, and Dance in Universities*, 8, 13-23.

### **MINDFULNESS TRAINING AND ATTENTION CONTROL IN ELITE SPORT**

Thienot, E.1,2, Dimmock, J.1, Jackson, B.1, Grove, B.1, Bernier, M.3, Fournier, J.4

1: University of Western Australia (Perth, Australia), 2: Western Australian Institute of Sport (Perth, Australia), 3: University of Caen (France), 4: INSEP French Institute of Sport (Paris, France)

In sport, the ability to self-regulate and respond efficiently when facing disruptive stimuli, by allocating the focus of attention to appropriate cues, is an essential prerequisite of success. Mindfulness is defined as a meta-cognitive skill that encompasses self-regulation of attention coupled with an attitude of acceptance towards one's present experience. To date, no studies conducted in sport have tested

the impact of a mindfulness-based intervention on variables associated with attention control. This study was designed to test the impact of mindfulness training (MT) on attention control using sport-specific and non-sport specific tasks. Elite swimmers were tested before and after an assignment to a four-week sport-based MT program ( $n = 15$ ) or to a control condition ( $n = 17$ ). Testing included a balance-task involving visual and audio distractions, a Stroop task, and a swimming task involving visual and audio distractions, as well as a validated instrument assessing the development of mindfulness skills in sport. We expected better post-intervention performances across the tasks among participants who attended MT in comparison to the control group. Two-way (group x time) MANOVAs were conducted for each task. Contrary to expectations, findings did not indicate that the MT provided benefits to attention control across sport and non-sport specific tasks. However, greater engagement in mindfulness practice during the intervention period was positively correlated with performances involving visual and audio distractions (i.e., swimming and balance task) and the development of non-judgmental skill. The nonsignificant multivariate effects may be explained by the lack of practice, but also by the nature of the tasks, the absence of incentive, and/or small sample size. However, this intervention provides an important framework for future sport-based studies, by implementing novel techniques for mindfulness training and incorporating objective measures of the mechanism underlying performance changes.

### **EMPOWERING PROFESSIONAL SOCCER PLAYERS IN SOUTH AFRICA: EVALUATION OF PROJECT ITHUSENG**

Taylor, G.

*Sports Science Institute of South Africa*

Introduction In response to the recognised need for life skills amongst professional soccer/football players in South Africa (SA), Project Ithuseng (meaning "Empower Yourself"), a life skills programme, was implemented by the Sports Science Institute of South Africa (SSISA). The programme was offered to Premier and First Division men's teams, women's national teams and nine top women's clubs. Evaluation of Project Ithuseng included formative, process and outcome evaluation components. Methods Prior to implementation of the programme, a needs assessment questionnaire was administered to all participating players, and seven focus groups were conducted with players ( $n=55$ ). A life skills questionnaire was administered to all participating players pre- and post-implementation. Post implementation, seven focus groups were conducted to assess players' perceptions of the programme ( $n=62$ ) and process evaluation data were collected via key informant interviews ( $n=9$ ). Results Seven Premier and 6 First Division clubs, 13 women's clubs, and 16 men's clubs from other divisions and academy teams completed the programme. Priority issues identified in the formative evaluation were planning for the future, leadership, communication, teamwork, self-confidence, taking responsibility and financial skills. Post-implementation focus groups revealed that Project Ithuseng was generally perceived as beneficial for players, and that fewer implementation challenges were experienced with women's clubs. Most valuable topics identified were finances, nutrition, conflict resolution and time management. The main factor influencing successful implementation was team management buy-in. A paired sample t-test ( $n=123$ ) showed a significant difference between pre- and post-implementation scores on the life skills questionnaire ( $p=0.046$ ). Discussion Evaluation recommendations include offering this programme to academy teams, younger players and other women's clubs, and that, in the interests of sustainability, a second phase is implemented to train soccer stakeholders to take over life skills facilitation. Through encouraging collaboration between soccer stakeholders in SA, Project Ithuseng has created a platform for future work in this area. (The full evaluation paper was published in the International Journal of Sports Science & Coaching. Volume 7.Number 3. 2012.)

### **COMPARISON OF PROBLEM SOLVING SKILLS OF STUDENTS STUDYING AT THE SCHOOL OF PHYSICAL EDUCATION AND SPORTS - AND FACULTY OF ARTS AND SCIENCE**

Unlü, C., Atan, T., Dilican, T., Yamaner, F., Çiçek, G.

*hitit üniversitesi*

INTRODUCTION: The aim of this study was to compare the problem solving abilities of the students between studying at the School of Physical Education and Sports (SPES) and Faculty of Arts and Science (FAS). MATERIALS AND METHODS: In this study, totally 350 students, 176 from SPES and 174 from FAS, participated voluntarily. As a data collecting instrument, Personal Information Form and "Problem Solving Inventory (PSI)" (Heppner and Petersen 1982) have been used in the research. In the adaptation of this scale to Turkey, 6 factors, such as "Hasty Approach," "Thinking Approach," "Avoiding Approach," "Evaluative Approach," "Self-Confident Approach" and "Planned Approach" have been found by Savasir and Sahin (1999). High total score means low problem solving ability of the individual. Mann Whitney-U test and Kruskal-Wallis test was used for the statistical analysis. RESULT: When all students were studied, Hast Approach, Thinking Approach and Evaluative Approach subscale scores and general PSI scores of SPES students were found to be higher than those of FAS students ( $p<0.01$  and  $p<0.05$ ). When the PSI and subscale scores of male students were compared, no statistically meaningful difference could be found between the males of different departments ( $p>0.05$ ). Once the scores of female students were analysed, the Evaluative Approach scores and general PSI scores of SPES students were found to be higher than FAS students' scores ( $p<0.05$ ). While Hasty approach scores of males were higher than females ( $p<0.01$ ), the other scores did show no statistically meaningful difference between genders ( $p>0.05$ ) when the PSI and subscale scores of boys and girls were compared regardless of department. DISCUSSION: In our study SPES students have higher PSI scores and this shows that SPES students have low level of problem solving abilities. Yildiz and et al. (2011) supported our finding that SPES students have high PSI scores. In our study PSI scores did not significantly differ between genders. Some previous studies supported our finding. In the study of Soyer and Bilgin (2010), the university students' perceptions of problem solving skills as adequate or inadequate did not differentiate between genders. Caglayan (2007), in his study, has found that there is not a statistically meaningful difference between PSI approaches of male and female students and that both genders will show an approach in the same way when they face such a situation. REFERENCES Caglayan HS. (2007). Gazi Universitesi, Egitim Bil. Enst. Beden Egitimi ve Spor Anabilim Dalı Beden Egitimi ve Spor Öğretmenliği Bilim Dalı. Heppner PP, Peterson C. (1982). Journal of Coun Psych, 29(1), 66-75. Savasir I, Sahin N. (1999). Bilisel ve Davranisci Terapilerde Degerlendirme, Turk Psikologlar Dernegi Yay., Ankara. Soyer MK, Bilgin A. (2010). International Conference on New Trends in Education and Their Implications, , 307-314. Yildiz I, Zirhlioglu G, Yalcinkaya M, Guven S. (2011). VAN/YYU Egitim Fak. Der. Ozel Sayisi, 18-36.

### **ANALYSIS OF NAVIGATION EXPERIENCE IN ORIENTEERING: WHAT IS MEANINGFUL FOR NOVICE ORIENTEERS?**

Mottet, M.

*MIP, Université de Nantes*

Introduction Most previous psychological studies on orienteering have focused on the characteristics of the expert orienteer's activity. They pointed out the importance of the cognitive processes to navigate in a quick and efficient way (Macquet et al., 2012). The aim of this

study was to understand the experience of novices in orienteering from the analysis of the meanings they were building through their navigation. This study was carried out referring to the "course of action" framework in line with the empirical phenomenological psychology perspective (Theureau, 2006). Methods Eight male novices volunteered to participate in the study which took place during an orienteering teaching cycle. Two types of data were gathered: (a) audiovisual recordings made with glasses camera worn by orienteers, (b) verbalizations during self-confrontation interviews. Forty interviews were carried out. The analysis of the data consisted of reconstruct the participants' "courses of experience", which enabled to characterise the various dimensions of their experience during orienteering tasks. Results The analysis showed the fluctuating character of the orienteers' navigation experience. They varied on continuum between two contrasted feelings of doubt and confidence concerning the conviction of their correct location. When they were confident, the orienteers' activity was defined by algorithmic reasoning aiming at solving the navigation problems based on comparing the map and the terrain. When they had a strong doubt (feeling of being lost) the orienteers' reasonings were more erratic, thus taking into account other elements more meaningful to them: (a) the aggressions and obstacles of the forest environment, (b) the feeling of urgency considering their limited time to carry out the task, (c) their being close or far from the others and (d) from emotionally charged man-made features. Discussion These results show that the experience of novices in orienteering does not only consist in some cognitive operations aiming to solve a well-defined navigational problem thanks to map-terrain comparison. This adaptive mode only occurs when orienteers are confident enough. Conversely, in time of doubt, we can notice more complex experiential forms which show the physical, material, social and cultural dimensions of the navigation. In that case, the orienteers seem to be faced with ill-defined problems of navigation that can not be reduced to an algorithmic problem of wayfinding. These results highlight the conception of tasks and practical modalities in orienteering teaching and training. References Macquet, A.-C., Eccles, D. W., Barraux, E. (2012). *J Sports Sci*, 30, 91-99. Theureau, J. (2006). *Le cours d'action: Méthode développée* [Course of action: Developments in methods]. Toulouse, FR: Octarès.

### THE BADMINTON'S PRACTICE AND ITS EFFECTS ON COGNITIVE SKILLS

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*UNICAMP*

Introduction The practice of Badminton has expanded during the last decade in our country due to the easiness of adaptation of spaces and the low cost of materials for its practice. However, the benefits of this sport have been poorly studied in the Brazilian literature. The purpose of this research was to evaluate the differences in levels of attention, concentration, reasoning and speed of processing in Badminton practitioners, comparing initial and final results and also comparing with a Control Group. Methods This study was performed with 21 subjects: 12 in the experimental group (EG) and 9 in the control group (CG). In the EG, tests were applied in the beginning and after four weeks of Badminton lessons, twice a week, about 60min. The GC also had tests but did not attend classes. The cognitive skills included: 1. Reasoning - BPR-5: consists in five subtests - Abstract, Verbal, Numerical, Mechanical and Spatial Reasoning, which are evaluated according to the responses (higher score, better ability of reasoning). 2. Attention and concentration - subtest of WAIS: assesses attention, concentration and the ability to differentiate essential from nonessential details in 25 figures. 3. Processing speed: subtest codes of WAIS: assesses selective attention and processing speed, throughout a series of numbers and symbols, which must be reproduced in 2 minutes (maximum score 133). Results The results showed differences in cognitive abilities measured in GE before and after training: speed of processing: pre-test = 85.42, post-test = 91.67 (paired  $t = 3.59$ ,  $df = 11$ ;  $p < 0.001$ ), attention and concentration: pre-test = 20.25, post-test = 22.67 (paired  $t = 5.56$ ,  $df = 11$ ,  $p < 0.001$ ), verbal reasoning: pre-test = 83.42, post-test = 87.33 (paired  $t = 1.02$ ,  $df = 11$ ,  $p = 0.33$ ), abstract reasoning: pre-test = 70.17, post-test = 85.67 (paired  $t = 3.05$ ,  $df = 11$ ,  $p = 0.01$ ), mechanical reasoning: pre-test = 79.00, post-test = 77.17 (paired  $t = 0.51$ ,  $df = 11$ ,  $p = 0.62$ ), spatial reasoning: pre-test = 77.50, post-test = 89.17 (paired  $t = 2.89$ ,  $df = 11$ ,  $p = 0.01$ ), numerical reasoning: pre-test = 67.83, post-test = 76.42 (paired  $t = 1.95$ ,  $df = 11$ ,  $p = 0.08$ ); general reasoning: pre-test = 79.83, post-test = 87.08 (paired  $t = 3.02$ ,  $df = 11$ ,  $p = 0.01$ ). In the GC there was little difference in the evaluation in two stages: although most cognitive abilities (with the exception of processing speed and abstract reasoning) showed some improvement in the two periods evaluated, only the attention / concentration was statistically different. Discussion Thus, we conclude that the practice of Badminton, proposed in this study, was effective in improving cognitive skills, since the changes occurred not only for the simple passage of time or the knowledge of the tests in a second time.

### GAME LOCATION AND TEAMS' ENTITATIVITY

Guraj, K., Kofta, M.

*University of Warsaw*

Introduction: Home advantage has been an issue in team sports since a long time. Studies examined multiple factors that may contribute to the phenomenon, yet no definite answer has been found (p.e. Nevill, Holder, 1999; Bray et al., 2002). However, most of them didn't put much attention to possible effects of intergroup context. The aim of this study is therefore to examine inter- and intragroup processes in relation to game location. Methods: A questionnaire study was conducted in a repeated measures design with 3 conditions included – control (at practice) and 2 experimental (home and away). We examined responses from 31 male elite volleyball players from Polish first division. They assessed following variables: both competing teams' entitativity, own team's cohesion, inclusion of foreigners into the team, perceived consensus within team-members, liking of own team and anxiety level before the competition. Results: Territory had a strong influence on the variables related with social functioning within the group. Competing on the opponents' territory increased perceived level of opponents' entitativity without significantly changing the perception of the own team. Nevertheless, high own team entitativity proved itself to be a strong determinant of general positive attitude towards the team, especially of social cohesion and perceived consensus. There was no significant effect of stress level (measured by CSAI 2-R). Conclusion/Discussion: The study has proven that game location has a significant effect on athletes' perception of others. Observed changes may be the reason why athletes differ in the way they perceive threat. The increase in opponents' perceived entitativity level while playing away suggests that group processes and group perception may play a significant role in sports competition. Therefore, further research explaining whether discovered phenomenon leads to an increase in mobilization and a better performance or the opposite – to threat being perceived as bigger and a poorer performance – is a must. Selected references: Bray, S.R., Jones, M.V., Owen, S. (2002). *Journal of Sport Behavior*, Vol.25, No.3, 231-242. Brewer, M. B., Hong, Y., & Li, Q. (2004). In: V. Zyerby, C. Judd, & O. Corneille (Eds.), *The Psychology of Group Perception: Contributions to the Study of Homogeneity, Entitativity, and Essentialism* (pp. 25–38). New York: Psychology Press. Castano, E., Sacchi, S., Gries, P.H. (2003). *Political Psychology*, 24, 449-468. Dasgupta, N., Banaji, M. R., Abelson, R. P. (1999). *Journal of Personality and Social Psychology*, 77, 991–1003. Kofta, M., Narkiewicz-Jodko, W., (2004). In: Kofta, M. (ed.) *Myślenie stereotypowe i uprzedzenia. Mechanizmy poznawcze i afektywne. [Stereotyped Thinking and Prejudice: Cognitive and Affective Mechanisms]* 79-94. Warsaw: Wydawnictwo Instytutu Psychologii PAN. Nevill, A.M., Holder, R.L. (1999). *Sports Medicine*, 28, 221-236.

15:00 - 16:00

## Mini-Orals

## PP-SH23 Sport Statistics and Analyses [SA] 2

**DOES NUMBER OF QUALITY THROW ATTEMPTS AFFECT THE COMBAT OUTCOME IN TOP WORLD JUDO COMPETITIONS?**

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Introduction Judo is an Olympic sport in which it is extremely hard to predict winners of the most important competitions. Neither one Olympic champion from Beijing defended his title in London four years later. In addition to this fact, 45 from 56 medal winners in London won their first medal on the Olympics. Research was conducted in order to find out if there are differences between winners and losers in number of quality attacks in finals and semi-finals of the most important championships, depending on the combat period. Methods Applying observational methodology, a total of 273 combats from males and females finals and semi-finals of 12 Top World Tournament were analyzed by 13 trained judo observers. Inter and intra-observer reliability were assessed, by calculating Randolph's free-marginal multirater kappa (Randolph, 2008) and Cohen's Kappa. An ad hoc instrument was developed using Lince software (Gabin et al., 2012), including the variables a) quality throw attempts - analysis includes throw attempts that referee declares valid and ineffective actions in which a contestant clearly threw his opponent out of balance b) combat outcome and c) combat period - first two minutes and last three minutes of the fight. Statistical analysis included cross-tabulations analysis with Chi-square testing. Results Male winners perform a 26.8% more of quality throw attempts than losers during the last three minutes of the combat (ASRs= 2.7; p= .008). No significant differences were found in female fighters and between weight categories. Discussion The most important finding was that in the second part of the fight, male winners increase number of quality throw attempts while losers decrease the number. As coaching advice we recommend that constant activity is needed through the fight, but most important is to rapidly increase number of quality attempts during last three minutes. For doing this judokas need developed system of lactic anaerobic endurance (Lech et al., 2010) in order to get to those final moments of combat in good condition. No differences found in female competitors led us to conclusion that physical preparedness is not a crucial factor for success in decisive matches. Our suggestion is that in female competitors more attention should be given to psychological and tactical preparation, which according to results of Sterkowicz et al. 2007, are 2nd and 3rd factor most important for the sport result. References Gabin, B., Camerino, O., Anguera, M.T., Castaner, M. (2012). *Procedia Computer Science Technology*. 46. 4692 ñ 4694. Lech, G., Palka, T., Sterkowicz, S., Tyka, A., Krawczyk. (2010). *Archives of Budo*, 6(3), 123-128. Randolph, J. J. (2008). Retrieved February 10, 2013, from <http://justus.randolph.name/kappa> Sterkowicz, S., Garcia, J.M.G., Suay i Lerma, F. (2007). *Archives of Budo*, 3, 57-61.

**COMPARISON OF MONO- AND MULTIFREQUENCY BIA DEVICES IN THE ASSESSMENT OF HYDRATION STATUS IN ELITE ATHLETES**

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Introduction Hydration status assessment can be a useful tool for monitoring training, nutrition and environmental health-related factors. Bioelectrical impedance analysis (BIA) is an easy non-invasive method for clinical and field studies (Armstrong, 2007). BIA device comparisons typically conclude that they are accurate (Wang et al., 2013), but it seems to fail in some studies on athletic and non-athletic populations (Moon, 2013). We compared two (mono- and multi-frequency) BIA devices for assessing total body water content (TBW) in a selected group of elite swimmers with the purpose of determining its crossed validity for field studies in athletes. Methods 48 elite swimmers (23 M, 25 F; age 22.0±3.8 y; body mass (BM), M 79.3±6.6, F 62.5±4.8 kg; height, M 186.3±5.6, F 173.0±5.6 cm) were assessed at the same occasion using two BIA devices: a foot-to-foot mono-frequency (50 Hz) BIA device (Tanita BC-420MA, Japan) and a multi-frequency wrist-to-ankle device (Z-Metrix®, BioparHom Co, France) (MONO and MULTI, respectively). TBW estimates were compared and inter-method agreement was assessed by two-tailed paired t-test, Pearson correlation (r), and Bland-Altman analysis. Results In males, TBW (l) by MULTI were greater (53.5±7.9, TEM 1.6) than by MONO (50.3±3.8, TEM 0.8) (18% diff., p<0.001). In females, TBW by MULTI were also greater (41.8±5.4, TEM 1.1) than by MONO (35.4±2.8, TEM 0.6) (6.4% diff., p=0.006). TBW estimates by both methods were highly correlated in males (r=0.86, p<0.001) but moderately in females (r=0.61, p=0.001). Discussion Both BIA methods were not in good agreement in estimating TBW content. The multi-frequency impedanciometer systematically measured greater TBW values, particularly in males. More important, measured values were highly correlated in males but not so in females. Even if none of the two devices can be considered a 'gold standard', it seems reasonable to assume that the multi-frequency device would provide more valid estimations of TBW content because of its more advanced technical design and fewer sources of error (e.g. electrode vs. foot plant). Adequate validation studies are warranted before BIA can be considered a valid tool in monitoring athletes' hydration status. References Armstrong LE (2007). *J Am Coll Nutr*, 25(5 suppl.), 575-584S. Moon JR (2013), *Eur J Clin Nutr*, 67 (Suppl1), S54-S59. Wang JG, Zhang Y, Chen HE, Li Y, Chen XG, Xu L, Guo Z, Zhao XS, et al. (2013), *J Strength Cond Res* 27(1): 236-243.

**SUCCESSFUL TEAMS' TACTICAL BEHAVIOR WITHOUT BALL IN THE U17 WORLD CUP MEXICO 2011**

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Introduction Tactical behavior in soccer is often unpredictable as it depends on the interactions between offense and defense (Lames, 2006). However, it can be assumed that successful teams present tactical patterns with certain consistency that explain their positive results (Lames & McGarry, 2007). Tactical behaviors that characterize successful teams should become tactical training aims (Garganta, 2009). In this study, the actions of players without the ball were categorized and assessed by online-observation during the U-17 World Cup Mexico 2011; the ball-actions were analyzed in a second study using video-analysis. Methods The actions of 149 players (excluding goalkeepers) were observed in 8 matches; these actions were categorized according to different variables of tactical behavior: 12 actions

were assessed qualitatively (graded on a Likert scale of 5 levels) and 17 assessed quantitatively (frequency and outcome of the actions). The qualitative and quantitative variables were selected from a list of scouting criteria for talented players of Club Pachuca. The actions of each player were assessed by a trained observer. Afterwards, they were compared in order to identify those tactical variables that characterized successful teams. Score averages and frequencies (both absolute and relative) of actions between winning and losing teams were compared using Student's T-test. Results For qualitative variables, the defenders and midfielders of the winning teams: repeated efforts, made themselves available for a pass more often, guided their teammates, marked closely and pressed the opponent more than losing teams. Attackers showed no significant differences in any variable. The quantitative evaluation showed that the players of winning teams won more running duels and offered themselves more often in the center stripe. The midfielders and defenders of the winning teams showed a tendency to join the attack more often after winning the ball and to let the opposition's attackers get to their back less frequently. Discussion Significant differences between winning and losing teams focused on defenders' and midfielders' tactical behavior, while attackers showed no significant differences. This could lead to the conclusion that, at U-17 level, the training concentrates more on attacking play. According to these conclusions, the tactical training should aim on vertical play, on quick counterattack after recovering ball possession, and on tactical behaviors related with physical efforts, such as constant pressing upon the opponent, repeating efforts throughout the game and marking closely. References Garganta J (2009). *Rev Port Cien Desp*, 9(1), 81-89. Lames M (2006). *Journal of Sport Science and Medicine*, 5, 556-560. Lames M, McGarry T (2007). *International Journal of Performance Analysis*, 7(1), 62-79.

## CHARACTERISTICS OF SKI MOTIONS FOR BEGINNERS ON SHORT STAY SKI PROGRAM OF ELEMENTARY SCHOOL

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Introduction There are various difficulties to master ski skills even if child is beginner. It is important to elucidate the methods to estimate objectively ski motion for making sure of the current state of ski ability. The purposes of this study were to examine characteristics of ski motions for beginners, to elucidate procedure for mastering ski skills and the construct the simplified check points for evaluate beginners' ski ability. Methods The school children in Kobe city participate of the 3 days ski program. The samples of the study were 6th grade children, 6 boys and 5 girls. Their ski motions were recorded 6 times during the ski program. They were analyzed based on 28 observational motion points, which have multi rating categories. The graded response model of item response theory (IRT) was applied in order to estimate the ski ability of the children and item characteristics such as item difficulty (ID) and discrimination power (DP). Repeated-measure ANOVA and multiple comparisons were applied in order to examine the proficiency of ski skill through the activity. Results and discussion The 2 motions were 'looking down (ID=0.476)' and 'mistakes (ID=0.523)', had high ID. These motions were much difficult for beginners. Item was 'Bad waist position (ID=-0.841)' showed the highest ID at low-level category. It was suggested that beginners feeling to fear of ski or fall lost their postures. There were 4 motions, 'speed control and stopping (DP=3.092)', 'motion with center of gravity (DP=2.613)', 'looking ahead (DP=2.575)', and 'turning smoothly (DP=2.683)' which had high DP. It was suggested that edging skills like Pflugfahren (a double stem) and Pflugbogen (a double stem turn) were closely related to beginners' proficiency of ski skills. 'Bad waist position (DP=1.886)' also showed high DP. It was suggested that conquest of the fear was related to beginners' proficiency. The ski skills were improved significantly between beginning and end of the 1st day program, morning and afternoon of 2nd day programs repeating. It was suggested that beginners improve steadily through 2-hour programs. Their ski skills improved significantly through programs of two days and the average of ability scores after all programs ( $\theta=0.760$ ) was higher than IDs of items related to Pflugbogen skill. It was suggested that beginners' Pflugfahren skill and Pflugbogen skill was mastered through programs of two days. References Suzuki H. (1997). *Bulletin of Hokkaido University of Education*, 25, 21-30, (in Japanese). Sato M. (2002). *Bulletin of Komazawa University*, 18, 7-20, (in Japanese).

## OCCURANCE OF CHOKING IN ATP TENNIS

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Introduction Choking under pressure is a common occurrence in professional sports. The aim of this paper was to investigate the nature and prevalence of choking in ATP tennis, and determine whether choking is more prevalent among certain athletes or stages within tournaments. Methods A database of matches played between 2007 and 2011 was developed on ATP matches and a total of 13,059 matches were included. Matches had to meet certain criteria to be considered potential choking. Best-of-three set matches were required to be played to three sets, and in terms of the best of five matches, all five sets of a match had to be played. The deciding set(s) of the match must have also had a final score of 7-6 or 7-5. These criteria were congruent with Wang's (2002) operationalisation in that the player could have won the match if they had not choked. Of the initial sample, 3,559 matches were played to three sets, whilst 656 finished to 7-6 or 7-5 in the second and/or third sets; 181 matches from the best-of-five met the criteria. Results Players were found to have choked in 236 matches. Players won the first set and choked in the second or third sets in 168 matches, whilst in 68 matches, the player lost the first set, won the second set, and choked in the third and final set. The most common choking comprised players serving for the match in the second or third sets, yet went on to lose the match. In over 15% of these matches, the player had match points on serve yet went on to lose the match. It was found that 2.8% of all matches played involved choking. Given that the majority of three set tournaments contain 64 players and 63 matches, this equates to approximately one choking incident per tournament. Quite a high proportion of matches (37) incorporated a player choking in both the second and third sets of a match and only 1 match for both 4th & 5th sets. Discussion Choking occurred in 2.2% of best-of-three set ATP matches and 1.43% for the best-of-five matches. The most common type of choking was the circumstance where a player had at least one opportunity to serve for the match, yet went on to lose their service game and subsequently, the match. On 23 occasions a player had a single match point and lost on serve, however there were 57 occasions when a player had at least one match point when receiving serve yet went on to lose the match. This finding provides evidence for the likelihood of winning points when on serve, but also the difficulty players have closing out a match when receiving, even if their general play has been superior to their opponent for the duration of the match. References Wang (2002). *Developing and Testing an Integrated Model of choking in sport*. PhD Thesis. Victoria University.

## MULTIVARIATE STATISTICAL APPROACHES TO TALENT IDENTIFICATION

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Do not insert authors here Introduction Talent identification (ID) is a major focus of many national sports associations. Sport promotes national pride, such as World Championships, Olympic and Commonwealth Games Paralympic Games. The foci of talent ID is to identify talent for World Championships, Olympic, Commonwealth and Paralympic Games; identify human talent for professional sports due to high turnover of athletes; enhance the use of limited resources by targeting the appropriate athletes and identify the next generation of high performance athletes. Many programs in Australia and overseas are directed towards target populations, such as children, adolescents and adults athletes. Predictive problems with univariate statistical approaches to talent ID include analysis of variables in isolation and they do not describe complex interactions that often occur between many tests that are conducted in talent ID. A significant level of redundancy within test variable sets may exist and this redundancy is difficult to evaluate using the univariate approaches. Multivariate prediction models permit a more holistic analysis of factors (Arbuckle, 2009; Hair et al., 2010) that explain and predict high performance athletes. Multivariate methods exist that can explain complex interactions that predict competition performance (Vaeyens, 2008). Methods A number of sports were analysed using multivariate statistical methods, such as multiple linear regression using kinanthropometric, exercise physiological, biomechanical and sports psychological factors to predict high performance triathlete times, factor analysis to examine the more complex relationship between torque, power, work, fatigue and acceleration, path analysis and structural equation modeling to predict performance outcomes in the decathlon and heptathlon, kinanthropometric, exercise physiological, biomechanical factors predicting BMX competition performance and neural network analysis to classify karate ability based on general motor and specific motor fitness tests. Results The multivariate methods were capable of developing hierarchies of importance for the predictor variable sets that explain and predict competitive performance. The explained variance utilising multivariate statistical methods was more substantive and enabled redundancy analysis and the identification of critical predictive subsets of factors predicting performance. Discussion Multivariate statistical approaches to talent identification provide both more meaningful and more complex explanations in predicting performance and as a more complete method of talent identification. References Arbuckle J (2009). AMOS 18 Users Guide. SPSS Inc, Chicago. Hair JE, Black W, Babin BJ, Anderson, RE (2010). Multivariate Data Analysis (7th Ed.). Pearson - Prentice Hall, Upper Saddle River. Vaeyens R, Lenoir M, Williams A, Philippaerts R (2008). Sports Med. 38(9), 703-714.

## THE EFFECT OF RULE MODIFICATIONS ON TECHNICAL DEMANDS AND DECISION MAKING IN JUNIOR RUGBY LEAGUE GAMES

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Introduction Currently the Australian Rugby League is examining the junior game in relation to recruitment, retention and the skill development of 6-12 yr old players (ARLC, 2012). Preliminary findings from stakeholder forums indicated there were concerns that the game in its current form 'discouraged players from developing game awareness and tactical skills' (ARLC, 2012, p.5). The aim of this study was to investigate the influence of three proposed rule modifications (introduction of arm bands for the dummy-half and first receiver allowing these players to run the ball without fear of losing possession for their team if tackled, narrower field and kicking allowed on any tackle) on player involvement, decision making and skill development. Methods Participants were from 36 teams competing in Australian domestic Under 11 competitions. Thirty three games were filmed (17 played under traditional rules and 16 played under the new rules) and systemically analysed using the developed RL coding sheet (inter and intra tester reliability was  $r > 0.85$ ). Results Initial results indicated there was no significant difference ( $p > 0.05$ ) in the total number of plays or average number of sets of tackles performed in each game format. Furthermore, there was no significant difference in the technical skills (passes, catches, kicks and tackles) performed, effective plays such as line breaks and offloads, errors made (e.g. missed tackles, ball lost, penalties), or tries scored. However under the new rules players gained more metres on each play ( $p < 0.001$ ) and the dummy-halves decided to run more, were tackled more ( $p < 0.001$ ), kicked more, and gained more metres when they ran ( $p < 0.05$ ). Under the new rules the first receiver also ran on more occasions compared to standing and passing ( $p = .01$ ). Discussion The main aim of this study was to determine whether the introduction of three rule changes would provide greater opportunities for the development of technical skills and tactical awareness as these are considered paramount to the enjoyment and retention of players. Preliminary results revealed limited differences in overall game performance particularly in relation to the similar number of opportunities for executing technical skills and effective plays such as line breaks. However the introduction of the arm bands may have provided more decision making opportunities for the play makers and assist in developing their game sense and tactical awareness. These preliminary findings support the need for further research incorporating a larger sample before administrators can make an informed decision on the impact of these rule modifications on the development of junior rugby league players. References Australian Rugby League Commission (2012) Rugby League Participation Pathways Review, 1-16.

## THE TEMPORAL CHARACTERISTICS OF BASKETBALL OFFENSIVE PERFORMANCE

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Introduction The play-by-play records of the basketball game provide records of players' performance associated with time during the game, therefore it is possible to reconstruct the game based on these records and analyze the performance with respect to time. The purpose of the study was to examine the temporal characteristics of the offensive performance in 2012 FIBA Asia Cup, specifically the distributions of the ball possession time and shooting performance. Methods The analyses were based on the FIBA official records of 32 games of 2012 Asia Cup, and the cluster analysis on the game score difference (Csataljay et al., 2009) was used to group the 32 games into Closed Games (12 and under, CG), Balanced Games (13-35, BG), and Unbalanced Games (36 and above, UG). Ball possession time was calculated from the play-by-play records and the number of shots taken was also calculated for ball possession time of 5 s and under, 5-8 s, 8-14 s, and 14 s and above (Chen et al., 2005). In addition, the situation of how the ball possession was initiated was categorized into offensive rebound (OR), defensive rebound (DR), steal (S), and boundary (B). ANOVAs on the ball possession time and the distribution of shots made were used to examine the differences between winning (W) and losing (L) teams and among different ball possession time categories. Results The W teams of the UG group show a significantly shorter ball possession time than the L teams. The CG and BG groups show a general trend of shorter ball possession time for the hit than missed shooting results, and shorter 2-pt than 3-

pt shot attempts. The W teams of both BG and UG show significantly higher shooting percentage than the L teams in the 5 s and under category, the CG group shows a significantly higher shooting percentage for the 5 s and under category than the 8-14 s and 14 s and above categories. The analyses of the distribution of shots made from different ball possession time categories and ball possession initiation situations show that shots made from DR dominates the 5-8 s category and the W teams had significantly more shots than the L teams for all 3 groups. Discussion Fast pace has always been considered as a characteristic of basketball game. The analyses of offensive performance in different ball possession periods provide evidence to support the fast pace nature of basketball games. The official play-by-play records of basketball game offer the opportunity to analyze the players' performance dynamically. Future studies should take advantage of these dynamic data and examine time-related performance in basketball games. References Csataljaj G, O'Donoghue P, Hughes M, Dancs H. (2009). *Int J Perform Anal Sports*, 9(1), 60-66. Chen K-W, Zhu T-Q, Xu Y-L, Liu J-Q. (2005). *J Wuhan Inst Phys Educ*, 39(2), 91-93.

### **SUBJECTIVE EVALUATION OF BATTING FORM IN YOUNG JAPANESE CHILDREN USING ITEM RESPONSE THEORY**

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Purpose Children's motor performance should be evaluated in terms of whether their form is proper or reasonable, but not using measurements such as time, distance, or force. The method which classifies various motor forms into two or more typical motor patterns and investigates changes in these motor patterns by individual cannot discriminate the short-term development of motor form. This study aimed to propose a new evaluation method for assessing batting form that can discriminate development over a short time span. The new evaluation method used a subjective rating by body part and item response theory to build a ratio scale. Methods One hundred and thirty-four Japanese young children aged 5 to 6 years volunteered to be measured while batting a ball. Two different sized rubber balls were rolled toward them on the ground and they were asked to hit the balls strongly and straight ahead. We evaluated how strongly and accurately they hit a ball using a 3-grade-scale: "strong/accurate," "medium," and "weak/inaccurate". At the same time, we videotaped their hitting performance and subjectively rated their form afterwards using 19 subjective rating items such as "Was the child's head stable before hitting?" "Did the child swing his/her arm smoothly?" and "Did the child hold the bat with one hand or two hands?" In addition, we also evaluated the child's form using a 3-grade-scale: "yes," "not discernible" and "no". Results and discussion A one-dimensional individual ability parameter, theta, and a step difficulty parameter, indicating the difficulty on the 3-point-scale subjective rating scale, were derived using the Partial Credit Model, a type of item response theory. Correlation coefficients of individual ability parameters with the speed of the big and small ball and the accuracy with the big and small ball were 0.442, 0.004, 0.294, and 0.050, respectively, showing that the correlation coefficient of the big ball had a significant relationship with individual ability parameters at the 1% significance level. Correlation coefficients of individual ability parameters with age, standing height, and body weight were 0.465, 0.336, and 0.219, respectively. These significant relationships indicated that estimated individual ability parameters reflected the maturity of subjects. The total item information function was 9.0, which corresponded to a reliability coefficient of 0.90, covered a value of theta from -1.0 to 0.7, indicating that this test was reliable in the middle to slightly inferior sample group. The objectivity coefficient between two groups of individual ability parameters computed from two raters was 0.684. Finally we proposed a practical method of computing individual ability parameters by a score that summed up the subjectively rated form score as 2 as "yes", 1 as "not discernible" and 0 as "no".

### **THE ROLE OF PREVIOUS ACTION IN THE ACCURACY OF THE JUMP SHOT IN MEN AND WOMEN BASKETBALL PLAYERS**

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Introduction The jump shot (JS) is the most common type of shot in a basketball game (Ibanez et al., 2007). The accuracy of the JS (JSA) is determined by kinematic factors (Bartlett et al., 2007) and by factors of visual control (Vickers et al., 2009). The previous action (PrAc) (technical skill and tactical cooperation) aims to create the kinematic and visual conditions most favorable for an accurate JS execution; however there is lack of data on its role in the JSA. The purpose of this study was to investigate the role of the PrAc in the JSA in men and women basketball players. Methods A notational analysis (Hughes and Franks, 2004) was used in 30 men's and 27 women's games (A1 league championship - first 6 ranking teams, respectively). The PrAc examined were those of technical skills (way of receiving the ball, way of stopping, number of dribbles, hand of last dribble, receiver's movement) and tactical cooperation (use of screen, area and side where the pass came from). To test the significance of the relationship between PrAc and JSA the technique of cross-classification was applied (Chi-Square index,  $p \leq 0.05$ ) with gender as a control variable, separately for each PrAc. Results The significant correlations between the JSA and PrAc had a different gender pattern. For the technical skills, the JSA was significantly related to the way of receiving the ball and the receiver's movement in the women ( $p \leq 0.05$ ) while in men no significant correlations were found ( $p > 0.05$ ). For the tactical cooperation, the JSA was significantly related with the area where the pass came from for both genders, while, it was significantly related to the use of screen for receiving the pass and the side where the pass came from only in men ( $p \leq 0.05$ ). Discussion The different gender pattern of the significance of the correlations between the JSA and the previous technical and tactical action indicates the need for a gender specific training design. For improving the JSA coaches should take into consideration the particular needs of the men and the women basketball players as well as the gender differences in cooperation and competition (Van Vugt et al., 2007). References Bartlett R, Wheat J, Robins M. (2007). *Sports Biomech*, 6 (2), 224-243. Hughes M, Franks, IM (2004). *Notational Analysis of Sport* (2nd ed.). London: Routledge. Ibanez SJ, Feu S, Garcia J, Canadas M, Parejo I. (2007). *Iberian Congress on Basketball Research*, 4, 54-57. Van Vugt M, De Cremer D, Janssen DP. (2007). *Psychol Sci*, 18 (1), 19-23. Vickers JN. (2009). *Prog Brain Res*, 174, 279-288.

### **DISCRIMINATION OF DEFEAT AND VICTORY GAME PATTERNS IN HANDBALL**

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Introduction Game's study and analysis are essential to achieve the highest levels of performance. It is therefore important to access information in order to increase game's knowledge. This study objective was to build an handball winning teams profile, using efficacy values derived from the combination of simple game indices, and therefore establishing what level of relationship in their application is necessary to obtain relevant information. Methods Sample for this study was composed by a total of 192 games of the Handball 1st division Portuguese Championship. Independent variables were the condition of game winner and loser and dependent variable the

efficacy coefficient. A descriptive statistical analysis of proposed rates was applied, T-tests for the two independent samples with normal requirements (KSL) and equal variance (Levene), non-parametric tests (Man-Withney U) and also Spearman bivariate correlations. Results indicate that the attack efficacy rate, the missed shots rate in the attack, the shot efficacy rate, the efficacy and inefficiency shot rate and the goalkeeper efficacy rate are the most relevant when doing associations with final standings. It appears to exist a relationship between the shot efficacy and the final standings and a strong relationship between goalkeeper's efficacy and final standings. Discussion Proposed efficacy coefficients are valid to determine the winner or loser condition in a handball match, namely the attack efficacy rates, the missed shots in the attack, the efficacy and inefficiency shot rate, and the goalkeeper's efficacy rate are the only ones who seem to have significant differences between the winner and loser teams. Goalkeeper's efficacy rate was the main coefficient when relating to the final standings. There was a very marked difference in the comparison between the first and the last ranked, reinforcing the importance of the handball goalkeeper's and their teams end results. (Pascual, 2008; Sá, 2012). It was possible to identify a considerable number of factors that can contribute to an improvement in the performance of handball teams. Thus, it is important to transfer the competition data to training, preparing in a more careful, adjusted and focused way teams for a better performance. References Pascual, X. (2008). La actividad competitiva del portero de balonmano en el alto rendimiento (Unpublished Tese de Doutoramento). Faculdade de Ciencias da Educación e do Deporte. Universidade de Vigo. Sá, P. (2012). O treino do guarda-redes. In M. Arraya & P. Sequeira (Eds.), *Andebol: Um caminho para o alto rendimento* (pp. 143-167). Lisboa: Visão e Contextos.

### ANALYSIS OF SEQUENCE OF PASS, SHOTS ON GOAL AND GOALS CONVERTED IN THE HANDBALL FEMALE IN THE 2008 OLYMPIC GAMES

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**Introduction** The handball is a sport in which the pass is a technical element of great importance in the construction of sequences offensive and which determines the actions prior to submission attempt on goal. Thus, studying the use of this technique for shot the goal is characterized as an index of relevance for understanding the logic of the game of handball. The literature review presents studies related to the analysis of sequence of passes in moments that precede the loss of possession, however, there is no agreement among studies, which warrants further investigations on this subject. The aim of this study is to compare the data obtained on the sequence of passes (SP) on the basis of the shots on goal and situations where there is not a goal, seeking information that may help in studies on the topic. **Methods** The method is the systematic observational indirect and not participant (ANGUERA et al, 1978) in 12 female handball matches of the 2008 Olympics Games. Was considered sequence of passes (SP) the period beginning with the conquest of possession until the interruption of the sequence of passes or loss of possession. The categories analyzed were: FS= shot on goal without converted; FG= goal converted, and N = loss of possession in other situations. Results Compared SP with FG, FS and N, was observed that for SP=0: (FG=56,7%, FS=28,9% e N= 14,4%) and to SP=1: (FG =35,5%, FS=33,1% e N=31,5%), with p-value <2.2e-16, which is inversely proportional relation between SP and FG, with better of FG between SP = 0 and 1 and occurrence of a directly proportional relationship between SP and N. For FS + FG (total shot on goal) it was found that have an inverse relationship between SP and FG + FS, with better use of FG + FS between SP=0 (FG + FS=85.6% and N=14.4%), SP=4 (FG + FS = 52.6%) and SP=7 (FG + FS = 52.6%), and occurrence of a directly proportional relationship between SP and N (p-value = 3.985e-16). **Discussion** The present study is the first to make a relationship between sequence of passes and the different situations of loss of possession (FG, FS and N) of female national teams in the 2008 Olympics Games, that is to our knowledge. Regarding the literature, these present data agree with Tavares and Moreira (2004) and Garcia et al (2008) studies who analyzed only male teams. This study demonstrates that for handball games analyzed, the lower number of passes is more objective (creation of some passages) and is the best decision-making to create situations more effective as demonstrated in an inverse relationship between the sequence of passes and the criteria FG and FS. References ANGUERA, T. et al. Metodología de la observación en ciencias humanas. Madrid. Cátedra, 1978. MOREIRA, I.; TAVARES, F. Configuração do processo ofensivo no jogo de Andebol pela relação cooperação/oposição relativa à zona da bola. Estudo em equipas portuguesas de diferentes níveis competitiuos. Revista Portuguesa de Ciências do Desporto, Porto, v.4, n.1, 2004.

### OBSERVATIONAL TOOL TO EVALUATE DECISION MAKING IN BASKETBALL PLAYERS

Serna, J., Lavega, P., Hileno, R., March, J., Sáez de Ocáriz, U.

*INEFC(Lleida, Spain)*

**Introduction** According to motor praxiology, basketball is a cooperation-oposition game (Parlebas, 2001). In this kind of games, decision making is a key factor for the performance. All players must use its motor intelligence in order to interpret the internal logic of sport and motor behaviors of teammates and opponents (Lagardera and Lavega, 2004). Observational methodology allows great opportunities to study player's motor intelligence. The aim of this study was to create an observational tool to evaluate decision making within coach's game plan. **Methods** Nine Spanish male players participated in this study (age 23.0 ±2.4 years). Following observational methodology (Castellano et al., 2008), we built a tool with 48 categories organized in 7 criteria. Four trained and expert observers were divided in two groups so as to analyze one EBA Spanish League game. Each group of observers analyzed 1539 units of observation. Afterwards, the optimization of observational system included a strict control of the quality of data based on ANOVA and Generalizability Theory (Cronbach et al., 1963). The EduG (Cardinet et al., 2010) was used to design two facets for making random infinite calculations in order to determine the reliability between the observers (Gorospe et al., 2005). **Results** The statistical analysis of inter-observer reliability revealed that most variability (99.9%) corresponded to the categories, and was zero for the observers and very low in the categories-observers interaction (0.1%). The overall analysis generalizability coefficients showed that the accuracy reliability generalization of the results was excellent (1.00). In addition, we observed highly significant goodness categories through the generalizability coefficient (0.00). **Discussion** Observational tool built adhoc allowed us to identify decision making of basketball players depending on team's strategy. According to background (Lagardera and Lavega, 2004; Parlebas, 2001), we identify different levels of motor intelligence when we study decision making within game coach's strategy. Players with the ball and their defenders can be studied with a high reliability using this tool. **References** Cardinet J, Johnson S, Pini, G (2010). Applying Generalizability Theory using EduG. Routledge Academic, New York. Castellano J, Perea A, Alday L, Hernández- Mendo, A (2008). Behav Res Meth, 40(3), 898-905. Cronbach L J, Rajaratnam N, Gleser, GC (1963). Br J Math Stat Psychol, 16, 137-163. Gorospe G, Hernández-Mendo A, Anguera MT, Marfínez R (2005). Psicothema, 17(1), 123-127. Lagardera F, Lavega P (2004). La ciencia de la acción motriz. Edicions de la UdL, Lleida. Parlebas P (2001). Juegos, deportes y sociedades: Léxico de praxiología motriz. Paidotribo, Barcelona.

**16:20 - 17:50****Invited symposia****IS-PM09 The brain at work \*****EXERCISE IN THE HEAT**

Nybo, L.

*University of Copenhagen*

This presentation focus on central fatigue provoked by prolonged exercise in the heat and evaluates the possible associations between hyperthermia-induced fatigue and changes in the cerebral perfusion, metabolism, thermodynamic and neurohumoral responses. Exercise-induced hyperthermia is associated with an impaired ability to maintain voluntary activation of the alpha-motor neurons during sustained maximal muscle contractions. An elevated brain temperature as consequence of heat accumulation in the brain appears to be a main factor influencing the ability and will to continue exercising, but neurotransmitter activity of the dopaminergic system and inhibitory signals from thermoreceptors arising secondary to the elevated core and skin temperature and augmented afferent feedback from the exercising muscles and the cardiorespiratory system are also of importance. Hyperventilation-induced reductions in cerebral blood flow and the associated lowering of the cerebral oxygenation is also considered in the integrated model that is presented to describe the interplay among peripheral and central factors influencing fatigue during exercise in the heat.

**EFFECT OF ORTHOSTASIS ON CEREBRAL BLOOD FLOW AND OXYGENATION**

Van Lieshout, J.

*Dpt Internal Medicine & Laboratory for Clinical Cardiovascular Physiology*

Upon either passive or active assumption of the upright body position, the first circulatory event is a gravitational displacement of blood away from the thorax to dependent regions of the body with a fall in venous return. Depending on the type of orthostatic stress (i.e. active standing vs. passive head-up tilt or simulated orthostatic stress by lower body negative pressure) approximately one half to one litre of blood is transferred to the regions below the diaphragm. Orthostatic pooling of venous blood begins immediately and the total transfer is almost complete within 3-5 min depending on the investigated body region. In addition to this transfer of thoracic blood, the central blood volume is affected by transcapillary filtration of fluid into the interstitial spaces in the dependent parts of the body. The circulatory adjustment to active standing up includes an initial ~30 s lasting fluctuation in mean arterial pressure (MAP) followed in 1-2 min by a phase of relative stability. Initially, MAP drops some 25 mmHg as total peripheral resistance falls ~40% for 6 to 8 s unrelated to orthostasis or straining and attributed to the instantaneous increase in vascular conductance of the active leg muscles. This transient and rapid fall in MAP is likely to explain the feelings of light-headedness that even healthy humans sometimes experience shortly after standing up, and may even cause recurrent transient loss of consciousness (TLOC). When standing, both the position of the cerebral circulation and the reductions in MAP and cardiac output challenge cerebrovascular autoregulatory mechanisms and cerebral perfusion and oxygenation decrease. The mechanisms underlying the postural reduction in cerebral perfusion are as yet incompletely understood. The role of systemic pressure/flow control, static and dynamic cerebrovascular autoregulation and the carbon dioxide (CO<sub>2</sub>) responsiveness of the brain vasculature will be discussed. With exercise the initial increase in cerebral blood flow is blunted at higher exercise intensities by a hyperventilation-induced lowering of the arterial CO<sub>2</sub> partial pressure and subsequent cerebral vasoconstriction. For exercise-related fainting the key question is whether TLOC developed during or after stopping exercise.

**CEREBRAL BLOOD FLOW AND METABOLISM DURING EXERCISE**

Secher, N.

*University of Copenhagen*

Regulation of cerebral blood flow (CBF) is markedly different from control of flow to skeletal muscles. While flow to skeletal muscles is inadequate to maintain muscle oxygenation during exercise, cerebral activation is associated with a marked increase in (regional) CBF and the activated regions of the brain may be identified by their enhanced oxygenation. Yet, for the brain as a whole, small muscle exercise (e.g. with one forearm) does not affect CBF. On the other hand, whole body exercise is associated with an approximately 20% increase in CBF, at least as long as the work rate is moderate. During intense exercise, CBF approaches the resting level and may become even smaller than the resting level because of the associated marked increase in ventilation and therefore decrease in the arterial carbon dioxide tension. However, the cerebral metabolic rate for oxygen (CMRO<sub>2</sub>) increases with work rate and, accordingly cerebral oxygenation becomes affected during intense exercise, may be to the extent that cerebral oxygenation limits cerebral activation and induces (central) fatigue. Also, the brain releases lactate during exercise and, as demonstrated in the rat, its glycogen deposit is used. Thus, brain glycogen depletion may represent another avenue for developing central fatigue and during exercise in the heat; brain temperature may reach a critical level. Taken together, exercise affects both cerebral blood flow and metabolism and that seems to implicate slow rather than rapid muscle contractions, providing a framework for insight into motor control when exercise becomes challenging.

16:20 - 17:50

## Oral presentations

### OP-PM46 Sports Medicine [SM] 7

#### NEUROMUSCULAR FUNCTION, HORMONAL AND REDOX STATUS AND MUSCLE DAMAGE OF PROFESSIONAL SOCCER PLAYERS AFTER A HIGH-LEVEL COMPETITIVE MATCH

Silva, J.R.1, Rebelo, A.1, Marques, F.2, Pereira, L.2, Seabra, A.1, Ascensão, A.3, Magalhães, J.3

*Faculty of Sport, University of Porto*

**Introduction** Professional players should be able to successfully compete during a 10–11 months congested competitive schedule. Match competition, in particular, seems to represent a major source of physical stress and physiological demands during the competitive season. The purpose of the present study was to examine the impact of an official match on biochemical and neuromuscular parameters of professional players. **Methods** Seven professional players from the same team performed an official match being data collected 72-h before, 24-h, 48-h and 72-h post-match. Plasma testosterone/cortisol ratio (T/C), creatine kinase (CK), superoxide dismutase (SOD), glutathione peroxidase (GPX) and reductase (GR) activities, myoglobin (Mb), C-reactive protein (CRP), uric acid (UA), protein sulfhydryls (-SH), malondialdehyde (MDA) concentrations and total antioxidant status (TAS) were measured. Sprint, jump and change of direction performance, and maximal isokinetic knee extension and flexion were obtained. Results Cortisol increased and T/C decreased until 48-h recovery ( $P < 0.05$ ). Mb, CRP and -SH ( $P < 0.05$ ) increased at 24-h and CK, TAS, SOD and MDA ( $P < 0.05$ ) increased up to 48-h recovery. GR increased and GPX decreased at 24-h recovery ( $P < 0.05$ ). Jump performance decreased 24-h post-match ( $P < 0.05$ ). **Discussion** Data demonstrate that an official soccer match of male professional players induces a hormonal catabolic environment during the recovery period. Also, increased levels of oxidative stress and muscle damage throughout 48-h of the recovery period were observed (Fatouros et al., 2010; Magalhães et al., 2010; Rampinini et al., 2011). Although match induced certain biochemical alterations, data from the present study suggest that professional players present small performance impairments and biochemical responses than those described in semi-professional players after a soccer official match (72-h; Magalhães et al., 2011; Fatouros et al., 2010). **References** Fatouros IG, Chatziniakolaou A, Douroudos, II, Nikolaidis MG, Kyparos A, Margonis K, Michailidis Y, Vantarakis A, Taxildaris K, Katrabasas I, Mandalidis D, Kouretas D, Jamurtas AZ. (2010). J Strength Cond Res. 24 (12):3278-3286 Magalhães J, Rebelo A, Oliveira E, Silva JR, Marques F, Ascensao A. (2010). Eur J Appl Physiol. 108 (1):39-48. Rampinini E, Bosio A, Ferraresi I, Petruolo A, Morelli A, Sassi A. (2011.) Match-Related Fatigue in Soccer Players. Med Sci Sports Exerc. 43(11):2161-70

#### BICYCLE COMMUTING AND PHYSICAL ACTIVITY LEVELS

Donaire-Gonzalez, D., Jerrett, M., Rodriguez, D., Cole-Hunter, T., de Nazelle, A., Mendez, M., Garcia-Aymerich, J., Basagaña, X., Curto, A., Nieuwenhuijsen, M.

*Center for Research in Environmental Epidemiology (CREAL)*

**Background:** Physical inactivity has emerged as a major public health problem The World Health Organization's recent assessments rank physical inactivity as the 10th leading cause of premature death globally. Active transportation such as bicycling has been proposed as a method to increase physical activity levels, reduce air and noise pollution, and therefore improve public health. As present, however, it is uncertain whether a transport mode shift to bicycling from other less active commuting modes will increase physical activity or only a replace other physical activity regularly performed by individuals. **Objective:** We sought to assess whether bicycle travelling duration creates a difference in individual level of physical activity as an addition or as a replacement to other physical activity. **Methods:** Given the low prevalence of cyclists in Barcelona, a case-control sampling scheme was used, in which adult cyclists and non-cyclists (car drivers, motor drivers and public transport users) were recruited in the street, at forty random points in the city. The questionnaire, answered by participants, includes physical activity from the international physical activity questionnaire short form, common use of bicycle and walk modes of transport, commuter travel behaviour, health condition and socio-demographic questions. **Statistical analyses** included: (i) multivariate linear regression analysis and (ii) multivariate non-linear regression analysis. **Results:** Participants ( $n = 752$ : 49% female; mean (standard deviation) age = 37 (10) years, body mass index = 24 (3)  $\text{kg}/\text{m}^2$ ). Fifty-six percent of participants ( $n = 422/752$ ) bicycle travelled within the previous reported week for a total duration of 3.1 (2.5) h/week. The main determinants of lower levels of physical activity were female gender, older age, higher number of children and lower social class, while the main confounder of the relationship between commute mode and physical activity level was vigorous activity level. Active travel (including bicycle commuting and walking) was found to result in positive statistically significant differences in physical activity level across participants ( $p < 0.05$ ) and represented 2.8, 0.9, 1.1 and 1.8 h/week of physical activity levels for bicycle commuters, private motorized (car and motorcycle) commuters and public transport commuters, respectively. There was no relation between bike travel duration and physical activity level for those with low ( $< 29$  min/week) or high ( $> 9.5$  h/week) bike use. In those with intermediate levels of bike use, bike travel duration was positively and significantly associated with physical activity duration. **Conclusions:** Bicycle commuters exhibited higher level of physical activity than users of other commute transport modes, which was attributable to, and increased with, bicycle travel duration. Physical activity from bicycle travelling did not replace the performance of other physical activity in this sample.

#### VALIDITY OF THREE COMMONLY USED ACTIVITY MONITORS FOR ESTIMATING SEDENTARY TIME IN SCHOOL CHILDREN

Staalesen, J., Vik, F.N., Berntsen, S.

*University of Agder, Norway*

**Introduction** Sedentary behaviors, defined as sitting and lying down and activities of low levels of energy expenditure, is gaining more attention regarding health aspects, especially in western societies. It is important to focus on the health aspect and prevention of extensive sedentary behaviors in children. The major challenge today is to find a cost-affordable way to measure sedentary behavior in which both are applicable and valid so that it is possible to get an overview of the behavior and extent. The aim of the present study was to compare and assess the validity of the three monitors, ActivPAL™ (PAL Technologies Ltd., Glasgow, UK), ActiGraph GT3X+ (GT3X+;

Pensacola, FL, USA) and Sensewear Armband Pro3 (SWA; Bodymedia, Pittsburgh, PA, USA), used for estimating sedentary behavioral time (SB), compared to indirect calorimetry. Method Thirty-five boys and 32 girls (10-12 years) wore the GT3X+, SWA and ActivPAL when performing 6 different activities: 3 play-exercises and 3 screen-based activities (6 min each, 36 min in total). A sub-sample also wore a portable oxygen analyzer (MetaMax II or MetaMax 3B, Cortex Biophysic, Leipzig, Germany). Exercises 1: Ball-toss, standing, 2: Ball-toss, sitting, 3: "Musical chairs" (walking in circles around chairs using a whistle as signal), 4: TV viewing, 5: Playing videogames when sitting, and 6: Playing videogames standing with movement-based games (Playstation Move™). Counts per minute (CPM) <100 were used for GT3X+ to define SB. For ActivPAL sitting posture was defined as SB. The VO<sub>2</sub> data from the portable oxygen analyzers were calculated and categorized accordingly into categories of sedentary time (>1.50 times Basal metabolic rate BMR). BMR were found using predicted BMR for children (WHO/FAO/UNU 1985). Results During standing and walking activities indirect calorimetry calculated 0 minutes of sedentary time while ActivPAL estimated 47%, GT3X+ estimated 14%, and SWA estimated 2% sitting time in this period. During sitting activities we found, using indirect calorimetry, that 10% was sedentary time, while SWA estimated sedentary time to be 46% of the time, GT3X+ estimated 52% and ActivPAL estimated 60% sedentary time. Compared to only each other, during walking activities SWA estimated sedentary time 3% of the time, GT3X+ estimated 9% and ActivPAL estimated 78% sedentary time. Discussion Compared to indirect calorimetry, and compared to SWA and GT3X+, ActivPAL seems to overestimate sedentary time and may not be accurate when assessing sedentary behaviors. SWA can be recommended in estimating sedentary time in walking and standing activities, but may not be accurate when assessing sedentary time in sitting activities or activities that include extensive arm-movements. The GT3X+ may be a more cost-affordable way to measure sedentary time, but it does not appear to be as accurate as SWA.

### THE CONTRIBUTION OF YOUTH SPORT TOWARDS WEEKEND AND WEEKLY PHYSICAL ACTIVITY AND RELATIONSHIPS WITH INDICATORS OF ADIPOSITY AND CARDIOVASCULAR RISK

Fenton, S., Duda, J.L., Barrett, T.G.

*University of Birmingham*

Introduction As indicated via heightened BMI and body fat % (BF%) values and due to associated cardiovascular risk (e.g., waist circumference, WC), attention is being paid to the increasing incidence of childhood overweight and obesity. Participation in Organised Youth Sport (OYS) contributes around 23% towards daily weekday moderate to vigorous physical activity (MVPA) and has been advocated as a vehicle for obesity treatment and prevention in young people. The weekend offers greater opportunity for engagement in OYS and therefore MVPA and vigorous physical activity (VPA). Thus, the contribution of OYS towards daily physical activity (PA) and its utility as a tool for obesity prevention/treatment might have been previously underestimated. Aims 1) Determine the contribution of weekend OYS towards total weekend and weekly levels of MVPA and VPA. 2) Identify whether a) MVPA and VPA from OYS, b) Average weekend (AW) MVPA and VPA, and c) Average daily (AD = weekend + weekday) MVPA and VPA predict BMI, BF% and WC in OYS participants. Methods Anthropometric and PA data were collected from 164, OYS participants (Female, N = 47; Male, N = 117). Participants wore a GT3X accelerometer for 7 days and measures of height (SECA), weight, BF% (Tanita, SC331S) and WC were taken. Weekend OYS data was available from a sub-sample of 90 male grassroots football participants. Results OYS (min/day) were MVPA, M = 39.62 ± 17.26 and VPA, M = 21.13 ± 11.86. OYS contributed on average 49.59% and 60.54% towards total weekend MVPA and VPA respectively. For total weekly activity, the contribution was less (M = 15.84% (MVPA) and M = 23.29% (VPA)). Hierarchical linear regression demonstrated weekend OYS MVPA and VPA (min/day) did not predict BMI, BF% or WC. Both AW and AD MVPA and VPA (min/day) significantly and negatively predicted BMI (AW = MVPA,  $\beta = -.18$ , VPA,  $\beta = -.22$ ; AD = MVPA,  $\beta = -.21$ , VPA,  $\beta = -.27$ ) and BF% (AW = MVPA,  $\beta = -.20$ , VPA,  $\beta = -.24$ ; AD = MVPA,  $\beta = -.25$ , VPA,  $\beta = -.28$ ). Only AD VPA significantly and negatively predicted WC ( $\beta = -.18$ ). Conclusion Participation in OYS makes a substantial contribution towards weekend and weekly levels of MVPA and VPA. Whilst PA from OYS did not predict indicators of adiposity, weekend and daily MVPA and VPA were negatively related to BMI and BF%. Daily VPA was also negatively associated with a cardiovascular risk factor (WC). Results point towards OYS being a vehicle through which we can increase levels of MVPA and VPA to levels required to maintain a healthy body composition in youth. In addition, relationships were stronger for VPA than MVPA. Given that OYS appears to make a greater contribution towards VPA than MVPA, OYS may serve as an important source of VPA and thus contribute to associated health benefits.

### INFLUENCE OF 30-HOURS OF EXERCISE AND SLEEP DEPRIVATION ON LACTATE METABOLISM DURING GRADED TEST TO EXHAUSTION

Ziemba, A.1, Mikulski, T.1, Dabrowski, J.1, Kozacz, A.1, Bogdan, A.2

*1 Mossakowski Medical Research Centre PAS, Warsaw, Poland. 2 Central Institute for Labour Protection – National Research Institute, Warsaw, Poland.*

Introduction Popularity of ultra-endurance events is increasing. Although the exercise intensity is moderate during most of the event it often ends with a sprint finish. Thus, the aim of the present study was to evaluate the lactate metabolism during graded maximal effort performed by subjects submitted to prolonged exercise combined with complete sleep deprivation beforehand. Methods Graded maximal test (50 W every 3 min) to volitional exhaustion was performed on cycloergometer by 11 endurance trained men before (trial B) and immediately after (trial A) 30 hours of prolonged exercise (simulated adventure race) combined with complete sleep deprivation. Heart rate (HR), oxygen consumption (VO<sub>2</sub>), carbon dioxide secretion (VCO<sub>2</sub>) were recorded continuously and blood lactate (LA) concentration was measured at the end of each completed workload. Lactate threshold (LAT) was calculated according to the log-log transformation method. Results Subjects completed exercise test at the similar workload in both trials B and A (336±12 W vs. 331±14 W, respectively) and VO<sub>2</sub>max (58±3 ml/kg/min vs. 52±3 ml/kg/min). Both maximal HR and LA were significantly lower in trial A than B (179.5±4.0 bpm vs. 184.5±3.2 bpm, p<0.05 and 5.8±0.6 mmol/l vs. 8.6±0.7 mmol/l, p<0.01). Lactate concentration at LAT was also significantly lower in trial A than B (1.5±0.1 mmol/l vs. 1.9±0.1 mmol/l, p<0.05), whereas workload corresponding to LAT was similar 182±8 W and 191±8 W). Discussion Prolonged physical activity promotes mobilization of fat energy substrates from adipose tissue and increases its contribution in energy metabolism during exercise. On the other hand, carbohydrate stores are decreased, what altogether limits the availability of substrates for lactate formation during anaerobic exercise but did not limit performance. Additionally, lactate utilization for gluconeogenesis is enhanced by prolonged exercise.

**INFLUENCE OF REGULAR BREATH-HOLDS ON HEART RATE AND ARYTHMIA IN ELITE BREATH-HOLD DIVERS.**

Narycheva, I.I, Chomahidze, P.I, Achkasov, E.I

*1: MSMU (Moscow, Russia).*

Introduction In breath-hold divers cardiac arrhythmias have been reported during deep breath hold dives (Muth et al. 2005) and in static apnea (Lemaître et al. 2005). Prolonged breath-holding may trigger abnormal automaticity, mechanical–electrical feedback mechanisms (Lin 1984) and re-entry signaling. Aim of the present study was to investigate cardiac status in elite breath-hold divers with long-term training experience. Methods Thirty volunteers: 15 healthy untrained males (C-group) and 15 male breath-hold divers (D-group) from 27 to 32 years ( $32.4 \pm 2.1$  years) participated in the study. The mean height of the subjects was (C-group  $181 \pm 1.9$  cm, D-group  $179.9 \pm 2.6$  cm), and the mean weight was (C-group  $76.8 \pm 3.7$  kg, D-group  $72.7 \pm 1.6$  kg). Training experience in D-group was from 2.5 to 7 years ( $3.6 \pm 0.6$  years). Athletes trained at least three times a week, duration of training was not less than 1.5 hours. Trainings included static and dynamic breath-holds. The study was carried out during competitive season. The measurement was carried out at least 48 hours later after the last training. Holter monitoring of ECG was conducted during 24 hours (SCHILLER MT-200 Halter-ECG V 2.51, Switzerland). ECG was evaluated for heart rate, cardiac arrhythmias, cardiac conduction, dynamics of the T wave and segment ST were evaluated. Results The mean heart rate was: C-group  $58 \pm 3.7$  beats/min, D-group  $66.1 \pm 3.2$  beats/min. Minimum heart rate was: C-group  $50 \pm 3.3$  beats/min, D-group  $41.6 \pm 2.1$  beats/min and the maximum heart rate C-group  $118 \pm 9.6$  beats/min, D-group  $126.4 \pm 7.3$  beats/min. The main difference between the groups was the presence of cardiac changes in D-group (in 6 of 15). Isolates supraventricular arrhythmias and couplets were found in three cases (27%), AV-blocks in three cases (20%) and both were found in one case (7%). AV blocks were registered only in highly trained athletes, members of Russian freediving team. None of those changes were observed in C-group. Discussion Highly trained breath-hold divers may be exposed to higher risk of AV blocks than general population. The changes found in cardiac status may be associated with changes of metabolism due to regular breath-holds. References 1. Muth CM, Ehrmann U, Radermacher P (2005) Physiological and clinical aspects of apnea diving. *Clin Chest Med* 26:381–394. doi:10.1016/j.ccm.2005.05.007. 2. Lemaître F, Bernier F, Petit I, Renard N, Gardette B, Joulia F (2005) Heart rate responses during a breath-hold competition in well-trained divers. *Int J Sports Med* 26:409–413. doi:10.1055/s-2004-821159. 3. Lin YC (1984) Circulatory functions during immersion and breath-hold dives in humans. *Undersea Biomed Res* 11:123–138.

**16:20 – 17:50****Invited symposia****IS-BN09 Biomechanics in disability sport: Challenges and solutions \*****MODELING AND OPTIMAL CONTROL OF DOUBLE AMPUTEE RUNNING**

Mombaur, K.

*University of Heidelberg*

Introduction Running motions of double transtibial amputees on special carbon fiber running prostheses, such as the Össur Cheetah, can lead to remarkable performance, as Oscar Pistorius has demonstrated in recent years. This has raised the question if the springy running prostheses which are lighter than lower legs and produce high passive torques might provide an advantage over able-bodied sprinters [2], and what the ethical consequences of admitting such devices are [3]. The goal of our research is to address this question using mathematical models and optimal control techniques to better understand the underlying mechanics and control of sprinting on prostheses. Methods We perform numerical optimal control computations based on dynamic models of the sprinters. We have established rigid multibody system models with 9 segments and 11 degrees of freedom for able bodied as well as double amputee sprinters in the sagittal plane. In the able bodied case, there are torque actuators in all 8 internal joints; in the double amputee case, the actuators at the ankles are replaced by linear spring damper elements, but the other 6 actuators remain. Running motions for these models are generated by solving hybrid multiphase optimal control problems with periodicity constraints, using a direct multiple shooting approach. Results In a first study we have generated optimal running motions for an imposed average speed of 9 m/s minimizing weighted joint torques squared for both models (able bodied as well as double amputee), thus selecting the most efficient out of many redundant motions. It could be shown that indeed the double amputee running motions require much less effort than the able-bodied motions in terms of different measures linked to mechanical work and joint torques. It could also be shown that the double amputee model exhibits a different type of running motion with a reduced knee flexion, compensated by a significant compression of the ankle spring [1]. Discussion From the above results it can NOT yet be concluded that prostheses provide an unfair advantage due to various reasons: - efficiency is not the only criterion for superiority in sprinting; also other criteria such as max. power have to be considered - in addition to constant speed running, also acceleration and deceleration phases would have to be taken into account - the models should include more details, e.g. the reduced strength of joints next to the amputation, or the coupling between leg and prosthesis. More computations in this sense are currently performed. References 1. K. Mombaur: A mathematical study of Sprinting on Artificial Legs, acc. for Proc. of HPSC 2012, LNSC, Springer 2. G.-P. Brüggemann, A. Arampatzis, F. Emrich, W. Potthast: Biomechanics of double transtibial amputee sprinting using dedicated sprinting prostheses, *Sports Techn.* 1:4-5, pp. 220-227, 2008. 3. B. Burkett, M. McNamee, W. Potthast: Shifting boundaries in sports technology and disability: equal rights or unfair advantage in the case of Oscar Pistorius?, *Disability & Society*, 26:5, 643-654, 2011.

**PROSTHESES FOR RECREATIONAL AND ELITE SPORTS: BIOMECHANICAL REQUIREMENTS AND TECHNICAL FULFILMENTS**

Brüggemann, G.

*German Sport University Cologne*

In the past the focus of technical improvements of artificial limbs was on performance enhancement mainly in running or sprinting. Little attention was given to technical aids and devices for recreational sports and other activities than straight running. A more comprehensive

understanding of the biomechanics and the energetic contribution under different prosthetic conditions and in different sports activities is essential for the development of technical aids and protection devices. In running of double amputees the role of artificial limbs has been intensively analyzed and revealed evident mechanical differences between double transtibial amputee sprinting and sprinting of able-bodied athletes. The energy contribution to the joints of the lower extremities in the symmetric runners is inverted in single amputee runners. When running at about 7 m/s the sound ankle does about two to three times more mechanical work than the sound knee or the sound hip joint. (Buckley, 2000). These biomechanical differences will lead to different requirements of the prostheses. Unilateral and bilateral transtibial or transfemoral amputees especially in recreational sports will not reduce their activities to straight running. Posture control and body balance in standing, walking, running and hiking, cutting or even pivoting maneuvers increase the requirement of sport prostheses. The technical requirements can be directly derived from the biomechanical demands of these activities. However, a critical review of recent technical fulfillments finds mainly solutions for straight running and related track and field disciplines. The most recent technical solutions allow a differentiation of beginners and advanced athletes through modification of the alignment of the knee rotation axis or the anterior-posterior placement of the prosthetic foot to the artificial knee. Different stiffness of the foot gives the opportunity to adapt the prosthesis to different body weights and different biomechanical requirements of running or jumping at different intensity. Recent swing phase control mechanisms are focused on running and gives free knee movement up to 60° knee flexion and a progressive hydraulic deceleration to a maximum flexion angle of 135°. The prosthetic feet or carbon blades are equipped with running surface related outer soles or even spikes. In summary the technical fulfillments of lower leg prostheses for recreational and elite sports partly meet the biomechanical requirement but have a great potential of further enhancement allowing the amputee to participate in sports and physical activity. Bruggemann, G.-P. et al. 2008. Biomechanics of double transtibial amputee sprinting using dedicated sprinting prostheses. *Sports Technol.* 2008, 1, No. 4–5, 220–227. Weyand, P. G. et al. 2009 The fastest runner on artificial legs: different limbs, similar function? *J. Appl. Physiol.* 107, 903–911. Buckley, J. G. 2000. Biomechanical adaptations of transtibial amputee sprinting in athletes using dedicated prostheses. *Clinical Biomechanics*; 15: 352–358.

## BIOMECHANICS OF SPRINTING ON NATURAL LIMBS AND SPRINTING ON ONE OR TWO PROSTHESES

Potthast, W.

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The role of artificial limbs in running biomechanics has been intensively discussed (Bruggemann et al., 2008; Weyand et al., 2009). The movement analysis of the double amputee Oscar Pistorius revealed evident mechanical differences between double transtibial amputee sprinting and sprinting of able-bodied athletes (Bruggemann et al., 2008; Weyand et al., 2009). In double amputee sprinting the loading of the lower extremity and the energetic contributions of the joints of the lower extremity show entirely different distributions. In the limb with prosthetic supply about 80-90% of the mechanical work is done in the artificial ankle (prosthesis). Knee and hip joints contribute hardly. In the sound athletes the energetic contribution of ankle, knee and hip joint is much more evenly distributed. However, this relationship of energy contribution in the symmetric runners (double amputee & sound athlete) is inverted in single amputee runners (asymmetric): When running at about 7 m/s the sound ankle does about two to three times more mechanical work than the sound knee or the sound hip joint. At the prosthetic side about 80% of the mechanical work is done at the hip joint while knee and (artificial) ankle contribute less (Buckley, 2000). A more comprehensive understanding of the energetic contribution under different prosthetic condition is essential for the adjustment for rules and regulations as well as for the development of technical aids and protection devices. References: Bruggemann, G.-P., Arampatzis, A., Emrich, F., Potthast, W. 2008. Biomechanics of double transtibial amputee sprinting using dedicated sprinting prostheses. *Sports Technol.* 2008, 1, No. 4–5, 220–227. Weyand, P. G., Bundle, M. W., McGowan, C. P., Grabowski, A., Brown, M. B., Kram, R. & Herr, H. 2009 The fastest runner on artificial legs: different limbs, similar function? *J. Appl. Physiol.* 107, 903–911. Buckley, J. G. 2000. Biomechanical adaptations of transtibial amputee sprinting in athletes using dedicated prostheses. *Clinical Biomechanics*; 15: 352–358.

**16:20 - 17:50**

## Oral presentations

### OP-PM09 Health and Fitness [HF] 5

#### USING THE ACTIVE WORKSTATION: CAN WE BE ACTIVE AT WORK AND STILL BE PRODUCTIVE?

Walsh, M., Funk, R., Ohlinger, C., Cox, R.

*Miami University*

**INTRODUCTION:** Integrating low-intensity physical activity into work environments by using the active workstation (treadmill with desk attached), could provide health benefits to many adults. Although use of the active workstation may increase health benefits, concerns have been raised about the ability to walk and perform tasks simultaneously. **PURPOSE:** To assess the effects of walking and typing practice on rectifying typing speed (WPM) decrements and improving walking mechanics. **METHOD:** Nineteen adults aged 43± 11, who could type at least 50 adjusted words per minute (AWPM) participated. All subjects completed a typing test while seated and while walking at 1.6 km/h. Subjects were randomly assigned to a massed practice session (3 consecutive 15 min blocks) or to distributed practice (daily sessions of 15 min each). During the pre and posttests, reflective markers were fixed placed to the right ankle, knee and hip and subjects were filmed while walking and walking and typing. Walking mechanics were assessed through a digitized analysis of this film. A series of 2 X 2 (Practice Condition by Time) Mixed Model ANOVAs with repeated measures on the second factor were conducted to assess the effects of the two practice conditions on subjects' typing performance and gait parameters. Paired samples t-tests were performed to compare postural conditions. **RESULTS:** A significant difference in participants' typing performance (WPM), was found between baseline sitting (67±9.5) and walking measurements (57±8.3)  $p < .00$ , as well as, significant changes in knee height between walking and walking & typing,  $p < .03$ ; and stride length between walking and walking & typing,  $p < .00$ . There was no significant improvement in typing performance in the massed practice group, but a significant improvement in the distributed practice group ( $p < .00$ ), while both groups exhibited significant increases in stride length. The initial result of walking while typing elicited a negative effect on typing performance and changed the gait pattern of the user, yet with distributed practice these variables reverted to baseline measure-

ments. CONCLUSION: Distributed practice was effective in the recovery of typing speed and may be associated with a return of normal walking mechanics.

### PHYSICAL FITNESS AND HEART RATE VARIABILITY IN PEOPLE WITH SCHIZOPHRENIA

Blasco-Lafarga, C.1, Tortosa-Marfínez, J.2, Caus Pertegaz, N.2, Marfínez-Navarro, I.1

*University of Valencia, Spain*

INTRODUCTION: People with schizophrenia have a reduced life-expectancy of 10 to 20 years, with cardiovascular diseases being responsible for two thirds of deaths (Brown et al. 2000). Cardiac autonomic dysfunction has been observed in schizophrenics being a major cause of cardiac events (Henry et al. 2010), but Physical Activity (PA) has been proved to promote autonomic nervous system integrity increasing Heart Rate Variability (HRV) in many clinical populations (Routledge et al, 2010). Since this remains to be elucidated in schizophrenics, the study aims to examine the relationship between physical fitness and HRV in schizophrenia. METHODS: 54 hospitalized patients diagnosed with schizophrenia (DSM-IV criteria) were recruited from a public mental health institution, Spain. Participants were assessed for HR dynamics and the Six-Minute Walk Test (6MWT). RR intervals were continuously recorded during 10 min with a Polar RS800 HR tachometer (Polar Electro, Oy, Finland), with subjects lying on bed, on fasting conditions. 5 min central data were analyzed by means of Kubios HRV 2.0 software, considering linear and non linear HRV analyses. RESULTS: Significant positive correlations were found between the 6MWT and DFA1 ( $p<0.05$ ); and SD2( $p<0.05$ ). A negative correlation was found for the SD1/SD2 ratio ( $p<0.01$ ). After controlling for confounding variables (RRi, age, illness duration, gender, nicotine intake, and Body Mass Index), the significance and the power of the correlation increased for SD2 and DFA1, and remained stable for SD1/SD2 ratio. DISCUSSION: Our results suggest that people with schizophrenia who can walk further distances in the 6MWT have better cardiovascular health as measured by non linear HRV indices, thus suggesting that non-linear methods could be more appropriate for controlling the effects of PA on HRV. However, longer periods must be registered since the time-series in the study is not long enough to ensure adequate confidence in SD2 (Rakobowchuk et al. 2012). There is a need for randomized controlled trials to better understand the effects of PA programs in HRV in schizophrenics. REFERENCES: Brown S, Inskip H, Barraclough B (2000). Causes of the excess mortality of schizophrenia. *Br J Psychiatry* 177, 212-217. Henry BL, Minassian A, Paulus MP, Geyer MA, Perry W (2010). Heart rate variability in bipolar mania and schizophrenia. *J Psychiatr Res* 44: 168-176. Rakobowchuk M, Harris E, Taylor A, Cubbon RM, Birch KM (2012). Moderate and heavy metabolic stress interval training improve arterial stiffness and heart rate dynamics in humans. *Eur J Appl Physiol* (E-pub). Routledge FS, Campbell TS, McFetridge-Durdle JA, Bacon SL (2010). Improvements in heart rate variability with exercise therapy. *Can J Cardiol*, 26(6): 303-312.

### PSYCHO-PHYSIOLOGICAL RESPONSES TO A STANDARDIZED EXERCISE PROGRAM INDOORS VS. NATURAL ENVIRONMENT: PRELIMINARY RESULTS FROM A PILOT STUDY. PART IV: CORTISOL PROFILE

Mikkila, S.1, Calogiuri, G.2, Weydahl, A.1, Patil, G.2

*1: Finnmark University College, Alta, Norway, 2: Norwegian University of Life Science, Aas, Norway*

Introduction Previous studies indicate that exposure to nature elicits faster recovery from psycho-physiological stress. It has been suggested that 'green exercise' may elicit wellbeing and enhanced health beyond exercising elsewhere, but its evidence of indicators of physical health is still scarce (Thompson Coon et al. 2011). Assessment of cortisol release has been used to investigate stress-related disorders. This assessment, however, presents challenges due to the circadian fluctuation of the cortisol. Lower cortisol concentration and a rapid reduction of the cortisol levels after awakening are considered as indicators of a healthy allostatic load status (Golden, Wand, Malhotra, Kamel, & Horton 2011). As a pilot study, we have studied the impact of standardized exercise program indoors (gym hall) vs. outdoors in a natural setting on the cortisol release. Methods Healthy adults, 7 females and 7 males (age 48.5+/-7.3 years; BMI 25.4+/-2.4; VO2 39.8+/-7.7 ml/min/kg), undertook two exercise sessions within 1-week, each consisting in 25-min biking (60.1+/-7.9 %HRR) followed by 20-min of circuit-strength training with rubber bands (49.7+/-9.6 %HRR). The subjects exercised at 15:30, randomized to the indoor or the outdoor exercise group. Cortisol was measured in baseline conditions (no exercise for at least 48-hours) and after each exercise session. Sample collection included 15-hour urine collection (18:00-09:00), a blood test (08:00), a 7-time point saliva collection determining PRE/POST-exercise values, POST-exercise recovery, amplitude of rhythm (AMP) and the cortisol awakening response (CAR) slope. Results When adjusted for individuals' baseline values, only a marginally significant difference across groups was found for the overnight urinary levels ( $p=0.057$ ), with more extensive reduction for the outdoor group compared to the indoor group. Moreover, the CAR showed improved profiles for the outdoor group ( $p=0.037$ ). No significant difference across groups was found for PRE/POST-exercise, POST-exercise recovery, AMP or serum morning values. Discussion These results provide further support for the positive effects on stress responses after exercising in natural environment, which may in the long term have a positive impact on health. The data also shows the importance of considering the cortisol release in its circadian complexity, rather than adopting simple measurements such as the PRE/POST changes or the morning serum release. References Golden, S. H., Wand, G. S., Malhotra, S., Kamel, I., & Horton, K. (2011). *Eur J Epidemiol*, 26(7), 511-525. Thompson Coon, J., Boddy, K., Stein, K., Whear, R., Barton, J., & Depledge, M. H. (2011). *Environ sci technol*, 45(5), 1761-1772.

### WALK@WORKSPAIN: EFFECTIVENESS ON INCREASING PHYSICAL ACTIVITY LEVELS IN OFFICE EMPLOYEES.

Bort-Roig, J.1, Puig-Ribera, A.1, González-Suárez, A.M.2, Martínez-Lemos, I.3, Giné-Garriga, M.4, Fortuño, J.4, Gilson, N.D.5

*1. Universitat de Vic, 2. Universidad del País Vasco, 3. Universidad de Vigo, 4. Universitat Ramon Llull-Blanquerna, (Spain) 5. The University of Queensland (Australia)*

Introduction: Physical inactivity is the fourth leading risk factor for global mortality (WHO, 2010). However, 50% of the Spanish population does not achieve physical activity (PA) recommendations for health. As most adults spend half of their waking day at work (Tudor-Locke et al., 2011), the workplace has become a convenient setting for delivering PA promotion interventions. This study investigated the impact of a web-based "sit less and move more at work" program had on employee's PA levels. Methods: Office employees from four Spanish universities engaged in the program over 19 weeks ( $n=264$ ; age  $42\pm 10$  years; 171 women). The intervention group (IG,  $n=129$ ) used a pedometer, a diary and a website which provided strategies, motivational materials and interactive features to increase step counts and reduce sitting time at work. Following baseline measures, the intervention consisted of a (i) ramping phase to progressively increase baseline step counts to 10,000 by integrating active working tasks, short and long walking routes at work, (ii) a maintenance phase to sustain the increased volume of step counts through researcher support. An additional campus in each university acted as a control

group (CG, n=135). Employees completed a PA questionnaire (IPAQ short version) at baseline, post-intervention, and two months follow-up. PA status changes (MET-h-wk-1) were analysed using ANOVA between and within groups. Results: The IG significantly increased PA levels at post-intervention (+205MET-h-wk-1;  $p < .05$ ), and two months follow-up (+590MET-h-wk-1;  $p < .05$ ). No statistically significant differences between groups were observed. When data from the IG were analysed relative to baseline activity status, inactive employees (n=17, 13%; <600MET-h-wk-1) increased PA levels the most at post-intervention(+1,330MET-h-wk-1;  $p < .05$ ) and follow-up (+1,366MET-h-wk-1;  $p < .001$ ). Active employees (n=70, 54%; 600-3,000 MET-h-wk-1) also showed significant increases at post-intervention (+991MET-h-wk-1;  $p < .001$ ) and at follow up (+1,237MET-h-wk-1;  $p < .001$ ), whereas highly active employees (n=42, 32%; >3,000MET-h-wk-1) decreased their PA levels (-809MET-h-wk-1;  $p > .05$ ). Discussion: Office employees that engaged the program increased their overall PA levels. Increases were most evident for the least active. Walk@WorkSpain may be effective to achieve PA recommendations for health in Spanish population. References: World Health Organization. (2010). Tudor-Locke C, Leonardi C, Johnson WD, Katzmarzyk PT. (2011). *J Occup Environ Med*, 53, 1382-7.

## RUNNING OUT OF TIME? STRATEGIES AND PERCEPTIONS IN CONNECTION TO PHYSICAL ACTIVITY

Book, K.

*Malmö University*

RUNNING OUT OF TIME? STRATEGIES AND PERCEPTIONS IN CONNECTION TO PHYSICAL ACTIVITY Introduction Although most people are aware of the health benefits of physical activity, it is not easy to fit it into the busy schedule of everyday life. The knowledge about how adults in the middle of their careers reason about physical activity and develop strategies to be active is surprisingly limited. Therefore, this study aims at increasing the knowledge by answering the following research questions: How, when and where do employed people (in Sweden), age 30-50, find time and space for physical activities? How do these people reason about physical activity and time in everyday life? At an early stage of the study, running stood out as a popular activity among the target population: How could the running trend be explained? Theoretical Departures and Methods The theoretical framework of the project concerns perspectives on time use and perception and strategies for physical activity (see for instance Robinson & Godbey, 2000; Zuzanek, 2004). Physical activity refers to the whole scale from light to intense activities. Methods for gathering empirical material: 550 surveys at three major work places in Malmö, interviews with gym owners regarding training trends, field studies and in-depth interviews with six persons within the target population. Finally, the running trend has been problematized. Results - The majority of full-time employees within knowledge-based sectors has an ambition to be physically active (and a majority is). A high preoccupation with the importance of exercising also results in feelings of pressure and guilt. - Difficulties in finding time for physical activity make individuals develop different strategies to cope with physical activity, such as: preferences for time-efficient and flexible activities, using lunch breaks for gym-session or for walks, exercising early mornings on the way to work, active transports, creating challenges in order to push themselves, etc. - Flexible work hours are considered favourable for being physically active, but also stressful as leisure and work time blend together. - Organizational rather than economic incentives for training by the employer are preferred. - The running trend could be understood in different ways: running as a flexible, accessible and efficient activity, as back to basics, a lifestyle, as pressure and inspiration from social media, as a demand for being challenged, as part of commodification and a product of the event industry, etc. References Robinson, J. & Godbey, G. (2000) *Time for Life. The Surprising Ways Americans Use Their Time*. Penn State Press, Pennsylvania State University. Zuzanek, J. (2004) *Work, leisure, time pressure and stress*. In: Haworth, J.T. & Veal, A.J. (ed.) *Work and Leisure*. Routledge, London.

16:20 - 17:50

## Oral presentations

### OP-BN05 Biomechanics [BM] 5

#### SHORT-TERM KINEMATIC ADAPTATION TO UNANTICIPATED SPRINT RUNNING CONDITIONS IN FIELD SPORT

Wdowski, M.M.1, Gittoes, M.J.R.1, Irwin, G.1, Nokes, L.2

*Cardiff Metropolitan University.1. & Cardiff University.2.*

SHORT-TERM KINEMATIC ADAPTATION TO UNANTICIPATED SPRINT RUNNING CONDITIONS IN FIELD SPORT Wdowski, MM.1, Gittoes, MJR.1, Irwin, G.1, & Nokes, L.2. 1: Cardiff Metropolitan University, Cardiff, UK 2: Cardiff University, Cardiff, UK. Introduction An important characteristic of skilled behaviour in unanticipated conditions, such as sprinting in field sports, concerns the functional relationship between adaptive movement variability and performance outcome. The process of improving a skilled behaviour involves developing a stable performance under different conditions with a consistent performance reflecting mastery in a given task (Preatoni et al., 2012). The aim of this study was to extend insight into lower limb kinematic adaptation to unanticipated sprint running conditions in field sport. Methods An automatic marker tracking system (200 Hz) was used to track three-dimensional, bilaterally (lower limb) located active markers during the initial 20 m of sprint run acceleration trials performed by twenty university footballers. The performers were made aware of the final sprint distance prior to initiating the sprint in the anticipated 20 m (A20) condition. In the unanticipated 20 m (U20) and 40 m (U40) conditions, the performers were informed of the final sprint distance immediately after initiating the sprint. The groups mean step velocity was determined as the primary performance measure with its mechanical step determinants e.g. step frequency, being the kinematic measures of adaptation. Results No difference in performance outcome or individual variability of performance outcome between conditions was observed (mean step velocity m.s<sup>-1</sup>; A20: 6.71±0.20; U20: 6.69±0.19; U40: 6.71±0.20). Determinants of step velocity and their variability were significantly different ( $p < .05$ ) between conditions (e.g. mean step frequency Hz; U20: 4.34±0.24; U40: 4.37±0.24). Discussion A stable performance outcome was maintained by the performers between all conditions, which suggested mastery in carrying out the specific task (Preatoni et al., 2012). The combination of a maintained step velocity and adapted determinants are in direct contrast to Hunter et al.'s (2004) mechanical model of sprinting, which may be an example of kinematic adaptations that are specific to the task (Wdowski & Gittoes, 2012). Differences observed in step determinant variability between conditions may allude to the functionality of movement variability in adapting to variable external conditions (Bartlett et al. 2007). Anticipated sprint protocols may subsequently not entirely facilitate skill specific adaptations for unanticipated field sport match conditions. References Bartlett R, Wheat J, Robins M. (2007). *Sports Biom*, 6 (2), 224-243. Hunter JP, Marshall RN, McNair PJ. (2004). *Med Sci in Sp & Ex*, 36 (2), 261-271. Preatoni E, Hamill J, Harrison

A, Hayes K, Van Emmerik R, Wilson C, Rodano R. (2012). Sports Biom, 1First article, 1-24. Wdowski MM, Gittoes MJR. (2012). Sports Biom, 1First article, 1-11.

### EFFECTS OF RESISTED SLED TOWING ON ACCELERATION SPRINT KINEMATICS IN SPRINTERS

Alcaraz, P.E.1, Jiménez-García, A.3, Elvira, J.L.L.4, García-Roca, J.A.1, Cánovas, J.F., Angulo, R.3

1: UCAM (Murcia, Spain), 2: UCLM (Toledo, Spain), 3: INEFC (Barcelona, Spain), 4: UMH (Elche, Spain)

**Introduction** Sled-towing exercise is a common method to improve power output in sprinting. Usually, many coaches set the weight of the sled to a percentage of athlete's body mass (Bm), but resisted sprint training has shown changes on sprint kinematics depending of the load used (1, 2). In this sense, the aim of this study was to define the effects of increasing of load on the sprint kinematics in national level sprinters. **Methods** Eleven active competitive athletes specialized in sprinting with previously sled-towing training experience (9 men and 2 women) were recruited to the study ( $18.8 \pm 3.3$  years;  $1.84 \pm 0.08$  m;  $72.0 \pm 13.1$  Kg). Subjects performed four 20-m sprints (unloaded, 10, 15 and 20% of Bm) from a crouched start. The athletes were placed 1-m behind the starting line and trials' order was randomized for each participant, and an unlimited rest period was given between trials. Sprint trials were performed using a weighed sled attached to each athlete by a 3.6-m cord and waist harness. Sprint trials were recorded with a digital video camera operating at 210 Hz. The camera's placement was at 90° angle to the direction of the sprinting, a distance of 20 m from the middle of the athlete's lane and it was mounted on a rigid tripod. Kwon3D biomechanical analysis software was used to analyse the video images of the trials. Twenty-two body landmarks that defined a 14-segment model of the athlete were digitized. The kinematic variables were measured at the instant of touchdown and take-off. To the analysis of stride length (SL), stride frequency (SF), and ground contact time (GCT) were considered at first, second and third step. One-way ANOVA with Tukey's post hoc was used to compare the four running conditions. Results SL decreased significantly with 20% Bm, while changes in GCT and SF were not relevant when sled weight increased. Minor changes in joint and segment angles were observed in lower limbs and trunk. There were no significant changes in angular velocities, neither hip nor knee during ground contact or take-off phase. COM velocity decreased significantly in ground contact and take-off phase with 20% Bm, while only COM velocity in stance phase changed significantly with 15% Bm. Body lean only changed significantly in take-off phase in all resisted conditions, while no effect was observed in ground contact phase. **Discussion** The aim of the present study was to show the effects on the athletes' sprint kinematics in order to set the load in an attempt to avoid negative changes on sprint technique. The results suggest that several important kinematic variables might appear when loads above to 15% Bm were used in the first steps of the acceleration phase in national sprinters. Therefore, caution must be used when sprinters use high loads resisted sprint training. **References** 1. Alcaraz et al. (2008) J Strength Cond Res 22,890-7 2. Cronin et al. (2008) Sports Biom, 7,160-172

### STANCE LIMB KINEMATIC VARIABILITY IN MAXIMUM VELOCITY PHASE SPRINT RUNNING

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1: Cardiff Metropolitan University, 2: University of Southampton

**Introduction** The stance leg action has been considered a major determining factor of sprint running performance (Hunter et al., 2004). Individuals may self-organise and vary their movement pattern (kinematics) to facilitate an optimal solution in athletic performance. A recent preference for individual athlete analyses (Salo et al., 2011; Exell et al., 2012) may be warranted to facilitate knowledge of the self-organising processes used to develop sprint running performance. The aim of this study was to enhance insight into the stance limb kinematic contributions to maximum velocity phase sprint running performance using individual athlete variability analyses. **Methods** Sagittal plane, joint centre coordinate data of the stance limb were obtained from automatic marker tracking (200 Hz) of maximum velocity phase sprint running trials performed by six well-trained athletes. Step velocities were subsequently derived and used to rank order the performance of individual athletes. The coefficients of variation (CV%) of stance limb joint (ankle, knee and hip) angular kinematic parameters were also derived for individual athletes. Results The most highly ranked athlete (mean step velocity:  $8.84 \pm 0.25$  m.s<sup>-1</sup>) produced a larger CV% in the knee joint configurations (e.g. touchdown: 1.9%, peak flexion: 2.3%) than their slowest (mean step velocity:  $7.87 \pm 0.13$  m.s<sup>-1</sup>) counterpart (e.g. touchdown: 0.9%, peak flexion: 0.8%). Higher ranking athletes typically demonstrated a larger CV% in the peak hip joint angular velocity (fastest athlete: 7.6%) when compared to slower athletes (slowest athlete: 4.2%). **Discussion** A larger CV% in the knee joint angular displacements and peak hip extensor angular velocity of the highly ranked athletes indicated greater kinematic variability in the respective joints than the slower athletes. Inconsistency in the joint actions of elite athletes across multiple sprint runs has been considered reflective of a compensatory joint function (Bezodis et al., 2008). The extent to which knee and hip joint stance kinematics are perturbed may indicate an individual athlete's ability to self-organise kinematic responses to achieve superior sprint performances. **References** Bezodis, I.N., Kerwin, D.G, Salo, A.I.T. (2008). Med and Sci in Sport and Ex, 40, 707-715. Exell, T.A., Irwin, G., Gittoes, M.J.R., Kerwin, D.G. (2012). J Sports Sci, 30, 403-409. Hunter, J.P., Marshall, R.N., McNair, P. J. (2004). Med and Sci in Sport and Ex, 36, 261-271. Salo, A.I.T., Bezodis, I.N., Batterham, A.M., Kerwin, D.G. (2011). Med and Sci in Sport and Ex, 43, 1055-1062.

### EFFECT OF MASAI BAREFOOT TECHNOLOGY SHOES ON KNEE JOINT MOMENTS IN SUBJECTS WITH KNEE OSTEOARTHRITIS

Tateuchi, H., Taniguchi, M., Takagi, Y., Goto, Y., Otsuka, N., Kobayashi, M., Ichihashi, N.

Kyoto University

**Introduction** Footwear modifications have been investigated as conservative ways to manage osteoarthritis of the knee (Knee OA). Although mobility shoes and variable-stiffness shoes can reduce external knee moment, high-heeled shoes and stability shoes result in an increase in knee load while walking (Radzimski et al., 2012). The purpose of this study was to evaluate the effect of Masai barefoot technology (MBT) shoes on knee joint moments during walking in subjects with knee OA; these shoes are characterized by a rounded sole in the anterior-posterior direction with a soft pad underneath the rear foot. **Methods** This study was performed in 17 women diagnosed with knee OA (age,  $63.6 \pm 7.9$  years). The protocol was approved by the local Ethics Committee. Participants were asked to walk at 2 speeds, a self-selected speed and a slow speed with control shoes. The shoes widely used in rehabilitation facilities (Ayumi; Tokutake Sangyo Co., Ltd.) were used as control shoes. The control shoes were flexible with a flat sole. Participants were given instructions on how to walk properly while wearing MBT shoes and then were asked to practice walking for approximately 20 min. After subjects became accustomed to walking with MBT shoes, they were asked to walk at self-selected speed. Kinematic and kinetic measurements were recorded using a 7-camera Vicon motion system and 4 force plates. The following dependent measures were analysed: walking speed; stride length; peak of knee flexion moment in early stance (KFM1) and in late stance (KFM2), knee extension moment in mid-stance (KEM), knee

adduction moment in early stance (KAM1) and in late stance (KAM2); peak of knee adduction moment (KAMp); and impulse of knee adduction moment (KAMimp). Joint moments were expressed as external joint moments and were normalized according to body weight and height. Three successful trials for control shoes and 5 trials for MBT shoes were used for subsequent analysis. Paired t-test was used to compare gait variables while walking with the 2 shoes. If the self-selected speeds while wearing the control and MBT shoes were significantly different, the walking speed, from among the self-selected speed and slow speed, that was closest to the speed while wearing the MBT shoes was chosen for comparison of joint moments. Results The self-selected speeds while wearing the 2 shoes were significantly different. After the adjustment for walking speed, there was no significant difference in the walking speed and stride length. KAM1, KAM2, KAMp, and KAMimp did not differ statistically while wearing the 2 shoes. Meanwhile, KFM1 was significantly lower while wearing MBT shoes (control shoes:  $0.30 \pm 0.19$  Nm/kgm vs MBT shoes:  $0.25 \pm 0.14$  Nm/kgm). Discussion The results suggest that MBT shoes is effective especially for patients with knee OA coexisting with patellofemoral osteoarthritis because these patients are required to reduce overload due to knee flexion moment. References Radzimski AO, Mundermann A, Sole G. (2012). *Knee*, 19, 163-175.

## HEIGHT OF THE COUNTERMOVEMENT JUMP – A PREDICTOR OF THE PEAK MECHANICAL POWER OUTPUT

Gajewski, J., Busko, K., Michalski, R., Mazur-Rozycka, J.

*Institute of Sport*

Introduction Countermovement jump (CMJ) is frequently used to assess jumping abilities of athletes. Many researchers demonstrated that jump height was related to peak power output at the take-off (Johnson and Bahamonde, 1996). Regression approach, used to assess peak power output usually involves jump height and body mass (Canavan and Vescovi, 2004). The aim of this study was to formulate non-linear prediction equation for the peak power taking into consideration also the countermovement depth. Methods One hundred young male sportsmen practicing various sports served as subjects in the study. Their mean ( $\pm$ SD) age, body mass and body height were  $16.8 \pm 1.9$  years,  $80.0 \pm 9.1$  kg and  $186.5 \pm 8.5$  cm, respectively. Every subject performed three CMJs on the force plate, the highest jump being taken for further analysis. The course of vertical displacement of the body mass center (take-off position adopted as zero) as well as power course were computed based on vertical ground reaction course. Body mass (m), height of jump (H) and countermovement depth (D; lowest position of the body mass center) were taken as possible peak power (PP) predictors. The variables were transformed to logarithms. A stepwise backward regression procedure was applied. Results The mean ( $\pm$ SD) peak power, jump height and countermovement depth were  $2641 \pm 620$  W,  $45.6 \pm 4.8$  cm and  $41.6 \pm 5.9$  cm, respectively. The multiple regression equation ( $R^2=0.897$ ) was retransformed to:  $PP=3.685 \cdot m^{0.974} \cdot H^{1.304} / D^{0.879}$ , where PP – peak power, H – height of jump, D – countermovement depth. Standard error of this prediction was 185 W (CV=7%). Since exponent value of body mass was nearly 1, the regression procedure was done also for the relative peak power ( $pp=PP/m$ ). The following equation was obtained:  $pp = 3.369 \cdot H^{1.455} / D^{0.883}$ . That prediction proved quite satisfactory ( $R^2=0.869$ ), its standard error amounting to 2.29 W/kg (CV=7%). Residuals from both predictions were not correlated either with body mass or body height. Discussion A relatively big sample size enabled concluding that peak power can be assessed accurately based on jump height, body mass and countermovement depth. If all subjects performed their jumps with the same countermovement depth (normalized technique), the jump height would exactly reflect the relative peak power. Thus, maximum jump height can be used as an indicator of subject's attainable peak power output. The peak power developed at single jump is affected by the technique applied and it cannot be treated as a trait. Acknowledgments The study was partly supported by Ministry of Science and Higher Education. References Johnson, DL, and Bahamonde, R. (1996). *J Strength Cond Res*, 10(3), 161-166. Canavan, PK, Vescovi, JD. (2004). *Med Sci Sports Exerc*, 36(9), 1589-1593.

## BIOMECHANICAL ANALYSIS OF LONG JUMP IN ATHLETES AMPUTEES

Padullés, J.M.1, Torralba, M.A.2, Olsson, H.2, López, J.L.3, Padullés, X.1, García, A.1, De Fuentes, M.L.2, Theodorou, A.4

1: INEFC, UB (Barcelona, Spain), 2: UB (Barcelona, Spain), 3: GREAF, UV (Vic, Spain), 4: UA (Athens, Greece)

Introduction The incorporation of disability sport in society requires a thorough knowledge of the techniques of each of the specialties. Using biomechanical tools allows to study and objectively assess the parameters that determine the performance improvement, facilitating their social inclusion. Methods Purpose: to analyze the running approach and duration of the take-off phase in the long jump F42-F44 men's final of the Paralympic Games London 2012. The results obtained were compared with the results of the able-bodied men's long jump final at the IAAF World Championships Berlin 2009 (Mendoza and Nixdorf, 2011). We have studied 11 male athletes participating in the categories F44 (6) and F42 (5), transtibial/transfemoral amputee. Data collection was performed using 4 high-speed cameras Casio Exilim F1 at a frequency of 300 Hz. The variables analyzed in the last three strides (3L, 2L, 1L) of the approach run were: Stride velocity, SV (m/s); Stride frequency, SF (Hz); Stride length, SL (m); Contact time, CT (s); Flight time, FT (s) and duration of the take-off (s). The image analysis was performed with Dartfish Pro Suite 2010 software. The statistical analysis of the data was performed using PASW V.18.0.0 software. Results 3 to last / 2 to last / 1 to last stride: F44: SV=  $8.38 \pm 0.52$  /  $8.56 \pm 0.71$  /  $10.12 \pm 0.24$ ; SF=  $4.54 \pm 0.53$  /  $4.07 \pm 0.45$  /  $5.40 \pm 0.23$ ; SL=  $1.86 \pm 0.13$  /  $2.10 \pm 0.12$  /  $1.88 \pm 0.04$ ; CT=  $0.106 \pm 0.01$  /  $0.107 \pm 0.01$  /  $0.104 \pm 0.01$ ; FT=  $0.117 \pm 0.02$  /  $0.141 \pm 0.02$  /  $0.081 \pm 0.01$ . F42: SV=  $7.78 \pm 0.95$  /  $7.45 \pm 0.80$  /  $8.88 \pm 0.96$ ; SF=  $4.52 \pm 0.96$  /  $3.70 \pm 0.82$  /  $5.04 \pm 0.76$ ; SL=  $1.75 \pm 0.16$  /  $2.07 \pm 0.36$  /  $1.79 \pm 0.27$ ; CT=  $0.113 \pm 0.03$  /  $0.119 \pm 0.02$  /  $0.115 \pm 0.01$ ; FT=  $0.116 \pm 0.03$  /  $0.161 \pm 0.04$  /  $0.087 \pm 0.03$ . Take-off duration: F44:  $0.123 \pm 0.01$ . F42:  $0.133 \pm 0.02$ . Discussion The F44 athletes can achieve further jumping distances ( $6.30$  m  $\pm 0.58$ ), than F42 ( $5.28$  m  $\pm 1.03$ ), and they recorded faster SV, SF and SL, and less CT, FT and duration of the take-off. For the London group, the average SV in the last three strides is 8.11, 8.05, 9.56 m/s respectively. This differs from results obtained in previous research with able-bodied athletes, where there is a loss of velocity in the last stride. Velocity at take-off is a key value both in the official jumping distance and the effective jumping distance. In the London group, a high correlation between take-off duration and both the official distance ( $r=0.797$ ,  $p=0.003$ ) and the effective distance ( $r=0.843$ ,  $p=0.001$ ) was found. Among 9 athletes within the London group that use prosthesis, 7 perform take-off with their prosthetic leg ( $6.03$  m  $\pm 0.91$ ) and 2 with the other leg ( $5.50$  m  $\pm 1.00$ ). References Mendoza L, Nixdorf E. (2011). *New Studies in Athletics*, 26(3/4): 25-60

16:20 - 17:50

## Invited symposia

## IS-BN08 Biomechanics of sport equipment: Triad of performance, comfort and injury prevention \*

**METHODOLOGICAL CHALLENGES AND BEST PRACTICE EXAMPLES IN SPORTS TECHNOLOGY RESEARCH AND DEVELOPMENT**

Senner, V.

*TUM Technische Universität München*

Most sportsmen have probably made the same experience: among the multitude of sport equipment, apparel, footwear in use, there a few which seem to stand above all the rest: The soft shell, which always finds the way into the backpack, the running shoe we would like to use for ever, the beloved tennis- or golf racket. This raises the question: What is it that makes these favourites so appealing? One major issue of sports technology research is to answer this difficult question. This not only includes the definition of "attractiveness" in the context of sports, but also the search for appropriate methods to quantify related items. Extending this to sports technology it involves the definition of "functionality" and consequently the establishment of science based product tests. After a brief introduction which gives possible definitions for the above three terminologies, the presentation will then describe four relevant research fields with a special focus on subjective product testing. Examples from ski tests and golf club fitting will be used to illustrate practical application. Returning to the given categorization of sports technology the second part of the presentation will then offer a selection of best practise examples in order to illustrate the variety of different approaches in sports technology and the results hereof. An outlook into the future of sports technology with some concluding remarks will complete the presentation.

**PERFORMANCE, COMFORT AND INJURY PREVENTION IN TENNIS EQUIPMENT**

Miller, S.

*International Tennis Federation*

Introduction Tennis equipment plays an important role in the outcome of a match. The manufacture and marketing of tennis equipment is based (in part) on performance, comfort and injury prevention, all of which are intertwined and not mutually exclusive. This paper assesses each factor as it relates to tennis equipment. Discussion The main characteristics of a tennis racket in the context of this paper are: frame and string bed stiffness, string type, and damping. Racket performance (power) is generated by virtue of an impact with the ball. For a non-spinning shot, the post-impact ball speed is determined by the energy losses during impact. These losses arise from deformation of the racket frame, strings and ball, with lower total energy losses being associated with higher post-impact ball speed. The commonest injury risk due to rackets is 'tennis elbow' (lateral epicondylitis). It is generally accepted that this is due to rapid extension of the wrist extensor muscles, while playing a backhand, particularly while with a flexed wrist (e.g. Pluim, 2004). All other things being equal, increases in stiffness will increase the magnitude of the force generating this extension. It has also been postulated that the impact vibrations of the racket influences tennis elbow (Kotze et al., 2003), and that effective damping reduces that influence. Modern rackets, due to their high stiffness, have a lower damping ratio than wooden rackets, and so are less effective in that regard. There appears to be little, if any, published research on racket 'comfort'. It is hypothesised, however, that ball and string stiffness are influential factors. That is, an increased dwell time of the ball on the strings will be associated with greater comfort. By implication, therefore, stiffer strings would be perceived as less comfortable. However, modern string materials tend to be stiffer than their predecessors. In addition to using less stiff string materials, reduction of string tension will lead to lower string bed stiffness, which will be perceived as more comfortable. This has the knock-on effect of increasing post-impact ball speed, as a greater amount of the energy generated during impact will be stored in the strings, which return that energy much more efficiently than the ball. Haake et al. (2003) demonstrated that players prefer stiffer tennis balls, which tend to suffer less hysteresis energy loss. However, this decreases dwell time, which suggests that comfort is not the most important characteristic in determining ball preference. Discussion With the exception of the relationship between stringbed stiffness and post-impact ball velocity, it appears that there are limited opportunities for equipment manufacturers to increase equipment performance (as defined by post-impact ball speed), while maintaining or increasing comfort and/or reducing the risk of injury.

**ALPINE SKI RACING EQUIPMENT – THE CHALLENGE OF BALANCING PERFORMANCE AND SAFETY ASPECTS**

Spörri, J., Kröll, J., Schwameder, H., Müller, E.

*University of Salzburg*

A main challenge for sports equipment design is balancing performance and safety aspects. On the one hand a certain equipment modification may improve safety, but on the other hand it may negatively affect performance and vice versa. Furthermore, this compromise is not only influenced by equipment design itself, but also by the athletes' adaptations on modified equipment. These are two of the main reasons why injury prevention by equipment rules is very challenging, as the following example of alpine ski racing illustrates. Recent data by the International Ski Federation (FIS) Injury Surveillance System showed an alarmingly high incidence of severe injuries (Florenes et al., 2009). In most of the knee injuries the athletes initially lost balance inward and/or backward; then, while trying to regain the grip on the outer ski the inner edge of either the inner or the outer ski abruptly caught the snow, forcing the knee into valgus and internal rotation (Bere et al., 2011). A main contributor for this sudden catch of the edge seems to be the system "ski, binding, plate and boot", in particular its self-steering behaviour (Spörri et al., 2012a). Based on these findings, different ski prototypes (varying in length, width and side-cut) have been constructed and have undergone a rigorous testing process (Kröll et al., 2012). Finally, FIS introduced new equipment rules for the competition season 2012/2013. In a recent study we investigated the influence of this rule change on biomechanical variables related to performance. For the new regimented skis, it was found that, by tendency, turns were initiated and terminated lower regarding the vertical position on the slope plane and centre of mass showed a longer substantial change of direction; two factors known to be related to lower performance (Spörri et al., 2012c). While the athletes tried to compensate the reduced self-steering behaviour of the skis by increasing their hip angulation at the beginning of the turn (positive trend with respect to safety), some of the equipment suppliers started to adapt their equipment components within the regimentation boundaries and/or lacks. These adaptations in equip-

ment design, however, might result in new safety problems and start a next round in the circle of sufficiently balancing performance and safety aspects. References Bere T, Florenes TW, Krosshaug T, et al. (2011). *Am J Sports Med*, 39(7):1421-9. Florenes TW, Bere T, Nordsletten L, et al. (2009). *Br J Sports Med*, 43(13):973-8. Kröll J, Spörri J, Gilgien M, et al. (2012). In: *Book of Abstracts - 17th ECSS*, Bruges: p.479. Spörri J, Kröll J, Amesberger G, et al. (2012a). *Br J Sports Med*, 46(15):1059-64. Spörri J, Kröll J, Schwameder H, et al. (2012c). *Int J Sport Sci Coach*, 7(4):647-59.

### BIOMECHANICS OF SPORT EQUIPMENT: TRIAD OF PERFORMANCE, COMFORT AND INJURY PREVENTION

Schwameder, H.

*University of Salzburg*

Motor activities are always executed with an interaction between at least one contact area of the human body and its environment. Sport related activities are mainly performed using specific sport equipment, which has to be used in a very wide sense and does not only cover typical sport equipment, but also surfaces and clothes. In the context of 'human-movement' interaction 'sport equipment' builds an important interface. 'Sport equipment' shows both biological and mechanical effects on the human body and on human movement. It is well documented in the literature that the type of equipment used in sport or daily life can have substantial effects on the coordination and the loading of joints and biological. In some cases even fairly small changes of the equipment lead to extensive biomechanical responses. From the goal-oriented perspective the equipment interventions can follow the aspects regarding the triad of performance and/or comfort and/or injury prevention with partly diverging issues. While it would be eligible to follow all three goals at once, often contradictory circumstances impede to aim that. Elite athletes definitively focus on equipment interventions related to performance, while aspects of comfort or injury prevention only play a minor role. In recreational sports, however, the main focus is given to comfort and injury prevention. Furthermore it has to be considered that the use and handling of high end sport equipment requires a certain amount of physical condition and coordinative skills. Otherwise the probability of discomfort or even pain, disorders and injuries might occur. There are evidences in the literature that performance, comfort and injury prevention are interrelated to a certain extent, due to the high complexity of the human-equipment-interaction, the high amount of influencing factors and the methodological challenge to proof pain or injury causing factors, the named relationships are still not well understood. The high complexity of the 'human-equipment interaction' requires to observe and to study these interactions with respect to various aspects. First to mention are the issues of stability (consistency of movement and loading of a person during a set of repeated cycles), sensitivity (intensity of an individuals' reaction regarding movement pattern and loading on changes of the sport equipment or environment) and laterality (difference between the left and the right limb regarding performance, movement pattern or loading; this issue is specifically important in cases of unilateral overloading or for laterality-based tuning of sport equipment). Another aspect to look at is if changes of sport equipment show general effects (similar for everyone), group effects (specific for groups, e.g. gender, age, sports relation, skill level) or individual effects (subject-specific reaction on equipment). Furthermore, it is important to look at time related effects including issues of adaptation, fatigue and learning.

16:20 - 17:50

## Invited symposia

### IS-BN06 Evolution and adaptation in human locomotion \*

#### NEUROMUSCULAR INTERACTION DURING RUNNING FOR ELITE LONG-DISTANCE RUNNERS

Ishikawa, M., Kunimasa, Y., Sano, K., Oda, T., Nicol, C., Komi, P.V., Locatelli, E., Ito, A.

*Osaka University of Health and Sport Sciences*

The recent years have demonstrated the great success of the East-African middle- and long-distance runners. Their high running economy could not be explained by any of the physiological, histochemical and/or biomechanical parameters (Saltin et al 2003). Consequently, the question can be asked whether the East-African runners possess particular advantages of mechanical and functional muscle-tendon complex, which could favor efficient storage and reutilization of elastic energy in Achilles tendon during locomotion. The purpose of the present study was to examine the muscle-tendon architectures and the muscle-tendon interaction during stretch-shortening cycle (SSC) exercises for international level East-African runners. Musculoskeletal ultrasonography, EMG and kinematics were measured together with ground reaction forces during SSC exercises. The present report will emphasize how the muscles of these athletes function efficiently during SSC exercises. Furthermore, our results suggest that the neuromuscular interaction of the East-African runners can be behaved differently as compared to Japanese distance runners during SSC exercises (Sano et al 2013) due to the differences of mechanical properties. These differences between East-African and Japanese middle- and long-distance runners could be crucial effects for running economy. References Sano K et al. (2013) *Eur J Appl Physiol*. In Press. Saltin B. (2003) *New Studies in Athletics*. 18:15-24.

#### MESSING WITH EVOLUTION: EXAMPLES FROM HUMAN WALKING

Cronin, N., Lichtwark, G.

*University of Jyväskylä*

In the human lower limb, muscles and tendons interact efficiently during level walking. During the stance phase, a large proportion of the muscle-tendon unit (MTU) stretch is taken up by the relatively compliant Achilles tendon, whilst muscles perform minimal work and shorten slowly relative to their maximal shortening velocity during the pushoff phase (1, 2). This pattern of interaction exploits the force-length and force-velocity relationships of muscle, whilst enabling tendons to act as springs that store elastic energy during the contact phase, and return a large proportion of that energy in the pushoff phase. However, this 'natural' pattern of muscle-tendon interaction may be disrupted in certain conditions, such as when walking in high heeled shoes. In women who wear high heels (> 5cm) regularly, the gastrocnemius muscle fascicles are shorter than in controls subjects. During walking, the heel wearers walk less efficiently with or without heels. The Achilles tendon is also stiffer in long-term high-heel wearers (3), and the muscle fascicles consequently undergo higher strains and higher strain rates during the stance phase of walking (4). To date, studies of the effects of high heels on gait parameters have been

limited to small sample sizes, and although long-term adaptations in neuromechanical parameters due to high heel use have been identified, the parameters responsible for such adaptations are not known. For example, heel height and duration of use seem likely to influence whether adaptations occur, and the extent of these adaptations. This in turn will influence how much the normal pattern of muscle-tendon interaction is disturbed. In this session I will present data from an ongoing study of muscle fascicle behaviour and ground reaction forces in a group of approximately 50 women aged 18 - 70. This group exhibit a wide range of shoe wearing habits, thus allowing us to examine the effects of various parameters on long-term neuromuscular adaptations to disruption of the natural foot position during gait. REFERENCES: 1. Finni et al. (2000). In vivo human triceps surae and quadriceps femoris muscle function in a squat jump and counter movement jump. *Eur J Appl Physiol*, 83(4 -5), 416-26. 2. Lichtwark & Wilson (2006). Interactions between the human gastrocnemius muscle and the Achilles tendon during incline, level and decline locomotion. *The Journal of experimental biology*, 209(21), 4379-4388. 3. Csapo et al. (2010). On muscle, tendon and high heels. *The Journal of experimental biology*, 213(15), 2582-2588. 4. Cronin et al. (2012). Long-term use of high heeled shoes alters the neuromechanics of human walking. *Journal of applied physiology*, 112(6), 1054-8.

## CORTICAL ADAPTATIONS FOR HUMAN WALKING

Grey, M.J.

*University of Birmingham*

The demands of bipedal locomotion have led to significant evolutionary pressure on the mechanisms by which it is controlled. It is commonly accepted that the supraspinal control mechanisms have a more predominant role in human walking than quadruped walking. This talk will review evidence for the involvement of the primary motor cortex and corticospinal tract during normal and perturbed walking and during gait adaptation. It will be argued that such knowledge is critical for an understanding of the basic motor control of walking and for rehabilitation of gait in patients with lesions of the brain and spinal cord.

**16:20 - 17:50**

## Oral presentations

### OP-PM52 Training and Testing [TT] 6

#### DIFFERENCES IN SWIMMING FORCE METRICS INDUCED BY GENDER

Amaro, N., Marinho, D.A., Batalha, N., Morouço, P.

*Polytechnic Institute of Leiria*

**Introduction** Swimming performance differences are notorious among male and female post-puberty swimmers. Previous studies point that, in adolescence, boys are taller and heavier than girls; taking advantage in swimming performance with that anthropometric difference (Morouço et al., 2012). Therefore, the aim of this study was to identify possible differences between performance (personal best at 50m freestyle) and parameters obtained in tethered swimming tests (force and impulse), between genders. **Methods** One group of 14 male adolescent swimmers (age: 14.6±1.2years of age, body mass: 53.1±9.0kg, height: 1.66±0.1m, arm span: 1.69±0.1m) and other of 8 female adolescent swimmers (age: 13.9±2.1years of age, body mass: 46.3±9.2kg, height: 1.57±0.1m, arm span: 1.59±0.1m) took part in the study. Each participant performed a 30 s maximal front crawl tethered swimming test (described in detail by Morouço et al, 2011) and a 50m in-water maximal bout. After normality assumption checked, speed in 50m in-water maximal bout (s50) and force metrics (average force – Favg; maximum force – Fmax; and impulse of force – Fimp) were assessed for each group. Results 50m swimming speed was significantly higher for the males group comparing with females cohort (1.69±0.11 vs. 1.52±0.13 m/s, p=0.004; respectively). The same superiority was observed in tethered swimming metrics (Favg: 78.1±17.1 vs. 56.0±14.5 N, p=0.006; Fmax: 200.8±51.4 vs. 141.4±35.48 N, p=0.009; Fimp: 74.7±15.6 vs. 52.8±16.3 N.s, p=0.006; respectively). No differences were found in body mass, height and arm span (p>0.05). **Discussion** It is assumed that body mass and height differences among males and females intensively increase after puberty (Kraemer et al., 1989). Thus, it is pointed that at these ages males are capable to produce more strength (Schneider & Meyer, 2005). However, in the present study no anthropometrical differences were noticed, and still performance and force exertion in-water were higher for the males group. These results suggest that other variables, rather than body constitution, should be considered when evaluating adolescent swimmers. The higher values in tethered swimming metrics may imply that male swimmers had higher muscle strength levels and/or a greater capacity to apply propulsive force to water. **References** Bencke J, Damsgaard R, Saekmose A, Jorgensen P, Jorgensen K, & Klausen K, (2002). *Scand J Med Sci Sport*. ; 12:171-178. Kraemer WJ, Fry AC, Frykman PN, Conroy B, Hoffman J, (1989) *Pediatr Exerc Sci*, v.1, p.336-350. Morouço P, Vilas-Boas JP, Fernandes R, (2012). *Pediatr Exerc Sci*,v 24, 312-321 Schneider P, Meyer F,(2005). *Rev Bras Med Esporte*,v.11, p.209-13.

#### REPRODUCIBILITY OF SELECTED PHYSIOLOGICAL PARAMETERS IN SWIMMING

Götz, J.K., Klug, A., Sperling, W., Hartmann, U.

*Universität Leipzig, Faculty of Sport Science*

**Introduction** There are numerous studies that deal with the energy cost and the measurement of respiratory gas parameters in swimming (e.g. Karpovich et al., 1944). But these investigations do not consider the reproducibility of the physiological parameters. Alberty et al. 2006 examined the repeatability of the performance of swimmers during training but did not consider the reproducibility of physiological parameters. **Aim** The aim of this study was to determine the reproducibility of the parameters oxygen uptake (VO<sub>2</sub>), carbon dioxide output, ventilation, breathing frequency, lactate (Lac) and movement frequency (MF). **Methods** In the study took part three trained male (VO<sub>2</sub>peak 4.55 ± 0.45 l/min) and four female (VO<sub>2</sub>peak 3.11 ± 0.83 l/min) swimmers and triathletes. Each of them swam on two different days 2x400 m front crawl with a passive break of 20 min in a swimming flume. The first 400 m of each testing day they performed their individual velocity at an aerobic training zone (aZ) and the second in a higher velocity, representing the individual aerobic-anaerobic (aanZ) training zone. At the two testing days, the swimming speeds of the 2x400 m were exactly the same. **Results** For the respiratory parameters and MF no significant differences between the two days were found. The correlation coefficient (CV) for VO<sub>2</sub> was calculated

for aZ with 5.56 % and for aanZ with 4.68 %. The lowest CV was calculated for MF with 2.21 % and 2.81 % and the highest for Lac with 12.96 % for aZ and 21.39 % for aanZ. Discussion The CV for VO<sub>2</sub> of our study was comparable with the results from Becque et al., 1993. Brisswalter et al., 1994 reported the lowest variability for the MF, like we did. A high variability for Lac was also already found by Batschelet et al., 2004, with a CV of 10 %. We concluded that the selected respiratory gas parameters and the MF were highly reproducible. The lactate concentration, in contrast, showed a higher variability. References Alberty, M.; Sidney, M.; Huot-Marchand, F.; Dekerle, J.; Bosquet, L.; Gorce, P., and Lensele, G. Reproducibility of performance in three types of training test in swimming. *Int J Sports Med.* 2006 Aug; 27(8):623-8. Batschelet, A. Zimmermann C. Schmid K. Boutellier U. Knöpfli-Lenzin C. Reproduzierbarkeit des maximalen Laktat-steady-states. *Schweiz Z Sportmed Sporttraumatol.* 2004; 52:154-156. Becque, M. D.; Katch, V.; Marks, C., and Dyer, R. Reliability and within subject variability of VE, VO<sub>2</sub>, heart rate and blood pressure during submaximum cycle ergometry. *Int J Sports Med.* 1993 May; 14(4):220-3. Brisswalter, J. and Legros, P. Daily stability in energy cost of running, respiratory parameters and stride rate among well-trained middle distance runners. *Int J Sports Med.* 1994 Jul; 15(5):238-41. Karpovich, P. V. and Millman, N. Energy expenditure in swimming. *Am J. Physiol.* 1944; 142:140.

## TRAINING VOLUME OF TRIATHLETES OF DIFFERENT AGE CATEGORIES: A NATIONAL INVESTIGATION

Comotto, S.1, Concari, R.1, Guerci, M.1, Bottoni, A.2, Piacentini, M.F.1

1: *University of Rome*

**Introduction** As a result of the interactions in the performance of three different disciplines (swim, cycle and run), triathlon is a complex sport in terms of training load control and quantification [2]. Training related triathlon studies are mainly focused on the amount of training elite athletes perform [4] while the knowledge of training for children and adolescents is currently based on limited scientific evidence [3]. Knowledge of training characteristics may help on the promotion and the selection of talent. So, the aim of this study is to describe the volume of training of young triathletes of different age categories. **Methods** A questionnaire specifically designed in collaboration with FITRI, was submitted to all the clubs in Italy that train the age categories between 8 and 19yrs. The questionnaire consists of 3 different parts: 1)club and coach data, 2)training volume (V) data of athletes between 8 and 13 yrs of age (Kids,K) and 3)training V data of athletes between 14 and 19 yrs of age (Youth,Y). Only 11 clubs out of a total of 63 contacted, answered the questionnaire. V data were analyzed as descriptive statistic, whereas ANOVA was used to verify difference in number of sessions and time spent for training between groups ( $P<0.05$ ). **Results** The 11 responders are the most representative clubs in Italy. K athletes swim 2-3 sessions per week (SW), cycle and run 1-2SW with a volume ranged from 2 to 5, from 20 to 40 and from 5 to 10km, respectively. Y athletes swim 3-6SW and cycle and run 2-3SW with a volume ranged from 10 to 20, from 50 to 170, and from 15 to 30km, respectively. All clubs train at least two disciplines during the same training session. Y have a significant higher number of SW ( $P<0.001$ ). The same aspect is evident analyzing each discipline except for cycling that showed the same number of SW for all age categories. Time spent for training per week increasing from K to Y ( $P<0.001$ ). Same results are evident analyzing each discipline separately ( $P<0.03$ ). **Discussion** Selection and promotion of talent is based not only on the performance of the athletes but also on their past training history. Therefore, these data may help the FITRI understand if there are differences in training modalities between different clubs in order to create specific guidelines based on the age category and to design the best strategy to achieve top level sporting results. In fact, cut-off model to select talent seems to be inadequate [1], but the selection should also take into account mental ability, rate of abilities' development, load and stress tolerance. References [1]Bottoni et al JHSE, 2011 [2]Cejuela Anta & Esteve-Lanao JHSE, 2011 [3]Millet et al IJSP, 2007 [4]Vleck et al JSCR, 2010

## A MODIFIED METHOD OF TRIMP CALCULATION TO QUANTIFY TRAINING LOAD IN ELITE SWIMMERS

García-Ramos, A., Feriche, B., Iglesias, X., Calderón, C., Chaverri, D., Barrero, A., Nebot, V., Schuller, T., Hynynen, E., Rodríguez, F.A.

FCADF, *University of Granada (Granada, Spain)*

**INTRODUCTION** The training impulse (TRIMP) method (Banister & Hamilton, 1985), based on heart rate (HR) monitoring and exercise duration, is an objective procedure for quantifying internal training load. It requires steady state HR measurements, thus limiting the accuracy with which interval exercise can be quantified (Borresen & Lambert, 2009). Moreover, the classical method does not discriminate between work and rest periods, which are merged into a single intensity parameter (HRmean). Here we propose a modified method to calculate TRIMP based on the addition of partial impulse units within a session (TRIMPa), and compare experimental results computed with the classical procedure. **METHODS** 17 elite swimmers' pool sessions were monitored for four consecutive weeks. HR was measured from RR intervals, and 50-m swimming and recovery intervals were timed using an integrated system with portable beacon transmitters placed by the pool (CardioSwim, TX H2O, Freemap, Fleurier, Switzerland). TRIMP were calculated using the classical procedure, and the proposed accumulative method (TRIMPa), which adds partial TRIMP values computed for each lap during the workout. Session RPE (s-RPE) (Foster et al., 2001) was self-administered within 30 min after each workout. **RESULTS** Data were obtained from 328 individual pool sessions. Mean ( $\pm$ sd) session TRIMPa values (116.6 $\pm$ 53) were greater than TRIMP (107 $\pm$ 47.4) (+9.2%;  $P<0.001$ ). Inter-method differences were larger with increasing HR standard deviation (HRsd) and number of recorded time intervals (Nint). TRIMPa values could be estimated using the equation ( $r^2=0.994$ ;  $p<0.001$ ):  $TRIMPa = -6.348 + 1.086 TRIMP + 0.266 HRsd + 0.013 Nint$ . Both TRIMPa and TRIMP showed a strong correlation with s-RPE ( $r=0.724$  and  $0.702$ , respectively,  $p<0.001$ ). **DISCUSSION** Our results agreed with previous studies in showing a good association between subjective (s-RPE) and objective HR-based quantification methods (Wallace et al., 2009). In contrast to TRIMPa, s-RPE and the classical TRIMP methods do not discriminate the different character of each training interval during a workout. Therefore, TRIMPa appears to be a more accurate and appropriate procedure for quantifying training load, particularly when monitoring interval training sessions. **REFERENCES** Banister EW & Hamilton CL (1985). *Eur J Appl Physiol*, 54, 16-23. Borresen J, Lambert MI (2009) *Sports Med*, 39(9), 779-795. Foster et al. (2001). *J Strength Cond Res*, 15, 109-115. Wallace LK, Slattery KM, Coutts AJ (2009). *J Strength Cond Res*, 23, 33-38.

## PLAYERS BORN DURING EVEN YEARS ARE MORE SUCCESSFUL IN ELITE HANDBALL

Karcher, C.1, Ahmaidj, S.1, Buchheit, M.1,2

1 *Laboratory of physiological adaptations and rehabilitations to exercise (Amiens, France)*, 2 *Aspire (Doha, Qatar)*

**Introduction**

16:20 – 17:50

## Invited symposia

### IS-SH08 Strategies for preventing sexual harassment in sport – in between voluntariness and obligation

#### SEXUAL HARASSMENT PREVENTION IN EUROPEAN SPORT: SCIENCE, ACTIVISM AND POLICY

Brackenridge, C.

*Brunel University London*

This paper will address the rise of scientific enquiry into sexually exploitative behaviour in sport. It will start by examining contested definitions and move on to explore how scientific enquiry has driven activism for social change. The paper will posit that a tipping point is approaching whereby the combined forces of science and activism will result in acceptance of athlete welfare within European sport policy agendas. Possible consequences for sport management and coaching will also be discussed. SYMPOSIUM ID: 5234 - Session-ID: IS-SH08

#### PREVENTING SEXUAL HARASSMENT AND ABUSE IN SPORT - THE NORWEGIAN PERSPECTIVE

Fasting, K.

*Norwegian School of Sport Sciences*

The first Norwegian study surveying the prevalence of sexual harassment and abuse in Norway took place in 1998. About the same time, a big scandal occurred in Norwegian Sport. The coach of Vebjørn Rodahl, a Norwegian runner who had won a gold medal in 800m in the Olympics in 1996, was sacked by the Norwegian Track and Field Association, by his club, and a couple of days later by Vebjørn Rodahl himself. The coach was accused of having sexually harassed and abused two female athletes. The case never got to court, because it was settled out of court. The case received extensive media attention, and raised many questions inside Norwegian sport, because it became clear that Norwegian sport didn't have a system to handle such cases. When the report from the above mentioned survey was released some time later it led to The Norwegian Olympic, Paralympic and Confederation of Sport (NIF) deciding upon the first guidelines to prevent sexual harassment (NIF 2000). More empirical studies have now been done. Also the numbers of criminal court cases involving abuse in sport have been more visible in the Norwegian media. A short overview of the knowledge produced by these empirical studies about sexual harassment and abuse in a Norwegian Context is presented. This knowledge led to the revision of the guidelines of 2000. As a consequence of that "An open and inclusive sport" had been chosen as the aim for future sports policy by the Norwegian Olympic and Paralympic and Confederation of Sports (NIF), it became a goal "to develop tolerance, understanding and to establish recognition of people's equality in order to avoid discrimination, harassment and bullying" (NIF 2007). At the General Assembly the motion "Zero tolerance for discrimination and harassment irrespective of gender, ethnic background, religious faith, sexual orientation and disability" was passed. Soon after the board of NIF decided "that all sports clubs from 1 January 2009 are obliged to procure a police certificate of good conduct for persons who are to carry out tasks for the club that entail a relationship of trust and responsibility in relation to minors or persons with mental disability" (NIF 2008). A police certificate contains information about whether a person is charged with or has earlier been convicted of violations of certain provisions in Penal Code on sexual offenses. Some figures from this police checking are presented and discussed. Ten new guidelines on preventing sexual harassment and abuse were then adopted in 2010. A booklet has been developed which, in addition to definitions and general information, has paragraphs about the prevention of sexual harassment and abuse and suggests mandatory procedures when sexual harassment and abuse occur. The guidelines are presented and their consequences discussed particularly in relation to how a sport club/organization should and could react when an incident occurs.

#### INTERVENTIONS AGAINST SEXUAL EXPLOITATION IN SPORT FROM A GREEK PERSPECTIVE

Chroni, S.

*University of Thessaly*

Abstract for the ECSS-Invited Symposium ID: 5234 – Session-ID: IS\_SH08. Strategies for preventing sexual harassment in sport – in between voluntariness and obligation. Neither prevention nor control laws, policies, procedures against sexual exploitation are in effect specifically covering the world of Greek sport. The media repeatedly has brought to light sexual exploitation sport stories concerning both genders. Greek data revealed sexual harassment experiences in 71.5% of 308 female athletes asked (Chroni & Fasting, 2009); yet no other study has been conducted to inform us on sexual harassment experiences of male athletes or on sexual abuse incidents in sport. Today, the state of Greece has still not taken any initiative toward safeguarding sport participants and thus confronting sexual exploitation incidents remains a privately held issue. The present paper will discuss individual efforts put forth by a local football association to educate parents and coaches on sexual abuse; a local women's football team that was formed by the parents of the athletes in order to leave behind an abusive coach; and the research findings based on Greek data that highlight the need for action by the state. Consequences for coach education will also be discussed.

#### CHILD PROTECTION AND PREVENTION OF SEXUALIZED VIOLENCE IN SPORT – THE GERMAN PERSPECTIVE

Rulofs, B.

*German Sport University Cologne*

Due to the media coverage of severe cases of child abuse in institutions, the topic of preventing sexual harassment and abuse has once again been put on the agenda of sport organisations. In 2011, the German Olympic Sport Federation – as the head of all sport organisations in Germany – finally started a broad campaign against sexualized violence in sport. Yet, the governing bodies of German sport were initially slow to adopt measures to prevent sexualized violence. This paper aims at investigating the steps and changes that were necessary in order to establish a comprehensive campaign for child protection in the German sport system. The model of "activation states", developed by Brackenridge et al. (2005), is used as a heuristic device for analysing the development of policy and action against

sexualized violence in German sport. Furthermore the German status quo in child protection in sport is compared to the progress in other European countries. A project funded by the European Commission in the year 2012, that aimed at compiling a catalogue of European initiatives for child protection in sport, serves as a basis for this comparison (cp. Chroni et al. 2012). Taking into account the policy and action that have been undertaken by the German governing bodies in sport throughout the last two years, it can be stated that they have quit the state of being "opposed" or "inactive" in the field of child protection in favour of being "active" (cp. Brackenridge et al., 2005). For example, all regional sports confederations have officially appointed a commissioner for child protection in sport and have integrated child protection as a topic in their educational system (cp. UBSKM, 2012, p. 12). Yet, with regard to the progress that some European neighbour countries have made (e.g. United Kingdom, Norway), it has to be concluded that further measures have to be taken in Germany. Considering the quite complex and decentralized structure of the German sport system, the main challenge is to carry the action through the various member organisations down to the bottom of the sport system, namely to 91,000 sport clubs. References: Brackenridge, C., Pawlaczek, Z., Bringer, J.D., Cockburn, C., Nutt, G., Pitchford, A., Rusell, K. (2005), Measuring the impact of child protection through Activation States. *Sport, Education and Society*, Vol. 10, No. 2, pp. 239-256. Chroni, S., Fasting, K., Hartill, M., Knorre, N., Martin, M., Papaefstathiou, M., Rhind, D., Rulofs, B., Toffegaard Stockel, J., Vertommen, T., Zurc, J. (2012). Prevention of sexual and gender harassment and abuse in sports – Initiatives in Europe and beyond. Frankfurt: German Sport Youth. Unabhangiger Beauftragter fur Fragen des sexuellen Kindesmissbrauchs [UBSKM] (2012). Monitoring zum Umsetzungsstand der Empfehlungen des Runden Tisches sexueller Kindesmissbrauch. Available at <http://beauftragter-missbrauch.de/course/view.php?id=31>

## 16:20 - 17:50

### Oral presentations

#### OP-PM07 Health and Fitness [HF] 3

##### PERCEPTIONS AND AWARENESS OF PARENTS ABOUT PEDIATRIC OVERWEIGHT: THE ACORDA PROJECT

Lagoa, M.J.1,2, Mota, J.1, Pizarro, A.1, Ribeiro, J.C.1, Aires, L.1,2

*1Research Centre in Physical Activity, Health and Leisure (CIAFEL) Faculty of Sports – University of Porto. 2 High Education Institute from Maia (ISMAI), Portugal*

**Introduction** Parents are important influences on children's lifestyle but there is lack of research on strategies to increase parents' effectiveness as part the process. The aim of this study was to evaluate parents' awareness about restrictions, decisions, concerns and certainties of children's eating habits of that took part in a school-based intervention program to prevent obesity. **Methods** Parents of 79 children from 6 schools in Porto district took part in this study. The students included in the project ACORDA i.e. obese children and adolescents involved in PA (PE classes 5 days per week) and diet counseling. The program lasted 8 months. To evaluate parental awareness, attitudes and practices about infant feeding, a Child Feeding Questionnaire (CFQ) was used with 7 factors: i Perceived responsibility (PR); ii Parent perceived weight (PPW); iii Perceived child weight (PCW); iv Parents' concerns about child weight (CN); v Restriction (RST); vi Pressure to eat (PE); vii Monitoring (MN). For physical activity levels accelerometers ActiGraph GTX3 were used for 7 days. %BF and %TF was obtained through DXA (whole body protocol). Additional android region (AR) was defined using the software provided by the manufacturer. The lower boundary was the top of the pelvis line of demarcation. The upper boundary was placed above the pelvis line of demarcation at a position that was equivalent to 20% of the distance between the pelvis and the femoral neck. Lateral boundaries were the lines for the arms when in normal position for a whole-body scan. To analyze how variables changed over time, deltas ( $\Delta$ ) (Time point 1 minus Time point 0) were calculated. Pearson correlations were used. Results The results showed that there were significant correlations between Factor 2 PPW:  $\Delta$ %BF (-0,41;  $p=0,041$ )/  $\Delta$  TF (-0,357;  $p=0,019$ ); Factor 4 CN:  $\Delta$  AR (-0,329;  $p=0,033$ )/ mother's schooling (0,266;  $p=0,019$ )/ mother's profession (-0,301;  $p=0,009$ ); Factor 6 PE:  $\Delta$  AR (0,406;  $p=0,009$ )/  $\Delta$  %BF (0,420;  $p=0,006$ )/ mother's profession (0,251;  $p=0,035$ )/  $\Delta$  %TF (0,388;  $p=0,012$ ); Factor 7 MN:  $\Delta$  Time MV PA (0,395;  $p=0,016$ )/  $\Delta$  weight (0,306;  $p=0,017$ ). **Conclusions** There is concern about children's weight mainly by mothers, depending on their education level and profession. The inverse correlations observed between PPW and  $\Delta$ %BF and  $\Delta$  TF, as well as the positive correlations between parents' PE and loss of % BF, %TF and AR, can highlight the importance of an knowledgeable family for an efficient support of overweight children to a successful change to an healthy lifestyle. **Acknowledgments:** DGS (General Health Board); Project PEst-OE/SAU/UI0617/2011 and PTDC/DTP-DES/1328/2012.

##### THE REAL ENERGY EXPENDITURE OF OBESE ADULTS IN A FITNESS WORKOUT

Vallejo, L.1, Porta, J.1

*INEFC Barcelona*

**Do not insert authors here** THE REAL ENERGY EXPENDITURE OF OBESE ADULTS DURING A FITNESS WORKOUT: A PILOT STUDY. To fight against the XXI's century obesity pandemia, it's of primary interest to propose the type of exercise that maximizes caloric expenditure (CE). Although walking has become very popular, doesn't provide, in a normal 60 min workout session, the necessary overload to achieve the desired goal. Luckily, nowadays, the different types of ergometers we can find in the fitness centers can help the professionals in promoting an effective "burning-fat" workout. But, despite the many studies on exercise metabolism available, we haven't been able to find any intending to quantify the real CE of overweight or obese subjects through a real fitness workout. This justifies the aim of this study being: "quantification of the energy expenditure of obese adults in a 60 min workout" **Methods** Subjects: 6 moderately active subjects volunteered to participate in this study signing an informed consent; 3 women aged  $52.0 \pm 9.4$  with a BMI=  $33.4 \pm 7.1$ , and 3 men aged  $54.0 \pm 8.1$ , with a BMI=  $30.4 \pm 4.6$ . **Materials:** Gas analyzer Fitmate-Pro (Cosmed, Italy), bicycle, hand-bicycle, treadmill, elliptical, rower. **Protocol:** after evaluating their Basal Metabolic Rate (BMR), and the maximum walking speed during 1 min (MWS-1) in a treadmill, the subjects, were asked to exercise in all the ergometers at 75 % of their MHR ( $208-(0.7 \times \text{age})$ ), and/or at the level 6 (somewhat hard) in the Borg 10-RPE Scale®, during 5 min (podal bicycle, elliptical and treadmill) or 3 min in the manual bicycle and rower. **Results** The 3 women's mean BMR for a period of 10 min ( $\text{VO}_2 = 201 \pm 24 \text{ ml} \cdot \text{min}^{-1}$ ) was lower ( $p < 0,001$ ) than the 3 males ( $\text{VO}_2 = 262 \pm \text{ml} \cdot \text{min}^{-1}$ ). The level 6 of the Borg Scale was much related to the 75% of MHR ( $\approx 65\% \text{ VO}_2\text{max.}$ ) in the treadmill, elliptical and rower, but not in the manual & podal bicycles. As expected the women had a much lower energy expenditure in all the ergometers than the males ( $p < 0,0001$ ). Women & men had a maximum caloric expenditure rowing ( $x= 540 \text{ kcal} \cdot \text{h}$  and  $745 \text{ kcal} \cdot \text{h}$  respect.) and walking ( $x= 430 \text{ kcal} \cdot \text{h}$  and  $569 \text{ kcal} \cdot \text{h}$ ) Discus-

sion/conclusion This study demonstrates that's very difficult to "burn-fat" just exercising. Even a motivated and fit overweight or obese adult can't sustain a caloric expenditure of 745 kcal•h. The only way to get thinner and healthy should be to diet and exercise with the "interval-fitness" method. That's, 5-10 min exercise at 85% followed by a 5-10 min at 65-75% of MHR. References Haskell W. L., Lee R. R., PATE K, et al. (2007). Physical Activity and Public Health: Updated Recommendation for Adults from the ACSM & AHA. *Med. Sci. Sports Exerc.*, Vol. 39, No. 8: 1423-1434. Achten J., Gleeson M., Jeukendrup A.E. (2002). Determination of exercise intensity... *Med.Sci. Sports Exerc.*, Vol 34,1: 92-97.

### CHANGES IN ADIPOSITY AMONG PORTUGUESE YOUTH WITH OR WITHOUT INDIVIDUALIZED COUNSELING APPROACH AS PART OF A SCHOOL-BASED PROGRAM: THE ACORDA PROJECT

Aires, L.1,2, Martins, C.1,2, Silva, G.1, Rego, C.3, Marques, E.A.1,2, Ribeiro, J.C.1, Santos, M.P.1, Mota, J.1

*1Research Centre in Physical Activity, Health and Leisure (CIAFEL) Faculty of Sports – University of Porto 4200-450 Porto, Portugal 2 High Education Institute from Maia (ISMAI), Portugal 3 Child and A*

Introduction School-based interventions show inconsistent results in reducing weight-related problems. Some limitations can be due to sensitivity of methodology, as the use of BMI or waist Circumference (WC) as a single marker of adiposity response to intervention. Another limitation is that type of interventions do not easily allow for individualized targeted messages. Therefore, the aim of this study was to explore the changes observed in BMI, WC, percentage of Body Fat (%BF) and Trunk Fat (%TF) observed in a school-based intervention program, with or without individualized counseling for diet. Methods 75 children and adolescents (46 girls, 61.3%) from 6 schools in Porto district took part in this study. "ACORDA Project" (e.g. obese children and adolescent involved in PA and diet program) is an 8-month interdisciplinary, school-based intervention program. The Project consists of regular physical exercise (one hour/session; 4 to 5 days/week) plus dietary individualized counselling. Dietary counseling was delivered in through medical appointments. Two groups of 16 subjects each with and without individualized counselling accomplished all evaluations, respectively with, 54.1% and 44.7% of overweight and 45.9% and 55.3% of obesity. To analyze changed over time, deltas  $\Delta$  (Time point 1 minus Time point 0) were calculated. %BF and %TF was obtained through DXA. Tanner scale was used to characterize maturation status and logistic regression, adjusted for gender and maturation to examine associations between  $\Delta$  %BF and  $\Delta$  % TF according to groups. Results Results showed that there was inverse associations of  $\Delta$  % BF ( $\beta=-0.768$ ; 95% CI: 0.054;4.015;  $p<0.046$ ),  $\Delta$ %TF ( $\beta=-0.527$ ; 95% CI:0.359;0.972;  $p=0.038$ ) and take part of individualized counseling group. No significant associations were observed in changes of BMI and WC. Conclusions School-based intervention programs can be an important key of counteracting obesity in children and adolescents. However our results point out for the low sensitivity of BMI and WC, in opposition to % BF and %TF, measured by DXA, proving to be a better marker of body composition. In addition, the link between schools and health centers should be prioritized including individualized counseling for overweight children. Acknowledgments: This study was supported by DGS (General Health Board), Projeto PESt-OE/SAU/UI0617/2011 and PTDC/DTP-DES/1328/2012

### INFLUENCE OF THE BMI ON THE MOTOR DEVELOPMENT OF CHILDREN AND ADOLESCENTS

Albrecht, C.1, Worth, A.1, Oberger, J.1, Schlenker, L.2, Schmidt, S.2, Bös, K.2

*1: University of education Karlsruhe (Germany); 2:Karlsruhe Institute of Technology (Germany)*

Introduction Several studies have shown a negative association between overweight/ obesity and motor performance (MP) in children and adolescents (Bös et al., 2009; D'Hont et al., 2009). However, it is unknown how overweight influences the development of MP over the lifespan. The purpose of this longitudinal study is to investigate, whether inter-individual changes in MP from baseline (base) to wave 1 depend on BMI-group affiliation. Methods To examine the influence of overweight/obesity on the development of MP longitudinally, we tested MP in two waves with a 3-year-interval in a representative, nationwide sample of 4,529 (base)/ 5,290 (wave 1) children and adolescents aged 4 to 23 years in Germany (MoMo longitudinal study). MP was assessed by means of the MoMo test profile including 11 test items (Bös et al., 2009). For the statistical analysis ANOVAs for repeated measurements were conducted. BMI-group affiliation was defined according to the international cut-off points from Cole et al. (2000). Results Results of the ANOVA revealed significant differences in MP development from base to wave 1 between over- and normal weight participants (time\*group:  $F(1, 1249) = 10.70$ ,  $p < .01$ ,  $\eta^2 = .01$ ) for the test item standing long jump. Participants with normal weight show an increase of MP from baseline to wave 1 of 32.1%, overweight participants of 23.7 %. For the test item balancing backwards, the ANOVA revealed no significant differences in MP development from base to wave 1 between over- and normal weight participants (time\*group:  $F(1, 1257) = 2.55$ ,  $p = .11$ ,  $\eta^2 = .00$ ). Discussion The development of MP from base to wave 1 differs significantly among children/adolescents with over- and normal weight in tasks which are conditional-determined (standing long jump) but not in tasks which are coordinative-determined (balancing backwards). Our results indicate that obesity prevention should begin as early as possible due to the fact that overweight children show a significantly lower development of MP. In further studies we examine whether the shown scissors effect between over- and normal weight children/adolescents reinforces in adulthood. The BMI as a tool to assess the body constitution is often criticized. In future analyses, alternatives, such as waist-to-hip ratio or data from bioelectrical impedance analysis will be included. References Bös, K., Worth, A., Opper, E. (2009). Das Motorik-Modul. Nomos, Baden-Baden. Cole, T.J., Bellizzi, M.C., Flegal, K.M., & Dietz, W.H. (2000). *British Med J*, 320, 1-6. D'Hondt, E., Deforche, B., De Bourdeaudhuij, I., Lenoir, M. (2009). *Adapted Physical Activity Quarterly*, 26, 21-37 Woll, A., Kurth, B. M., Opper, E., Worth, A., & Bös, K. (2011). *Eur J Pediatr*, 170 (9), 1129-42.

### EFFECTS OF HOSPITALIZATION ON OXIDATIVE STRESS AND BODY COMPOSITION IN PATIENTS WITH RHEUMATOID ARTHRITIS

Stavropoulos-Kalinoglou, A., Bourokosta, Z., Georgakouli, K., Kitas, G.D., Jamurtas, A.

*University of Thessaly*

Oxidative stress is considered to be central in the development and progression of Rheumatoid Arthritis (RA), a chronic inflammatory condition affecting mainly synovial joints. A mechanistic link between inflammation and oxidative stress has been described and higher levels of oxidative stress are observed during more active periods of the disease. In a similar line, inflammation is considered to be the main reason why RA patients loose muscle mass. However, the short-term effects of effective control of inflammation by medication on oxidative stress and body composition in RA have not been studied. Purpose: To investigate the effects of short (2 weeks) hospitalisation on oxidative stress and body composition in patients with RA Methods: 12 RA patients (8 females) admitted to the hospital due to a flare in disease activity were assessed for oxidative stress (total anti-oxidant capacity: TAC; and uric acid: UA; Thiobarbituric acid reactive substances: TBARS) and body composition (height, weight, body mass index: BMI; body fat percentage: BF; fat free mass: FFM) at the day of

admission, one week later, and at check-out. Moreover, markers of inflammation (C-reactive protein: CRP) and disease activity (Disease Activity Score: DAS) were assessed as per routine clinical practice at the same time-points. Repeated measures ANOVA were used to identify differences in the assessed parameters between the three time-points. Results: Mean length of stay was  $14 \pm 1.2$  days. Inflammation, was significantly reduced from baseline to check-out (ESR:  $p=0.018$ ; CRP  $p=0.004$ ), and disease activity was lowered (DAS:  $p<0.001$ ). However there was no statistically significant change in TAC, UA, or TBARS. On the contrary body weight, BMI, BF, and kilograms of body fat were slightly but significantly reduced during hospitalisation ( $p<0.001$  in all cases) as was FFM ( $p=0.001$ ) Conclusions: Control of inflammation following two weeks of hospitalization does not affect markers of oxidative stress in patients with RA while body weight is significantly reduced. This comes as a result from reductions in both BF and FFM. Given the mechanistic association of inflammation with oxidative stress, possibly medication-induced oxidative stress might explain this outcome. Moreover, very limited physical movement for the two weeks might induce oxidative pathways and muscle wasting.

### DIETARY HABITS, BODY MASS INDEX AND PHYSICAL ACTIVITY OF BRITISH AND SAUDI YOUTH: A CROSS-CULTURAL CLUSTER ANALYSIS

Al-Nakeeb, Y.1,2, Dodd, L.2, Collins, P.2, Al-Nuaim, A.3, Lyons, M.4

1: Qatar University (Qatar), 2: Newman University College (United Kingdom), 3: King Faisal University (Saudi Arabia), 4: University of Limerick (Ireland).

Do not insert authors here Introduction Obesity is a leading risk factor for global mortality, promoted by poor dietary habits and sedentary behaviour in youth and in later life (Swinburn et al., 2011). This study explores the clustering and differences in dietary habits, body mass index (BMI) and physical activity (PA) amongst youth from United Kingdom (UK) and Saudi Arabia (SA). Methods 2,290 males and females aged 15–17 years completed a validated self-report questionnaire to assess dietary habits, BMI and PA. Based on the metabolic equivalent (MET-min) values of each activity reported by the participant, total energy expenditure per week was calculated (Ridley et al., 2008). The questionnaire also included specific questions designed to quantify the frequency of healthy and unhealthy dietary habits of youth. BMI was calculated using the formulae: Weight (kg)/Height (m<sup>2</sup>). In accordance with the International Obesity Task Force (IOTF) criteria, age and gender-specific BMI cut-off points were used for overweight and obesity classification (Cole et al., 2000). Results Youth from SA had a higher prevalence of overweight/obesity and lower levels of PA than youth from the UK. Males were more physically active than females across both countries. Three clusters were identified: (1) a "high risk" cluster with least healthy dietary habits, low PA and high BMI; (2) a "moderate cluster" with moderate healthy dietary habits, PA and BMI; (3) a "low risk" cluster with healthiest dietary habits, most active and the least BMI compared to the other two clusters. There were more SA youth in the high and moderate risk clusters. Discussion While males from both the UK and SA had healthier lifestyle and dietary habits than females, the younger the youth the healthier the lifestyle and dietary habits. Overall, youth from the UK pursued a comparatively healthier lifestyle and followed better dietary habits than SA youth. These findings reveal a worrying picture of young people's lifestyle and recognise some important practical implications for both countries that could be of interest to policy makers, teachers and health professionals. Furthermore, the findings reaffirm the notion that health practices tend to occur in clusters rather than in isolation and indicate that one should consider the patterns within these clusters of behaviours when planning policies and designing intervention strategies regarding obesity, PA and nutritional habits of youth. References Swinburn, B.A. et al., (2011) *Lancet*, 378, 804-814. Ridley, K. et al., (2008) *Int J Behav Nutr Phys Act*, 5, 1-8. Cole, T.J. et al., (2000) *Br Med J*, 320, 1240-1243.

## 16:20 - 17:50

### Oral presentations

#### OP-PM57 Training and Testing [TT] 11

##### EFFECT OF INTEGRATIVE TRAINING ON INJURY FREQUENCY IN PROFESSIONAL SOCCER PLAYERS

Reer, R., Stein, D., Wellmann, K., Braumann, K.M.

*University of Hamburg*

Introduction FIFA Medical Assessment and Research Center (1) and the Oslo Sports Trauma Research Center (2,3) and other organizations have attempted to determine and quantify the frequency and causes of soccer injuries. These injuries are also associated with excessive costs for various professional clubs due to inability of players to participate in soccer matches. Therefore, the aim of this study was to assess if the frequency of injuries can be reduced or even eliminated by employing a specific injury prevention and reduction training program. In a previously conducted pilot study with a group of professional soccer players we were able to determine that employment of an injury prevention training program resulted in significant reduction and frequency of soccer related injuries. Methods We collected injury data over 4 soccer seasons of the same professional soccer team. The program consisted of sport specific endurance, sprint and jumping ability as well as strength/power of various muscle groups. We documented the occurrence of injuries of professional soccer players over 4 subsequent soccer seasons. The specific injury prevention program was not employed during the first season. We subsequently compared injuries that occurred during the first to the fourth playing season. Players were divided into three groups. Group 1 (G1) consisted of players who played at least one game during each season. Group 2 (G2) consisted of players that played at least 50% of the time during each season and group 3 (G3) consisted of players who played in all games during all four playing seasons. Results We found that our injury prevention program that was implemented after the first soccer season revealed the following results: G1 (N=25) had  $4.15 \pm 2.2$  injuries during the first season and injury rate was reduced to  $2.35 \pm 1.2$  (N=26) at the end of fourth season ( $p<0.01$ ). In G2 (N=12) the injury reduction was from  $4.92 \pm 1.4$  to  $2.36 \pm 1.4$  (N=11) ( $p<0.01$ ) and in G3 from  $4.33 \pm 1.7$  (N=9) to  $2.67 \pm 1.6$  (N=9) ( $p<0.05$ ). Discussion The results of our study revealed that our injury prevention and reduction program significantly reduced the injury rate of our professional soccer players from first to fourth playing season and that systematic and consistent application of our program had a positive effect on injury prevention and reduction in our professional soccer players. References 1. Hawkins RD, Hulse MA, Wilkinson C, Hodson A, Gibson M (2001). *Br J Sports Med*, 35, 43-47. 2. Andersen T, Tenga A, Engebretsen L, et al (2004). *Br J Sports Med*, 38, 626-631. 3. Woods C, Hawkins RD, Hulse M et al (2002). *Br J Sports Med*, 36, 436-441.

## EFFECTS OF AN INJURY PREVENTION WARM-UP PROGRAM ON POSTURAL CONTROL MEASURES IN YOUTH TEAM ATHLETES. A RANDOMIZED CONTROLLED TRIAL

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1University of Hamburg; 2University of Erlangen-Nuremberg

**Introduction** Young team athletes in the age of 10 to 16 years are at increased risk of sustaining lower extremity injuries. Exercise interventions have shown to be effective in preventing injuries in this population (Hübscher et al 2010). These effects have been partly attributed to sensorimotor (postural) control adaptations. The objective of this study was to determine how various measures of postural control respond to an injury prevention warm-up program in youth field hockey athletes. **Methods** Thirty youth (14.9±3 years) field hockey athletes without previous lower extremity injuries were randomized to a control or intervention group. The intervention group performed a 20-minute warm-up program (11+) with strength, plyometric and balance exercises before each practice session. Participants in the control group followed their regular warm-up routine. The interventions were performed twice weekly for ten weeks. All participants completed pre- and post-tests as well as two test after week three and six in order to assess functional balance (star excursion balance test = SEBT, balance error scoring system = BESS), dynamic balance (jump landing time-to-stabilization =TTS) and static balance (center of pressure (COP) sway velocity). Interactions between group and intervention were analyzed by using repeated measures ANOVA. **Results** At baseline, there were no statistically significant differences between groups in age, mass, height, BMI or balance measures. Adherence was at 86% in the intervention group and 77% in controls. Significant group by time interactions were found for the BESS ( $p < 0.001$ ). The intervention group demonstrated larger error score reductions ( $69.3 \pm 10.3\%$ ) after ten weeks compared to controls ( $31.8 \pm 22.1\%$ ). SEBT maximum reach distances ( $p < 0.001$ ), TTS in anterior-posterior direction ( $p < 0.01$ ) and COP sway velocity ( $p < 0.001$ ) also improved significantly, whereas there were no significant differences between groups. **Conclusions** All balance measures improved significantly over time. However, only the changes in the BESS score seemed to be related to the warm-up intervention program. The similar increase in both groups in the other balance measures suggests that (a) test learning effects were still present at post-tests, (b) the regular sports practice had an additional effect or (c) the duration of 10 weeks was not sufficient for significant intervention effects. More studies are needed to identify underlying postural or sensorimotor mechanism of injury prevention. Hübscher M, Zech A, Pfeifer K, Hänsel F, Vogt L, Banzer W. Neuromuscular training for sports injury prevention: a systematic review. *Med Sci Sports Exerc.* 2010;42(3):413-21.

## RELIABILITY OF FUNCTIONAL CAPACITY TESTS IN FIBROMYALGIA PATIENTS.

Carbonell-Baeza, A.1,2, Segura-Jiménez, V.2, Álvarez-Gallardo, I.C.2, Castro-Piñero, P.1, Ruiz, J.R.2, Delgado-Fernández, M.2, Aparicio, V.A.2,3

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**Introduction** The assessment of functional capacity in fibromyalgia patients is important for determining the efficacy of treatment interventions. Specially, due to the presence of reduced functional capacity in these patients. Studies analyzing the reliability of fitness test in this population are needed. The aim of this study was to determine the reliability of a functional capacity test battery in female fibromyalgia patients. **Methods** One hundred and three fibromyalgia patients ( $51.2 \pm 9.1$  years) performed the following tests twice (7 days interval test-retest): chair sit and reach, back scratch, handgrip strength, arm curl, chair stand, 8 feet up & go and 6-minute walk. A paired t-test was used to compare mean differences between measurements. Intraclass correlation coefficient (ICC), 95% confidence interval for the ICC, standard error of the measurement (SEM) and Bland-Altman plots were analyzed. **Results** Significant differences between test and retest were found in four tests: back scratch ( $P < 0.05$ ), arm curl, chair stand and 8 feet up & go (all,  $P < 0.001$ ) tests. We found high test-retest reliability in all tests (ICCs from 0.83 to 0.96). The SEMs obtained were: 4.5 and 3.8 cm for chair sit and reach and back scratch, respectively; 2.1 kg for handgrip strength; 1.5 and 1.2 repetitions for arm curl and chair stand, respectively, 0.8 s. for 8 feet up & go and 32.6 m. for 6-minute walk tests. The Bland-Altman plots 95% limits of agreement for the different tests were: chair sit and reach (12.54, -12.78 cm), back scratch (11.51, -9.31 cm), handgrip strength (6.16, -5.72 Kg), arm curl (5.90, -3.16 repetitions), chair stand (4.32, -2.30 repetitions), 8 feet up & go (1.75, -2.57 s.) and 6 minute walk (95.41, -87.2 m). **Discussion** Despite there were significant differences in back scratch, arm curl, chair stand and 8 feet up & go tests, the mean difference between test and retest were only 1 cm, 1 repetition for the next two tests and 0.4 s., respectively. The tests showed a good reliability and can be recommended for evaluating functional capacity in fibromyalgia patients. These results are in agreement with the studies of Manerkoppi et al. (1999) and Pankoff et al. (2000) that concluded that the 6-minute walk test is a reliable measure in people with fibromyalgia. **References** Mannerkorpi K, Svantesson U, Carlsson J, Ekdahl C. (1999). *Arthritis Care Res*, 12, 193-9. Pankoff BA, Overend TJ, Lucy SD, White KP. (2000). *Arthritis Care Res*, 13, 291-5.

## EFFECTS OF 9 WEEKS OF WHOLE BODY VIBRATION VS. UNSTABLE SURFACE TRAINING ON STRENGTH IN POSTMENOPAUSAL WOMEN

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UCAM (Murcia)

**Introduction** One of the biggest expenses in the health sector is caused by hospitalization and intervention of injuries resulting from falls in older people. Thus, the need to create training protocols focused on one of the main factors that cause falls: the loss of strength in the ankle stabilizing muscles which leads to functional instability (3). **Methods** We conducted a quasi-experimental design intra-and inter-subject with a control group of 39 sedentary postmenopausal women ( $58.8 \pm 1.6$  years,  $73.5 \pm 8.9$  kg,  $1.56 \pm 0.06$  m). The participants were divided according to their BMD at three experimental groups and control group (G4). The experimental groups performed an incremental training, WBV (G1), unstable surface (G2) and floor (G3), for 9 weeks 3 sessions/week. All participants maintained a static position of semi-squat and every 6 times (1-0-5, 100bpm) performed ankle plantar flexion. At the beginning and in the end of the process it was assessed maximum isometric and isokinetic ankle plantar-dorsal flexion and eversion-inversion, at angular velocities of  $60^\circ \bullet s$  and  $120^\circ \bullet s$ . **Results** Significant differences, between pre-test and post-test, were observed for isokinetic strength in G1 values were 0.021 in dorsal flexion at  $60^\circ \bullet s$ , and 0.004 to  $120^\circ \bullet s$ ; 0.032 in eversion and 0.001 in inversion at  $60^\circ \bullet s$ ; and 0.018 in eversion y 0.001 in inversion at  $120^\circ \bullet s$ . For G2, values were 0.003 in plantar flexion at  $60^\circ \bullet s$ ; in eversion 0.000 and inversion 0.012 at  $60^\circ \bullet s$ ; and 0.001 in eversion at  $120^\circ \bullet s$ . For isometric strength in G2, values were 0.032 in eversion and 0.007 in inversion. **Discussion** Concerning ankle dorsal flexion, the values of G1 were improved, and as for eversion as inversion in all angular velocities. Due to the position of instability, the gathered strength is added to the MVC (maximum voluntary contraction) of the dorsal flexors through vibration training (1). In group G2, there were improvements in plantar flexion as both investment and investment due to the dynamic instability caused by movement soft surface since

it has a continuous contraction of the musculature (4). In this case, both trainings, unstable surface and wbv, improved significantly the strength values of the stabilizing musculature ankle. Moreover, the unstable surface training improves the muscle strength which deficits are more related to the risk of falls. References 1. Abercromby, A.F., Amonette, W.E., Layne, C.S., McFarlin, B.K., Hinman, M.R., & Paloski, W.H. (2007). *Medicine Science Sports Exercise*, 39 2. Marín, P.J., Martín-López, A., Vicente, D., Angulo-Carrere, M., García-Pastor, T., Garatachea, N. (2011). *J Sports Sci Med*, 10. 3. Melzer, I., Benjuya, N., & Kaplanski, J. (2008). *Age Aging*. 38(1). 4. Nelson-Wong, E., Appell, R., McKay, M., Nawaz, H., Roth, J. (2012). *Eur J Appl Physiol*, 112(4)

### **WHOLE-BODY CRYOTHERAPY <-110 °C> DO NOT AFFECT VERTICAL JUMP PERFORMANCE AFTER HIGH-INTENSITY EXERCISE**

Vieira, A.1, Ferreira-Júnior, J.B.1, Cleto, V.A.1, Vieira, C.1, Soares, S.1, Magalhães, I.J.1, Simões, H.G.2, Do Carmo, J.1, Bottaro, M.1

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**Introduction** Cryotherapy involves the application of any substance that results in withdrawal of heat energy from the body (Knight, 2000). For decades has been used as part of strategy to enhance recovery post heavy exercises and sports performance. A recent modality of cryotherapy, known as whole-body cryotherapy (WBC), has been using very cold air (-110°C) instead of traditional modalities such as ice pack or cold water (Costello et al., 2012). However, few studies have investigated the effects of WBC after training on functional performance activities such as vertical jump. Therefore, the aim of this study was to verify the effects of WBC on vertical jump parameters performed after high-intensity resistance training. **Methods** Twelve healthy trained males (23.9±5.9 years) participated in the study. On two separated knee-extension resistance training sessions, subjects were assigned in a balanced order to a single bout of 3 min of WBC or rest (control). The resistance protocol consisted of 6 sets of 10 repetitions at 60°.s<sup>-1</sup> for concentric and 180°.s<sup>-1</sup> for eccentric actions in an isokinetic dynamometer (BYODEX System 3). The vertical jump was performed before and after the lower-body resistance training protocol. **Results** There was no difference between both experimental conditions (p>0.05). In addition, pre-post analyzes showed that the vertical jump height decreased (7-11%; p<0.05) after the resistance training protocol for both WBC and control conditions. Also, the power output was reduced during WBC (10%; p=0.005). **Discussion** The main finding of this study was that WBC has not been different of control condition. In addition, it is necessary attention during activities that requires maximal power output after WBC. Richendollar et al., 2006 found similar results using a traditional cryotherapy. According to the authors the reduction in power could be explained by decrease on motor nerve conduction velocity and increase tissue stiffness. Further studies should investigate the effect of WBC for longer recovery period or the use of more than a single bout of WBC between recovery days. **References** Costello JT, Algar LA, Donnelly AE (2012). *Scand J Med Sci Sports*, 22, 190-198. Knight KL (1995). *Cryotherapy in Sport Injury Management*. Human Kinetics Publishers, Champaign. Richendollar ML, Darby LA, Brown TM (2006). *J Athl Train*, 41, 364-370. Financial support: CAPES and FAPDF

### **PRESCRIBING AND MONITORING HIGH INTENSITY INTERVAL TRAINING IN CVD**

Christle, J., Pressler, A., Halle, M.

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The application of interval training in cardiovascular disease has shown great promise. Improvements in physiological, psychological and clinical measures have led to the acceptance of this form of training as superior to moderate training in several populations, including chronic heart disease, coronary artery disease and metabolic syndrome. This has led to novel questions about the best methodologies in prescribing and monitoring this form of training. Until now, the gold standard for prescription of interval (and continuous) endurance training has been the use of maximal exercise testing to establish peak oxygen consumption capacity (VO<sub>2peak</sub>), and to train patients at percentages of VO<sub>2peak</sub>. Monitoring of interval training is performed through a combination of heart rate monitoring and ratings of perceived exertion, both inadequate methods for monitoring patients who typically (1) are not physically active and (2) have irregular heart rate responses to exercise. Therefore this study investigates the utility of using arterial lactate concentrations both in CPX and interval training to superiorly prescribe and monitor interval training in patients with cardiovascular disease. Forty-two stable coronary artery disease patients from a local cardiac rehabilitation clinic volunteered to take part in the study. Stepwise symptom-limited CPX were performed on electronically-braked cycle ergometers, starting at 25W and increasing every three minutes an additional 25W until volitional exhaustion was reached. After approximately one week, patients conducted one bout of 4 x 4 minute cycle ergometer interval training, with load, heart rate, RPE and lactate monitoring. Spearman correlations were conducted for all intensity factors and lactate kinetic curves were visually contrasted with curves for the other factors. No complications during CPX or IT were experienced, and over 85% of target heart rates were reached during IT. Arterial lactate showed the strongest correlations with the other intensity parameters during CPX (VO<sub>2peak</sub> (r<sub>2</sub>= 0.64), HR<sub>peak</sub> (r<sub>2</sub>=0.64), RPE (r<sub>2</sub>=0.72) and W (r<sub>2</sub>=0.54)). However, during IT, arterial lactate kinetics did not match other intensity factor kinetics. Furthermore, arterial lactate kinetic analysis shows that the lower intensities used during recovery intervals does little to reduce overall lactate levels to steady state levels. The primary findings of this investigation suggest that using lactate kinetics may help improve current techniques in interval training prescription and monitoring, in that it adds a parameter that is not dependent on subjective reporting or heart rate variation, and reflects the metabolic environment during training. Further research is necessary to investigate the effect of applying lactate analyses to interval training interventions over longer periods of time and in different patient populations.

18:00 - 19:30

## Oral presentations

### OP-PM33 Physiology [PH] 10

#### NOVEL PERIPHERAL TRAINING AS A PRIMER FOR INCREASED GAINS IN FUNCTIONAL CAPACITY IN THE ELDERLY

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**Introduction** From 2005 to 2030 the number of people over 65 will increase by 52% (European Commission, 2005). Aging is associated with a decline in functional capacity (Huang, et al., 2005), increase in disability, and loss of independence. Current exercise guidelines are focused predominantly on whole-body aerobic programs despite evidence to suggest age-associated declines maybe mediated by changes in peripheral muscle beds (vascular function and lean mass) (Fleg, et al., 2005). The FIT for LIFE trial proposes a new paradigm for exercise training in the elderly by initially focusing training on peripheral muscle beds using exercises involving contractions with moderate load and extended duration (RSTS) that causes minimal central cardiovascular stress. **Methods** Elderly subjects who were at risk of losing independence were randomly assigned to: PHASE 1: 4 weeks of training (3 x 1 hour/week) of either: A) aerobic training (AT) which included walking/cycling at 50-85% HRR; or B) RSTS [8 exercises, 3-5 min each at 1 contraction every 4 sec, at ~40-70% of their MVC]. All subjects advanced to PHASE 2: a traditional exercise program, including both AT and resistance training (40 min of AT at 60-85% HRR; 8 sets of 10-15 reps of RT). **Results** Both groups included 54 subjects (age=76±5). After adjustment for baseline, there was a group\*time interaction effect in favor of RSTS for VO<sub>2</sub>peak (19.3 vs. 18.4 mL/kg/min) and 6 minute walk (463 vs. 449m) following PHASE 2 (p<0.05). RSTS also showed greater gains in combined 1RM following both PHASE 1 (+21.3 vs. +3.2 kg, p<0.01) and PHASE 2 (+23.8 vs. +13.6 kg, p<0.01) compared with AT. Data for vascular and muscle physiology outcomes will also be presented. **Discussion** These results suggest RSTS training (compared to AT) may be an effective modality early in a training program to enhance strength, improve aerobic fitness, which may preserve independence in older adults. The underlying mechanisms for these improvements are likely muscle contraction induced hyperemia and local vessel shear stress (Laughlin, et al., 2008). **References** Communication from the European Commission Green Paper (2005). COM, 94. Fleg J, Morrell C, Bos A, Brant L, Talbot L, Wright J. (2005). *Circulation*, 112(5):674-82. Laughlin M, Newcomer S, Bender S. (2008). *J Appl Physiol*, 104:588-600. Huang G, Gibson C, Tran Z, Osness W. (2005). *Prev Cardiol*, 8(4):217-25 Nelson M, Rejeski W, Blair S, Duncan P, Judge J, King A. (2007), 116(9):1094-105.

#### THE INFLUENCE OF AGEING AND TRAINING STATUS ON EXERCISE EFFICIENCY AND CYCLING PERFORMANCE

Hopker, J.1, Coleman, D.A.2, Jobson, S.A.3, Von der Haar, T.1, Wiles, J.2, Passfield, L.1

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**Introduction** Of the key physiological determinants of performance, VO<sub>2</sub>max has received the most attention with well-documented reductions across the lifespan of approximately 1% per year. By comparison, the influence of ageing on exercise efficiency has received little attention. However, recent publications (Venturelli et al., 2012) and a point-counterpoint (Venturelli & Richardson, 2012; Ortega, 2012) have demonstrated that there is considerable debate on the effects of ageing, exercise efficiency and performance. Consequently, the aim of this study was to assess the effect of training status, age and muscle fiber composition on cycling gross efficiency (GE) and exercise performance. **Methods** Forty males were recruited into one of 4 groups: young and old trained cyclists, young and old untrained individuals. In a series of laboratory visits all participants completed an incremental ramp test to measure their VO<sub>2</sub>max, maximal heart rate (HRmax) and MMP, a submaximal test of GE at a series of relative work rates, and in trained participants only, a 1-hour cycling time trial. Finally, all participants underwent a muscle biopsy of their right vastus lateralis muscle. **Results** A univariate general linear model of VO<sub>2</sub>max and MMP data demonstrated significant main effects of training status (P<0.01), and age (P<0.01), whereas HRmax was only affected by age (P<0.01). At relative work rates of 50% and 60% MMP, 60% MMP 60 rev.min<sup>-1</sup>, and 60% MMP 120 rev.min<sup>-1</sup> there was an effect of training status on GE (P<0.01), the effect of age was only significant at 50% MMP and 60% MMP (P<0.01). The proportion of type I muscle fibers in the vastus lateralis muscle was higher in the trained groups (P<0.01), with no effect of age. Further, performance power output was predicted by performance VO<sub>2</sub> and GE with standardized beta coefficients of 0.94 and 0.34 respectively. Independently, only age significantly added to the prediction for parameters in the model where MMP was included (standardized beta coefficients of 1.21 for MMP and 0.45 for age). **Discussion** These data demonstrate that key physiological factors influencing endurance exercise performance are detrimentally affected by ageing, although exercise training can potentially moderate some of these effects. Further, even though biological ageing provides an influence, oxygen cost is the main factor affecting exercise performance. Therefore, the reductions in exercise performance with age are mostly likely influenced by lower exercise efficiency. **References** Ortega JD. (2012). *J Appl Physiol*, doi: 10.1152/jappphysiol.01438.2012. Venturelli M, Richardson RS. (2012). *J Appl Physiol*, doi:10.1152/jappphysiol.01438.2012. Venturelli M, Schena F, Scarsini R, Muti E & Richardson RS. (2012). *Age*, doi:10.1007/s11357-011-9379-1.

#### THE EFFECTS OF TRAINING INVOLVING SIMULTANEOUS WALKING WITH ISOMETRIC EXERCISE ON RESTING BLOOD PRESSURE IN YOUNG HEALTHY ADULTS

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*1. Sport and Exercise Science, UON (UK) 2. Sport and Exercise Science, CCCU (UK)*

**Introduction** In separate studies, walking and isometric training have been shown to reduce resting blood pressure. Combined aerobic and resistance training, where participants undertake one element of the training programme followed by the second has been seen to produce larger reductions in resting blood pressure (BP) compared to a single exercise protocol such as, walking (Calders et al. 2010). To date, no studies have investigated the effects of simultaneous, combined training on resting BP. Therefore, this study aims to determine the effect of 6-weeks simultaneous, combined isometric (handgrip) and walking training (HGW) on resting systolic (SBP) and diastolic blood pressure (DBP), compared to a walking training programme (WLK). **Methods** A total of 26 healthy sedentary participants (male, n = 16; female, n = 10; age 21.3±2yrs; mass 69.2±12.5kg; height 170.4±9cm) were randomly allocated, into three groups walking training (WLK; n=12), simultaneous walking and handgrip training (HGW; n=12) or controls. Resting SBP, DBP and mean arterial blood pressure

(MAP) were measured at baseline and post-training. Analysis of covariance was used to determine if post-training measures were significantly different to baseline, using the baseline values as the covariate. Results The preliminary data show that, in the three groups, resting SBP was reduced after the 6-weeks, by -12.3, -6.7 and -0.4 mmHg, for HGW, WLK and CON groups respectively. DBP was reduced by -6.4, -3.3 and -0.2 mmHg and MAP by -3.3, -2.2 and -0.2 mmHg. Whilst all changes in the HGW and WLK groups were significant ( $P < 0.05$ ), there were no significant changes in any of the resting blood pressure measured in the control group. Discussion The results indicate that combining walking with simultaneous handgrip isometric exercise, caused greater reductions in resting SBP, DBP and MAP, than walking only. The magnitude of the changes in the HGW group are substantially greater than those observed in previous walking only studies (7.4-1.9 mmHg; Murphy et al. 2007) despite a considerably shorter training intervention. The reductions are also greater than many of the previous studies involving handgrip only training in normotensive participants (McGowan et al. 2007). These sizeable reductions in resting BP emphasise the antihypertensive potential of simultaneous combined exercise training especially since they are evident even in individuals whose BP is considered to be in the normal range. Calders P, Elmahgoub S, Roman de Mettelinge T, Vanderbroeck C, Dewandele I Rombaut L, Vandeveldel A, Cambier D. (2011). Clin. Rhab. 25, 1097-1108. McGowan CL, Levy AS, McCartney N, MacDonald MJ. (2007). Clin. Sci. 112, 403-409. Murphy MH, Nevill AM, Murtagh EM, Holder RL. (2007). Preventive Med. 44, 377-385.

### DOES HbA1c RESPOND TO STRENGTH TRAINING IN POST-MENOPAUSAL FEMALES?

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**Introduction** Physical activity is fundamental to the management of glycaemic control, and it has been reported that for all levels of HbA1c habitually active individuals are protected against risk (Reddigan et al., 2012). However, there is no data on strength training in a cohort of post-menopausal women and whether this is effective in improving glycaemic control in this population. As such, the purpose of this study was to evaluate the effect of 12 weeks of progressive strength training on glycated haemoglobin in healthy post-menopausal females. **Method** Females ( $n=30$ ) aged  $59.76 \pm 3.07$  years were recruited to a 12 week progressive resistance training programme. Participants were post-menopausal, non-smokers, and previously sedentary. No individuals were taking hormone replacement therapy and none were diagnosed diabetics. All were screened by a medical practitioner prior to commencing the study. Training took place on five days of the week and each session lasted 30 minutes. Ten exercises were completed at 70 - 90% of the pre-determined 1-repetition maximum (1RM). Each exercise was repeated for 12 repetitions and for three sets. Progression took place every four weeks following a re-evaluation of the 1RM. Measurements of glycated haemoglobin (HbA1c) were taken at baseline and every four weeks thereafter. Individuals presented for blood withdrawal at 08h30 at a registered commercial laboratory on specified days. A Dimension® clinical chemistry system assay (Flex® reagent cartridge) was used to quantify the HbA1c in the sampled blood by measuring both total haemoglobin content as well as haemoglobin A1c presence. Participants were requested to ensure that dietary intake remained unchanged and this was monitored via three day dietary recall diaries submitted every four weeks. Results HbA1c was measured at  $5.66 \pm 0.54\%$  at baseline and at  $5.81 \pm 0.47\%$  after 12 weeks. The increase of 0.15% was not significant ( $p=0.15$ ) and does not infer an increased clinical risk. Carbohydrate intake during the 12 week programme remained unchanged ( $p=0.658$ ). **Discussion and Conclusion** Previously sedentary females in this sample presented with an HbA1c level equivalent to a multivariate adjusted hazard ratio of 1.86 for diabetes and 1.23 for cardiovascular disease (5.5 - 6.0% category) (Selvin et al., 2010). The addition of exercise to habitual lifestyles did not alter this hazard ratio. CHO ingestion is known to influence HbA1c levels and analysis of diet recalls indicated that carbohydrate (CHO) intake was  $188.92 \pm 60.70$ g at baseline and  $200.14 \pm 83.62$ g at week 12 ( $p=0.658$ ). It is probable that either 12 weeks is insufficient for changes in HbA1c, or HbA1c is not sensitive to exercise without concomitant dietary modifications, as dietary adjustments have previously been found to have an effect on HbA1c levels (Kang & Kim, 2012; Schulze et al., 2004; Xu et al., 2007). Further research into the relationship of physical activity and glycated haemoglobin is required.

### CHANGES IN METABOLIC PROFILES AND MUSCLE FUNCTION OF ELDERLY MEN AFTER ECCENTRIC OR CONCENTRIC TRAINING

Chen, T.C.1, Chen, H.L.1, Tseng, W.C.1, Huang, G.L.1, Tseng, K.W.2, Nosaka, K.3

1: NCYU (Taiwan), 2: TPEC (Taiwan), 3: ECU (Australia)

**Introduction** Performing eccentric exercise of the knee extensors (KE) once a week for 8 weeks has been shown to improve resting blood lipid profile and insulin sensitivity in young women (1). It is possible that eccentric training (ET) is more effective than concentric training (CT) for improving metabolic profiles and muscle function, but no previous studies have compared ET and CT for their effects on elderly individuals. ET is better to be introduced to elderly individuals without muscle damage, thus the training should be progressively increased from low intensity (2). The present study investigated the effects of 12-week progressive ET versus CT of the KE on muscle function and blood profiles related to metabolic syndrome in elderly men. **Methods** Healthy but untrained elderly men ( $65.9 \pm 4.7$  y) were assigned to either a progressive ET or CT group ( $n=13$ /group) based on their pre-training 1RM concentric strength (1RMcon) of the KE. The ET and CT were performed once a week for 12 weeks using 10~100% and 50~100% of 1RMcon, respectively, consisting of 3 or 6 sets of 10 contractions of the KE for each leg, on a leg extension machine. Blood samples were taken one week before the first training session and 4 days after the last training session, and analysed for serum triacylglycerols (TG), total (TC), high-density lipoprotein (HDL) and low-density lipoprotein cholesterol (LDL), glucose (GLU), insulin, homeostasis model assessment (HOMA), whole blood glycosylated hemoglobin (HbA1c) and oral glucose tolerance test (OGTT). Measurements of resting heart rate, systolic and diastolic blood pressure, and 8 functional physical fitness tests (e.g. 30-second chair stand: 30SCST, 6-minute walk) were also performed in the same time points as those for blood samples. Indirect markers of muscle damage were assessed before, immediately after, and 2 and 4 days after the first and last training sessions. Changes in these variables over time were compared between groups by a two-way repeated measures ANOVA. Results No or little indications of muscle damage were evident after neither ET nor CT. Most blood variables changed significantly from pre- to post-training, but greater improvement ( $P < 0.05$ ) of lipid profile (TG, TC, HDL, LDL, GLU, HbA1c, OGTT) and insulin resistance (resting insulin, HOMA) were found for ET than CT. Both ET and CT resulted in improvement ( $P < 0.05$ ) of most of functional physical fitness tests (e.g. ET: 44%, CT: 31% in 30SCST) and muscle function (e.g. ET: 53%, CT: 36% in 1RMcon), but the magnitude of the improvement was greater ( $P < 0.05$ ) for ET than CT. **Discussion** These results show that ET of KE improved metabolic profiles and muscle function better than CT without muscle damage. It is concluded that ET could produce greater improvement of quality of life for elderly individuals when compared with CT. References 1. Paschalis et al. MSSE. 43:64-73, 2011 2. Chen et al. EJAP. DOI 10.1007/s00421-012-2517-3, 2012

## NO EFFECT OF 16 WEEKS' ENDURANCE TRAINING ON RATE OF LIPID OXIDATION DURING SUBMAXIMAL EXERCISE IN OBESITY AND TYPE 2 DIABETES.

O'Hagan, C., Rodrigues-Krause, J., Medlow, P., Krause, M., De Vito, G., Davison, G., Colleran, G., Newsholme, P., Murphy, C., Boreham, C.

*Sheffield Hallam University*

**Introduction** The ability to oxidise lipids is impaired in obesity and Type 2 Diabetes (T2D). It has been suggested that exercise training at the intensity which elicits the maximal rate of lipid oxidation may improve oxidative capacity and insulin sensitivity (1). The aim of this study was to compare the effects of training at different intensities on lipid oxidation rate, and to determine whether the effect differs in obese participants with and without T2D. **Methods** Seventeen obese males with Type 2 Diabetes (T2D; age  $58.4 \pm 7.0$  years, BMI  $32.8 \pm 4.3$  kg.m<sup>-2</sup>) and 16 BMI-matched controls (CON, age  $49.9 \pm 5.3$  years, BMI  $30.9 \pm 3.1$  kg.m<sup>-2</sup>) participated. Participants completed a submaximal incremental treadmill test for determination of the intensity corresponding to ventilatory threshold (Tvent); maximal rate of lipid oxidation (Fatmax-rate) and the intensity at which this occurred (Fatmax-intensity) were determined by indirect calorimetry during four 6-minute bouts of exercise at 25%, 35%, 45% and 60% of each participant's estimated VO<sub>2</sub>max. Participants were then randomly assigned to train at either Fatmax intensity or Tvent intensity for 16 weeks (walking, 3 times per week, 30 minutes per session). Between-group (T2D vs CON) differences at baseline were compared using a T-test; a three-way mixed ANOVA (time x intensity x disease) was used to compare training responses between groups. Data are expressed as mean  $\pm$  SD, significance was set as  $p < 0.05$ . **Results.** Baseline differences: There were no significant differences in Fatmax-rate at baseline (CON:  $504 \pm 127$  mg.min<sup>-1</sup>, T2D:  $525 \pm 153$  mg.min<sup>-1</sup>) nor Fatmax-intensity (CON:  $49.2 \pm 6.7$  %VO<sub>2</sub>maxEst, CON, T2D:  $45.5 \pm 10.1$  %VO<sub>2</sub>maxEst). **Effects of training:** Adherence to the 48-session training programme was good (mean number of sessions completed:  $45 \pm 7$ , mean difference from prescribed training heart rate  $0.5 \pm 7.0$  bpm). Fatmax-rate did not change in any of the groups after training; Fatmax-intensity decreased in CON-Tvent only (pre training:  $51 \pm 6$  % VO<sub>2</sub>maxEst, post-training  $35 \pm 8$  % VO<sub>2</sub>maxEst). **Discussion** These results support some previous findings that the maximal rate of lipid oxidation and the exercise intensity at which it occurs do not differ between obese T2D and obese controls (2); other authors have reported that maximal rate of lipid oxidation is lower in T2D (3). Furthermore, these results contradict previous findings of increased rate and intensity of maximal lipid oxidation after Fatmax training in type 2 diabetes (2,4) and the obese (2,5) and do not demonstrate the proposed benefits of training at Fatmax-intensity. **References** 1. Romain, AJ et al. (2012) *J Nutr. Metab.* Doi: 10.1155/2012/285395. 2. Mogensen, M et al. (2009) *Diabetes Obes Metab* 11(9): 874-883. 3. Ghanassia, E et al. (2006) *Diabetes Metab* 32: 604-610. 4. Bordenave, S et al. (2008) *Diabetes Metab* 34: 162 – 168. 5. Van Aggel Leijssen et al. (2002) *J Appl Physiology* 92(3): 1300-1309.

**18:00 - 19:30**

## Oral presentations

### OP-PM55 Training and Testing [TT] 9

#### USEFULNESS OF REACTIME SYSTEM IN TRACK AND FIELD

Dolenec, A., Bavdek, R., Strojnik, V.

*University of Ljubljana, Faculty of sport*

**Introduction** In track and field, reaction time has been described as the time elapsed between the sound of the starter's gun, and the first reaction of an athlete. There is a rule in major competitions that the athlete cannot react faster than 100 ms. ReactTime System (Lynx System Developers, Inc., Haverhill) is one of the official IAAF false start detection systems. It is known that in many young and low level athletes this system shows unexpected long reaction time. The aim of the present study was to compare reaction time measured with the ReactTime System with time calculated from force plate data in different level athletes. **Methods** 22 athletes ( $74.6$  kg  $\pm$  12.3;  $179.5$  cm  $\pm$  8; 23 years  $\pm$  7.2) with different knowledge in sprint start participated in the experiment. Each athlete performed 3 sprint starts with official track and field starting block equipped with the ReactTime System, and standing on a force plate (Kistler, Winterthur). The trial with the shortest reaction time of each athlete according to the ReactTime System was used for further analysis. Hierarchical Cluster analyzes and correlation (Pearson's coefficient) statistics were made. **Results** Reaction times were  $0.224$  s  $\pm$  0.109,  $0.115$  s  $\pm$  0.031 measured with the ReactTime System and the force plate respectively. When the athletes were analyzed as a single group there was no correlation in reaction times as measured with different methods. As the athletes were divided into fast (N=11) and slow (N=11) group according to the ReactTime System data ( $0.143$  s  $\pm$  0.018 and  $0.305$  s  $\pm$  0.100, respectively) correlation coefficient between reaction times measured with the ReactTime System became statistically significant in the fast group only ( $r=0.675$ ;  $P=0.023$ ). **Discussion** Reaction times measured with the force platform for all athletes, and reaction times measured with the ReactTime System for the first group were similar to reaction times found by other investigators (Mero and Komi, 1990) while reaction times measured with the ReactTime System for the second group were much longer and were not found in the literature. Also there was no correlation between reaction times measured with the ReactTime System, and the force plate for the second group. Athletes in the second group could be characterized as rookies in sprint start from the starting block. As the ReactTime System showed unreasonably longer reaction times as the force plate in the athletes that are not very familiar with starting blocks we conclude that the ReactTime is not proper system for measuring reaction times in these athletes. It is presumed that the reason is in accelerometer technology and data transformation used by the ReactTime System as exact procedures are not available. **References** Mero A, Komi PV (1990). *Eur J Appl Physiol*, 61, 73-80.

#### SEASONAL PROGRESSION OF MAXIMAL SPRINTING AND AEROBIC SPEEDS IN HIGHLY-TRAINED YOUNG SOCCER PLAYERS

Mendez-Villanueva, A.

*ASPIRE, Academy for Sports Academy*

**Introduction** At least for some playing positions, maximal sprinting speed (MSS) (Mendez-Villanueva et al., 2011) and estimated maximal aerobic speed (MAS) have been shown to impact young soccer player's locomotor performance during games (Buchheit et al., 2011;

Mendez-Villanueva et al., 2013). However, MSS and MAS may respond differently to systematic training at different stages of growth and maturation in children and adolescents (Malina et al., 2004). In this regard, children and adolescents are often suggested to be more responsive to physical training during periods of accelerated improvements, the so-called "windows of opportunity". Thus, the ability to identify those periods of accelerated improvements in MSS and MAS in young soccer players might be important to maximize their physical development. Accordingly, the aim of this study was to quantify, in highly-trained young soccer players of varying age and maturational status, the magnitude of change in both MSS and MAS within a competitive season. Methods Hundred and five players across five age groups (U13-U17) from the same soccer academy were assessed for MSS and MAS at 9 months intervals (i.e., a season) over a 3-y period. Results All the age groups showed moderate-to-large season improvements in MSS (mean changes: +4.4% to +5.4%: Cohen's effect sizes (ESs)=0.55 to 0.93) and MAS (mean changes: +2.2% to +6.3%: ESs=0.49 to 0.81). The largest mean differences in the seasonal responses for MSS occurred between the U14 and U17 groups (ES=0.59 ± (CI:0.58) and qualitative indications of likely greater improvements in the U14 group). For MAS, the largest difference in seasonal response was found between U14 and U16 (ES= 0.98 ± (CI:0.51), with almost certainly greater improvements in the U14 group). Discussion Present results confirm that the magnitude of seasonal changes in physical capacities are age-group dependent. In the present academy, the greater improvements in MSS and MAS over a competitive season appeared to occur in the U14 group. References Buchheit M, Mendez-Villanueva A, Simpson BM, and Bourdon PC. (2010). *Int J Sports Med*, 11, 818-825. Malina R, Bouchard C, Bar-Or O. (2004). *Human Kinetics*. Mendez-Villanueva A, Buchheit M, Simpson BM, Peltola E, and Bourdon P. (2011). *J Strength Cond Res*, 25, 2634-2638. Mendez-Villanueva A, Buchheit M, Simpson BM, Bourdon P. (2013). *Int J Sports Med*, 34, 101-110.

## REPRODUCIBILITY OF PHYSIOLOGICAL, NEUROMUSCULAR AND PERCEPTUAL RESPONSES TO SMALL-SIDED GAMES IN HIGHLY-TRAINED YOUNG SOCCER PLAYERS

Mayer, N.1,2, Bosquet, L.1,2, Plaine, F.1, Marles, A.1, Jullien, H.1, Lambert, P.1, Buchheit, M.1,3

*1French Football Federation (Clairefontaine, France) 2Faculty of Sport Sciences (Poitiers, France) 3Aspire (Doha, Qatar)*

Introduction While there is extensive research on the acute physiological responses to various forms of SSG in soccer (Hill-Hass, 2012), little is known about their delayed neuromuscular effects (i.e. post 24h), which can have carry-over effects on subsequent performance. Additionally, the reliability of neuromuscular load during and after SSG (e.g., acceleration, post SSG jumping performance) has been poorly described. Understanding the acute and delayed physiological effect of SSG in young soccer players is important for the optimal design and periodization of training drills in this population. The aim of the present study was therefore to examine acute and delayed physiological and perceptual responses to 4 vs. 4 SSG in highly-trained adolescent soccer players. Methods Eleven highly-trained U14 soccer players from an elite academy participated, 2 months apart, in 4 x 3-min 4 vs. 4 SSG (40m x 16.5m, no goal keeper, free touch). Heart rate (HR), rate of perceived exertion (CR10 scale, RPE) and running patterns were recorded with GPS (GPSport, 15 Hz). Average HR, total distance covered (TD), distance >19 km/h, peak game speed (GS), maximal acceleration (Amax), number of acceleration (>2.5 m/s/s, #Acc) and distance covered >2.5 m/s/s were collected. Counter movement jump height was measured pre, immediately post and 24h post SSG. Perception of muscle soreness (1-5 scale) was collected the day of the SSG and the following. Results Coefficient of variations (CV) and intraclass correlation coefficients (ICC) were: HR: CV 2.1%, 90% confidence limits (1.5;3.7) and ICC, 0.85(0.56;0.95); RPE: 15%(1;25) and 0.34(-0.19;0.71); TD: 6.4%(4.7;10.3) and 0.55(0.07;0.82); distance >19 km/h: 105%(69;227) and 0.25(-0.32;0.68); GS: 13%(9.5;21.5) and 0.03(-0.48;0.52); Amax: 10.1%(16.4;16.6) and -0.35(-0.72;0.18); #Acc: 35%(26;61) and 0.22(-0.31;0.65); distance >2.5 m/s/s: 51.1%(35.3;93.4) and 0.15(-0.38;0.60); CMJ pre : 6.4%(4.7;10.3) and 0.53(0.05;0.81); CMJ post: 4.9%(3.6;8.0) and 0.80(0.51;0.93); CMJ post 24h : 2.6%(1.9;4.2) and 0.95(0.86;0.98); soreness pre : 30%(22;53) and -0.27(-0.68;0.26); soreness post 24h: 31%(22;54) and 0.29(-0.24;0.69). Discussion Present results confirm the moderate reliability of HR, RPE and TD during SSG (Hill-Haas, 2011), but show for the first time that acute neuromuscular responses display very large CVs, which may limit the use of such drills to accurately target these factors. The good to moderate reliability of post SSG CMJ and perceived soreness has to be taken into account when interpreting delayed neuromuscular responses. References Hill-Hass et al. *Sport Med* 2011, 41:199-220

## RELATIONSHIP BETWEEN EFFICIENCY OF PISTOL SHOOTING AND SELECTED PHYSICAL-PHYSIOLOGICAL PARAMETERS OF POLICE

Kayihan, G.1, Ersoz, G.2, Ozkan, A.3, Koz, M.2

*1: Sakarya University School of Physical Education and Sports (Turkey) 2: Ankara University 3: Bartın University*

Introduction Since the duty of law enforcement is a high-risk profession and often accompanied by high levels of acute stress, personnel have to endure adverse conditions that might arise from this risk, and have to expend very high physical efforts when encountering crime. Police officers may suddenly find themselves in a life-threatening situation (Anderson, Litzenberger, & Plecas, 2002; Sztajnkrzyer, Callaway, & Baez, 2007; Vrij & Dingemans, 1996). Consequently policeman should always be physically, physiological and mentally fit, in compliance with their work and as stated above, for the safety and peace of the community. Therefore, the aim of this study was to investigate the relation between selected physical-physiological parameters and efficiency of pistol shooting. Methods In this study, 237 male volunteers, studying at Police Academy (Ankara) within the age range of 19-20 years old were investigated. The physical fitness levels of the students were evaluated by using valid and reliable physical fitness test batteries. The Spielberger Trait-State Anxiety Inventory for anxiety level and "Polar Team2 Pro" device for heart rate were used as data collection tools. The efficiency of pistol shooting was evaluated by the total points of the bullets which hit the target from 10 metres Results The correlation coefficient between the result of pistol shooting achievement and change in heart rate, anxiety variability, mean heart rate during shooting, coordination, state anxiety, maximal heart rate during shooting, balance, hand-grip strength, biceps circumference, femur diameter, wrist circumference and flexibility ( $p<0.005$ ) were significant. Discussion Some studies indicated that the correlation coefficient between the result of the pistol shooting achievement and selected physical fitness variables were significant (Anderson & Plecas, 2000; Kayihan, 2010; Vučković & Dopsaj, 2007) In general, the results of our study have supported previous studies and produced the profile of a good shooter. This result could be useful for choosing police for Special Forces, Public Security, Anti-Terror and Smuggling branches in which shooting skills are important. In addition, we suggest that this result could be used for choosing marksmen and guiding shooting training. References Anderson, G. S., Litzenberger, R., & Plecas, D. (2002). *Policing: an international journal of police strategies & management*, 25(2), 399-420. Anderson, G. S., & Plecas, D. B. (2000). *Policing: an international journal of police strategies & management*, 23(4), 525-537. Kayihan, G., Özkan, A., Köklü, Y., Eyuboğlu, E., Akça, F., Koz, M., Ersöz, G. . (2010). Paper presented at the 15th Annual Congress of the European College of Sport Science, Antalya, Turkey. Sztajnkrzyer, M. D., Callaway, D. W., & Baez, A. A. (2007). *Prehospital and Disaster Medicine* 22(4), 335. Vrij, A.,

& Dingemans, L. (1996). *The Journal of social psychology*, 136(4), 461-468. Vučković, G., & Dopsaj, M. (2007). *Serbian journal of sports sciences*, 1(1-4), 29-42.

### ASSOCIATION BETWEEN PHYSICAL FITNESS, MOTOR COMPETENCE, COGNITIVE SKILLS AND INTELLIGENCE LEVEL IN 15 YEAR-OLD ADOLESCENTS

Hafsteinsson, T.1, Sveinsson, T.2

1: RU (Reykjavik, Iceland), 2: UI (Reykjavik, Iceland)

ASSOCIATION BETWEEN PHYSICAL FITNESS, MOTOR COMPETENCE, COGNITIVE SKILLS AND INTELLIGENCE LEVEL IN 15 YEAR-OLD ADOLESCENTS Introduction Participation in sport has been associated with less smoking and alcoholic consumption in adolescents (Thorlindsson et al., 1994). The aim of this study was to examine the association between high level sport participation, physical fitness, motor competence, cognitive skills and intelligence level in adolescents. Methods For the study, 141 adolescents from two elementary schools in Reykjavik, Iceland, were randomly selected to participate. Also, 34 adolescents from the Icelandic youth national team programs (INYTP) in football, team handball and athletics participated. Fitness was tested by four standardized tests: 20 m sprint, 6 min run, standing long jump and sit-and-reach test. Motor competence was measured with Movement Assessment Battery for Children-2 (MABC-2) (Henderson et al., 2007). Cognitive skills were measured with the Ottawa Mental Skills Assessment Tool (OMSAT-3) (Durand-Bush et al., 2001). Intelligence was assessed by the Raven Standard Progressive Matrices (Raven SPM) (Raven et al., 2003). Results The INYTP group scored significantly higher on the fitness tests than the school group (z-score: 2.4 vs -0.8,  $p < 0.05$ ). Also they scored higher on MABC-2 (11.1 vs 9.2,  $p < 0.01$ ), on OMSAT-3 (209 vs 189,  $p < 0.01$ ) and on Raven SPM (48.5 vs 46.0,  $p < 0.01$ ). Discussion The results indicate that high performance youth in sports, not only have higher fitness level than other adolescents of the same age, but also have better motor control, cognitive function and intelligence level. This suggests that sport participation at high level may positively affect both physical and mental skills in adolescents. References Henderson SE, Sugden DA, Barnett, AL (2007). *The movement assessment battery for children-2*. London, U.K.: Pearson. Durand-Bush, N., Salmela, J. H., & Green-Demers, I. (2001). *The Sport Psychologist*, 15(1), 1-19. Henderson, S. E., Sugden, D. A., & Barnett, A. L. (2007). *The movement assessment battery for children-2*. London, U.K.: Pearson. Raven, J., Raven, J. C., & Court, J. H. (2003). *Manual for Raven's Progressive Matrices and Vocabulary Scales*. Harcourt Assessment. Thorlindsson Th, Karlsson Th, Sigfusdottir ID (1994) *Um gildi íþróttta fyrir íslensk ungmenni*. Reykjavik: Rannsóknastofnun uppeldis og menntamála (in Icelandic)

18:00 - 19:30

## Oral presentations

### OP-PM35 Physiology [PH] 12

#### POST-RESISTANCE EXERCISE HYPOTENSION IN NORMOTENSIVE AND HYPERTENSIVE MEN: HEMODYNAMIC AND NEURAL MECHANISMS

Forjaz, C.L.M., Queiroz, A.C.C., Sousa, J.C.S., Cavalli, A.A.P., Silva Jr, N.D., Costa, L.A.R., Tobaldini, E., Montano, N., Ortega, K., Mion Jr, D., Tinucci, T.

*University of São Paulo; University of Milan.*

Introduction A session of resistance exercise promotes post-exercise hypotension in normotensive (NT) and hypertensive (HT) subjects. In NT, mechanisms involved in blood pressure (BP) response have been studied, but in HT, they are unknown. The aim of this study was to compare BP responses and its hemodynamic and neural mechanisms after a session of resistance exercise in NT and HT men. Methods Fourteen NT (44 ± 3 years) and 12 unmedicated HT (50 ± 3 years) underwent 2 experimental sessions, performed in random order: control (40min of rest) and exercise (6 exercises, 3 sets until moderate fatigue, 50% of 1 RM). BP, cardiac output (CO), heart rate (HR) and HR variability were measured before and after 45min and 7h of the interventions. Ambulatory BP was monitored for 24h. Results At 45 min post-exercise, systolic BP decreased similarly in both groups (NT= -8±2 and HT= -13±2 mmHg). Diastolic BP also decreased, but HT presented a greater decrease (NT= -4±1 vs. HT= -9±1 mmHg,  $P < 0.05$ ). In some subjects, exercise promoted a reduction in CO and, in another part of the subjects, exercise promoted a reduction in systemic vascular resistance (SVR). Stroke volume decreased and HR increased similarly in both groups (NT= -14±5 and HT= -11±5 mL; NT= +13±3 and HT= +13±2 bpm). Cardiac sympathovagal balance increased and baroreflex sensitivity decreased similarly between groups after the exercise (NT= +14±6 and HT= +9±3; NT= -5.2±1.2 and HT= -4.3±1.5 bpm/mmHg). After 7h, in both groups, exercise had no effect on any variable. BP, HR and rate pressure product 24h, awake and asleep means were similar between sessions in both groups. Discussion A bout of resistance exercise promotes post-exercise hypotension in NT and HT middle age men. Diastolic BP decrease is greater in HT. The hemodynamic determinant of post-exercise hypotension (decrease in CO or SVR) changes from one subject to another. BP decrease is accompanied by an increase in HR due an increase in cardiac sympathovagal balance and a reduction in baroreflex sensitivity. The hypotensive effect is not maintained under ambulatory conditions. Financial support FAPESP 2009/18219-3 e 2011/06689-5, Capes, CNPq, Pró-Reitoria de Graduação USP.

#### INTER-INDIVIDUAL DIFFERENCES IN CONTROL OF ALVEOLAR CAPILLARY BLOOD VOLUME IN EXERCISE AND HYPOXIA: ANY RELATION WITH INCREASED MIROVASCULAR FILTRATION?

Bartesaghi, M.

*Laboratory of Clinical Physiology and Exercise, Milano-Bicocca*

We explored the hypothesis that inter-individual differences of the air-blood barrier might influence the recruitment of alveolar capillaries in exercise and on hypoxia exposure, conditions causing an increase in microvascular filtration. Twenty two subjects were studied at sea level (SL) and in hypobaric hypoxia (HA, 3269m). We measured: diffusion sub-components capillary blood volume (Vc) and membrane diffusion capacity (Dm), normalized to alveolar volume (Va); respiratory resistance (Rrs) and reactance (Xrs) by forced oscillatory technique. Group1 subjects (N=11) showed lower rest values (mean±SD) of Vc/Va at SL and HA, compared to Group2 (N=11): at SL, 16.1±6.8 ml/L vs 25±7.7, respectively; in HA, 15.9±5.7 vs 19.0±6.0, respectively. During exercise, Vc/Va, an index of alveolar capillary extension, increased

in Group1 at SL ( $26.3 \pm 8.6$ ) and at HA ( $28.75 \pm 10.2$ ) while in Group2 it showed a decrease or not significant change. In hypoxia, the frequency dependence of Rrs (difference between Rrs measured at 5 and 20Hz) increased 4 fold from 0.008 to 0.3 cmH<sub>2</sub>O  $-(s^{-1})^{-1}$  in Group2 and only 1.5 fold, from 0.02 to 0.03 in Group1. Furthermore, in HA, Xrs at 5Hz decreased significantly more in Group2. Both Rrs and Xrs data suggest greater heterogeneity of alveolar ventilation and increase in extravascular water in Group2 in HA. We hypothesize that in exercise and hypoxia, the adaptive response of Group1 favours capillary recruitment and oxygen diffusion, while in Group2 de-recruitment limits microvascular filtration. We suggest that Group1 has a superior control on extravascular lung water, unlike Group2 that appears more prone to develop interstitial lung edema.

### TOTAL HEMOGLOBIN MASS IN RELATION TO BLOOD AND PLASMA VOLUMES: LONGITUDINAL INSIGHTS INTO THE ROLE OF GENDER

Pringle, J., Fudge, B., Spilsbury, K., Turner, T., Wraith, E., Ingham, S.

*English Institute of Sport*

The optimized carbon monoxide rebreathing method is used to determine total hemoglobin mass (tHbmass) and blood volume (BV), with high precision (<1% test-retest variation). tHbmass and BV are predictably linearly related, and changes in tHbmass are classically reflected in commensurate changes in BV. However, there is a paucity of data on tHbmass and BV of elite female athletes or the constancy of these measures over time. We sought to characterize the relationship between tHbmass, BV and PV in males and females, and to identify the nature of their change over longitudinal observations. Over a 20 month period, 21 females and 33 males (age  $26 \pm 6$  y (mean  $\pm$  SD); body mass  $66.7 \pm 9.5$  kg) from British national teams (athletics, triathlon, swimming) were underwent repeat assessments for tHbmass and BV (average visits: 3.7; range: 2 - 18; total of 200 observations). Significance in difference or relationship was declared at  $P < 0.05$ . tHbmass was significantly lower in females than males ( $13.0 \pm 1.8$  vs.  $14.9 \pm 1.9$  g/kg; independent t-test) as was BV ( $104 \pm 14$  vs.  $109 \pm 14$  mL/kg). tHbmass was significantly related to BV ( $r^2 = 0.86$  and  $0.83$  in females and males, respectively). Females showed a significantly greater blood volume per unit of Hbmass than males ( $8.0 \pm 0.4$  vs.  $7.3 \pm 0.4$  mL/gHb), although PV relative to body mass was identical ( $65.2 \pm 9.0$  vs.  $64.9 \pm 9.0$  mL/kg). Notwithstanding the potential for differing time course in their acute temporal changes, longitudinal changes in tHbmass (in g/kg) were significantly related to changes in BV (in mL/kg) in females ( $r^2 = 0.78$ ) but less so in males ( $r^2 = 0.31$ ). There was no relationship between changes in tHbmass (in g or g/kg) and changes in traditionally determined [Hb] or ([Hct]), although changes in the latter were significantly related to changes in PV in males ( $r^2 = -0.56$ ), but not in females ( $r^2 = -0.24$ ). Neither hemoglobin concentration nor hematocrit offer sufficient insight into an athlete's tHbmass or its longitudinal changes. As expected, female athletes of similar performance standard have lower tHbmass and lower BV than males, relative to body mass, but have similar PV. Females have greater BV per unit of Hbmass. The stronger relationship between changes in tHbmass and BV (and PV) in females may suggest a gender-specific role in the regulation of erythropoiesis and/or neocytolysis that is possibly BV mediated.

### HEMODYNAMIC CHANGES DURING DEEP DIVING BY MEANS OF A PORTABLE DEVICE

Tocco, F., Marongiu, E.I, Ghiani, G.I, Sanna, I.I, Palazzolo, G.I, Pinna, M.I, Migliaccio, G.M.2, Olla, S.I, Roberto, S.I, Pusceddu, M.I, Concu, A.I, Crisafulli, A.I

*Cagliari University*

**Introduction.** Stroke volume (SV) and cardiac output (CO) measurements in divers have never been performed during Constant Weight Apnea (CWA), but only in the laboratory settings (Tocco F et al., 2012) or during static and dynamic apnea in a pool (Tocco F et al., 2013). Thus, the knowledge of the real human diving response in this condition is scanty. **Methods.** Three dips were performed by 7 divers: immersion at 10m depth (test A), at 20m depth (B) and at 30m depth (C). Each test consisted of three apnea phases: descent, static on the sea bottom, and ascent. Hemodynamics were assessed through an impedance cardiograph contained within an underwater torch. The impedance method provides non-invasive reliable data of trans-thoracic fluid index (TFI), SV, heart rate (HR) and CO. Besides, at the beginning and at the end of each test we collected blood pressure (MBP), arterial O<sub>2</sub> saturation (SaO<sub>2</sub>) and blood lactate (BLa). **Results.** The group mean duration of three dives was  $76.4 \pm 29.2$ ,  $92.7 \pm 28$  and  $98.6 \pm 18$  s for Test A, B, and C respectively ( $p < 0.01$  both test B and C vs. test A). Both B and C conditions led to a HR increase during descent and ascent phases compared to rest condition and static apnea (+23% and +35% at 20 and 30m depth respectively). A similar behavior was shown by SV (+46% and +27% at 20 and 30m depth respectively). As a consequence, a significant rise in CO was detected (+50% and +25% at 20 and 30m depth respectively). MBP was augmented at the end of both B and C tests compared to rest (+30%), while SVR decreased during descent and ascent phases with respect to both rest and static apnea conditions (-6%). A significant SaO<sub>2</sub> drop was present only during test C (-5% vs. rest), contemporary to a BLa increment (+200%). **Conclusion.** We concluded that typical diving response was not present during CWA, probably due to sympathetic activation induced by exercise with bi-fins during descent and ascent phases, which obscured the effects of the diving response. We hypothesized that the exercise pressor reflex and the central command were responsible for the phenomenon. **References** Tocco F, Crisafulli A, Melis F, Porru C, Pittau G, Milia R, Concu A. (2012). *Eur J Appl Physiol* 112, 543-554. Tocco F, Marongiu E, Pinna M, Roberto S, Pusceddu M, Angius L, Migliaccio G, Milia R, Concu A, Crisafulli A. (2013). *Acta Physiol (Oxf)*. 207 (2), 290-298.

### EFFECT OF PROLONGED DYNAMIC EXERCISE AND SLEEP DEPRIVATION ON CARDIOVASCULAR AND PLASMA ADRENOMEDULLIN RESPONSES TO STATIC EXERCISE IN HEALTHY YOUNG MEN

Krzeminski, K.I, Mikulski, T.I, Dabrowski, J.I, Laskowska, D.I, Bogdan, A.2

*1 Mossakowski Medical Research Centre, Polish Academy of Sciences, Warsaw, Poland. 2 Central Institute for Labour Protection – National Research Institute, Warsaw, Poland.*

**Introduction** As the popularity of ultra-endurance events is increasing questions arise, if such an extreme load is healthy and safe for the circulatory system. Thus, the aim of the present study was to examine cardiovascular responses to static exercise performed by subjects submitted to prolonged exercise combined with complete sleep deprivation. **Methods** Eleven endurance trained young men ( $31 \pm 2$  years) performed 3-min static-handgrip at 30% of maximal voluntary contraction before (trial B) and immediately after (trial A) 30 hours of prolonged exercise (simulated adventure race) combined with complete sleep deprivation. Heart rate and arterial blood pressure were measured continuously (Portapress, Netherlands). Before and at the end of exercise venous blood samples were taken for adrenomedullin (ADM), norepinephrine, epinephrine and lactate determination. **Results** There were no significant differences between the two trials in maximal voluntary contraction, resting heart rate and lactate, whilst mean arterial pressure (MAP) was lower and plasma adrenomedullin, norepinephrine and epinephrine concentrations higher in trial A than in trial B ( $p < 0.05$ ). The handgrip-induced increases

in MAP, HR and blood lactate did not differ between the trials, whereas MAP remained lower in trial A than B throughout the whole static exercise period ( $p < 0.05$ ). During handgrip adrenomedullin concentration increased only in trial B (from  $2.80 \pm 0.73$  pmol/l to  $5.11 \pm 0.66$  pmol/l,  $p < 0.05$ ), in trial A and in catecholamines there were no significant differences. Discussion Prolonged physical activity combined with sleep deprivation increased both sympathetic activity and plasma adrenomedullin concentration, but did not increase arterial blood pressure. Present data suggest, that increase in sympathetic nervous activity during prolonged physical activity may be involved in plasma ADM release and that increase in ADM secretion may be a compensatory mechanism against elevation of blood pressure. The possibility of the direct stimulation of ADM secretion in the heart by hemodynamic changes may be considered, since prolonged dynamic exercise results in phenomenon described as "cardiac fatigue". Lower blood pressure in trial A could be caused by decreased vascular sensitivity to some vasoconstricting factors, by attenuated "central command" and/or increased cardiac sympathetic modulation, as well as by changes in the sensitivity of arterial baroreceptors. It is concluded that the prolonged exercise improves cardiovascular response to static exercise in endurance trained young men.

**18:00 - 19:30**

## Oral presentations

### OP-PM06 Health and Fitness [HF] 2

#### MOTOR FITNESS OF HEARING-IMPAIRED PRIMARY SCHOOL CHILDREN

Augste, C., Lichtner, H.

*University of Augsburg*

**Introduction** The acoustic sensory system is a major source of information in sports movements. For hearing-impaired children, verbal information (e.g. for movement descriptions and corrections), but also sensory feedback during movement execution is significantly reduced in the teaching-learning process. There is some evidence of reduced performance of hearing impaired children in coordinative motor skills like balancing (Engel-Yeger and Weissman, 2009). In the present study the effects of different degrees of hearing impairment in primary school children should be examined not only for coordination but also for further motor fitness aspects like flexibility, strength, and endurance. **Methods** 85 hearing impaired primary school children (age:  $M = 9.1$ ,  $SD = 1.5$ , 32 female) and 97 hearing children (age:  $M = 8.3$ ,  $SD = 0.9$ , 44 female) performed the 8 tasks of the German Motor Test 6-18 (Bös, 2009). The raw data of each task were transformed into a Z-score according to gender and age specific normalized data. According to their audiogram the children were classified into impairment categories: severely deaf, completely deaf, auditory processing and perception disorder. **Results** Hearing impaired children performed significantly worse in balancing backwards ( $T = 5.61$ ;  $df = 177$ ,  $p < .001$ ), in bidirectional jumping ( $T = 5.61$ ;  $df = 177$ ,  $p < .001$ ), in the 20 m sprint ( $T = 2.48$ ;  $df = 166$ ,  $p = .014$ ), and in the 6-min endurance run ( $T = 7.41$ ;  $df = 140$ ,  $p < .001$ ). In the strength endurance tasks push-ups ( $T = 1.19$ ;  $df = 167$ ,  $p = .232$ ) and sit-ups ( $T = 0.98$ ;  $df = 178$ ,  $p = .327$ ) as well as in the stand-and-reach test ( $T = 0.94$ ;  $df = 175$ ,  $p = .386$ ) and the standing long jump ( $T = 0.993$ ;  $df = 175$ ,  $p = .152$ ) they had no significant deficits. Regarding the category of the hearing impairment significant differences only occurred in bidirectional jumping, where completely deaf children fell behind their mates ( $T = 3.01$ ,  $df = 38$ ,  $p = .005$ ). **Discussion** The findings on speed and coordination are quite in line with previous research (Engel-Yeger and Weissman, 2009). The poorer performance in the aerobic endurance, however, is not documented so clearly. As there is little evidence for purely physiological reasons, performance improvements through specific programmes in this area seem very likely. New aspects could be contributed for the areas of flexibility, strength endurance, and springiness, where hearing impaired children are on par with hearing children. **References** Bös, K. (2009). Deutscher Motorik Test 6-18 (DMT 6-18). Hamburg: Czwalina.

#### EFFECTS OF A 6-MONTH INTEGRAL PROGRAM OF EXERCISE ON PHYSICAL FITNESS AND BODY COMPOSITION IN LIVER TRANSPLANTATION RECIPIENTS.

Moya-Nájera, D.

*University of Valencia*

After transplantation, the patients adopt a hypoactive and unhealthy lifestyle that increases the gain of body fat percentage, loss of bone and muscle mass, leading them to have metabolic problems which very often result in heart problems. There is a lack of knowledge about the effects of exercise programs that integrate different physical fitness activities because it is believed that they cannot perform them. In fact, it is not known an integral program of exercise in this population applied during a long term. **Purpose:** To check the effects of a long term integrative training program on the physical capacity, strength, functional performance and body composition in patients who underwent liver transplant. **Methods:** A prospective randomized study involving 30 voluntary subjects (17 control group -CG-, and 13 intervention group -IG-) was performed. The following assessments were performed before and after the program: 1) Isokinetic strength (hip flexion/extension, elbow flexion/extension, shoulder flexion/extension, shoulder abduction/adduction and knee flexion/extension); 2) Agility (stand up and go); 3) Flexibility (sit and reach); 4) Balance (star excursion test); 5) physical capacity ( $VO_2$  max); and 5) Body composition (body weight and %fat). During the 6 months the IG trained 2 one-hour sessions per week. The training sessions involved balance (Soft Stability Trainers of Thera-Band®), strength (Thera-Band®elastic bands), endurance (walking activities), and flexibility (passive stretching activities). The heart rate was controlled by a heart rate monitor (bpm) and the resistance intensity with the OMNI-RES Scale for elastic bands. **Results:** IG showed significant ( $p \leq 0.05$ ) increases by 19.52% of the initial  $VO_2$ max. value ( $16.37$  mL/kg/min), by 15.24% of the initial peak torque value (N), by 20.13% of the initial peak torque/body weight value (N/kg), by 185.15% of the initial sit and reach value (cm), by 19.03% of the initial dynamic balance value (cm) and by 14.89% of the initial stand up and go value (s). IG showed significantly ( $p \leq 0.05$ ) reduced by -3.08% of the initial body weight value (kg) and by -13.51% of the initial fat mass value. No significance differences were measured on pre-post test in the control group. **Conclusions:** These results suggest that including this kind of integrative programs of physical exercise may be positive for these patients, because an improvement of physical fitness is important to perform daily activity tasks successfully and this could lead to improving their quality of life.

## HEALTH-RELATED PHYSICAL FITNESS IN MARTIAL ARTS AND COMBAT SPORTS PRACTITIONERS

Franchini, E., Schwartz, J., Antonietti, L.S., Del Vecchio, F.B., Takito, M.Y.

*University of São Paulo*

**Introduction** Nowadays, people practice martial arts and combat sports with different purposes and physical fitness is among the main ones. However, little information is available concerning the health benefits of such activities (Bu et al., 2010). Thus, the purpose of this study was to evaluate health-related physical fitness in martial arts and combat sports practitioners in the city of São Paulo, Brazil. **Methods** The study included 935 males (20-35 years), practitioners of karate (n=229), Brazilian jiu-jitsu (n=136), judo (n=180), kung-fu (n=140) and taekwondo (n=250), in São Paulo, Brazil. They were evaluated using the fitness assessment tests proposed by the ACSM (2005): body mass index (BMI), waist-hip ratio (WHR), and body fat percentage; the maximal oxygen uptake (VO<sub>2</sub>max) estimated by the Queens College test; muscle strength, measured by the handgrip strength test; muscle endurance, obtained by using a one-minute sit-up test; and flexibility, measured using the sit-and-reach test. Analysis of variance was used to compare groups, followed by Tukey test (5% as significance level). **Results** Most subjects had a BMI between overweight (karate, Brazilian jiu-jitsu and judo) and normal (kung-fu and taekwondo). WHR and body fat percentage indicated moderate risks for all groups. Regarding VO<sub>2</sub>max, the kung-fu group showed lower scores compared to the Brazilian jiu-jitsu and judo groups, although all groups were above average in comparison with the standard population. Furthermore, most practitioners were classified as below average concerning muscle strength in all styles, while the kung-fu group was rated as poor. Concerning strength endurance all groups were classified as above average, and the Brazilian jiu-jitsu group showed higher scores when compared to taekwondo and judo groups, the latter showing lower scores than the kung-fu group. Flexibility was classified as average in all groups, and the Brazilian jiu-jitsu group had lower scores when compared to the karate, taekwondo, and kung-fu groups, with this last one showing better results when compared to the judo group. **Discussion** The practice of the various styles investigated is associated with above average health-related fitness, except concerning muscle strength and body composition. Thus, martial arts and combat sports instructors should create strategies to improve these variables or practitioners should engage in other physical activities to achieve a better result in these components. Bu B, Haijun H, Yong L, Chaohui Z, Xiaoyuan Y, Singh MF (2010). *J Evid Based Med*, 3(4), 205-19. American College of Sports Medicine (2005). ACSM's health-related physical fitness assessment manual. Baltimore: Lippincott Williams & Wilkins.

## VALIDITY OF AEROBIC FITNESS ESTIMATED BASED ON THE SUBMAXIMAL OXYGEN PULSE IN INDIVIDUALS WITH CEREBRAL PALSY

Satonaka, A.1,2, Terada, K.3, Suzuki, N.1,2

*1: Nagoya U. (Nagoya), 2: IDR (Kasugai), 3: Nagoya College (Toyoake)*

**Introduction** Aerobic fitness is an indicator of physical endurance and is usually evaluated by the peak oxygen uptake (VO<sub>2</sub>peak) that is achieved during exercise under maximal effort up to exhaustion (ACSM, 2000). However, it is hard for the individuals without sufficient experience of exercise to perform such maximal exercise. The aim of this study was to provide alternative method rather than the maximal exercise test to evaluate aerobic fitness of the individuals with cerebral palsy. **Methods** We recruited 14 individuals with cerebral palsy (averaged 42.4±14.2 years) who underwent two types of exercise tests. **Test 1** (maximal test): VO<sub>2</sub>peak was determined by the maximal test. The participants pedaled the cycle ergometer. The work rate was initially 10W. After 1 min at 10 W, the work rate was increased at 5 W/min in a ramp fashion. The participants were encouraged to perform until exhaustion. VO<sub>2</sub>peak was defined as the plateaued oxygen uptake (VO<sub>2</sub>) despite of increase of work rate and as the VO<sub>2</sub> when the respiratory exchange ration was greater than 1.0. The work rate was also recorded when heart rate reached 120 beats/min (WHR120). **Test 2** (Oxygen pulse at WHR120): The participants pedaled the cycle ergometer at WHR120 for 3 min. Oxygen pulse (Wasserman, et al., 1994) was calculated by the oxygen uptake and the heart rate during the last 30 min. **Results** The average VO<sub>2</sub>peak was 923.3±187.4 mL/min. Average WHR120 was 22.1±13.5 W. There was a significant correlation between VO<sub>2</sub>peak and oxygen pulse (r=0.83, P<0.001). It was also found that VO<sub>2</sub>peak correlated with what was produced by WHR120 times age-predicted maximal heart rate (HRmax) (r=0.86, P<0.001). **Discussion** It is apparent that oxygen pulse at WHR120 well represents VO<sub>2</sub>peak in the individuals with cerebral palsy. Not all individuals with cerebral palsy can undergo the maximal test. Even the multistage submaximal cycle ergometer test (Satonaka, et al., 2012) could be difficult for certain individuals with cerebral palsy though we validated the method for individuals with cerebral palsy. The work rate that corresponds to 120 beats/min of heart rate is not difficult at all for individuals who have no sufficient experience of exercise. Therefore, it will be very easy to evaluate the aerobic fitness for those with physical challenges like cerebral palsy. **References** American College of Sports Medicine. (2000). ACSM's Guidelines for Exercise Testing and Prescription, Lippincott Williams & Wilkins, Philadelphia.35-90. Wasserman K, Hansen JE, Sue DY, Whipp BJ, Casaburi R. (1994). Principles of exercise testing and interpretation, Lea & Febiger. Philadelphia.65-66. Satonaka A, Suzuki N, Kawamura M. (2012). *Arch Phys Med Rehabil*, 93, 485-489.

18:00 - 19:30

## Oral presentations

### OP-PM23 Nutrition [NU] 4

#### EVALUATION OF FLUID STATUS AND EFFECT OF AN INDIVIDUAL INTERVENTION IN FEMALE SOCCER PLAYERS BEFORE MATCH PLAY

Domnik, K., Braun, H., Koehler, K., Mester, J., Schänzer, W.

*German Sport University Cologne*

**Introduction** It is recommended that athletes should start training and/or competition well hydrated (Maughan & Shirreffs, 2008). While studies show a substantial number of athletes being hypohydrated at the start of a match (Gibson et al., 2012; Silva et al., 2011), data on fluid status in female soccer players are described rarely. Moreover, to our knowledge, there is no information about the influence of an intervention on the fluid status in soccer. Therefore, one aim of the present study was to evaluate the fluid status of female soccer players

immediately before competition. Furthermore, the effect of an individual intervention on the fluid status prior to the match was examined. Methods 63 female senior (age:  $21.2 \pm 4.2$ ) and 40 female junior soccer players (age:  $15.6 \pm 0.8$ ) were recruited. Urine specific gravity (USG) was measured on matchday to evaluate the hydration status prior to the game. USG  $> 1.020$  g/ml was defined as cut-off for hypohydration. After the first match (Pre-Test) every athlete received individual coaching (lecture, evaluation sheet, poster) based on Pre-Test results. Four to six weeks after the intervention hydration status was assessed again prior to a match (Post-Test). Results Mean USG in the Pre-Test was  $1.020 \pm 0.008$  g/ml for seniors and juniors. We found the majority of the players (37 seniors (65%) and 23 juniors (59%)) were hypohydrated prior to the game, of which 16 seniors (25%) and 12 juniors (30%): showed USG values  $> 1.025$  g/ml. After the educational intervention mean USG decreased to  $1.014 \pm 0.008$  g/ml (seniors) and  $1.018 \pm 0.009$  g/ml (juniors). Players who were stated hypohydrated in the Pre-Test improved their fluid status significantly in the Post-Test (seniors:  $p=0.001$ ; juniors:  $p<0.05$ ). Discussion This study shows that based on USG measurement a large number of female athletes can be considered not adequately hydrated prior to a game. Individual coaching turned out to be a successful intervention to positively affect the players' fluid status. However, we propose a higher support of the juniors during the intervention in order to achieve a greater effect. References Gibson, J.C., Stuart-Hill, L.A., Pethick, W. & Gaul, C.A. (2012). *Appl Physiol Nutr Metab.*, 37, 931-937. Maughan, R.J. & Shirreffs, S.M. (2008). *Int J Sp Nutr Exerc Met.* 18, 457-472. Silva, R.P., Mündel, T., Natali, A.J., Bara Filho, M.G., Lima, J.R.P. & Alfenas, R.C.G. (2011). *J Sp Sci*, 29 (7), 725-732.

## EFFECTS OF FLUID REPLENISHMENT IN HYPOHYDRATED INDIVIDUALS DURING EXERCISE IN THE TROPICS

Lee, J., Fun, D., Teo, Y., Nio, A.

*Defence Medical and Environmental Research Institute, DSO National Laboratories, Singapore*

**INTRODUCTION** An individual's pre-exercise hydration status is an important factor determining the impact of fluid intake during exercise (Armstrong et al. 1997). We profiled the associated thermoregulatory, circulatory and fluid balance parameters during a military exercise in a warm and humid environment, and examined the effect of fluid replenishment on physiological strain in mostly hypohydrated individuals. **METHODS** Seventeen heat-acclimatised male soldiers (Mean $\pm$ SD; age  $21 \pm 1$  years) performed an 11.5-km tactical walk in a warm and humid environment (WBGT= $32.3 \pm 1.4^\circ\text{C}$ ). Thermoregulatory, circulatory and fluid balance parameters were measured. The cumulative heat strain index was calculated (Frank et al. 2001). Participants were divided into two groups: (A) euhydrated ( $n=3$ ) and hypohydrated with greater percent sweat loss replenished ( $n=7$ ; MW) and (B) hypohydrated with less sweat loss replenished ( $n=7$ ; LW). **RESULTS** Twelve soldiers completed the infantry exercise in 297 min, two were stopped with core temperatures  $>39.5^\circ\text{C}$ , and three withdrew with symptoms of exhaustion. Fourteen soldiers were hypohydrated pre-exercise (urine osmolality  $824 \pm 186$  mOsmol $\cdot$ kg $^{-1}$ ). Change in body mass was  $-1.5 \pm 1.1\%$  and ad libitum water intake replenished  $78 \pm 23\%$  of sweat loss. Mean heart rate was  $151 \pm 9$  bpm, maximum heart rate was  $176 \pm 8$  bpm, mean core temperature was  $38.5 \pm 0.3^\circ\text{C}$ , and maximum core temperature was  $39.2 \pm 0.4^\circ\text{C}$ . Greater percent sweat loss was replenished in MW ( $89 \pm 24\%$ ) than LW ( $63 \pm 8\%$ ;  $P<0.01$ ). Maximum heart rate (MW  $172 \pm 5$ , LW  $181 \pm 8$  bpm;  $P<0.05$ ) and maximum core temperature (MW  $39.0 \pm 0.3$ , LW  $39.4 \pm 0.4^\circ\text{C}$ ;  $P<0.05$ ) were raised in hypohydrated soldiers with less sweat loss replenished. When the cumulative heat strain index was extrapolated using individual quadratic equations in participants who did not complete the exercise ( $n=5$ ), a greater physiological strain at exercise completion was predicted in those who had less sweat loss replenished (MW  $2346 \pm 1102$ , LW  $4631 \pm 2205$ ;  $P<0.05$ ). **CONCLUSION** The additional replacement of 26% sweat loss by fluid intake during exercise significantly reduces thermoregulatory and circulatory strain in pre-exercise hypohydrated soldiers. When commencing military activity hypohydrated, adequate rehydration during exercise mitigates the physiological stress experienced and improves the likelihood of task completion. **REFERENCES** Armstrong LE, Maresh CM, Gabaree CV, Hoffman JR, Kavouras SA, Kenefick RW, Castellani JW, Ahlquist LE (1997). *J Appl Physiol*, 82, 2028–2035. Frank A, Belokopytov M, Shapiro Y, Epstein Y (2001). *Eur J Appl Physiol*, 84, 527–532.

## THE EFFECT OF EXERCISE-INDUCED HYPOHYDRATION UPON TREADMILL RUNNING PERFORMANCE

Baker, D., Coleman, D.A., Wiles, J.D.

*Canterbury Christ Church University*

**Introduction** Whilst it is often cited that hypohydration (HYP) levels ( $>2\%$  body mass (BM) losses) result in impaired endurance performance, it has been suggested that endurance runners that drink ad libitum (AL) during exercise and avoid becoming thirsty can negate this impairment (Sawka & Noakes 2007; Noakes 2012). Speculation also exists in the literature that HYP during exercise can potentially benefit the runner by reducing BM leading to improved running economy (RE) during exercise. However little research exists investigating the links between BM lost during exercise-induced HYP, alterations to RE, and performance (Saunders et al. 2004). Therefore the aim of this study was to investigate the impact of variations in exercise-induced HYP on 5km time-trial (TT) performance in trained runners. **Methods** Forty-eight trained male runners were familiarised to procedures and reported to the laboratory on five occasions. An initial visit established  $\text{VO}_{2\text{peak}}$  which preceded four 90 minute treadmill running trials performed at a running speed equivalent to  $65\% \text{VO}_{2\text{peak}}$ . During the 90 minute trials hydration status was manipulated through fluid ingestion with participants completing trials at  $0\% \text{HYP}$ ,  $\sim 1\% \text{HYP}$ , No Fluid, and AL in a random order. Expired gases were analysed at 30, 60 and 90 minutes of the trials. On completion of each 90 minute trial participants undertook a self-paced, blinded maximal 5km performance TT on the treadmill. **Results** The AL trials resulted in a  $1.7 \pm 0.4\%$  reduction in BM and a 5km TT of  $1404 \pm 177$ s. AL trials did not result in the fastest performance time; where individual fastest trials were analysed, a significantly faster mean time of  $1361 \pm 171$ s ( $p<0.05$ ) was recorded at a significantly higher BM (only  $1.2 \pm 0.7\%$  BM loss) when compared to AL ( $p<0.05$ ). RE was significantly lower during the 90 minute run prior to fastest 5km TT performance compared to the AL trial ( $p<0.05$ ). **Discussion** This study demonstrates that an AL drinking strategy did not result in fastest 5km treadmill TT performance following a 90 minute preload run. Faster times were recorded by participants with increased fluid ingestion during the preload where significantly better RE was also apparent despite a higher mean BM when compared to AL trials. A drinking strategy with water ingestion  $0.5\% \text{BM}$  above AL in a 90 minute period when exercising at this intensity would appear to be more appropriate in attempting to maximise performance using this protocol. **References** Noakes, T.D. (2012) "Thirst as a signal for fluid intake" in *Waterlogged; Human Kinetics*; Champaign; IL. Pp.57–58 Saunders, P.U., Pyne, D.B, Telford, R.D. & Hawley, J.A. (2004) "Factors affecting running economy in trained distance runners" in *Sports Med*; Vol. 34;(7); Pp. 465–485 Sawka, M.N. & Noakes, T.D. (2007) "Does dehydration impair exercise performance?" in *Med & Sci in Sports & Exercise*; Vol. 39;(8); Pp. 1209–1217

## EFFECT OF VITAMIN D SUPPLEMENTATION ON PERFORMANCE IN ELITE RUGBY UNION PLAYERS OF SOUTHERN NEW ZEALAND

Fairbairn, K.A.1, Perry, T.L.1, Ceelen, I.J.M.2, Cameron, C.M.1, Skeaff, C.M.S.1

*University of Otago*

1: UNIVERSITY OF OTAGO (NEW ZEALAND), 2: UNIVERSITY OF APPLIED SCIENCES OF ARNHEM AND NIJMEGEN (THE NETHERLANDS) INTRODUCTION: There is evidence that vitamin D status may affect athletic performance (Cannell et al, 2009). Low vitamin D status has been shown in many athletic groups globally (Galan et al 2012; Hamilton et al, 2010; Lovell 2008). However, randomised controlled trials investigating the effect of vitamin D supplementation on performance in athletes are lacking. Thus, the aim of this study was to investigate the impact of vitamin D supplementation on strength and speed performance during 12 weeks of pre-season training in elite rugby union players living in southern New Zealand (34-48°S). METHODS: We conducted a randomised, double blind, placebo controlled intervention trial in 57 elite rugby union players. Players received either 3,570 IU/day vitamin D (n=28) or placebo (n=29) for 11-12 weeks during pre-season training. Fasting serum samples and standardised performance tests were conducted at baseline (autumn/fall), Weeks 5-6 and Weeks 11-12 (winter). Performance testing consisted of 10m and 30m sprints, the Yoyo Intermittent Recovery Test, and 1RM for Bench Press, Bench Pull, Box Squat and Weighted Chin-up (reverse grip). RESULTS: At baseline, mean (SD) serum 25-hydroxyvitaminD (25(OH)D) concentrations were 93 (19) nmol/L and 95 (17) nmol/L in the vitamin D and placebo groups respectively. As there was no time by treatment interaction effect between weeks 5-6 and Weeks 11-12 for performance outcomes, these time-points were combined for analysis. There was a significant treatment effect for serum 25(OH)D, with serum 25(OH)D concentrations 32 nmol/L higher (95% CI, 26 to 38 nmol/L;  $p < 0.001$ ) in the group supplemented with Vitamin D compared to the placebo group. Of the performance measures tested in this study, only weighted chin-up demonstrated a significant treatment effect, where the Vitamin D group lifted 5.5kg more (95% CI, 2.0 to 8.9kg;  $p < 0.01$ ) compared to the placebo group. DISCUSSION AND CONCLUSION: This is the first randomised controlled trial to investigate the effect of vitamin D supplementation on strength and speed performance in elite athletes. These results suggest that vitamin D supplementation in a vitamin D replete population has minimal effect on speed and strength in elite rugby union players, however we cannot exclude the possibility of a performance effect. REFERENCES: Cannell J.J., et al. (2009). *Med Sci Sports Exerc.* 41(5):1102-1110. Galan F., et al. (2012). *Clin Nutr.* 31(1):123-136. Hamilton B., et al. (2010). *Pub Health Nutr.* 13(10):1528-1534. Lovell G. (2008). *Clin J Sports Med.* 18(2):159-161.

## SIMILAR FUNCTIONAL RECOVERY AND SORENESS RESPONSE TO THE INGESTION OF A COMMERCIAL OR HOMEMADE BEVERAGE AFTER AN EXHAUSTIVE ECCENTRIC PROTOCOL

Sousa, M.1, Brito, J.1, Carvalho, P.2, Pinto, L.1, Guimarães, J.T.3, Teixeira, V.H.2,4, Soares, J.1

1: CIFI2D (Porto, Portugal), 2: FCNAUP (Porto, Portugal), 3: FMUP (Porto, Portugal), 4: CIAFEL (Porto, Portugal)

Introduction The aim was to compare the effect of 2 isoproteic and isoglucidic recovery beverages (commercially available vs. homemade) on functional response and muscle soreness after an eccentric protocol until exhaustion. Methods Thirteen male athletes (21.6±3.2 yrs; 72.4±6.6 kg) completed 2 trials separated by ≈2 weeks. In each trial, using alternate lower limbs, participants performed an exhaustion protocol on an isokinetic device comprising concentric/eccentric knee extension/flexion bouts at 60°/s. The protocol consisted on 3 sets, with a 200-sec rest time between sets. The 1st and 2nd sets comprised 100 repetitions (rps); in the 3rd set, n rps were performed until the torque of 3 consecutive rps fell below 25% of the eccentric peak torque of the quadriceps (PTq). During the 2 h after the protocol, participants ingested 0.8 g/kg/h carbohydrates and 0.3 g/kg/h protein, in 2 bolus/h of a commercially available supplement or a milk-shake with skimmed milk, strawberries and banana. PTq and jumping height (countermovement jump) were determined before (M1), immediately (M2), 24 h (M4), and 48 h (M5) after the protocol. General muscle soreness (DOMS) and soreness from palpation, using a 100-mm visual analogue scale (VAS), were evaluated at the same moments and 2 h after the protocol (M3). The VAS was also used to assess the flavour enjoyment of the beverage. Results There was a main effect of time for PTq ( $p < 0.001$ ;  $\eta^2 = 0.72$ ), with significant differences between M2 and the remaining moments and between M4 and M1 and M5 (M1, M2, M4, M5: 389.2±70.6, 276.3±64.2, 347.0±49.5, 368.1±50.8 N•m;  $p < 0.05$ ). Also, a main effect of time for jumping height ( $p < 0.001$ ;  $\eta^2 = 0.64$ ) was detected between M2 and the other moments (46.8±4.7, 40.8±5.4, 45.1±5.2, 45.1±4.7 cm;  $p < 0.05$ ). There was a main effect of time for general DOMS ( $p < 0.001$ ;  $\eta^2 = 0.60$ ), with M1 different from the remaining moments, and M3 from M4 (7.5±13.1, 43.2±21.4, 34.0±15.8, 49.5±20.6, 46.1±23.3 mm;  $p < 0.05$ ); also, a main effect of time for soreness from palpation ( $p < 0.001$ ;  $\eta^2 = 0.47$ ) was detected, with M1 different from M3, M4 and M5 (5.3±9.3, 21.7±22.2, 20.2±19.6, 34.7±26.3, 37.5±28.7 mm;  $p < 0.05$ ). Neither a main effect, nor an interaction effect was found in beverages for any of these parameters. The participants found similar the flavour of both beverages (homemade: 67.9±15.7, commercial: 67.3±24.5 mm;  $p = 0.935$ ). Discussion Given that the effect of functional parameters and muscle soreness did not differ among the tested beverages, it can be concluded that similar recovery processes can be obtained regardless of the nature (commercial or natural food) of the beverage.

18:00 - 19:30

## Oral presentations

### OP-PM08 Health and Fitness [HF] 4

#### ALTERATIONS IN MUSCLE STRENGTH, MUSCLE THICKNESS AND LEAN MASS UPON WORK ECONOMY IN ELDERLY MEN FOLLOWING STRENGTH TRAINING

Salvesen, S.1, Bjørnsen, T.1, Lohne-Seiler, H.1, Hetlelid, K.J.1, Stea, T.H.1, Paulsen, G.2, Berntsen, S.1

*University of Agder*

1Department of Public Health, Sport and Nutrition, Faculty of Health and Sport Sciences, University of Agder, Kristiansand, Norway, 2 Department of Physical Performance, Norwegian School of Sport Sciences, Oslo, Norway Introduction In addition to increases in strength and muscle mass, it seems that resistance exercise can improve the capacity of the oxygen transport and/or utilization and increase the aerobic capacity in elderly subjects. Since most daily activities are based on submaximal efforts, the aim of the present study was to

examine the effect of traditional strength training upon work economy among elderly men. Methods Fifty elderly men (60 – 81 years) participated in this 12 week undulating periodized strength training program. The strength training consisted of three full body workouts per week; two of these were 8-10 repetitions maximum (RM) with 1 min rest, and the third differed between 3-5 RM with 2 min rest, and 13-15 RM with 45 sec rest. The load and volume increased progressively throughout the intervention. Measurements before and after the intervention: Lean mass (Dual-energy X-ray absorptiometry), muscle strength (1RM; leg press and knee extension) and muscle thickness (ultrasound; vastus lateralis and rectus femoris). Work economy, determined as body mass adjusted oxygen consumption, was measured while walking on a treadmill at 5 km/h at three different inclinations: 0 %, 4 % and 8 %; 5 min at each work load. Blood lactate (La-), heart rate (HR), oxygen consumption (VO<sub>2</sub>), respiratory gas exchange ratio (RER) and minute ventilation (VE) was measured during each test period. Seventeen participants were excluded in the analyses due to high lactate levels (>2.5 mmol/l). Results In addition to significant increases in muscle strength and muscle mass ( $p < 0.001$ ), the participants significantly improved their work economy, at the three different work loads by, respectively, 4.0% (0.3-7.4) (median and 95% confidence intervals ( $p = 0.01$ )), 2.8% (-1.4-7.1 ( $p = 0.016$ )) and 2.5% (-0.2-5.0 ( $p < 0.06$ )). However, there were no significant differences between the work loads. No significant positive associations were found between changes in muscle strength and work economy, nor muscle mass and work economy. However, changes in muscle thickness for rectus femoris were significantly and negatively associated ( $r = -0.425$ ;  $p = 0.014$ ) with work economy at the steepest inclination (8%). There was no association between muscle thickness of vastus lateralis and work economy. Discussion In the present study, walking work economy improved after 12 weeks of strength training in elderly men. However, these data suggests that other factors than changes in muscle strength, mass and thickness are the mechanisms behind the improved work economy.

### PHYSICAL ACTIVITY IN OLD AGE – A CROSS-SECTIONAL ANALYSIS OF GERMAN PRIMARY HEALTH CARE PATIENTS

Gaedtke, A., Hinrichs, T., Klaatzen-Mielke, R., Trampisch, U., Platen, P., Moschny, A.

*University of Bochum*

Background To date, little is known about the physical activity behaviour of older adults in Germany. Existing studies focus exclusively on sports and exercise. They thereby overlook activity domains that are particularly important for people in old age. The aim of the study was thus to analyse the engagement in different types of physical activity that are relevant for older men and women in Germany. Methods Within the 7-year follow-up telephone interviews of the getABI cohort (community-dwelling primary health care patients in Germany), participants were surveyed on their everyday physical activity patterns using the PRISCUS-PAQ. Detailed information on the development, structure, and quality criteria of the 10-item PRISCUS-PAQ has already been published [1]. Participants had to state the number of days for each activity and the mean duration for activities performed in the week prior to the interview. Time and energy expenditure per week were then calculated for the single items and for the following activity categories: housework [H], sporting activities [S], walking [W], gardening [G], total [T]. Descriptive analyses were performed for all respondents and stratified by sex. Median values are presented. Results A total of 1503 primary health care patients (50.4% women) with a median age of 77 (range 72-93) years were included into the analyses. Looking at the activity categories, results for time (hh:mm) per week were as follows: H=9:00, S=1:30, W=4:05, G=0:30, T=21:30; and H=4:15/14:00, S=1:45/1:10, W=4:30/4:00, G=1:00/0:15, T=18:15/25:00 for men and women, respectively. The energy expenditure (MET-hours) per week was H=23.8, S=6.1, W=14.3, G=2.0, T=72.1; and H=11.8/38.7, S=8.0/5.8, W=15.8/14.0, G=4.0/1.0, T=65.0/78.1 for men and women, respectively. Discussion This study contributes to the understanding of physical activity behaviour in the older population in Germany. In addition to sports, walking and housework markedly contributed to total physical activity. Studies of older adults' physical activity thus should not be limited to the assessment of sports and exercise alone. Moreover some distinctive gender-related differences were shown, which may have implications for activity programs addressing older men and women. The study was conducted within the research cooperation PRISCUS and funded by the German Federal Ministry of Education and Research (01ET0720). 1. Trampisch, U., et al., Measurement of physical activity in older adults: Correlation between the PRISCUS-PAQ and accelerometry. *Zeitschrift für Gerontologie und Geriatrie*, 2012. 45(3): p. 212-217.

### EFFECTS OF A SPECIFIC PHYSICAL ACTIVITY PROGRAM ON FITNESS IN POST-MENOPAUSAL WOMEN

Mateu, M.1, Peirau, X.2, Iruñia, A.3, Planas, T.2, Torrents, C.2

1: *INEFC-Barcelona, UB (Spain)*, 2: *INEFC-Lleida, UdL (Spain)*, 3: *GRCE, INEFC-Barcelona, UB (Spain)*

Introduction Postural dysfunctions and loss of balance control and stability are among the many well-documented consequences of musculoskeletal changes that occur over the lifespan. Some of these age-related changes can be minimized through proprioceptive, postural stability and core-strengthening physical activity programs (De Souza Santos et al., 2011). On the other hand, the menopausal process represents a biological and psychological turning point in the lives of the women that can be conducted by the benefits of an adequate proposal of physical activity program (Slaven & Lee, 1994) The objective of this study was to evaluate the effect of specific postural stability program on body composition, physical aptitude and body balance in post-menopausal women. Method A total of 14 post-menopausal women (age: 55,3±5,4 years) participated in this study. They performed, two times weekly for 16 weeks, an exercise session lasted approximately 65–70 min, subdivided into: 1) proprioceptive and postural stability exercises based on classical ballet barre exercises (e.g plié, relevé...); 2) physical fitness exercises based on centre floor ballet exercises; 3) stretching. The assessment protocols used were the following: a) body composition (weight -Wt-, fat mass -FM-, lean body mass -LBM-, total body water -TBW-); b) physical aptitude (adapted sit & reach test -SR-, grip strength dynamometer test -GS-, abdominal crunch test -AC-); c) body balance (balance eyes closed test -BE-). Data pre-post were analyzed by non-parametric Wilcoxon test for paired samples. The adopted significance level was  $p < 0.05$ . Results No significant differences were found in body composition ( $p > 0.05$ ): Wt: 71,7±9,8 kg vs 71,7±9,9 kg; FM: 35,2±6,9% vs 34,9±6,2%; LBM: 46,0±3,9 kg vs 46,2±3,9 kg; TBW: 45,0±3,8 L vs 45,1±3,4 L. Significant differences were found in physical aptitude (SR: 43,8±3,5° vs 39,9±4,8°  $p = 0,003$ ; GS: 21,5±3,9 kg vs 26,5±4,1 kg  $p = 0,003$ ; AC: 25,6±7,7 rep/min vs 33,8±6,8 rep/min  $p = 0,001$ ) and body balance (BE: 5,1±3,2 falls/min vs 3,3±2,7 falls/min  $p = 0,03$ ). Discussion The physical activities employed during the specific postural stability program based on simple classical ballet exercises resulted in significant improvements in the physical aptitude and the body balance of post-menopausal women. Our results are in general agreement with previous studies using similar methods such as Pilates (Babayigit Irez et al. 2011). References Babayigit Irez G, Ali Ozdemir R, Evin R, Gokhan Irez S & Korkusuz F (2011). *J Sport Sci Med*, 10, 105-111. De Souza Santos CA, Dantas EE, Moreira MH (2011). *Arch Gerontol Geriatr* 53(3), 344-349. Slaven L, Lee C (1994). *Psychology & Health* 9(4), 297-303.

## **NUTRITIONAL HABITS, PHYSICAL ACTIVITY, SEDENTARY TIME AND WEIGHT STATUS OF SAUDI YOUTH FROM RURAL AND URBAN COMMUNITIES.**

Alnuaim, A., Al-Nakeeb, Y.

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**Introduction** Over the past three decades, the Kingdom of Saudi Arabia has witnessed significant lifestyle changes as a result of the economic boom. During this time period, studies have indicated that the prevalence of obesity in Saudi Arabia has overtaken many Western countries, including the USA (Alhyas, et al 2011, Al-Nakeeb et al, 2012). Therefore, the aims of this study were to: (1) explore the nutritional and lifestyle habits of Al-Ahsa youth; (2) evaluate the association between the dietary habits and behavioural factors; (3) investigate differences due to gender and geographical location. **Methods** 1270 volunteered youth (15–19 years) from different geographical locations (i.e. urban, rural farm and rural desert) completed a self-report questionnaire that contained 47 items relating to patterns of physical activity (PA), sedentary activity, and eating habits. The questionnaire allows the calculation of total energy expenditure in metabolic equivalent (MET-min) values per week. **Results** Significant differences in the PA levels of youth were evident with regard to gender and geographical areas. A higher proportion of males compared to females exceeded the cut-off scores for most of the dietary habits, including daily consumption of breakfast, fruit, vegetables, fast food, milk and dairy products. On the other hand, a higher proportion of females than males exceeded the cut-off scores of more than 3 days consumption per week of chips/crisps, cake /doughnuts, and sweets/chocolate. In males, TV viewing (OR=1.112; 95% CI 1.011-1.223), missed breakfast (OR=.926; 95% CI .863-.994) chips consumption (OR=.894; 95% CI .822-.974) and energy drink consumption (OR=1.106; 95% CI 1.021-1.198) were all positively associated with obesity. In females, there was a positive association between obesity and missed breakfast (OR=.922; 95% CI .859-.989) and energy drink consumption (OR=1.209; 95% CI 1.117-1.308). **Discussion** In general, males were more physically active and had a healthier diet compared to females. In addition, normal weight males reported the highest levels of PA compared to overweight and obese. With regards to geographical location, youth living in the rural desert were less physically active than those living in urban or rural farm environments. **In conclusion**, lifestyle and environment factors appear to play a major role in the prevalence of obesity. It is recommended that future research should identify effective policy actions and evaluate intervention strategies designed to prevent obesity and promote physical activity and healthy lifestyle habits. **References** Alhyas, L., McKay, A., Balasanthiran, A. and Majeed, A. (2011). *J. Roy. Soc. Med.* vol. 2, article 55. Al-Nakeeb, Y., Lyons, M., Collins, P., Al-Nuaim, A., Al-Hazzaa, H., Duncan, M.J. and Nevill, A. (2012). *Int. J. Environ. Res. Public Health* 9, 1490-1506.

## **THE IMPACT OF PHYSICAL INACTIVITY ON FUNCTIONAL LIMITATIONS IN OLDER BRAZILIAN ADULTS**

Sebastiao, E., Schwingel, A., Chodzko-Zajko, W.

*University of Illinois*

**Introduction** Physical Inactivity (PI) is a major health concern worldwide due to its negative health outcomes. The present study explored the association between PI and limitations (FL) in advanced activities of daily living (AADL) in community dwelling older Brazilian adults. **Methods** The 2008 Brazilian National Household Survey was analyzed for 38,406 individuals aged 60 years and over (44% men). PI was assessed for transportation and leisure domains, using the following questions. Do you usually walk or ride your bicycle from home to work? Did you engage in exercise or sports within the last three months? Participants were considered active if reporting "yes" for at least one of the questions; otherwise they were considered inactive. FL was assessed based on an individual's self-reported ability to do the following activities; run or perform hard physical work, lift heavy objects, climb stairs; and walk more than one kilometer. Data were analyzed using the chi-square test to compare proportions and logistic regression to test the association between FL and PI. The significance level was set in 5%. **Results** Nearly 90% of both older men and women were classified as physically inactive. Regarding FL, 35.7% of men and 49.5% of women reported being unable to perform at least one AADL (chi-square;  $p < 0.001$ ). After adjusting for sociodemographic variables, PI presented a strong association with FL. Those classified as inactive were found to be 2.05 more likely to report FL than their active counterparts. **Discussion** PI rates were high for both sexes with women reporting more FL than men. After controlling for various sociodemographic variables, PI was found to be positively associated with FL. The PI rates reported here are higher than those reported in the literature (VIGITEL, 2010). These differences could be partially explained by the criteria adopted to classify individuals as active and inactive. However, the findings observed for FL and the association between FL and PI are consistent with findings published in the literature (Guerra et al., 2008). PA is strongly recommended for all ages and especially for older adults due to its positive effects on health outcomes (Chodzko-Zajko et al., 2009). **References** VIGITEL. (2010). *Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico*. In B. Ministry of Health (Ed.), (pp. 151). Brasília. Guerra, R. O., Alvarado, B. E., Zunzunegui, M. V. (2008). Life course, gender and ethnic inequalities in functional disability in a Brazilian urban elderly population. *Aging Clin Exp Res*, 20(1), 53-61. Chodzko-Zajko, W.J., Proctor, D. N., Fiatarone Singh, M. A., et al. (2009). American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Med Sci Sports Exerc*, 41(7), 1510-1530.

## **REACTIVE VS. ANTICIPATORY BALANCE TRAINING IN OLDER ADULTS.**

Welman, K.E., Robertson, N., Fourie, C.

*Stellenbosch University*

**Introduction** Good balance is one of the most important components in controlling body movement and independence (Stemplewski et al., 2012). However, with increased age, the ability to maintain postural control deteriorates, and is therefore one of the important predictors of falls within the elderly population. More specifically, ageing leads to changes in the ability to counteract unexpected and expected perturbations (Chen et al., 2012). Limited studies have investigated the effect of anticipatory (expected perturbations) vs. reactive (unexpected perturbations) balance training (BT) techniques distinctly. The objective of this study was thus to explore the changes in postural control among elderly after following either an anticipatory (ABT) or a reactive (RBT) balance training program. **Methods** The study involved 12 healthy elderly individuals (77.2±5.3 years) from 2 retirement homes. Two BT programs, i.e. RBT and ABT, were administered over 5 weeks followed by a 2 week retention period. Perceptual ratings of confidence (ABC questionnaire and falls efficacy scale), limits of stability (LoS), anticipatory- (APC) and reactive postural control (RPC) (BESTest; Horak et al., 2009), overall stability (PS), sway index (SI), eyes open (EO); eyes closed (EC) and postural sway (anterior-posterior (AP), medial-lateral (ML); Balance Biodex) as well as lower leg endurance (LB; sit-to-stand) were assessed pre-, post-intervention and at retention. **Results** Improvements in LoS, APC, RPC, PS and LB ( $p < 0.05$ ) were observed in both BT programs from pre- to post-intervention, but with no significant differences between the two groups ( $p > 0.05$ ). RPC benefits were not maintained after cessation of the RBT program ( $p = 0.03$ ). ABT improved confidence and ML sway compared to RPC

( $p=0.05$ ). During the retention period AP postural sway improved by 35% in RBT ( $p=0.05$ ) compared to 14% in ABT ( $p>0.05$ ). Discussion Both reactive and anticipatory balance training techniques improved balance similarly during the 5 week training and could therefore be used as alternative training methods in elderly to prevent falls. However caution should be taken when prescribing RBT programs which may attenuate confidence and increase perception of fall risk. Interestingly practice-related improvements in RPC are not maintained 2 weeks after training was terminated. The absence of such effects upon retention assessment suggests that benefits are transient and subject to issues related to compliance of RBT training. References Chen, E. W., Fu, A. S., Chan, K. M., & Tsang, W. W. (2012). Balance control in very old adults with and without visual impairment. *European journal of applied physiology*, 112(5), 1631-1636. Horak, F. B., Wrisley, D. M., & Frank, J. (2009). The balance evaluation systems test (BESTest) to differentiate balance deficits. *Physical Therapy*, 89(5), 484-498. Stemplewski, R., Maciaszek, J., Salamon, A., Tomczak, M., & Osiński, W. (2012). Effect of moderate physical exercise on postural control among 65–74 years old men. *Archives of Gerontology and Geriatrics*.

**18:00 - 19:30**

## Oral presentations

### OP-PM16 Neuromuscular Physiology [NP] 3

#### QUANTIFICATION OF MOTOR UNITS BETWEEN FUNCTIONAL TASKS AND ANISOMETRIC CONTRACTIONS

Cornett, K.M.D., Neubauer, N., Harwood, B., Jakobi, J.M.

*University of British Columbia*

**Introduction** Task specific force control is accomplished through adjustments in the number of active motor units (recruitment) and through modulation of motor unit (MU) discharge rate. Task specificity is well documented between isometric and anisometric contractions where MU recruitment thresholds are lower and discharge rates higher in anisometric contractions (Harwood et al, 2010; Linnamo et al, 2002). Whether adjustments in MU activity are exhibited for goal directed movements is unknown. The purpose of this study is to measure steadiness and MU activity in young females in anisometric contractions and functional tasks. It is hypothesized that discharge rates will be higher during functional tasks than anisometric contractions and that functional tasks will be steadier. **Methods** Three tasks, representing different degrees of complexity, were completed. The functional task involved lifting a water bottle from a table, drinking through a straw and returning the bottle to the table. The movement of the second task was identical but drinking was not executed. Finally an anisometric contraction with an equivalent load (0.8kg) was executed. Tasks were completed at a constant velocity through the same range of motion (30°). A computer monitor 125cm in front of subjects provided visual feedback of acceleration. Surface EMG of the short (SH) and long head (LH) of the biceps brachii, triceps brachii and brachioradialis was recorded. Intramuscular fine wire electrodes were placed in the SH and LH to track MUs in the 3 conditions and quantify recruitment thresholds and discharge rates. Steadiness was measured as the standard deviation of acceleration. **Results** Thirteen female subjects ( $23\pm 3$  y) participated in this study. Surface EMG and steadiness was similar across the three conditions. In 5 females, analysis of 21 MUs indicates that discharge rate was highest during the functional task (~15.94Hz) compared with the water bottle lift (~14.01 Hz) and anisometric contractions (~13.85Hz). Five additional MUs were recruited during the functional task. Across all tasks, discharge rate was higher during the lifting (shortening) phase than the lowering (lengthening) phase of the contraction. **Discussion** Steadiness and surface EMG did not differ among the three tasks. Yet, the functional task exhibited different mechanistic control. The higher discharge rate and recruitment of additional MUs in the functional task indicates there was an increase in motor neuron excitability related to the complexity of the task. This suggests that when movement patterns are matched, the intent of the task also influences motor neuron output. **References** Harwood B, Davidson AW, Rice CL (2010) *Exp Brain Res*, 208, 103-113. Linnamo V, Moritani T, Nicol C, Komi PV (2002) *J Electromyogr Kines*, 13, 93-101.

#### IS V-WAVE A RELEVANT TOOL TO INVESTIGATE THE LEVEL OF CORTICAL NEURAL DRIVE ?

Grospretre, S., Martin, A.

*INSERM U1093*

**Introduction** V-wave is an electrophysiological variant of the H-reflex obtained by stimulation of a peripheral nerve at a supramaximal intensity (maximal M wave) during a voluntary contraction. This response is a result of a collision in motor axons between antidromic impulses generated by the electrical stimulation and the descending neural drive generated by the voluntary motor command (Upton et al. 1971). V-wave is often used as a tool to reflect the amount of cortical command (Aagaard et al. 2002; Pensini and Martin 2004). However, the nature of this antidromic collision has never been investigated, questioning if the amplitude of V-wave could really be considered as an index of the level of the descending neural drive. **Method** This study was carried out on 9 young healthy subjects. Subjects were asked to reach 10 percents of their maximal voluntary contraction (MVC) in plantar flexion, and posterior tibial nerve (PTN) was electrically stimulated in order to elicit V-waves and maximal M-waves of triceps surae muscles (Soleus and gastrocnemii). Maximal Motor Evoked Potentials (MEPmax) of the same muscles were obtained by transcranial magnetic stimulation (TMS) of M1 area. Then, V-waves were conditioned by a preceding TMS stimulation at an inter-stimuli interval of 10 ms. MEPmax and 50 percents of MEPmax intensities were used to condition V-waves. **Results** V-waves amplitudes were higher with a conditioning TMS compared to unconditioned value. The greatest increase (about 3 times its initial value) of V-waves was observed with a conditioning TMS at a maximal intensity (MEPmax). V-wave facilitation was radically reduced when the conditioning TMS intensity was reduced to 50 percents of its maximal motor evoked potential. **Discussion** The amount of this facilitation was linked to the amplitude of the cortical magnetic stimulation. **In conclusion**, V-wave could be a reliable clue to estimate the amplitude of the final cortical command reaching the muscle. **References** Aagaard P, Simonsen EB, Andersen JL, Magnusson P, and Dyhre-Poulsen P (2002), *J Appl Physiol* 92: 2309-2318. Pensini M and Martin A (2004), *Neurosci Lett* 367: 369-374. Upton AR, McComas AJ, and Sica RE (1971), *J Neurol Neurosurg Psychiatry* 34: 699-711.

## IS THE SPINAL REFLEX EXCITABILITY OF POSTURAL MUSCLES MAINLY AFFECTED BY MUSCLE ACTIVITY OR BODY POSITION?

Cattagni, T., Martin, A., Scaglioni, G.

*Université de Bourgogne*

**Introduction:** There is substantial evidence in the literature that the segmental reflex response of the postural muscles decreases as the complexity of the postural task increases (Capaday and Stein 1986; Kocaja et al., 1993). This modulation essentially depends on: (i) muscles background activity and (ii) body orientation. The aim of the present study was thus to determine the specific contribution of each of these factors to the triceps surae H-reflex modulation, observed when an individual passes from sitting to standing. **Methods:** The maximal H-reflex (Hmax) and M-wave (Mmax) were evoked in soleus (SOL), medial gastrocnemius (MG) and lateral gastrocnemius (LG) of both legs in 10 healthy males (age:  $24.4 \pm 2.3$  yrs), in three experimental conditions: i) seated passive (SP); ii) upright standing (US); iii) seated active (SA) with the same level of SOL background EMG as that recorded in the upright stance. The Hmax/Mmax ratios were calculated in order to assess the proportion of motor units activated by the Ia afferents. **Results:** Hmax/Mmax was significantly ( $P < 0.05$ ) lower in SA ( $0.57 \pm 0.15$ ) compared to SP ( $0.67 \pm 0.13$ ) in SOL while in the gastrocnemii the ratio was not modulated by muscle background activity. For the three muscles, the ratio was significantly ( $P < 0.05$ ) lower in US (SOL:  $0.44 \pm 0.16$ ; MG:  $0.17 \pm 0.08$ ; LG:  $0.17 \pm 0.08$ ) compared to SA (SOL:  $0.57 \pm 0.15$ ; MG:  $0.26 \pm 0.1$ ; LG:  $0.28 \pm 0.12$ ). **Discussion:** It thus appears that the SOL H-reflex is similarly affected by the increase of background activity of postural muscles and by change in body orientation. Indeed, these two parameters account respectively for 43% and 57% of the down-modulation of  $\alpha$ -motoneurons excitability while the H-reflex of the synergists (MG and LG) was only affected by change of posture. The lack of modulation of gastrocnemii H-reflex amplitude by the muscle contraction could be due to the fact that gastrocnemii are less affected by the peripheral inhibitory mechanisms. **Reference:** Capaday C and Stein RB. Amplitude modulation of the soleus H-reflex in the human during walking and standing. *J Neurosci* 6: 1308-1313, 1986. Kocaja DM, Trimble MH, and Earles DR. Inhibition of the soleus H-reflex in standing man. *Brain Res* 629: 155-158, 1993.

## AGE-RELATED CHANGES IN CORTICAL EXCITABILITY DURING UPRIGHT STANDING

Baudry, S., Penzer, F., Duchateau, J.

*Université Libre de Bruxelles*

**Age-related changes in cortical excitability during upright standing** **Introduction** It has been hypothesized that ageing could induce a greater cortical involvement in the control of leg muscle activity during upright standing (Baudry and Duchateau, 2012). Moreover, greater body sways during upright standing in elderly adults have been associated with a decrease in maximal force of the plantarflexor muscles (Billot et al. 2010). This raises the additional question of whether the force required to keep upright standing can influence the cortical contribution to the control of the plantarflexor muscles during postural activities in elderly adults. This study investigated the motor cortical excitability in young and elderly adults during upright standing. **Methods** Ten young and ten elderly adults were asked to stand upright on a rigid surface with eyes open and closed, and on a foam mat with eyes open; all conditions being performed on a force platform to compute the displacements of the centre of pressure (CoP). The maximal amplitude of the Hoffmann (H) reflex (Hmax) and M wave (Mmax), and the motor evoked potential (MEP) by transcranial magnetic stimulation (TMS) were recorded in soleus muscle. Cortical excitability was investigated by assessing the facilitation of the H-reflex induced by subthreshold TMS. The torque developed by plantar flexor muscles during a maximal voluntary contraction (MVC) was also assessed. **Results** Data indicate that the Hmax/Mmax ratio was smaller for elderly ( $20.3 \pm 5.8\%$ ) than young adults ( $44.3 \pm 17.6\%$  Mmax;  $P < 0.001$ ) whereas the amplitude of the MEP/Mmax ratio was similar for both groups (elderly:  $19.1 \pm 7.5\%$ ; young:  $19.0 \pm 16.4\%$ ;  $P = 0.99$ ). The H-reflex facilitation was greater for elderly ( $211.5 \pm 82.2\%$ ) than young adults ( $137.8 \pm 27.6\%$ ;  $P = 0.013$ ). Moreover, the MVC torque was negatively associated ( $P < 0.05$ ) with plantarflexor EMG ( $r^2 = 0.55$ ), maximal excursion of CoP ( $r^2 = 0.64$ ) and H-reflex facilitation ( $r^2 = 0.45$ ) for elderly adults when standing on a foam mat. **Discussion** The results indicate that motor cortical excitability during upright standing increases with ageing whereas the H-reflex amplitude was depressed, suggesting a greater cortical involvement in postural leg muscle activity in elderly adults. Moreover, when standing on unstable support, the negative association of maximal torque with cortical excitability suggests that cortical involvement can be modulated depending on the relative force level required by the upright standing posture. **References** Baudry S, Duchateau J. *J Physiol* 590:5541-5554, 2012. Billot M, Simoneau EM, Van Hoecke J, Martin A. *Eur J Appl Physiol* 109:669-680, 2010.

## NEUROPHYSIOLOGICAL ALTERATIONS DURING 800M RUNNING AND FATIGUE

Poulsen, M.K., Brøchner, N.P., Pedersen, M., Jørgensen, R.M., Voigt, M., Mrachacz-Kersting, N.

*Aalborg University*

**Introduction** In a maximal 800m run velocity decreases progressively (Thomas et al., 2004) possibly as a result of fatigue. Metabolic limitations contribute though alterations in neurophysiologic factors are unknown. Studies have been conducted during sustained (Walton et al., 2002) and intermittent contractions (Nordlund et al., 2004) to fatigue. Here we investigate the changes in the amplitude of the human soleus H-reflex during maximum effort to investigate possible changes in neural drive. Data may provide insights into the underlying mechanisms (Taylor et al., 2008) associated with the decreased running velocity in the final 100m and help to optimize running performance. **Method** In this ongoing study, 3 highly trained 800m runners were asked to run at their race pace on a 400m tartan track. Subsequently they partook in two trials on a treadmill. In trial one, electrical stimulation was applied to the tibial nerve at mid-foot ground contact for each stride, to evoke an H-reflex in the soleus of 25% of the maximum M-wave. Trial two consisted of another maximal run to quantify stride time and muscle activation. The Borg rating was measured every 100m of each trial. **Results** The preliminary results showed a decrease in the H-reflex amplitude for all subjects ( $19.5$ ,  $6.1$  and  $2.8\%$ ) from the first to the last 100m. This was inversely related to ratings of perceived exertion. Modulation of the reflex during the 800m showed a steep decline during the first 200m ( $22.1$ ,  $9.1$  and  $4.6\%$ ) followed by a plateau and a decrease in the final 100m. No modulation of EMG activation or stride-length were observed. **Discussion** The magnitude of the H-reflex decrease was different between subjects likely due to variations in voluntary activation. The relative decrease of the H-reflex amplitude was similar for all subjects, indicating that reflex modulation is evident as fatigue is occurring. Presynaptic inhibition or supraspinal alteration might be the mechanisms responsible for the decrease and require further investigation. Given the possible impact of supraspinal factors, V-wave measures and MVC twitch data are being conducted. **References** [1] Thomas C, Hanon C, Perrey S, Le Chechali J & Vandewalle H (2004) Oxygen uptake response to an 800-m running race *Int J Sports Med* 25: 1-6. [2] Walton D, Kuchinad R, Ivanova T & Garland S (2002) Reflex inhibition during muscle fatigue in endurance-trained and sedentary individuals *Eur J Appl Physiol* 87: 462-8. [3] Nordlund M, Thorstenson A & Cresswell A (2004) Central and peripheral contributions to fatigue in

relation to level of activation during repeated maximal voluntary isometric plantar flexions J Appl Physiol 96: 218-25. [4] Taylor J & Gandevia S (2008) A comparison of central aspects of fatigue in submaximal and maximal voluntary contractions J Appl Physiol 104: 542-50.

### CHANGES IN BALANCE STRATEGY AND NEUROMUSCULAR CONTROL IN RESPONSE TO FATIGUE – A STUDY IN UN-ANTICIPATED PERTURBATION DURING UNILATERAL STANCE

Ritzmann, R., Freyler, K., Gollhofer, A.

*University Freiburg*

**Introduction:** Fatigue impairs motor performance, considerably affects neuromuscular control, diminishes spinal reflexes and comprises the interaction of antagonistic muscles in complex motor tasks (Gandevia 2001). Although there is literature dealing with the interference of fatigue and postural control, the interpretation is confounded by the variety of paradigms used to study it. Further, little is known regarding modulations in dynamic balance control occurring within the neuromuscular system induced by fatigue. Therefore, the objective of this study was to evaluate the effect of fatigue on postural stability and to gather knowledge about its influence on balance strategy and neuromuscular control. **Methods:** In 22 subjects a fatigue protocol (FAT) consisting of continuous exposure to medio-lateral and anterior-posterior perturbations (PERT) until exhaustion was compared to a volume-matched standard protocol (CON, consecutive 30s PERT/30s rest). Centre of pressure displacement (COP), ankle, knee and hip kinematics, electromyographic activity of the soleus (SOL), tibialis anterior (TA), rectus femoris (RF), vastus lateralis (VL), biceps femoris (BF) and gluteus maximus muscles (G) and spinal excitability of SOL at the peak of the short-latency responses (SLR) were recorded after posterior PERT. Cocontraction index (CCI) was calculated for TA/SOL, VL/BF and RF/G (Lewek et al. 2004). **Results:** (1) The number of failures in response to a balance PERT increased (+8%,  $P < 0.05$ ) and (2) COP amplitude (FAT vs. CON -9%,  $P < 0.05$ ) and velocity (-13%,  $P < 0.05$ ) decreased with fatigue. These changes were accompanied by (3) a decreased angular excursion at the knee (-1°,  $P < 0.05$ ) and hip joints (-2°,  $P < 0.05$ ), and (4) an increasing CCI of SOL/TA (+14%,  $P < 0.05$ ), VL/BF (+15%,  $P < 0.05$ ) and RF/G (+32%,  $P < 0.05$ ). (5) Spinal excitability in SOL declined in response to fatigue (-18%,  $P < 0.05$ ). **Discussion:** As a main outcome we found a distinctly deteriorated balance ability that occurred with a modified neuromuscular control due to fatigue. Hence, the increase in cocontraction reflected by simultaneously activated agonists and antagonists is accompanied with smaller knee and hip joint excursions indicating an elevated level of joint stiffness. These functional and neuromuscular modulations may be associated with an exaggerated postural rigidity and could have caused the delayed and reduced postural reactions that are reflected in the changes in COP displacement when compensating for sudden PERT. The reduction in spinal excitability in SOL may either be caused by fatigue itself (Gandevia 2001) or by an increase in reciprocal inhibition due to an augmented TA activity. **References:** Gandevia SC (2001). *Physiol Rev*, 81, 1725-89 Lewek MD et al. (2004). *Osteo Arthritis*, 12, 745-51

**18:00 - 19:30**

## Oral presentations

### OP-PM51 Training and Testing [TT] 5

#### KINETICS STUDY OF EXERCISE-INDUCED HYPOXEMIA AT MODERATE ALTITUDE VERSUS SEA LEVEL IN TRIATHLETES

Hapkova, I., Estribeau, P., Gaston, A.F., Durand, F.

*Performance Health and Altitude Laboratory.*

**Introduction** The purpose of this study was to determine the impact of 1850 m altitude on the kinetics of Exercise-Induced Hypoxemia (EIH) and performance endurance-trained athletes. Among athletes are adepts of endurance at moderate altitude for which acclimatization is materially impossible, also lack of time and / or resources. However, acute exposure to altitude has physiological consequences that could increase EIH present at the sea level (SL) and reach the performance of athletes. Indeed, a recent study by Chapman et al. (2011) indicates that the altitude performance is closely linked to the level of arterial saturation O<sub>2</sub> (SpO<sub>2</sub>) measured in normoxia, that is to say, the amplitude of EIH. **Methods** 9 triathletes (41 ± 2 years) participated. All developed EIH at SL. Athletes performed two maximal exercise tests in the field (Leger-Boucher track) with measurements of gas exchanges, heart rate (HR) and SpO<sub>2</sub>: one at SL (Perpignan) and the other at 1850 m (ALT, Font-Romeu), randomized in blocks 4 and 5. EIH was defined as a decrease in SpO<sub>2</sub> by 4% from the baseline. **Results** No difference at SL vs ALT of SpO<sub>2</sub> was measured in rest. SpO<sub>2</sub> measured at maximal exercise was different between SL and ALT (respectively 92 ± 0.9 vs 84 ± 1%,  $p < 0.001$ ). Amplitude of EIH was significantly lower at SL vs ALT (respectively 6 ± 0.8% vs 12 ± 1%,  $p < 0.001$ ). SpO<sub>2</sub> was different and decreased significantly from 60% VO<sub>2</sub>max between SL and ALT. VO<sub>2</sub>max was significantly lower at ALT than at SL (66.3 ± 2 vs 57.2 ± 2 ml.min<sup>-1</sup>.kg<sup>-1</sup>,  $p < 0.001$ ), as well as maximal aerobic speed (MAS; 16.4 ± 0.5 vs 15.4 ± 0.6 km.h<sup>-1</sup>,  $p < 0.01$ ) and HRmax. No significant difference was observed in maximal ventilation. **Discussion** The most interesting aspect concerns the kinetics and amplitude of SpO<sub>2</sub>. Lack of a difference in levels up to 50% VO<sub>2</sub>max between both conditions suggest that hyperventilation induced by acute exposure to hypoxia could compensate the alveolar hypoventilation in first phase of EIH. The second phase of EIH indicates gas exchange abnormality, the difference of SpO<sub>2</sub> decrease from 60% VO<sub>2</sub>max until VO<sub>2</sub>max suggest impairment of gas exchange abnormality. It is well known that exercise at ALT can induce a sub-edema (West et al., 1991). Whereas the possibility to a shift of the Barcroft's curve as well related to acute hypoxia high levels of lactatemia could be discussed. This study shows that athletes exhibit EIH are more impacted at 1850 m altitude and less performance. **References** Chapman RF, Stager JM, Tanner DA, Stray-Gundersen J, Levine BD. (2011). Impairment of 3,000m Run Time at Altitude Is Influenced By Arterial Oxyhemoglobin Saturation. *Med Sci Sports Exerc*, 43(9):1649-56. West JB, Tsukimoto K, Mathieu Costello O, Prediletto R. (1991). Stress failure in pulmonary capillaries. *J Appl Physiol*. 70: 1732-1742.

### INFLUENCE OF AEROBIC CAPACITY IN RECOVERY AND INFLUENCE OF RECOVERY CAPACITY IN RSA TEST

Rodríguez-Fernández, A.1, Sánchez-Sánchez, J.2, Rodríguez-Marroyo, J.A.1, Morante-Rabago, J.C.1, Ogueta-Alday, A., Villa, J.G.1

1 *Institute of Biomedicine, University of León.* 2 *Pontifical University of Salamanca.*

**INTRODUCTION** Team sports are characterized by efforts acyclic and discontinuous with recovery after different intensities. RSAtest provide a simple way to evaluate the basic physical characteristics to excel in multiple-sprint sports [1]. The aim was checking if soccer players who have a better aerobic performance are the best in RSAtest and have better recovery at different intensities in field test, TIVRE-Futbol@Test interval, progressive and maximal. **METHODS** 45 young soccer players made: an incremental running test in laboratory (start at 8 km/h with increased 1 km/h every 1 min so that exhaustion) with electrocardiograph, on a motorized treadmill (Cosmos® Pulsar 4.0), expired gases were analyzed (Medisoft®). TIVRE-Futbol@Test (start at 9 km/h with 30 s of recovery every 256 m increases of 0.6 km/h each interval controlled by audio beeps; wore a PolarTeam® to register HR) to estimate the speed of anaerobic interval threshold (UAI) (Probst methodology) and determine Total Recovery (%REC-Tot), and pre (%REC-PreUAI), and post interval anaerobic threshold recovery (%REC-PostUAI). RSAtest of 8x30 m sprints with 25 s of active recovery, analyzing: total time (TT), mean time (MT), best time (MT), decrement (%DEC), and differences between best and worst (CHANGE). **RESULTS** The group with high %REC-Tot in field test (=15%) obtained significantly ( $p=0.001$ ) better fatigue index in %DEC ( $3.00\pm 1.45\%$ ) and CHANGE ( $6.05\pm 3.59\%$ ) than the group with mean recovery (=10% & <15%)  $5.03\pm 2.26\%$  and  $9.79\pm 4.53\%$ , and the group with low recovery (<10%)  $5.15\pm 2.06\%$  and  $9.27\pm 2.98\%$ . The soccer's with high  $VO_{2max}$  (>60 ml/kg-1/min-1) have significantly better HR recovery to 30 s after laboratory test (%RECHRmax) that the subjects with low  $VO_{2max}$  (<60 ml/kg-1/min-1) ( $10.17\pm 0.67\%$  vs.  $8.11\pm 0.65\%$ ) ( $p=0.042$ ); better %REC-Tot ( $14.24\pm 1.60\%$  vs.  $11.37\pm 0.51\%$ ) ( $p=0.037$ ); and better %REC-PreUAI ( $16.99\pm 2.16\%$  vs.  $13.31\pm 0.52\%$ ) ( $p=0.019$ ) **DISCUSSION** Studies reported higher levels of recovery in subjects with better  $VO_{2max}$  [2]. The subject with high %REC-Tot obtaining significant better results than other subjects with low recovery, in the fatigue index. TIVRE-Futbol@Test evaluated the recovery in different levels of intensity, have that subject with high aerobic capacity not only have significant best recovery at the end of lab test, but also they have significant best recovery into the different intensities that composite an interval and progressive field test. This highlights the importance of aerobic capacity in the recovery and the influence of the recovery in RSAtest. **REFERENCES** 1. Glaister, M. (2008). *Int J Sports Physiol Perform*, 3(1), 107-112. 2. Ostojic, S.M. et al., (2011). *Chin J Physiol*, 54(2), 105-110.

### COMPARISON OF HIGH INTENSITY AEROBIC AND REPEATED SPRINT TRAINING ON PERFORMANCE AND PHYSIOLOGICAL VARIABLES OF JUNIOR SPRINT KAYAK ATHLETES

Oliveira Borges, T.1,2,3, Dascombe, B.J.4, Bullock, N.2,3, Coufts, A.J.1

1. *UTS, AUSTRALIA*, 2. *AIS, AUSTRALIA*, 3. *AUSTRALIAN CANOEING* 4. *UNIVERSITY OF NEWCASTLE, AUSTRALIA*

**Introduction** The purpose of the present study was to compare the effects of high intensity aerobic training (HIA) vs. repeated sprints (RS) the on physiological and performance adaptations in Junior Sprint Kayak athletes ( $n=20$ ,  $17\pm 1.2$  y). Methods Athletes were matched by  $VO_{2max}$  and TT performance and randomly allocated to complete 5 weeks of either RS or HIA training on water (6 session/wk) and resistance training (3 session/wk). Training was monitored using heart rate, session-RPE and GPS. On-water Sprint Kayak performance (200 m and 1000 m), aerobic fitness ( $VO_{2max}$  and lactate threshold (LT)), muscle and whole body oxygen ( $O_2$ ) kinetics were assessed pre, and post training. Results There was very likely difference in average training heart rate between groups ( $136\pm 8$  vs.  $146\pm 8$  bpm for the RS vs. HIA, respectively, [7.2%, 90%CL [2.3 to 12.3], ES=1.0]. The difference in the internal training load was unclear ( $1004\pm 460$  vs.  $1030\pm 372$  AU for the RS vs. HIA, [12.6% 90%CL [-26.0 to 73.1]); whilst the external training load (distance) was most likely different [ $6131\pm 275$  vs.  $7659\pm 543$  m, 24.8%, 90%CL [19 to 30.8], ES=1.7]. Performance changes over 200 and 1000-m were unclear for both groups [1.7 and -0.4%, 90% CL [-0.3 to 3.9 for 200-m and -3.5 to 2.8 for the 1000 m]]. The change in  $VO_{2max}$  was possibly trivial [0.9% [-3.2 to 5.3]] for both groups. Power at LT showed a very likely difference between groups [-18.3% [-30.6 to -3.9] and a possible change [-2.7% [-14 to 10]] after the training period. The HIA group demonstrated a likely speeding of the  $O_2$  kinetics at moderate [-7.5% [-20.2 to 7.1]] and severe [-17.6% [-37.1 to 8.1] ES=-0.5] domains. Muscle  $O_2$  kinetics were likely different between groups for moderate [-21.2% [-41.3 to 5.9]], heavy [-4.6% [-9.8 to 0.5]] and severe [-32.5% [-54.8 to 0.8]] domains. Speeding of the muscle  $O_2$  kinetics possibly occurred in the RS group for the heavy [1.5% [-2.9 to 6.0] ES=0.2] and severe [13.9% [-27.5 to 79.1] ES=0.2] domains. Discussion Despite different external training loads, Junior Sprint Kayak athletes reported similar internal training doses and demonstrated trivial changes in on-water time trial performance and  $VO_{2max}$ . In contrast, there were large changes in power at LT in both training groups, with faster whole body  $O_2$  kinetics with HIA training, and increased muscle  $O_2$  kinetics with RS training. The present findings show that 5-weeks of HIA or RS training induce different positive physiological adaptations in Junior Sprint Kayak athletes. These different adaptations are important considerations for coaches when periodising training programs.

### EFFECTS OF LOCAL BODY COOLING ON ENDURANCE PERFORMANCE DURING CYCLING UNDER WARM AND HUMID ENVIRONMENTAL CONDITIONS

Clijisen, R.1,2,4, Allemann, A.1, Baeyens, J.P.1,2, Cabri, J.1,3, Clarys, P.2

1. *University College Physiotherapy „Thim van der Laan”, Switzerland* 2. *Vrije Universiteit Brussel, Brussels, Belgium* 3. *Norwegian School of Sport Sciences, Oslo, Norway* 4. *SUPSI Landquart, Switzerland*

**Introduction** Humidity and temperature have an influence on physical and psychological performance. Especially in exhaustive endurance sports, high environmental temperatures can increase body temperature and decrease endurance capacity. To avoid a strong decrease of performance the body must adjust rapidly by increasing heat loss through evaporation, radiation and conduction. The goal of this study was to examine the effect of cooling devices, like vests and wristbands, on the endurance cycling performance in warm and humid environmental conditions. **Methods** Thirteen young healthy subjects, male ( $n=2$ ) female ( $n=11$ ) volunteered in this study. A random, cross-over design was used. Subjects were tested under two different conditions, with cooling and without cooling and performed a 60-minute work out on a bicycle ergometer at 60% of their maximal capacity, directly followed by a workout at 80% of their maximal performance until complete exhaustion. Cycle time to exhaustion was determined and used as the independent variable for endurance performance. Every three minutes the following variables were measured: heart rate, skin temperature, body temperature and perceived exhaustion (BORG scale). Environmental temperature (35°C) and relative humidity (44%) were kept constant during the tests. Results Evaluation of the data revealed a significant difference ( $p=0.02$ ) in the mean cycle time to exhaustion when subjects were using cooling devices ( $72.9\pm 8.8$  vs.  $69.1\pm 5.6$ ). There was no significant effect on the heart rate nor on core temperature, both ( $p>0.05$ ). The skin temperature in the chest region was significantly lower during the first 15 minutes of cooling. No differences were found in the individual

perception of the exercise intensity with or without cooling ( $p > 0.05$ ). Discussion Although we did not observe any significant changes in body temperature, heart rate and rated perceived exertion, our preliminary results indicate that wearing a cooling device in the form of a cooling vest can increase the cycling performance in warm and humid environmental conditions. References: Duffield R, Dawson B, Bishop D, Fitzsimons M, Lawrence S. (2003). *Br J Sports Med*, 37:164-169. Nybo L. (2007). *J App. Physiol*, 104:871-878. not insert authors here

### **ALTITUDE TRAINING FOR ELITE ENDURANCE ATHLETES PRIOR MAJOR COMPETITIONS: A SIMPLE MEANS FOR INCREASING THE RELATIVE TRAINING INTENSITY?**

Pugliese, L., Serpiello, F.R., Millet, G., La Torre, A.

*University of Milan*

**Background.** Altitude training has long been used by elite endurance athletes to attempt improving sea-level performance. Traditionally, Live High-Train High (LHTH) interventions were adopted, where athletes trained and lived at altitude to try maximising the benefits offered by hypoxic exposure. However, inconsistent scientific research proposed that the possible haematological benefits of hypoxia would be offset by the inability to maintain high training intensity, mainly due to altitude-induced reduction in maximal oxygen uptake. However, "true" elite athletes have been rarely used as experimental population, and training intensity has almost never been monitored during LHTH research. This led to confusion regarding the applicability of LHTH with world-class endurance athletes. **Purpose.** This case study is an attempt to provide a practical experience on successful LHTH interventions and subsequent performances in two Olympic gold medalist (Athens 2004) endurance athletes. **Methods.** The training diaries of two Italian elite endurance athletes (athlete 1, race walker; athlete 2, marathon runner) were collected during 9 weeks of training, divided in three 3-week periods before, during, and after a LHTH camp, respectively. Total training volumes and volumes at different intensities expressed as percentage of race pace (RP) were recorded. Sea-level performance results were recorded before and after LHTH. Typical race-to-race variability, expressed as percentage of coefficient of variation, was calculated to assess the magnitude of training effects on performance after-LHTH. **Results.** Both athletes successfully completed the LHTH camp (2090 m) without injury or illness. Total training volume was increased during compared to before LHTH by 11.2 and 8.7%, while dropping by 35 and 17% after LHTH for athlete 1 and 2, respectively. During LHTH, respect to before, absolute training intensity was maintained and training volume at high-intensity ( $> 91\%$  of RP) was similar (28.7% vs 30.8%) for athlete 1 and increased (17.9% vs 9.9%) for athlete 2. After the intervention both athletes improved performance. In both cases, enhancements in performance after LHTH overcame the individual race-to-race variability. **Discussion.** This case study provides a view of a unique LHTH experience of elite endurance athletes. In our opinion, LHTH interventions can be used as a simple, yet effective, method to maintain absolute and improving relative training intensity in elite endurance athletes with beneficial effects on sea-level performance. References 1. Wilber RL. *Med Sci Sports Exerc* 2007 Sep; 39 (9): 1610-24. 2. Millet GP, Roels B, Schmitt L, et al. *Sports Med* 2010 Jan; 40 (1): 1-25. 3. Lundby C, Millet GP, Calbet JA, et al. *Br J Sports Med* 2012 Sep; 46 (11): 792-5. 4. Mujika I. *Scand J Med Sci Sports* 2010 Oct; 20 Suppl 2: 24-31.

### **CHARACTERIZATION OF POLAR TRAINING LOAD IN PROFESSIONAL SOCCER TRAINING**

Bruch, A., Roecker, K., Kinnunen, H., Kuchno, H., Stapelfeldt, B.

*Albert-Ludwigs-Universität Freiburg*

**Introduction** Finding the optimal balance between training and recovery for an individual athlete is one key factor for successful team training. The novel Polar Training Load (TL) feature (Polar Electro Oy, Finland) aims at determining this balance. TL has been studied in cycling training with good results (1). Input information for cumulative TL (CTL) include gender, weight,  $VO_2\max$ , HRmax, HRrest, lactate threshold (LT), anaerobic threshold (IAT) and previous training. A training software (Polar Team2) collects the data of every player and gives feedback about the individual CTL-score of each player at any given point of time. This study evaluated the TL-concept in the training of a professional soccer team (2nd German soccer league). The purpose of this study was to describe professional soccer training in terms of CTL (without being TL controlled) and correlate CTL in soccer with individual performance outcome based on standardized incremental maximal exercise test (IET). **Methods** 30 male professional soccer players participated in this study (mean $\pm$ SD age 25.3 $\pm$ 4.2yr, height 182.6 $\pm$ 6.0cm, weight 78.4 $\pm$ 6.5kg). All players wore Polar HR-transmitters during all training sessions within a 12-week training period (8 weeks before, 4 weeks during the season). Training time and HR-profile of each player during every training session were recorded and CTL-scores calculated. At the beginning and end of the study an IET was performed by 14 players (age 28.5 $\pm$ 5.3yr, height 178.5 $\pm$ 5cm, weight 75.5 $\pm$ 4.9kg) on a treadmill with lactate-analysis including LT and IAT (2). Paired t-tests were used to analyze differences from pre to post IET. **Results** The 30 players completed 52 $\pm$ 19 training sessions with an average HR of 136 $\pm$ 6bpm and 64 $\pm$ 7 minutes (per training session) over 100 bpm. CTL-scores before a training session were on average 72 $\pm$ 24, after a training session 103 $\pm$ 32 resulting in an average TL-impact of one training session of 31 $\pm$ 9. IET showed unchanged running speed from pre to post-test at LT ( $p=0.35$ ) and an increase of 0.42km/h at IAT ( $p=0.01$ ). We found no significant correlations between CTL-values during the training period and performance development in terms of LT or IAT. **Discussion** In this study, the training routine of a professional soccer team during 12 weeks has been documented consistently in terms of HR-profiles and the novel CTL feature. The absence of a significant correlation between TL-values and results from IET could be explained by several reasons including the limited singular relevance of IET-markers (LT, IAT) in specific soccer performance as well as the small absolute increase in performance according to IET-markers. References 1 BRUCH, A.; KINNUNEN, H.; STAPELFELDT, B. (2011): Effect of Polar Training Load-guided versus non-guided training in cyclists, in Cable, Tim N., George, Keith (Hg.): 16th Annual Congress of the ECSS, July 6-9, 2011: Book of Abstracts, Liverpool, S. 316. 2 ROECKER, K., et al. (1998) Predicting competition performance in long-distance running by means of a treadmill test. *Med Sci Sports Exerc*, 30, 1552-1557.

18:00 - 19:30

## Oral presentations

### OP-SH09 Psychology [PS] 5

#### COGNITIVE FUNCTIONING IN YOUTH ELITE SOCCER PLAYERS

Verburgh, L., Scherder, E.J.A., Goedhart, E.A., Oosterlaan, J.

*VU University Amsterdam*

Background: Cognitive functions might be important for successful performance in sports, particularly in team sports requiring quick anticipation and adaptation to the continuously changing and unpredictable situations in the field. In the present study, we examined executive functioning in youth elite soccer players. Executive functions are higher order cognitive functions that manage other more basic cognitive functions and consist of functions such as various aspects of attention, visuospatial and verbal working memory, as well as motor inhibition. Method: Eighty-four youth elite soccer players and forty-two matched amateur soccer players in the age range 8 to 16 years ( $M = 11.8$ ), performed a Stop Signal task (motor inhibition), the Attentional Network Task (alerting, orienting, and executive attention), and two types of working memory tasks (verbal and visuospatial). Group differences were tested using univariate and multivariate analyses of variance. Results: The elite group showed superior performance on the Stop Signal task (stop signal reaction time) ( $F(1, 124)=7.84$ ,  $p < .0001$ ), indicating enhanced inhibitory control. Furthermore, the elite group showed a significant larger alerting effect ( $F(1,123)=4.78$ ,  $p < .05$ ) and a smaller orienting effect ( $F(1,123)=5.43$ ,  $p < .05$ ) on the Attentional Network Task, together indicating extreme efficiency in alerting attention. No significant group differences were found for the executive network of the Attentional Network Task ( $F(1,122)=1.30$ ,  $p=.26$ ) and verbal and visuospatial working memory ( $F(1, 108)=.64$ ,  $p=.42$  and  $F(1,124)=.24$ ,  $p =.62$  respectively). Conclusion: Results show that youth elite soccer players outperform youth amateur soccer players on suppressing an ongoing motor response and show superior alerting attention already at a young age. These executive functions indicates the presence of specific excellent cognitive functions in talented soccer players. Future research should investigate whether these cognitive functions are predictive for future success in soccer.

#### "GET IT OUT THE WAY. THE WAIT'S KILLING ME." HASTENING AND HIDING DURING SOCCER PENALTY KICKS.

Furley, P., Dicks, M., Memmert, D.

*German Sport University Cologne*

Introduction A recent study by Jordet and Hartmann (2008) suggested that performance pressure leads penalty takers to display "hastening and hiding" behavior—not looking at the goal when preparing the penalty kick and rushing through the penalty preparation—which in turn is associated with negative penalty taking performance. In the present study (Furley, Dicks, Stendtke, & Memmert, 2012), we extend these findings by (i) investigating how opposing goal-keepers perceived these nonverbal behaviors, how they affect outcome expectations, and (ii) how they affect the behavior of opposing goalkeepers. Method We examined the perception of nonverbal hastening and hiding behavior using the point-light technique during the soccer penalty kick among goalkeepers ( $n=20$ ). We measured how these nonverbal preparation behaviors affected the impression of the penalty taker, the expected performance against him, and the anticipated penalty. Furthermore, we analyzed how these respective penalty preparation strategies influenced the behavior of high-level goalkeepers ( $n = 12$ ) under in situ conditions. Results The results from Experiment 1 demonstrated that penalty takers showing hastening and hiding behaviors are perceived more negatively by soccer goalkeepers: (i) they are considered to possess less positive attributes, (ii) to have less accuracy in their penalties, and (iii) likely to perform less well in penalty situations. In Experiment 2, we provide first evidence that goalkeepers initiate their movement later following the observation of hastening and hiding behaviors during the penalty preparation as these are perceived as signs of an anxious, unconfident penalty taker. Discussion Our findings demonstrate the importance of investigating nonverbal behavior in sports as these have a major impact on impression formation, expected performance, and actual behavior of opposing players in the soccer penalty situation. References Furley, P., Dicks, M., Stendtke, F. & Memmert, D. (2012). "Get it out the way. The wait's killing me." Hastening and hiding during soccer penalty kicks. *Psychology of Sport and Exercise*, 13, 454–465. Jordet, G., & Hartman, E. (2008). Avoidance motivation and choking under pressure in soccer penalty shootouts. *Journal of Sport and Exercise Psychology*, 30, 450–457.

#### DISTINGUISHING BETWEEN PENALTY KICK STRATEGIES

Noël, B.1, Furley, P.1, van der Kamp, J.2, Dicks, M.2, Memmert, D.1

*1:German Sport University, 2:VU Amsterdam*

Distinguishing between penalty kick strategies Introduction A small number of rules cause many aspects of penalty kicks in association football (e.g. ball position) to be constant. That seems to play a major role in the increasing prominence of penalty kicks as a research environment in sport science and related fields. However, penalty kick attempts can differ on aspects outside the official rules under which penalty kick strategy plays an important role (van der Kamp, 2006). Penalty kickers can either employ a keeper independent or keeper dependent strategy. Though there are indications that measures of interest (e.g. gaze behavior) differ dependent on the penalty kick strategy employed (Noël & van der Kamp, 2012) there is currently no method that allows distinguishing between/predicting of penalty kick strategies. Methods We advised soccer players to carry out penalty kicks under the terms of certain penalty kick strategies. Video footage of these penalty kicks was used for Experiment 1. That is, participants rated twelve different aspects of penalty kicks that were part of the created video footage. Based on data of Experiment 1 we calculated a logistic regression model to predict penalty kick strategy in Experiment 2. To this end participants rated the same twelve aspects of penalty kicks carried out at FIFA World Cups and UEFA European Football Championships. Results Results of Experiment 1 showed that penalty kick strategies differed in several aspects like gaze behavior, ball speed, run-up and kick accuracy as a consequence of different penalty kick strategies employed. This could be used to predict penalty kick strategies in Experiment 2. Discussion The results of this study can be useful for scouting in professional soccer as well as for scientific purposes. In research using a penalty kicking paradigm there should be controlled for effects of different penalty kick strategies. Scouting of opposing penalty kickers in professional soccer should also include preferred penalty kick strategy because different strategies call for different behavior of the goalkeeper. Incidence and success rates of both penalty kick strategies in professional soccer are

also discussed. References Noël, B., & van der Kamp, J. (2012). Gaze behaviour during the soccer penalty kick: an investigation of the effects of strategy and anxiety. *Int. J. Sport Psychol.*, 43, 326-345. van der Kamp, J. (2006). A field simulation study of the effectiveness of penalty kick strategies in soccer: Late alterations of kick direction increase errors and reduce accuracy. *Journal of Sport Sciences*, 24, 467-477.

### **POSITIVE SELF-TALK IMPROVES 10 KM CYCLING TIME TRIAL PERFORMANCE FOLLOWING THE EVOLUTION OF A PACING TEMPLATE IN CONTRAST TO A NEUTRAL SELF-TALK INTERVENTION**

Barwood, M., Corbett, J., McVeigh, D., Wagstaff, C.

*Portsmouth University*

**Introduction** Pacing strategy is the spontaneous variation in speed during self-paced exercise and represents the interplay between previous exercise experience, available physiological resource and motivation (Corbett et al., 2009). The psychological demands of pacing strategy may manifest themselves as negative cognitions that impair performance (Barwood et al., 2008). The present study examined whether positive self-talk statements, to counteract negative cognitions, could influence pacing strategy and performance after the evolution of an initial pacing strategy. **Methods** Fourteen untrained male participants volunteered for this ethically approved study; mean [SD] age 19 [1]yr, mass 76.2 [8.9]kg, height: 1.82 [0.12]m; n=14. Participants undertook a total of four 10 km cycling time trials (TT) on a static bike. Following the third TT participants were matched in to two equal groups based on completion time and allocated to one of two self-talk intervention groups who received an intervention comprising 1) positive self talk (P-ST) or 2) neutral self-talk (N-ST). They then completed the final TT. Completion time, split time (1 km), RPE, and VO<sub>2</sub> were measured and anaerobic and aerobic energy distribution were estimated (PANAER & PAER). Data were compared within participant and between group using factorial ANOVA to an alpha level of 0.05. **Results** Prior to the final trial (i.e. after matching in to separate groups) TT completion times were 18.4 [1.9] and 18.4 [2.0] minutes in the P-ST and N-ST groups respectively. In the final TT completion time was faster in the P-ST group compared to the N-ST group who got slower relative to their pre-intervention TT; 17.7 [1.5] and 18.7 [1.9] minutes, p<0.05. In the P-ST group, this was achieved by a higher power output sustained from the 6th to 10th km of the TT and a greater contribution of PANAER to the energy distribution of the TT. The remaining variables were unchanged. **Discussion** Our data suggest that P-ST has a positive influence on cycling performance and pacing characterized by a faster completion time, a sustained power output, through greater usage of anaerobic energy resources in the latter part of the TT. In contrast, N-ST culminated in a slower performance time and gradual decline in power output as the 10 km TT ensued. Clearly P-ST can be ergogenic in untrained participants and the valence of self-talk is an important determinant of the efficacy of this psychological intervention. These data support previous work examining the efficacy of psychological skills (Barwood et al., 2009) with the important addition of a suitable control condition. **References** Barwood M, Thelwell R, Tipton M. (2008). *Med Sci Sport Exerc*; 40: 387-96. Corbett J, Barwood M, Parkhouse K. (2009). *Br J Sports Med*; 43:770-4.

### **I SPY WITH MY QUIET EYE. TRAINING CATCHING IN CHILDREN: A PILOT STUDY.**

Wood, G.1, Miles, C.1, Vine, S.J.1, Vickers, J.N.2, Wilson, M.R.1

*1. University of Exeter 2. University of Calgary*

**Introduction:** Recent research has identified differences in the quiet eye (QE) of children with high and low motor coordination (Wilson et al, 2012). Children with high motor coordination displayed earlier and longer QE durations in a catching and throwing task. The aim of the current study is to examine the efficacy of a QE training (QET) intervention designed to improve the throwing and catching performance of a sample of typically developing (TD) children. **Methods:** Thirty-eight year 5 primary school children were randomly allocated into either a QET group or a technical training (TT) group. Children wore a gaze registration system and performed 10 baseline and retention catching trials before and after a training intervention. The training consisted of three video demonstrations of an instruction followed by a series of practices. The QET group received gaze strategy instructions whereas the TT group received traditional throwing and catching instructions. **Results:** The performance results revealed that children who underwent the QET intervention experienced a greater training effect than their TT intervention counterparts; catching 22% (as opposed to 5%) more balls after training. This training effect was underpinned by fundamental changes in gaze control. Specifically, the QET group significantly increased both their targeting and tracking QE durations. **Conclusion:** QET appears to proffer a learning advantage over traditional training instructions when learning fundamental interception skills that are key building blocks for sport and playground games. Such interventions may therefore help children with low motor coordination break the negative cycle linking low motor skill competence with low levels of physical activity and cardio-respiratory fitness. A further study is underway to determine if these training effects are observed in children with developmental coordination disorder. **References:** Wilson, M. R., Miles, C. A., Vine, S. J., & Vickers, J. N. (2012). Quiet Eye Distinguishes Children of High and Low Motor Coordination Abilities. *Medicine and science in sports and exercise*.

### **CALIBRATION PROCESSES IN A SERIAL TALENT TEST**

Fasold, F.1, Memmert, D.1, Unkelbach, C.2

*1: German Sport University Cologne, 2: University of Cologne*

**Introduction** Serial evaluations like talent tests in which no objectives measured (e.g. times, heights) are available to assess the presented performances represents an intriguing problem for the talent scouts. Initially, they have to assess the talents without knowledge about following performances. Based on previous research (e.g. Memmert & Unkelbach, 2012; Unkelbach, Ostheimer, Fasold & Memmert, 2012) we assume that scouts have to observe a certain number of performances to calibrate their judgment scale on given context. This calibration process leads to systematic biases (avoidance of extreme judgments) in the beginning of the series and therefore to inconsistent judgments. To develop measures to ensure consistent and fair judgments, independent from the position in a series, it is important to determine the number of assessed performances that evaluators have to observe until their judgment scale is calibrated. Therefore we investigated how many performance observations are necessary to calibrate the internal judgment scales on performance context in a specific talent-test. **Methods** Twenty performances (videos) of a talent-test (team-handball) were used and the order was systematically varied three times. Thus, we presented same performances on three different positions (early, medium, late) in this series and tested the effect of the position on the assessment. Thirty participants were randomly assigned to these series. **Results** We found significant differences between the early and the later positions. Best and worst performances are rated more average in the early positions. On average, after nine judged performances the assessment of the same performances remains stable and consistent. **Discussion** Based on the results, we expected as well for other evaluations that up to a specific position good and bad performances become rated

more average. Alternative approaches for the explanation of biases in subjective judgments (e.g. social comparison, Mussweiler, 2003) could not explain these results. In conclusion, we assume that calibration is a necessary requirement for consistent judgments over the entire judgment series. Further research should be focused on the practicability and effectiveness of interventions to prevent talents and athletes from the negative calibration effects. References Fasold, F., Memmert, D., & Unkelbach, C. (2012). Extreme judgments depend on the expectation of following judgments: A calibration analysis. *Psychology of Sport and Exercise*, 13, 197-200. Mussweiler, T. (2003). Comparison processes in social judgment: Mechanisms and consequences. *Psychological Review*, 110, 472-489. Unkelbach, C., Ostheimer, V., Fasold, F., & Memmert, D. (2012). A calibration explanation of serial position effects in evaluative judgments. *Organizational Behavior and Human Decisions*, 119, 103-113.

**18:00 - 19:30**

## Oral presentations

### OP-PM15 Neuromuscular Physiology [NP] 2

#### GRADUATED COMPRESSION SLEEVES DO NOT ATTENUATE MUSCLE DAMAGE DURING EXERCISE IN TRAINED MEN

Bottaro, M.1, Pereira, M.C.C.1, Martorelli, S.1, Rocha-Júnior, V.A.1, Neumann, M.C.1, Nóbrega, O.T.1, Souza, V.C.1, Castanheira, R.P.M.1, Brown, L.E.2

1: *University of Brasília (Brasília, DF, Brazil)*, 2: *California State University, Fullerton (Fullerton, CA, USA)*

**Introduction** The rapid recovery of performance when engaging in multiple exercise bouts within a short period of time is of importance to maximize competitive success. Thus, professional basketball players and others have worn graduated compression sleeves during games to enhance both performance and post-exercise recovery. The effects of using lower-body compression garments on post-exercise clearance of muscle damage markers have been extensively studied (Duffield et al., 2010). However, to date, studies on the effects of using compression sleeves on muscle damage recovery following high-intensity exercise are lacking. Thus, the aim of this study was to investigate the effects of wearing graduated compression sleeves on recovery of muscle damage indirect markers. **Methods** Twenty-two trained male subjects were randomly assigned to two groups: 1) compression sleeves (CS, n= 11) or placebo sleeves (PS, n= 11). The participants performed 4 sets of 10 unilateral maximal elbow flexion' eccentric actions on an isokinetic dynamometer at 120°s<sup>-1</sup>. Peak torque (PT) and muscle soreness were measured at baseline, immediately post exercise (T1), and at 24, 48, 72 and 96 hours after exercise. Creatine Kinase (CK) was measured at baseline, 48 h and 96 h post-exercise. **Results** There were no significant differences between groups for peak torque (p>0.05) or muscle soreness (p>0.05) throughout 96 hours of recovery. However, strength was significantly lower (p<0.05) than baseline from T1 to 96h for both groups. Perceived muscle soreness peaked at 48 h post exercise-induced muscle damage for both groups. There was also no significant difference between groups for CK (p>0.05) which peaked at 96 h post-exercise in both groups. **Discussion** Our findings suggest that the use of compression sleeves during exercise has no effect on muscle damage marker recovery after 96 h in young trained subjects. It has been proposed that the compression garments may assist muscle contraction via the reduction of muscle oscillation and vibration during vertical jumps (Doan et al., 2003; Bringard et al., 2006). This drop in oscillation may reduce muscle damage. Thus, one of the reasons for the lack of differences may be related to the exercise mode used in the present study. Isokinetic elbow flexion contractions are very stable and controlled and may have produced low muscle oscillations and vibrations during the exercise protocol. **References** Duffield R, Cannon J, King M. (2010). *J Sci Med Sports*, 13, 136-40. Doan BK, Kwon YH, Newton RU, et al. (2003). *J Sports Sci* 21, 601-10. Bringard A, Perrey S, Belluye N. (2006). *Int J Sports Med* 27, 373-8.

#### ACUTE NEUROMUSCULAR AND METABOLIC RESPONSE AFTER A BOUT OF TWO DIFFERENT STRENGTH TRAINING PROTOCOLS: HIGH RESISTANCE CIRCUIT VS. TRADITIONAL STRENGTH TRAINING.

Márquez, G.1, Romero-Arenas, S.1, Marin-Pagan, C.1, Fernández del Olmo, M.2, Alcaraz, P.E.1

1) *Catholic University of Murcia*; 2) *Universidade de A Coruña*

**Introduction.** Recent research has shown that healthy adults produce the same amount of muscular force and power output both in a high resistance circuit (HRC) as in a traditional strength (TS) training session, under the same loading condition [1,2,3]. It has also been revealed higher cardiorespiratory responses during HRC than during TS training [3]. However, it still remains unknown the neuromuscular and metabolic effects after a bout of both training protocols. The main objective of this study was to investigate how HRC and TS training bout affects the neuromuscular function and metabolic response. **Method.** For this purpose, we recruited 11 volunteered healthy trained subjects (21±2 yr; 178±5 cm, 79±4 kg). After a familiarization session, subjects performed two different strength training sessions (HRC and TS) in a counterbalanced order. Each session consist in 8 sets of 6 repetitions maximum (6RM) of three different exercises (bench press, upright row and back squat). The amount of work load (set and session volume, and velocity) and local muscular rest period (3 minutes) were equated, however, the time between exercises was different (HRC: 35 sec.; TS: 180 sec.). Neuromuscular function of knee extensor muscles was explored using twitch interpolation technique. Metabolic response was assessed by means of blood acid lactate concentration. Subjects were tested before and after (1, 4, 7 and 10 minutes) both training protocols. A two way RM-ANOVA (training type and trial time) were performed for the next parameters: isometric MVC torque (N•m), voluntary activation (%), resting twitch amplitude (N•m) and blood lactate (mMol). **Results.** Results showed a significant reduction in the MVC after HRC, without changes after TS training bout. RM-ANOVA have also revealed lower resting twitch amplitudes after both protocols, however, it displayed a significant greater decrease in the HRC session. Blood lactate was significantly higher after HRC compared to TS training. Analysis has also shown a significant reduction in the amount of voluntary activation after both training bouts. **Discussion.** Present results have shown clear neuromuscular and metabolic differences after both training protocols. In this line, we can speculate that fatigue produced by HRC is a peripheral dependent effect since the reduction in MVC seems to be paralleled with the decrease in resting twitch amplitude. It could be related to the higher blood lactate concentrations found after this kind of training bout. However, although a reduction in voluntary activation reflects central fatigue, it is no type of training dependent. Our results could improve the understanding related to the chronic effects provoked by both HRC and TS training methods. **References.** [1] Alcaraz et al. (2011) *J Strength Cond Res.* 25(9):2519-27. [2] Romero-Arenas et al. (2013) *Exp Gerontol.* 23;48(3):334-40. [3] Alcaraz et al. (2008) *J Strength Cond Res.* 22(3):667-71.

### LOCALIZATION OF MUSCLE DAMAGE AFTER NEUROMUSCULAR ELECTROSTIMULATION DETECTED BY MULTIMODAL MAGNETIC RESONANCE IMAGING

Fouré, A.1, Duhamel, G.1, Wegrzyk, J.1, Vilmen, C.1, Jubeau, M.2, Nosaka, K.3, Mattei, J.P.1, Bendahan, D.1, Gondin, J.1

1: Aix Marseille University (Marseille, France), 2: University of Nantes (Nantes, France), 3: Edith Cowan University (Joondalup, Australia)

**Introduction** Neuromuscular electrostimulation (NMES) is useful for improving muscle function. However, it has been reported that NMES induces muscle damage mainly due to the specificity (i.e. non-selective, spatially fixed and synchronous) of motor unit recruitment, especially when it is used for the first time (1). Moreover, it is documented that NMES results in a preferential activation of muscle fibers close to the stimulating electrodes (2), so that one could expect heterogeneous damage between directly and indirectly stimulated muscles. The present study aimed to test the hypothesis that NMES-induced muscle damage would be different between directly and indirectly stimulated muscles of the knee extensors using multimodal magnetic resonance imaging (MRI) including T2 mapping and diffusion tensor imaging (DTI). **Methods** Eleven male subjects ( $22 \pm 1$  y) took part in a single bout of NMES (frequency = 75 Hz, 5 s on / 15 s off, 45 contractions) with the stimulation electrodes being placed over the belly of vastus lateralis (VL) and vastus medialis (VM) muscles. MRI was taken before and 4 days after the NMES session using a 1.5T scanner. Changes in T2 values and DTI metrics including diffusivities ( $\lambda_1$ ,  $\lambda_2$  and  $\lambda_3$ ) that quantify water molecules diffusivity within muscle, were compared between the directly stimulated VL and VM muscles and the indirectly stimulated rectus femoris (RF) and vastus intermedius (VI) muscles. **Results** Mean increases in T2 were larger for the VL (+17.7%) and VM (+8.0%) when compared with the VI (+3.5%) muscle ( $P < 0.05$ ). Diffusivities significantly increased for the VL [2.1 - 5.8%], VM [1.7 - 3.0%] and VI [1.1 - 2.0%] without difference among them. Both T2 values and DTI metrics remained unchanged for the RF. **Discussion** T2 and DTI metrics changes measured after the NMES session indicated that the extent of muscle damage was greater for the directly stimulated muscles (VL and VM) than indirectly stimulated muscles (VI). It should be noted that RF muscle was unaffected. Results obtained in the present study might be related to the activation of deep intramuscular nerve branches and shear stress between superficial (VL and VM) and deep (VI) muscles. The extent of MRI changes varied between T2 and DTI metrics suggesting that they reflect different physiological processes. Thus, combined T2 and DTI analyses would be of interest for monitoring in vivo skeletal muscle injury. **References** 1) Nosaka K et al. (2011). *Eur J Appl Physiol*, 111, 2427-37. 2) Vanderthommen M et al. (2000). *Muscle Nerve*, 23, 482-9.

### LONG-TERM EFFECTS OF ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION ON NEUROMUSCULAR ASYMMETRIES IN ELITE ALPINE SKI RACERS

Jordan, M.1, Maurer, C.1, Aagaard, P.2, Herzog, W.1

1: University of Calgary (Calgary, Canada) 2: University of Southern Denmark (Odense, Denmark)

**Introduction** The long-term effects of ACL reconstruction (ACL-R) in elite ski racers are unknown yet neuromuscular asymmetries implicated in re-injury may persist [1, 2]. ACL re-injury occurs frequently in elite ski racers [4] and a deeper understanding of the neuromuscular changes with ACL-R may improve return to snow outcome. The purpose of this study was to measure between-limb asymmetry in muscle mass, quadriceps/hamstrings strength, vertical ground reaction force (GRF) production in countermovement jumping (CMJ), and quadriceps/hamstrings muscle activity in the CMJ in elite ski racers with a history of ACL-R. ACL-R skiers (AS) were hypothesized to show greater asymmetry in these parameters compared to healthy skiers (HS). **Methods** Leg muscle mass was measured with Dual Energy X-Ray Absorptiometry in active elite skiers (8 HS; 8AS 33±11 months post-op). Using dual force plate analysis simultaneous measurement of GRF from each limb was used to evaluate asymmetry over 10 CMJs by calculating phase-specific impulse for the right and left leg [5]. Subsequently, 8 athletes (4 HS; 4 AS) performed isometric knee extensor and flexor maximal voluntary contractions (MVCs), and synchronized surface electromyography (EMG) recordings from the quadriceps and hamstrings muscles were obtained during 10 CMJs. EMG windows (100ms) were obtained over phases of the CMJ. An asymmetry index (AI) was calculated for all variables and compared between groups [3]. A within-group comparison of muscle activity levels between the left and right leg was also made. **Results** AS demonstrated greater AI in muscle mass (HS= -1.9%±2.7; AS= 4.7%±3.4) and impulse in the ascent phase of the CMJ (HS= -0.6%±2.0; AS= 8.8%±5.3) ( $p < 0.01$ ). Furthermore AS had a larger AI in explosive hamstring strength (MVC Impulse over 200ms: HS= -7.7%±5.7; AS= 12.4%±12.6; Impulse over 150ms: HS= -6.7%±7.1; AS= 11.4%±11.9) ( $p = 0.05$ ) along with a trend of increased semitendinosus muscle activity (Healthy Leg =  $0.06 \pm 0.02$ ; ACL-R Leg =  $0.24 \pm 0.13$ ) in the flight phase of the CMJ ( $p = 0.08$ ). **Discussion** Consistent with the literature [1], bilateral asymmetries (i.e. deficits) were found in AS. Asymmetry in explosive hamstring MVC strength and a trend towards asymmetry in semitendinosus muscle activity during the CMJ suggests an attenuated capacity for ACL protection in the operated limb of ACL-R skiers [6, 7]. **References** [1] Castanharo et al, *J Orthop Sci* 16, 2011; [2] Ford et al, *Med Sci Sports Exerc* 35, 2003; [3] Impellizzeri et al, *Med Sci Sports Exerc* 39, 2007; [4] Pujol et al, *Amer J Sport Med* 35, 2007; [5] Thorlund et al, *Scand J Med Sci Sports* 18, 2008; [6] Zebis et al, *J Strength Cond Res* 25, 2011; [7] Zebis et al, *Am J Sports Med* 37, 2009

### EFFECT OF COLD WATER IMMERSION FOR THE RECOVERY OF MUSCLE DAMAGE AND MUSCLE STRENGTH AND POWER AFTER RUGBY GAME

Takeda, M., Sato, T., Hasegawa, T., Shintaku, H., Kato, H., Radak, Z.

*Laboratory of Exercise Physiology*

**Introduction** Efficacy of cold water immersion (CWI) for endurance performance after endurance exercise has been reported (Vaile, et al., 2008; Peiffer et al., 2010). However, positive effect of CWI for the recovery to the reduction of muscle strength and muscle power or to the muscle damage after the severe muscle activity has not been clearly demonstrated (Bryane & Eston, 2002; Selwood et al., 2007). This study examined the effect of CWI used after the rugby game simulation training including severe body contact on biochemical parameters representing exercise-induced muscle damage and muscular functional test on rugby players. **Methods** Twenty collegiate male rugby players (age:  $20.3 \pm 0.6$  years old, body height:  $173.8 \pm 5.1$  cm, body weight:  $85.4 \pm 2.0$  kg) volunteered in this study. They were randomly assigned CWI group ( $n = 10$ ) or control group ( $n = 10$ ) matched body height and weight. They tried as 1st trial 80 minutes rugby game simulation training including tackles and body contacts. CWI group was immersed cold water ( $15^\circ\text{C}$  for 10 minutes) after the training. Serum creatine kinase (CPK), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and creatinine (Cre), blood lactate, 50 m dash running performance, vertical jump, reaction time, side step for 20 seconds, maximal anaerobic cycling power for 10 seconds, and subjective feeling of fatigue were measured before, immediately after, and 24 hours after the training. One week later, 2nd trial was conducted as interchangeably classified groups, cross over design. Two way repeated measure ANOVA was used for statistical evaluation. **Results** Body temperature was significantly reduced immediately after CWI ( $20.5 \pm 1.0^\circ\text{C}$  vs  $28.2 \pm 1.4^\circ\text{C}$  for control condition). Subjective feeling of fatigue was significantly low immediately after CWI. However, no statistically significant interactions were found in

any of blood variables and muscle functional tests in both between groups and time courses. Main effects of time courses were found in all blood variables and muscle functional tests except for 10 seconds maximal pedaling power. Conclusion Our results suggested that rugby game induces muscle damage and reduces muscle function. However, CWI has no restorative effect of 80 minutes rugby game in terms of muscle damage and muscle function. References Byrne C, Eston R. (2002), *J Sports Sci*, 20(5), 417-425. Peiffer JJ, Abbiss CR, Watson G, Nosaka K, Laursen PB. (2010). *Br J Sports* 44, 461-465. Sellwood K, Brukner P, Williams D, Nicol A, Hinman R. (2007). *Br J Sports Med*, 41, 392-397. Vaile J, Halson S, Gill N, Dawson B. (2008). *J Sports Sci*, 26(5), 431-440.

## 18:00 - 19:30

### Oral presentations

#### OP-PM38 Rehabilitation [RE] 1

##### **SUPERIOR DAILY PHYSICAL ACTIVITY AND EXERCISE ADHERENCE IN CARDIAC REHABILITATION USING INTELLIGENT TECHNOLOGY**

Hautala, A.J., Kiviniemi, A.M., Mäkikallio, T.H., Koistinen, P., Rynnänen, O.P., Huikuri, H.V., Tulppo, M.P.

*Verve Research*

**Introduction** Daily physical activity (PA) and exercise training (ET) are core tasks in cardiac rehabilitation (CR). However, the majority of cardiac patients are not engaging in targeted PA, even when they are enrolled or completed in CR (1). We hypothesized that CR concept using intelligent technology will increase PA and ET adherence in acute coronary syndrome (ACS) patients. **Methods** Angiographically documented coronary artery disease patients (n=33, age 61±13 yr, BMI 28±5 kg/m<sup>2</sup>, left ventricular ejection fraction 63±9%, 82% on β blockade) completed a six month exercise based CR program. PA and ET prescription was guided according to current guideline (2). A wrist-worn accelerometer PA device (Polar Electro, Kempele, Finland) was used to collect PA during the intervention. The patients were able to self-monitor their daily realized vigorous PA (> 3.5 METs) by the device aiming to 30 min/day. Once a week the patients performed a guided exercise session followed by a physiotherapist in fitness room equipped with intelligent strength devices (HUR Oy, Kakkola, Finland). After each session patients received an individual feedback from health related indexes, e.g. aerobic fitness and muscular strength, which were gathered during exercise. Instructions were also given for home based training and patients wrote all the training sessions in a diary. The realized ET was summed up from the diaries by calculating training load (Rating of Perceived Exertion (RPE) x duration of exercise session) (3) at monthly basis. PA data was analyzed accordingly to calculate daily vigorous PA. **Results** The average of monthly realized ET exceeded the prescribed ET (training load 14262±1033 vs. 9653±99, main effect p=0.019). 79% of patients (26/33) crossed the target amount of ET during intervention. Accordingly, the average of objectively measured vigorous PA was 46±1 min/day meaning that 25 out of 33 patients (76%) surpassed the daily 30 min of vigorous PA. **Discussion** The exercise based CR concept using intelligent technology seems effective to increase PA to the recommended level. Self-monitoring techniques such as keeping ET diary, wearing PA device and feedback of health-related indexes at weekly basis contribute markedly to daily PA and ET realized in ACS rehabilitation. **References** 1. Ferrier S, Blanchard CM, Vallis M et al. (2011) *Eur J Cardiovasc Prev Rehabil*, 18, 15-32. 2. Corra U, Piepoli MF, Carre F et al. (2010) *Eur Heart J*, 31, 1967-1974. 3. Foster C (1998) *Med Sci Sports Exerc*, 30, 1164-1168.

##### **A SIX-WEEK HIGH-INTENSITY VIRTUAL-REALITY INTERVAL TRAINING PROGRAM IN INDIVIDUALS WITH SPINAL CORD INJURY**

Davis, G.M.1, Hasnan, N.1,2, Engkasan, J.P.2, Husain, R.2

1. *University of Sydney (Sydney, Australia)*, 2. *University of Malaya (Kuala Lumpur, Malaysia)*

**Introduction** The aim of this study was to investigate the effect of high-intensity "hybrid" (arm and FES-leg cycling) interval training in a virtual reality environment on aerobic fitness, lipid profiles and glucose tolerance in persons with spinal cord injury (SCI) **Methods** Eight individuals with chronic SCI undertook 6 weeks of high-intensity (80-90% HRpeak) aerobic interval training using an arm+FES-leg tricycle. Training sessions were either 32 minutes, three times per week or 48 minutes, two times per week. The recumbent tricycle (BerkelBike®) was positioned on Tacx i-Magic VR Trainer®, indoors in front of a flat panel monitor displaying simulated outdoor overground cycling. Computer-controlled electrical stimulation was applied bilaterally to the quadriceps, hamstrings and glutei to evoke leg cycling. Voluntary arm cranking was at a cadence selected by the subjects to achieve their desired exercise intensity. The participants were assessed for their peak cardiorespiratory responses and power output before and following completion of the six-week training programme. Lipid profiles, cholesterol and oral glucose tolerance were also measured before and after the training programme. **Results** As a result of the high-intensity hybrid training program, subjects increased their peak aerobic fitness from 1.14±0.18 L/min to 1.37±0.23 L/min (p<0.05). Their body mass-adjusted VO<sub>2</sub> peak also increased from 19.3±3.4 mL/kg/min to 23.2±3.4 mL/kg/min (p<0.05). Arm+ leg peak power output during "hybrid" exercise was raised from 52.5±10.4 W to 70±12.0 W (P<0.05). Lipid profile TChol, HDL, LDL and oral glucose tolerance results were unchanged after training, although modest improvements were observed in some subjects. **Discussion** This was the first study to investigate indoor virtual-reality "hybrid" exercise training in individuals with SCI. These results reveal similar improvements of peak aerobic fitness observed in prior studies. Our 20% increase of aerobic fitness and 33% augmentation of peak power output was more than double that observed by Heesterbeek et al, 2005, for a 4-week BerkelBike® training program. The larger increases of the current study were likely due to a longer training period and our use of high-intensity aerobic interval training. There are no previous studies that have investigated changes of lipid profile and oral glucose tolerance following "hybrid" exercise training in SCI. The lack of changes in these biochemical measures suggests that six weeks of twice- or thrice-weekly training, even at a high intensity, may be too short to modify these biochemical markers of cardiovascular risk in the SCI population. **References** Heesterbeek PJC et al (2005) *Technology and Disability*, 17, 103-110

## EFFECTS OF CONCURRENT VERSUS NON-CONCURRENT REHABILITATIVE CONDITIONING IN AN ACL-RECONSTRUCTED POPULATION

Minshull, C.1, Bailey, A.2, Shepherd, J.1, Yates, C.3, Gleeson, N.3

1. Nottingham Trent University, 2. RJAH Orthopaedic Hospital, Oswestry, UK; 3. Queen Margaret University, Edinburgh, UK

**Introduction** Rupture of the anterior cruciate ligament (ACL) is a potentially career-threatening injury for sports performers, invariably requiring reconstructive surgery to restore knee function (1). The consequences of ACL injury involve considerable temporal and fiscal costs (3) to rehabilitate the patient and restore function to the knee. Concurrently training for strength and cardio-vascular endurance in close proximity may attenuate strength gains in healthy populations via the interference effect (2). This type of training is widely used in contemporary rehabilitative practice and as such, may have implications for patient rehabilitation. This study assessed the effectiveness of segregation of strength and endurance rehabilitative exercise compared to concurrent exercise methods. **Methods** 61 patients (54 males, 7 females) with arthroscopically verified unilateral ACL rupture were randomly assigned into either: i) non-concurrent rehabilitation (NCON, n = 36) involving phasing of strength and endurance exercise, or: ii) concurrent rehabilitation (CON, n = 25). Patients were assessed at pre-, 6 weeks, 12 weeks, 24 weeks and 48 weeks following surgery. Assessments of ACL laxity and peak force (PF) of the knee extensors and the knee flexors were obtained from the injured and non-injured limb on each occasion. Data were analysed by separate 3-way mixed-model repeated-measures ANOVAS. **Results** ACL laxity improved over time similarly in both groups (mean  $\pm$  SD: 11.2 (5.0) mm vs. 2.8 (0.6) mm at pre- and 48 weeks, respectively) ( $p < 0.001$ ). A decrease in KFPF and KEPPF of the non-injured limb was observed at 6 weeks in both groups. A continual increase in KFPF was observed at all time-points thereafter, which was greater in the NCON group compared to CON ( $p < 0.001$ ). At 48 weeks the KFs were 13.6% weaker compared to pre-surgery levels in the CON, compared to 21.0% stronger in the NCON group. KEPPF of the injured limb showed statistically similar improvements in both groups and was restored to within pre-surgery levels at 48 weeks (407.8 (137.4) N vs. 395.1 (106.7) N). Whilst no changes were observed to KEPPF in the non-injured limb, the data suggest a superior and improved performance of KFPF in the NCON group. **Discussion** Segregation of strength and endurance rehabilitative exercise may enhance performance of the knee flexors following surgery. Given the protective role of this muscle group to the ACL, such an approach may facilitate an optimised recovery and prevention of re-injury. **References:** 1. Beynon et al. (2005) *Am J Sp Med*, 33:1751-67 2. Karavirta et al. (2011) *Scand J Med, Sci Sports*, 21:402-11 3. Paxton et al. (2010). *Am J Sp Med*, 38:2417-25

## BIOCHEMICAL IMPACT OF SOCCER - MARKERS OF HORMONAL, MUSCLE DAMAGE AND REDOX MARKERS THROUGHOUT THE SEASON

Silva, J.R.1, Rebelo, A.1, Marques, F.2, Pereira, L.2, Seabra, A.1, Ascensão, A.3, Magalhães, J.3

University of Porto

**Introduction** This study aimed to analyze changes in performance, muscle function, as well as stress-related biochemical markers in professional soccer players throughout the soccer season. **Methods** 14 male professional soccer players were monitored throughout the season for hormonal, muscle damage, inflammatory and redox state markers [E1 – before the beginning of the preparation period; E2 - middle of the competitive season (January); E3 - end of the competitive season, and E4 – after the end of the recovery period and before the beginning of the preparation period of the next season]. Sprint, jump and change of direction (COD) performance, and maximal isokinetic knee extension (KE) and flexion (KF) parameters were also measured (E1-E3). **Results** COD increased in E2 and E3 ( $P < 0.01$ ). Cortisol decreased in E3 and plasma testosterone/cortisol ratio (T/C) increased in E2 and E3 ( $P < 0.01-0.05$ ). Myoglobin (Mb) increased in E2 and creatine kinase (CK) and C-reactive protein (CRP) in E2 and E3 ( $P < 0.01-0.05$ ). Superoxide dismutase (SOD), protein sulfhydryls (-SH) and malondialdehyde (MDA) increased in E2 and E3 ( $P < 0.01-0.05$ ). From E2-E3, T/C increased and C, Mb and glutathione reductase (GR;  $P < 0.01-0.05$ ) decreased. T/C, CK, SOD, -SH and MDA decreased and C and GR ( $P < 0.05$ ) increased during off-season (from E3 to E4). Testosterone, glutathione peroxidase, uric acid and total antioxidant status levels were stable throughout the observation period. Hormonal parameters were associated with KE and KF from E2-E3 ( $r = 0.85-0.86$ ) and in E3 ( $r = 0.56-0.68$ ). In E2, significant correlations were observed between match accumulated time (MATE2), performance, hormonal and redox parameters ( $r = 0.456-0.615$ ). **Discussion** The overall analysis of our data point out significant alterations in biochemical parameters of professional players throughout the soccer season period (Heisterberg et al., 2012; Meyer et al., 2011), but not during off-season. However, despite these changes suggest an increased intra-season physiological stress (Kraemer et al., 2004), the neuromuscular performance was not significantly affected during in-season. Additionally, results also suggest that MAT was associated with physical, hormonal and oxidative stress-related parameters. **References** Heisterberg MF, Fahrenkrug J, Krstrup P, Storskov A, Kjaer M, Andersen JL. (2012). *J Strength Cond Res*. Jun 27. [Epub ahead of print] Kraemer WJ, French DN, Paxton NJ, Hakkinen K, Volek JS, Sebastianelli WJ, Putukian M, Newton RU, Rubin MR, Gomez AL, Vescovi JD, Ratamess NA, Fleck SJ, Lynch JM, Knuttgen HG. (2004). *J Strength Cond Res* 18 (1):121-128. Meyer T, Meister S. (2011). *Int J Sports Med* 32 (11):875-88.

# Saturday, June 29th, 2013

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**08:30 - 10:00**

## Oral presentations

### OP-PM53 Training and Testing [TT] 7

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#### THE LACTATE MINIMUM TEST IN ROWING – A NEW CONVINCING TESTING CONCEPT

Perret, C.I, Vrana, A.2

*1: Institute of Sports Medicine and 2: Institute of Human Movement Sciences and Sport*

**Introduction** The lactate minimum test (LMT) was found to be a valid and reliable testing concept for different sport disciplines (Dotan et al., 2011; Johnson et al., 2009; Knöpfli-Lenzin and Boutellier, 2011; MacIntosh et al., 2002). Thus, it is surprising, that this testing method is still not used in rowing. Therefore, the aim of this study was to implement and validate the LMT concept in rowing. **Methods** 20 experienced male rowers (age: 22.8±6.7years, height: 185.9±5.2cm, body mass: 78.3±8.1kg, peak oxygen uptake (VO<sub>2</sub>peak): 65.6±6.5ml•min<sup>-1</sup>•kg<sup>-1</sup>) participated in this study. They completed two LMT, one 2000m all-out trial and several endurance tests for MLSS determination on a rowing ergometer. Peak performance as well as VO<sub>2</sub>peak during the first part of the LMT (LMTpeak) were compared with performance and VO<sub>2</sub>peak of the 2000m trial. Performance, heart rate, VO<sub>2</sub>peak and lactate concentration at lactate minimum (LM) were correlated with the corresponding data at MLSS. Further, coefficients of variation (CVs) were calculated for data at LM and LMTpeak. Results CVs for performance, heart rate and VO<sub>2</sub>peak at both, LM and LMTpeak, showed a high reproducibility (all CVs <3.5%). As expected according to Morton et al., only lactate concentrations revealed not to be well reproducible (CV>12%). Performance as well as VO<sub>2</sub>peak data highly correlated between LMTpeak and 2000m race performance (performance: r=0.96; p<0.001, VO<sub>2</sub>peak: r=0.93; p<0.001). Performance between LM and MLSS showed a significant correlation (r=0.81; p<0.001) as well. **Conclusions** The present LMT-protocol is highly reproducible and allows the assessment of VO<sub>2</sub>peak, MLSS as well as the prediction of 2000m race performance based on one single test. Therefore, our LMT-protocol represents a reliable and valid diagnostic tool for steering and monitoring the training process in rowing. **References** Dotan R, Zigel I, Rotstein A, Greenberg T, Benyamini Y, Falk B. (2011). *J Sports Med Phys Fitness* 51: 42-49. Johnson M, Sharpe G, Brown P. (2009). *Int J Sports Med* 30: 448-454. Knöpfli-Lenzin C, Boutellier U. (2011). *J Strength Cond Res* 25: 1355-1359. MacIntosh BR, Esau S, Svedahl K. (2002). *Can J Appl Physiol* 27: 232-249. Morton H, Stannard S, Kay B. (2012). *Br J Sports Med* 46: 64-69.

#### EXTERNAL AND INTERNAL TRAINING LOAD IN AUSTRALIAN FOOTBALLERS.

Gallo, T., Cormack, S., Gabbett, T., Lorenzen, C.

*Australian Catholic University*

**Introduction** Quantifying load is difficult in high-intensity intermittent contact team sport, where acceleration, direction change and collisions contribute to the load experienced by the athlete (Young, Hepner, & Robbins, 2012). Inter- and intra- individual variability in response to external workload further complicates matters. Research on the individual characteristics that impact on the relationship between external load (EL) and internal load (IL) are limited (Impellizzeri, Rampinini, & Marcora, 2005). The purpose of this study was to explore the relationship between EL and IL in elite Australian Football (AF). The primary aim was to determine if running performance and player experience impacts this relationship. **Methods** From 41 elite AF players (22.6 ± 3.0y, 45.4 ± 60.6 senior games), 302 samples were analysed. Global-Positioning Systems provided EL variables including; total distance (TD), relative distance (RD), high-speed running (HSR) (>18.1 km.hr<sup>-1</sup>) and player load (PL). Session-RPE provided IL (Foster et al., 2001). A 2-km time-trial determined running performance and senior playing years determined experience. Players were classified into low running (LR) and high running (HR) groups and young and mature groups using median splits. Relationships were determined using multiple regression and differences between groups were analysed using effect sizes (± 90% CI). **Results** Regression modelling generated the following equation: IL = 385.59 + 0.12 (TD) – 5.59 (RD) – 0.10 (PL) (r<sup>2</sup> = 89%, TEE = 0.33 x/± 1.07). The LR group had higher RPE's compared to the HR group; unadjusted (-0.25 ± 0.19) and adjusted for EL measures of time (-0.33 ± 0.19), TD (-0.43 ± 0.19), RD (-0.40 ± 0.19) and PL (-0.34 ± 0.19). The LR group also had higher IL when adjusted for time (-0.33 ± 0.19) and TD (-0.43 ± 0.19) and TD (-0.43 ± 0.19). There was no difference in RPE between experience groups. The mature group had higher IL when adjusted for TD (0.27 ± 0.19). **Discussion** There was a small effect on RPE between running groups unadjusted and adjusted for each EL variable (except HSR). Small differences were seen in IL when controlled for time and TD. As time and TD are external measures of volume, perhaps components of running performance are related to the internal response to external training volume. A small difference existed in IL based on experience when adjusted for TD. In summary, IL was linked to running performance and player experience when standardised to EL volume. **References** Foster, C., Florhaug, J. A., Franklin, J., et al. (2001). A new approach to monitoring exercise training. *Journal of Strength and Conditioning Research*, 15, 109-115. Impellizzeri, F. M., Rampinini, E., & Marcora, S. M. (2005). Physiological assessment of aerobic training in soccer. *Journal of Sports Sciences*, 23, 583-592. Young, W. B., Hepner, J., & Robbins, D. W. (2012). Movement demands in Australian Rules football as indicators of muscle damage. *Journal of Strength and Conditioning Research*, 26, 492-496.

#### SYSTEMATIC BIAS BETWEEN RUNNING SPEED AND METABOLIC POWER DATA IN ELITE SOCCER PLAYERS: INFLUENCE OF DRILL TYPE

Gaudino, P., Iaia, F.M., Alberti, G., Hawkins, R., Atkinson, G., Gregson, W.

*Liverpool John Moores University*

**Introduction** The physical demands of soccer are typically indicated by distance covered or time spent at specific velocities. Nevertheless, these measurements do not reflect the energy demands associated with accelerations and decelerations and, therefore, potentially underestimate the demands of match-play (Osgnach et al. 2010) and training (Gaudino et al., 2013). Small-sided games (SSG) are typically

incorporated into soccer training, but the degree to which the physical demands of SSG are underestimated by traditional monitoring approaches has not been evaluated. The aims of the present study were: i) to compare measurements of high-intensity demands of SSG between estimated metabolic power (di Prampero et al., 2005) and the traditional speed-referenced approach; ii) to evaluate whether any bias between the two approaches is dependent upon playing position or drill characteristics. Methods Three types of SSG (5v5, 7v7, 10v10) were completed by 26 elite soccer players competing in the English Premier League. A total of 420 individual drill observations were collected over the in-season period using portable GPS devices. High-intensity activity was compared in absolute units of distance covered at high metabolic power ( $>20W \cdot kg^{-1}$ ; TP) (di Prampero et al., 2005) and high speed ( $>14.4km \cdot h^{-1}$ ; TS) and, if appropriate, as a percentage of total distance. Players were categorised by playing position: central defender, wide defender, central midfielder, wide midfielder and attacker. Results High intensity activity distance was proportional to total distance, rendering a percentage statistic appropriate. High-intensity demands were on average  $99 \pm 144\%$  greater when expressed as high metabolic power versus high speed ( $p < 0.001$ ). The magnitude of this difference increased from  $55 \pm 33\%$  for 10v10 games to  $196 \pm 253\%$  for 5v5 games ( $p < 0.001$ ). The greatest difference between TP and TS was found to be  $349 \pm 532\%$  in the central defenders particularly during the 5v5 SSG ( $p < 0.001$ ). Discussion The high-intensity demands of SSG in elite soccer players are systematically underestimated by running speed alone particularly during 5v5 games and especially for central defenders. Therefore, estimations of metabolic power provide a more valid estimation of the true demands of SSG. References di Prampero PE, Fusi S, Sepulcri L, Morin JB, Belli A, Antonutto G. (2005). *J Exp Biol*; 208: 2809-2816. Gaudino P, Iaia FM, Alberti G, Strudwick AJ, Atkinson G, Gregson W. (2013). *Int J Sports Med*; (In press). Osgnach C, Poser S, Bernardini R, Rinaldo R, di Prampero PE. (2010). *Med Sci Sports Exerc*; 42: 170-178.

### THE MOXUS MODULAR METABOLIC SYSTEM EVALUATED WITH TWO SENSORS FOR VENTILATION AGAINST THE DOUGLAS BAG METHOD

Rosdahl, H., Lindberg, T., Edin, F., Nilsson, J.

*Swedish School of Sport and Health Sciences*

Introduction Determination of oxygen uptake with the criterion Douglas bag method (DBM) has over the years successively been replaced by automated metabolic systems while the need of further validations of these systems has strongly been emphasized (Macfarlane 2001). The Moxus metabolic system (MMS) is a stationary automated metabolic system equipped with a mixing chamber and ventilation (VE) determined on the inspiratory side with either a turbine flowmeter or a pneumotachometer sensor. It has recently been evaluated against DBM (Medbø et al. 2012) but with the turbine flowmeter only. In the present study (Rosdahl et al 2012) both ventilation sensors were included and MMS was investigated for validity and reliability in a wide measurement range. Methods A serial coupling setup was used to collect the gas exchange variables simultaneously with MMS and DBM. Thirteen well-trained athletes participated in four tests and exercised on a cycle ergometer at five submaximal power levels (50–263W) and at VO<sub>2</sub> max. Results Reliability with both sensors was comparable to DBM. The average coefficient of variation (CV) of all exercise intensities with the pneumotachometer was  $3.0 \pm 1.3$  for VO<sub>2</sub> and  $4.2 \pm 0.8$  for VE. CV with turbine flowmeter were  $2.7 \pm 0.3$  for VO<sub>2</sub> and  $4.8 \pm 1.4$  for VE. Validity was generally acceptable but small differences in VO<sub>2</sub> related to the determination of VE were noticed. The relative differences vs. DBM at the powers including VO<sub>2</sub>max were similar for both sensors with ranges being +5 to -3 % for VO<sub>2</sub> and +4 to -2 % for VE while RER did not differ. Discussion The current study indicate that the reliability of the MMS with both sensors for VE compare well with the results of the criterion DBM and previous investigations. CV at VO<sub>2</sub>max (about 2.5%) was similar to the values ( $\leq 3\%$ ) as reported by Medbø et al. (2012) for the MMS with a turbine flowmeter. These findings suggest a reliability being applicable for most common conditions. Concerning validity, overall the present results show that MMS, with both sensors to determine VE compare reasonably well with DBM. However, since VE determined both with the pneumotachometer and turbine flowmeter setups differed slightly at a few power levels, and resulted in concomitant changes in VO<sub>2</sub> and VCO<sub>2</sub>, we suggest that further validity improvements may be gained by small additional refinements in the measurement of ventilation. References Macfarlane DJ (2001). *Sports Med* 31: 841-861 Medbø JI, Mamen A, Beltrami FG (2012). *Appl Physiol Nutr Metab* 37: 860 - 871 Rosdahl H, Gullstrand L, Salier-Eriksson J, Johansson P, Schantz P (2010). *Eur J Appl Physiol* 109: 159-171 Rosdahl H, Lindberg T, Edin F, Nilsson J (2012). *Eur J Appl Physiol* DOI: 10.1007/s00421-012-2551-1

### THE CORRELATION BETWEEN THE KINETIC VARIABLES OF A SPRINT START AND THE FINISHING TIME FOR A DISTANCE OF FIVE METRES FOR GROUPS OF SKILLED AND NON-SKILLED SPRINTERS

Bavdek, R., Dolenc, A., Strojnik, V.

*University of Ljubljana*

Introduction: Sprint start is one of the factors of a successful sprint. Most sprint start research has been done including only trained sprinters (Bezodis, 2009; Mendoza and Schöllhorn, 1993; Mero et al., 1983). It is, therefore, impossible to say whether the results are valid for sprinters who are not as good or are beginners (non-skilled athletes). The aim of this research was to find correlations between kinetic variables of sprint start and the time during the distance of 5 meters in groups of athletes of different skilled categories. Methods The research included 22 sprinters ( $23 \pm 7.2$  years,  $179.5 \pm 8$  cm,  $74.5 \pm 12.3$  kg). Using hierarchical cluster analysis the sprinters were divided into two groups according to their time during the 5m distance (T5). 12 sprinters thus fell into the first group as skilled sprinters (T5 from 1.16 to 1.55 s), while 9 sprinters formed the second one as non-skilled sprinters (T5 from 1.60 to 1.79 s). Kinetic variables were measured with two force plates (Kistler, Winterthur) that carried starting blocks. T5 was measured with photocells. Every sprinter had two tries out of which the one with shorter T5 was used. The following variables were used: T5, velocity at the time of take-off from the starting block (VHSB), reaction time (RT), time of push (TPUSH), time of push with a rear leg (TRL), average horizontal acceleration (ACCH), and average horizontal power (POWH). Hierarchical Cluster analysis and correlation (Pearson's coefficient) statistics were made. Results In both groups of athletes VHSB, RT, TPUSH, ACCH, and POWH held a significant statistic correlation to T5 ( $P=0.00$ ;  $P=0.04$ ;  $P=0.00$ ;  $P=0.00$ ;  $P=0.00$  respectively). In the group of skilled athletes there was a statistically important correlation only among T5 and TPUSH ( $P=0.01$ ), ACCH ( $P=0.00$ ), POWH ( $P=0.00$ ) respectively, while in the group of non-skilled athletes there were no statistically significant correlations. Discussion The research clearly shows that in a heterogeneous group (combined group of skilled and non-skilled sprinters) there is a statistically significant correlation between measured variables and T5 like other authors suggest (Bezodis, 2009; Mendoza and Schöllhorn, 1993). The only exception is the TRL variable. In a group of skilled sprinters variables POWH, ACCH as Bezodis (2009) suggested and TPUSH were correlated to T5. We found no correlation between all variables and T5 in a group of non-skilled sprinters. We believe that the main reason is poor sprint start technique so the caution is needed in interpretation of the results for this group. References Bezodis NE. (2009). Unpublished PhD Thesis. University of Bath. Mendoza L, Schöllhorn W. (1993). *J Sports Sci*, 11(1), 25-29. Mero A, Luhtanen P, Komi P. (1983). *Scand J Sports Sci*, 5(1), 20-28.

**DEVELOPMENT AND VALIDITY OF A NEW SCALE OF PERCEPTION OF VELOCITY IN LOWER BODY RESISTANCE TRAINING**

Bautista, I.J.1, Chiroso, I.J.1, Chiroso, L.J.1, Reverter, J.2, Hernan, O.3, Gomez, P.1

*1 Universidad de Granada (Granada, Spain) 2 Universidad de Zaragoza (Zaragoza, Spain) 3 Federación Andaluza de Deportes de Invierno (Granada).*

Strength training has undergone a substantial advancement, especially qualitatively, in recent years thanks to advances in new technologies applied to training control (Randell et al., 2011). The use of tools such as linear positioning transducers mean that training variables such as velocity, strength or power can be quantified for each repetition. Therefore, the purpose of this study was to validate a new scale of perceived velocity of the squat exercise in young skiers. Method Eleven subjects (8 boys and 3 girls) participated voluntarily in this research. Age, weight and height of subjects were  $14.52 \pm 2.74$  years,  $58.79 \pm 10.27$  kg and  $170.05 \pm 7.11$  cm, respectively. All subjects were participating in an intensive training program at the High Performance Centre of Sierra Nevada (CARD). Six different intensities were selected based on the 1RM of the subjects (20%, 30%, 40%, 50%, 60% and 70%). Subsequent to the execution of each series, subjects were asked their average perceived bar velocity. Results The linear correlation analysis between the actual velocity (Velreal) and perceived velocity (Velscale) in the entire spectrum of loads analyzed resulted in  $r = 0.978$  ( $p = 0.01$ ) and  $r = 0.979$  ( $p = 0.01$ ) for days 1 and 2, respectively. The linear correlation analysis between Velreal and Velscale in each load range correlated to  $r =$  from 0.58 to 0.96 in the range of loads tested. Discussion It is important to note the difficulty of comparing the results of our research to other studies validating the OMNI-RES scale since the criterion variables used to test the validity of those studies were Hla and Wtot (Robertson et al., 2003) or the Borg CR10 scale itself (Lagally et al., 2006). The criterion variable used to test the validity of this research was the actual velocity of each of the repetitions and sets as measured on a linear displacement device. Since the new scale is designed to measure the average velocity of execution of the bar, it is proposed that this be the 'gold standard' possible for assessing validity. Conclusions The results obtained in this research provide concurrent validity of the new scale of perception of velocity for resistance exercise and demonstrate that it can be used as a means to quantify the intensity of the bench press exercise in a population of trained adults. References Randell, AD, Cronin, JB, Keogh, JW, Gill, ND, Pedersen, MC. Reliability of performance velocity for jump squats under feedback and nonfeedback conditions. *J Strength Cond Res.* 2011; 25(12): 3514–3518. Lagally, KM, Robertson, RJ. Construct validity of the omni resistance exercise scale. *J Strength Cond Res.* 2006; 20(2): 252–256. Robertson, RJ, Goss, FL, Rutkowski, J, Lenz, B, Dixon, C., Timmer, J, Frazee, K, Dube, J, Andreacii, JL. Concurrent validation of the OMNI perceived exertion scale for resistance exercise. *Med Sci Sports Exerc.* 2003; 35(2): 333–341. Key Words: resistance training, perceived velocity scale, squat exercise

**08:30 - 10:00****Oral presentations****OP-PM36 Physiology [PH] 13****MIXED-METHOD COOLING MAINTAINS MEDIUM-FAST BOWLING PERFORMANCE ON CONSECUTIVE DAYS IN THE HEAT**

Minett, G.M.1,2, Duffield, R.1,3, Kellett, A.4,5, Portus, M.4,6

*1: CSU (Bathurst, Australia), 2: QUT (Brisbane, Australia), 3: UTS (Sydney, Australia), 4: CA (Brisbane, Australia), 5: TA (Melbourne, Australia), 6: Praxis Sport Science (Brisbane, Australia)*

Introduction Medium-fast bowling in cricket evokes marked physiological demands that are often compounded by high environmental temperatures and brief periods of incomplete recovery between spells. Greater physiological, neuromuscular and perceptual recovery achieved using post-exercise cooling techniques would be of likely benefit for cricketers, though their effect on performance is unknown. This investigation examined physiological and performance effects of mixed-method cooling during recovery for medium-fast bowlers in the heat. Methods Eight, elite medium-fast bowlers completed two randomized trials, involving two sessions performed on consecutive days (Session 1: 10-overs and Session 2: 4-overs) in  $31(3)^{\circ}\text{C}$  and  $55(17)\%$  relative humidity. Recovery interventions were administered for 20 min after Session 1 (mixed-method cooling vs. control). Mixed-method cooling consisted of an iced towel worn over the head, neck and shoulders, ice-vest covering the torso, and ice-packs applied to the thighs. Heart rate, core and skin temperatures were recorded throughout both sessions. Bowling performance (ball speed, accuracy, run-up speed), physical demands (global positioning system, counter-movement jump), biochemical responses for damage and inflammation (creatinase, C-reactive protein) and perceptual variables (perceived exertion, muscle soreness) were measured for both conditions. Results Mean ball speed was higher after cooling in Session 2 ( $118.9(8.1)$  vs.  $115.5(8.6)$  km.h<sup>-1</sup>;  $P=0.001$ ;  $d=0.67$ ). Large effects indicated higher accuracy in Session 2 after cooling ( $46.0(11.2)$  vs.  $39.4(8.6)$  AU;  $P=0.13$ ;  $d=0.93$ ) without affecting total run-up speed ( $19.0(3.1)$  vs.  $19.0(2.5)$  km.h<sup>-1</sup>;  $P=0.97$ ;  $d=0.01$ ). Cooling improved 20 m sprint in Session 2 ( $22.0(1.9)$  vs.  $20.4(1.9)$  km.h<sup>-1</sup>;  $P=0.02$ ;  $d=1.15$ ); however, counter-movement jump performance was unchanged at all time points ( $P=0.25-0.88$ ;  $d=0.03-0.30$ ). Cooling reduced core and skin temperatures throughout the intervention ( $P=0.001-0.05$ ;  $d=1.31-5.78$ ); further, attenuating creatinase ( $P=0.04$ ;  $d=0.56$ ) and muscle soreness at 24 h ( $P=0.03$ ;  $d=2.05$ ). Discussion These data highlight mixed-method cooling as an effective recovery strategy for medium-fast bowling in hot conditions on consecutive days. Lowered thermal, biochemical and perceptual responses were found, corroborating previous findings. In addition, the cooling recovery intervention provided better maintenance of bowling performance between sessions.

**NEUROMUSCULAR FATIGUE DURING RESISTANCE EXERCISE AFFECTS CARDIAC AUTONOMIC MODULATION**

Carballeira, E.1, Iglesias-Soler, E.1, Mayo, X.1, Sánchez-Otero, T.1, Boullosa, D.A.2

*1. A Coruña University (UDC). Spain, 2. Catholic University of Brasilia. Brazil*

Introduction Acute changes in heart rate variability (HRV) have been shown to be a useful tool for quantifying training load on autonomic nervous system (Kaikkonen et al. 2010). Resistance exercise produces a disruption on homeostasis that can modify HRV and heart rate complexity (Heffernan et al. 2008). However, the magnitude of neuromuscular fatigue can be modulated by set configuration (Iglesias-Soler et al. 2012). Therefore, we studied the relationship between cardiac autonomic modulation and neuromuscular performance after

two same volume but different set configuration RE sessions. Methods Nine male subjects completed a session of three sets to failure (FS) of parallel squat with 4 repetitions maximum (4RM), and a rest of 180 seconds between sets (total resting time of 360 s). At least 72 hours after, subjects performed a cluster session (CS) with the same volume (load x repetitions) but total resting time distributed between each repetition. HRV and complexity (SampEn) analysis was performed before, during, and after sessions. Isometric and dynamic explosive performance (IEP) was tested before, immediately after, and seven minutes after every session. Results SampEn decreased during both sessions, whereas SampEn\_CS was higher than SampEn\_FS ( $p=0.047$ ;  $d=0.9$ ). Furthermore, we found a reduction from vagal modulation on the heart after CS and FS, being only high frequency band (HF=0.15-0.4) post-session higher in CS than FS ( $p=0.032$ ;  $d=0.80$ ). However, type of session and time presented no clear interaction. Regarding autonomic and mechanical association, we found that a higher increment in cardiac sympathetic modulation (i.e. higher increment in LF/HF) in FS was linked to a lower loss of mean propulsive power. In addition, Isometric performance changes in CS were positively related with SampEn changes. Discussion Our results agree with previous studies on RE (Heffernan et al. 2008). We speculate that fatigue produced by exercises was not enough to induce greater differences in cardiac autonomic control and studies with more stressful workouts are needed to clarify the effect of different set-configurations. In the other hand, correlations between HRV and IEP were evident in both sessions, therefore, further studies should be made in order to analyse the usefulness of HRV as a tool to monitoring neuromuscular fatigue in RE. References Heffernan KS, Sosnoff JJ, Jae SY, Gates GJ, Fernhall B (2008). *Int J Sports Med* 29:289-293. Iglesias-Soler E, Carballeira E, Sanchez-Otero T, Mayo X, Jimenez A, Chapman ML (2012). *Int J Sports Med* 33:351-358. Kaikkonen P, Hynynen E, Mann T, Rusko H, Nummela A (2010). *Eur J Appl Physiol* 108:435-442.

## LACTATE KINETICS AT THE LACTATE THRESHOLD IN TRAINED AND UNTRAINED MEN

Messonnier, L.A.1,2, Emhoff, C.A.W.1, Fattor, J.A.1, Horning, M.A.1, Carlson, T.J.1, Brooks, G.A.1

1: UCB (Berkeley, USA), 2: UDS (Le Bourget-du-Lac, France)

Introduction The lactate threshold (LT) remains unclear in its physiological significance, some interpreting the inflection point to indicate the onset of anaerobiosis (Wasserman and McIlroy, 1964), while others interpret the LT to reflect an imbalance between lactate appearance and removal (Stanley et al., 1985). Because none of the earlier investigations studied lactate kinetics (i.e., rates of appearance and disposal (Ra and Rd,  $\text{mg}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) and metabolic clearance rate (MCR,  $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) at the LT, our first aim was to determine lactate kinetics in trained subjects exercising at and just below the LT to test the hypothesis that the LT represents a limitation in lactate clearance. As well, because endurance training has been observed to decrease lactate concentrations by increasing lactate clearance capacity (Bergman et al., 1999), our second aim was to test the hypothesis that endurance training augments rates of lactate disposal and clearance at given relative exercise intensities and blood lactate concentrations ([lactate]b). Methods We studied six each untrained (UT) and trained (T) subjects during 60-min exercise bouts at power outputs (PO) eliciting the LT. Trained subjects performed two additional exercise bouts at a PO 10% lower (LT-10%), one of which involved a lactate clamp (LC) to match [lactate]b to that achieved during the LT trial. Results At LT, lactate Ra was higher in T ( $24.1 \pm 2.7$ ) than in UT ( $14.6 \pm 2.4$ ,  $P < 0.05$ ), but Ra was not different between UT and T when relative exercise intensities were matched (UT-LT vs. T-LT-10%, both 67%  $\text{VO}_{2\text{max}}$ ). Rd imitated Ra. At LT, MCR in T ( $62.5 \pm 5.0$ ) was 34% higher than in UT ( $46.5 \pm 7.0$ ,  $P < 0.05$ ), and a reduction in PO resulted in a significant increase in MCR by 46% (LT-10%,  $91.5 \pm 14.9$ ,  $P < 0.05$ ). At matched relative exercise intensities (67%  $\text{VO}_{2\text{max}}$ ), MCR in T was 97% higher than in UT ( $P < 0.05$ ). During the LC trial, MCR in T was 64% higher than in UT ( $P < 0.05$ ), where % $\text{VO}_{2\text{max}}$  and [lactate]b were similar. Discussion We conclude that: i) lactate MCR reaches an apex below the LT, ii) LT corresponds to a limitation in MCR, iii) endurance training augments capacity for lactate production, and iv) endurance training improves lactate disposal and clearance while exercising at LT (i.e., at a higher relative exercise intensity in trained subjects) as well as at given relative exercise intensities and blood lactate concentrations. References Bergman BC, Wolfel EE, Butterfield GE, Lopaschuk GD, Casazza GA, Horning MA, Brooks GA. (1999). *J Appl Physiol*, 87, 1684-1696. Stanley WC, Gertz EW, Wisneski JA, Morris DL, Neese RA, Brooks GA. (1985). *Am J Physiol*, 249, E595-602. Wasserman K, McIlroy M. (1964). *Am J Cardiol*, 14, 844-852.

## THE RELATIONSHIP BETWEEN MUSCLE HYPERTROPHY AND ACUTE HORMONAL RESPONSES OR MUSCLE ANDROGEN RECEPTOR CONTENT

Mitchell, C.J., Churchward-Venne, T.A., Bellamy, L., Parise, G., Baker, S.K., Phillips, S.M.

McMaster University

Introduction It is well known that supraphysiological doses of testosterone are potent stimulators of muscle hypertrophy. However, West et al. (2012) have shown that physiological variations in the magnitude of the post exercise testosterone response are not related to muscle hypertrophy following resistance training. The aim of the current study was to assess if changes in concentration of various hormones pre- and post-training, or the muscle androgen receptor (AR) provide a better predictor of muscle hypertrophy following resistance training. Methods Twenty three healthy young adult males ( $177.4 \pm 7.5$  cm,  $84.1 \pm 16.9$  kg,  $23.6 \pm 3.3$  y) completed 16 weeks of full body resistance training 4 x week. Two workouts focused on their upper body and two on their lower body. Muscle biopsies were obtained from the vastus lateralis at rest before and after the 16 week training period. Immunohistochemistry was used to measure changes in fiber type area. Western blotting was used to determine muscle androgen receptor protein content. Serum free testosterone was also measured immediately, 15, 30 and 60 minutes following the first and last workouts of the study. The area under the curve (AUC) was calculated as a single measure of the post exercise free testosterone response. Results Mean type II fiber area increased from  $6284 \pm 1869$  to  $7542 \pm 1736$   $\mu\text{M}^2$  ( $P < 0.001$ ) and type I fiber area increased from  $5355 \pm 1553$  to  $6098 \pm 1486$   $\mu\text{M}^2$  ( $P = 0.001$ ). There was no significant change in muscle AR protein content following training (fold change =  $1.17 \pm 0.61$ ;  $P = 0.186$ ); however, changes were highly variable. There were significant correlations between the fold change in androgen receptor content and the percentage change in type I ( $r = 0.47$ ,  $P = 0.023$ ) and type II ( $r = 0.60$ ,  $P = 0.002$ ) fiber area. There was a decrease in the AUC of the acute free testosterone response  $7557 \pm 1414$  to  $7190 \pm 1417$  (arbitrary units) ( $P < 0.001$ ) pre- to post-training; however, as reported previously there was no relationship between the magnitude of this response and muscle fiber hypertrophy ( $r = 0.06$ ,  $P = 0.772$ ) or for any other hormone including IGF-1 and GH. Discussion In agreement with our earlier findings no hormonal response correlated with hypertrophy. Instead, the findings from this study support the idea the muscle hypertrophy is regulated by local rather than systemic hormonal processes. If testosterone has any regulatory effect on muscle hypertrophy within its physiological range these effects are likely mediated by local changes androgen receptors and not changes in the post-exercise hormonal response. References West DW, Phillips SM. *Eur J Appl Physiol*. 112(7):2693-702.

## PULMONARY OXYGEN CONSUMPTION AND OXYGENATION OF UPPER-BODY MUSCLES DURING ISOLATED UPPER BODY POLING AT DIFFERENT EXERCISE INTENSITIES

Skovereng, K., Van Beekvelt, M., Ettema, G., Sandbakk, Ø.

*Norwegian University of Science and Technology*

**INTRODUCTION** Physiological responses to dynamic physical exercise have been studied extensively throughout history. However, there is limited knowledge on the responses of isolated upper-body exercise. In addition to pulmonary VO<sub>2</sub>, lactate and heart rate, near-infrared spectroscopy (NIRS) can be used to assess changes in local tissue oxygenation and calculate (muscle) tissue O<sub>2</sub> saturation (StO<sub>2</sub>), which represents the balance between O<sub>2</sub> supply and O<sub>2</sub> consumption(1), can provide knowledge regarding the demands of upper-body exercise and the adaptations of such training. To the best of our knowledge, the oxygenation of upper-body muscles in highly trained upper-body athletes has not yet been investigated. Therefore, the purpose of the present study was to investigate pulmonary VO<sub>2</sub> and oxygenation of upper-body muscles during isolated upper body poling at different exercise intensities. **METHODS** Fourteen male elite cross-country skiers (age 25±6.2, body mass 75.4±7.1 and whole body VO<sub>2</sub>max 73.4±4.2) performed three 4-min submaximal constant workloads when poling in a modified Concept2 ergometer, seated with the legs in a locked position. Pulmonary gas exchange was measured breath-by-breath and NIRS was used to measure total hemoglobin (tHb) and TSI on the biceps brachii (BB), triceps brachii (TB), latissimus dorsi (LD) and the vastus lateralis (VL) muscles. Blood lactate was measured after each work period. **RESULTS** The work rates for the three submaximal stages were 69±11, 93±14 and 122±20 W, respectively, with corresponding VO<sub>2</sub> of 22.7±3.6, 28.7±4.1 and 36.5±4.9 mL/kg/min and blood lactate concentrations of 1.28±0.79, 1.93±1.07 and 4.27±1.69 mmol/L respectively. For both the TB and LD muscles TSI decreased ( $p < 0.05$ ) and tHb increased ( $p < 0.05$ ) significantly with increasing intensity. Also in the BB muscle there was a significant decrease ( $p < 0.05$ ) but no significant change in tHb was seen. For the VL muscle, a decrease in TSI was seen from the first to the last workload, while an increase in tHb was seen only from the first to the second work load. **DISCUSSION** The current study shows that isolated upper body exercise elicits a significant physiological response in athletes well trained in the upper body. The oxygenation and TSI of the BB, TB and LD muscles decrease correspondingly with the increase in pulmonary oxygen consumption and heart rate with increasing work rate during upper-body exercise. Total hemoglobin increases in the TB and LD muscles indicating increased blood volume in these muscles. Our results for the VL muscle indicate that the legs have an energy requirement even though they are locked and unable to produce external work. **References:** 1.Buchheit & Uffland. 2011. Eur J Appl Physiol.

## EFFECT OF ALACTIC AND LACTIC TRAINING ON BRAIN DC POTENTIAL IN RECREATIONAL RUNNERS

Fomin, R.I., Masakov, L.I., Vesterinen, V.2, Nummela, A.2

*1: Omegawave (Espoo, Finland), 2: KIHU – Research Institute for Olympic Sports (Jyväskylä, Finland)*

**Introduction** The brain direct current potential (DC) is regarded in physiology and medicine as an integrated system marker for the assessment of the body's functional state, stress resistance, and adaptation capacity [1]. Researchers emphasize that the DC is highly sensitive to short-term and long-term adaptational changes in the body in response to external factors [2]. This research aims to study the specificity of DC changes with different training types in recreational runners. **Methods** Subjects: 27 healthy male recreational runners (35±6.7 yrs, 178±5.9 cm high, and weighing 76±7 kg) performed firstly 'alactic running training' (ALT) on a treadmill (H/P Cosmos Ergometer, Sportgerate, Germany): 30 min; 30 sessions 10 s each; 50 s of rest between sessions; an average speed of 93% of the maximal speed at VO<sub>2</sub>max; lactate not exceeding the anaerobic threshold (AT). Secondly, athletes performed 'lactic training' (LT) at field: 4 sessions 300 m each; the maximum speed; 5 min of rest between sessions; lactate above AT. The DC was recorded using method [1], with the Omegawave V.4 system (Omegawave, Finland). The DC was measured at rest before training, 15 min after training, and on the next 2 days. The lactate concentration was measured using a Biosen S-line Lab (EKF, Germany). **Results** After research, all subjects were divided into 2 subgroups, depending on the initial level of DC: 1) reduced DC (below 9 mV); 2) normal DC (9 to 35 mV). Before ALT, the average 'reduced' group DC was -2.3 mV (n=19). After training, the DC increased by 6 mV ( $p < 0.05$ ), becoming 3.7 mV. The DC did not change during the next 2 days. In the 'normal' group (n=8), a bidirectional trend of DC changes was observed after training; reducing in 5 athletes and increasing in 3 athletes. Before LT, the average 'reduced' group DC (n=20) was -1.5 mV. After training, the DC increased by 6.1 mV ( $p < 0.005$ ), becoming 4.6 mV. In the 'normal' group (n=6), the DC, which was 16.8 mV before training, decreased by 12.4 mV after training, becoming 4.4 mV ( $p < 0.05$ ). Thus, both training load models change the DC in recreational runners. The amount of changes depends on the initial DC before training. **Discussion** It is possible that the body response to training loads is associated with the initial CNS activation level. The role of the 'slow regulatory system of the brain' in short-term adaptation changes after physical loads is discussed [1]. **References** 1. Iliukhina V. (2011) Continuity and prospects of development of researches in area system-integrativity of psychophysiology of functional state and cognitive activity. Hum Phys, 37(4): 105-23. 2. Myznikov I, Shcherbina F. (2006) Characteristics of the formation of compensatory and adaptive responses of sailors to chronic stress. Hum Phys, 32(3): 92-7.

**08:30 - 10:00**

## Invited symposia

### IS-PM12 Regulation skeletal muscle carbohydrate and fat utilisation in exercise and disease in humans \*

#### LIMITS TO MAXIMAL FUEL UTILISATION IN HUMAN SKELETAL MUSCLE DURING EXERCISE

Jeukendrup, A.

*University of Birmingham*

Carbohydrate and fat are the most important fuels during exercise. The regulation of carbohydrate and fat metabolism has received a lot of attention but is still not completely understood. In the 1960's a theory was proposed by Randle at al referred to as the Randle or glucose-fatty acid cycle. This theory described how an increase in fatty acid availability (fat metabolism), reduced carbohydrate metabolism. However, it later appeared that during exercise, especially at higher exercise intensities this mechanism was not very important. Instead it was demonstrated that carbohydrate metabolism regulated fat metabolism and an increase in glycolytic flux reduced fat metabolism

through several mechanisms. It is known that carbohydrate and fat metabolism are influenced by diet (substrate availability), environmental conditions (heat, altitude), training status of the subject but most of all exercise duration and intensity. As exercise intensity increases fat metabolism increases at first and then decreases. In contrast, carbohydrate metabolism continues to increase as the intensity increases and the demand for energy increases. The increase and then decrease in fat metabolism has been demonstrated by several investigators but is probably best seen when a FATMAX test is applied. This graded exercise test, measures fat oxidation using indirect calorimetry over a wide range of intensities and the intensity at which fat oxidation is maximal can be determined relatively accurately. On average this may occur around 50-55% VO<sub>2</sub>max although intra-individual variation is very large. Only a small percentage of this variation can be explained. Many researchers have been puzzled by this decline in fat metabolism despite an increased demand. The underlying mechanisms that have been proposed include an increase in Malonyl CoA inhibiting CPTI and thus fatty acid transports into the mitochondria, a reduced free carnitine concentration in the muscle, limiting the fatty acid transport capacity and a decrease in pH, which could inhibit CPTI. Evidence for a causal relationship between these potential mechanisms and a reduction in fat metabolism is lacking. In addition to acute changes in the ability to oxidise fat, there are also chronic changes that might occur that increase the fat oxidative capacity. In fact, exercise training has been shown to be the most effective way to increase fat oxidation long term.

### **SKELETAL MUSCLE CARNITINE AVAILABILITY AND THE REGULATION OF FUEL SELECTION DURING EXERCISE**

Stephens, F.B.

*University of Nottingham*

More than 95% of the body's carnitine pool is confined to skeletal muscle where as a substrate for carnitine palmitoyltransferase 1 (CPT1) it translocates fatty acids into the mitochondrial matrix for  $\beta$ -oxidation, and as a substrate for carnitine acetyltransferase (CAT) it buffers excess acetyl-CoA from the pyruvate dehydrogenase complex (PDC) reaction during high glycolytic flux (Stephens et al, 2007). We have demonstrated in a series of studies that insulin stimulates muscle carnitine uptake (Stephens et al, 2007), and that 12-24 weeks of L-carnitine feeding in combination with a carbohydrate beverage in order to stimulate insulin release (1.4 g L-carnitine + 80 g carbohydrate twice daily) can increase the skeletal muscle carnitine store by 20-30% and have some remarkable effects upon fuel selection compared to carbohydrate feeding alone (Wall et al, 2011; Stephens et al, unpublished). For example, the increase in muscle carnitine content in these studies resulted in reduction in muscle glycogen utilisation (Wall et al, 2011), and an increase in whole-body fat oxidation and energy expenditure during low intensity exercise (cycling at 50% VO<sub>2</sub>max; Stephens et al, unpublished). Moreover, the increase in muscle carnitine after 12 weeks of supplementation resulted in a prevention of body fat accumulation associated with daily ingestion of a high carbohydrate beverage, and an adaptive increase in the expression of gene networks involved in insulin signalling, peroxisome proliferator activated receptor (PPAR) signalling, and fatty acid metabolism (Stephens et al, unpublished). Taken together, these findings suggest that increasing skeletal muscle carnitine content can maintain the capacity to oxidise fat in the face of high carbohydrate feeding, which is consistent with the premise that carnitine availability is limiting to CPT1. In contrast, the role of carnitine in carbohydrate oxidation becomes apparent during high intensity exercise (cycling at 80% VO<sub>2</sub>max) where an increase muscle carnitine content results in greater buffering of acetyl groups, and a better matching of glycolytic flux to mitochondrial ATP production as evidenced by increased muscle PDC activation and reduced muscle lactate accumulation. Manipulating both of these metabolic roles of carnitine will have implications for exercise performance. Stephens FB, Constantin-Teodosiu D, & Greenhaff PL (2007). New insights concerning the role of carnitine in the regulation of fuel metabolism in skeletal muscle. *J Physiol* 581, 431-444. Wall BT, Stephens FB, Constantin-Teodosiu D, Marimuthu K, Macdonald IA, & Greenhaff PL (2011). Chronic oral ingestion of L-carnitine and carbohydrate increases muscle carnitine content and alters muscle fuel metabolism during exercise in humans. *J Physiol* 589, 963-973.

### **SKELETAL MUSCLE FUEL UTILISATION DURING EXERCISE IN TYPE 2 DIABETES**

Van Loon, L.J.C.

*Maastricht University Medical Centre*

Elevated plasma free fatty acid (FFA) delivery and/or impaired FA oxidation, result in intramyocellular accumulation of triacylglycerol (TG) and FA metabolites (such as fatty acyl-CoA, ceramides, and diacylglycerol), which may induce defects in the insulin signaling cascade, causing skeletal muscle insulin resistance. Insulin resistance can subsequently lead to the development of the hyperglycemic and/or hyperinsulinemic state, which further stimulates IMTG accretion at the expense of IMTG mobilisation and subsequent oxidation. As such, excess IMTG accretion in sedentary, obese and/or type 2 diabetes patients is likely the result of a structural imbalance between FFA uptake, IMTG deposition and its subsequent mobilisation and/or oxidation. However, the proposed relationship between IMTG accumulation and insulin resistance does not appear to be functional, as endurance trained athletes are markedly insulin sensitive, despite substantially enlarged IMTG stores. The latter can be explained by the fact that in the trained athlete, elevated IMTG stores represent one of the many metabolic adaptive responses to endurance training, which enable a greater use of the IMTG pool as a substrate source during exercise. In contrast, the IMTG pool does not seem to represent a readily available substrate source in sedentary, obese and/or type 2 diabetes patients. An elevated IMTG utilisation rate could likely prevent and/or reduce excessive accumulation of intramyocellular TG and/or FA metabolites. Consequently, the turnover of the IMTG pool should form a major therapeutic target in the prevention and/or treatment of skeletal muscle insulin resistance and efforts should be made to develop strategies that stimulate IMTG use.

08:30 - 10:00

## Oral presentations

### OP-PM03 Adapted Physical Activity [AP] 3

#### EFFECTS OF A PROGRAM ABOUT ACTIVITIES IN THE WATER ON THE AQUATIC SKILLS OF CHILDREN WITH AUTISM SPECTRUM DISORDER

Nasser, J.P., Zuchetto, A.T.

UNIVERSIDADE FEDERAL DE SANTA CATARINA

**Introduction** The participation in physical activities programs is a challenge for children with Autism Spectrum Disorder (ASD) due to the lowest levels of motor development, low motivation, difficulty in planning, generalization and self-monitoring of activities. The therapeutic effects of water seem to moderate level of excitement and anxiety, and reduce the stereotypic behaviors and self-stimulation. The aim of this study was to analyze the effects of activities in the water and the development of aquatic skills of children with ASD. **Methods** This exploratory and qualitative research had a sample composed of two boys (4 and 5 years old) and two girls of 4 years old. Data was collected from the footages of water activities undertaken twice a week, for 36 weeks, totaling 72 sessions of 1 hour each. The analysis was performed before and after the intervention program through the assessment matrix of aquatic skills (Winnick, 2004), and the form they were developed. **Results** The participants demonstrated improvement in entrances and exits through the access ramp to the pool. First, they refused to do that, and after verbal and gestural instruction, they did it with autonomy and spontaneously entered in the pool. As for the respiratory control, the girls had significant advances in the ability of free diving, and a boy carried it out with physical conduction since the teacher handles his body in order to perform the specified task. In relation to the capacity for moving around the pool by floating, the students evolved in different evaluated skills, each one in his own way. **Discussion** The children not only evolved in the entrances and exits through the ramp of the pool, but also in the respiratory control and fluctuation displacements. The pool, with well-defined physical boundaries, may favor the concentration to the activities and help the students to identify and remember the exercises in each area in order to turn the actions more autonomous (Reid & O'Connor, 2003; Schultheis, Boswell, & Decker, 2000). It also shows positive responses regarding the initial activities of swimming and the improvement in aquatic orientation tasks (Yilmaz, Yanarda, Birkan, & Bumin, 2004). Reid, G., & O'Connor, J. (2003). *Palaestra*, 19(1), 21. Todd, T., & Reid, G. (2006). *Focus Autism Other Dev Disabl*, 21(3), 167-176. Schultheis, SF, Boswell, BB, & Decker, J. (2000). *Focus Autism Other Dev Disabl*, 15(3), 159. Winnick, JP. (2004). *Educação Física e Esportes Adaptados* (3 ed.). São Paulo: Manole. Yilmaz, I, Yanarda, M, Birkan, B & Bumin, G. (2004). *Pediatr Int*, 46(5), 624-626.

#### EFFECT OF COMBINED AEROBIC AND RESISTANCE EXERCISE TRAINING IN ADULTS WITH INTELLECTUAL DISABILITIES

Oviedo, G.1, Javierre, C.2, Álamo, J.2, Delicado, M.C.2, Soto, C.2, Giné-Garriga, M.1, Guerra, M.1

1-FPCEE Blanquerna-Ramon Llull University (Barcelona, Spain); 2-University of Barcelona (Spain)

**Introduction:** Individuals with intellectual disabilities (ID) show lower levels of physical activity (PA). Regular PA is essential for adults individuals with ID. **Purpose:** To investigate the effect of an exercise intervention program on physical fitness in adults with ID and compare it with a non trained group. **Methods:** Two groups of adults with moderate-severe ID participated in this study. The intervention group (IG) (17 women, 22 men; age=40.9±11y; BMI=27.6±5.34kg/m<sup>2</sup>) followed an aerobic and strength training program during 14 weeks, 1 h, 3 times a week. The control group (CG) (13 women; 15 men; age=45.6±12.3y; BMI=28.4±6.64kg/m<sup>2</sup>) did not train. Before and after the PA program, VO<sub>2</sub> peak, isometric strength, systolic and diastolic blood pressure (SBP and DBP) and body fat were evaluated. Independent t-test were used to compare groups. **Results:** After the PA intervention, VO<sub>2</sub> peak was 29.3±7.5 ml/kg/min and 24.4±4.8 ml/kg/min in the IG and CG respectively. IG showed a right handgrip of 22.8±8 kg (IG) meanwhile CG was 18.8±6.2 kg. Left handgrip was 21.1±6.8 kg for the IG and 18±6.7 kg for the CG. IG had legs dynamometry of 42.2±25.1 kg and 41.6±21.5 kg for CG. Resting SBP and DBP were 109.4±14.1/71.1±9.9 mm Hg in the IG and 114.9±17.8/72.6±8.6 mmHg in the CG. Maximal SBP and DBP were 131.9±18.9/67.3±9.8 mmHg in the IG and 134.8±19.2/74.5±13.4 mmHg in the CG. Body fat % was 29.1±10.6% in CG and 32.9±10.5% in IG. IG showed significant increases on VO<sub>2</sub> peak (p<0.05), right hand grip (p<0.05), and maximal workload achieved during the physical stress test (p<0.05). **Discussions:** This study showed the beneficial effects of a combined PA intervention in adults with ID that may also prevent cardiovascular diseases. **References** Bartlo, P., & Klein, P. J. (2011). Physical activity benefits and needs in adults with intellectual disabilities: Systematic review of the literature. *Am J Intell and Develop Dis*, 116(3), 220-232. Draheim, C. C., Williams, D. P., & McCubbin, J. A. (2002). Prevalence of physical inactivity and recommended physical activity in community-based adults with mental retardation. *Mental Retardation*, 40(6), 436-444. Fernhall, B., Pitetti, K. H., Rimmer, J. H., et al. (1996). Cardiorespiratory capacity of individuals with mental retardation including down syndrome. *MSSE*, 28(3), 366-371. Moss, S. J. (2009). Changes in coronary heart disease risk profile of adults with intellectual disabilities following a physical activity intervention. *J Intell Dis Research*, 53(8), 735-744. Temple, V. A., Frey, G. C., & Stanish, H. I. (2006). Physical activity of adults with mental retardation: Review and research needs. *AJHP*, 21(1), 2-12. (Supported by the MEC, ref. DEP2012-35335)

#### STANDING BALANCE IMPROVEMENTS IN ALCOHOLIC PATIENTS AFTER A SHORT-TERM TREATMENT

Carraro, A.1, Ferri, I.1, Gobbi, E.1, Greguol, M.2, Pavan, P.3

1: FISPPA, University of Padua (Italy); 2: SSD, State University of Londrina (Brazil); 3: DII, University of Padua (Italy)

**Introduction** Alcohol ingestion negatively impacts physical performance, causing worsening of psychomotor skills and reduced balance (Wober et al., 1999). Evidence indicates that exercise-related activities are associated with positive outcomes in the treatment of alcohol misuse disorders (Carraro, 2013; Weinstock, Barry & Petry, 2008). The purpose of the present study was to analyse changes in standing balance after a multidimensional short-term treatment of alcohol misuse, including exercise programs, in a group of chronic alcoholics. **Method** Participants were 32 alcoholic patients (20 men, 12 women; mean age 45.4, SD 9.2 years) consecutively admitted to a residential treatment. They participated to a mean of 15 (SD 3.5) group-based exercise sessions during a 4-week period of hospitalization. Pre- post-measures of standing balance were collected by using a low cost set up based on Nintendo Wii Balance Board (WBB) and administering a Romberg test with opened and closed eyes, with and without a pad-foam on the WBB. A 41 healthy subjects control group was also considered. **Results** Compared with healthy subjects, alcoholic patients revealed at the pre-test reduced standing balance (-44.3%, Co-

hen's  $d = -0.58$ ). Patients reported significant improvements after the treatment in the opened-eyes WBB tests (mean sway area pre vs. post without foam 7.0 vs. 4.1,  $p = .001$ ; with foam 25.8 vs. 15.5,  $p = .048$ ). Significant differences were recorded also in the closed-eyes tests (mean sway area 10.43 vs. 8.10,  $p = .041$ ; 84.6 vs. 59.2,  $p < .001$  respectively). Discussion Findings support the notion that standing balance control seems to be a serious problem for chronic alcoholics. A multidimensional treatment of alcohol misuse, including exercise-related activities, appears as an effective strategy to ameliorate in the short time standing balance control in this population. Further research is needed to evaluate the maintenance over the time of these positive outcomes. References Carraro A (2013). The role of exercise in alcohol dependence recovery. *Edi-Ermes, Milano*. Weinstock J, Barry D, Petry N (2008). *Addict Behav*, 33, 1072–1075. Wober C, Wober-Bingol C, Karwautz A, Nimmerichter A, Deecke L, Lesch O (1999). *Acta Neurol Scand*, 99, 48–53.

### ASSESSING PHYSICAL ACTIVITY IN POSTTRAUMATIC STRESS DISORDER: IS SELF-REPORT A VALID MEASURE?

Rosenbaum, S.1,2, Tiedemann, A.1, Sherrington, C.1, van der Ploeg, H.P.3

1 The George Institute for Global Health (Australia) 2 St John of God Healthcare (Australia) 3 EMGO Institute for Health and Care Research, VU University Medical Centre (Netherlands)

**Introduction** Individuals with posttraumatic stress disorder (PTSD) are less physically active (de Assis et al., 2008), and more likely to suffer from poor physical health than the general population (Boscarino, 2004). Physical activity research in this population is hampered by the lack of validated questionnaires. The objective of this study was to validate the International Physical Activity Questionnaire-Short Form (IPAQ-SF) for use among inpatients with PTSD. **Methods** Inpatients of the adult-trauma program at St John of God Hospital in Sydney (Australia) were recruited over a twelve-month period ( $n=59$ , 85% male; 49% police officers). Participants wore an Actigraph accelerometer for seven days, at the end of which participants self completed the IPAQ-SF. Analyses determined the construct validity of the IPAQ-SF against the accelerometer using Spearman rho correlation coefficients. Results The correlation between amount of moderate to vigorous physical activity measured by the Actigraph and total physical activity reported in the IPAQ-SF was 0.46 for the 29 participants with four or more valid days of accelerometer data and available IPAQ-SF data (0.45 for 3+ valid days,  $n=37$ ). Missing data were due to lower than expected compliance with wearing accelerometers ( $n=7$ , 3+ valid days;  $n=17$ , 4+ valid days), non-completion of IPAQ-SF due to early discharge ( $n=4$ ) or both reasons ( $n=3$ ). IPAQ-SF data were excluded from analysis if values were erroneously high (sum of physical activity  $\geq 16$  hours/day) ( $n=8$ ). When stratifying by severity of illness, based on the Health of the Nation Outcome Scale (HoNOS), the Spearman correlation was 0.59 for those with a greater illness severity (HoNOS total  $\geq 21$ ;  $n=14$ , 4+ valid days), and 0.48 for those with lower severity scores (HoNOS total  $\leq 20$ ;  $n=14$ , 4+ valid days). **Discussion** The IPAQ short form self-report questionnaire has acceptable construct validity for estimating physical activity participation of inpatients with PTSD. Poor compliance with wearing an objective activity monitor in this population is a limitation of this study. Clinician-facilitated administration of the IPAQ-SF is recommended to improve reliability in this population. References Boscarino, J. A. (2004). Posttraumatic Stress Disorder and Physical Illness: Results from Clinical and Epidemiologic Studies. *Annals New York Academy of Sciences*, 1032, 141-153. de Assis et al (2008). Evaluation of physical activity habits in patients with posttraumatic stress disorder. *Clinics (Sao Paulo, Brazil)*, 63(4), 473-478.

**08:30 - 10:00**

## Oral presentations

### OP-PM37 Physiotherapy [PT] 1

#### SURFACE EMG ACTIVITY OF SUBMENTAL MUSCLES DURING SWALLOWING AND EXPIRATORY MUSCLE TRAINING TASKS IN HUNTINGTON'S DISEASE PATIENTS

Reyes, A., Cruickshank, T., Thompson, J., Nosaka, K., Ziman, M.

*Edith Cowan University*

**Introduction** Huntington's disease (HD) is a neurodegenerative disorder characterised by involuntary movements, cognitive dysfunction and psychiatric disturbances. HD patients also suffer from dysphagia, leading to aspiration pneumonia, which is a major cause of death (1). It seems possible that submental muscles that are crucial for preventing an escape of a bolus into the airway, are affected by HD, but no previous studies have investigated this. Therefore, this study assessed surface electromyography (sEMG) activity of submental muscles during swallowing and expiratory muscle training (EMT) tasks in HD patients in comparison to healthy volunteers. **Methods** Average and peak sEMG activities of submental muscles during saliva, water (50 ml) swallowing, and EMT tasks performed at 25% and 75% of maximum expiratory pressure were recorded and normalised by the sEMG activity during an effortful swallow in which all throat and neck muscles are squeezed maximally. sEMG activities across the tasks were compared between 17 early to mid stage HD patients and 17 healthy volunteers (control) by a two-way repeated measures ANOVA. **Results** No significant differences in absolute and relative sEMG activities were evident between groups for saliva, water swallowing, EMT 25% and effortful swallow. sEMG activity was greater ( $p<0.05$ ) during EMT tasks at 25% ( $58.9 \pm 19.9\%$ ) and 75% ( $76.8 \pm 20.7\%$ ) than saliva ( $36.3 \pm 18.9\%$ ) and water swallowing ( $41.3 \pm 17.5\%$ ), and the activity was greater ( $p<0.05$ ) for 75% than 25% task for both groups. However, HD patients had lower ( $p<0.05$ ) percentage of sEMG activity ( $66.3 \pm 21.1\%$ ) relative to the activity during the effortful swallow compared with the control ( $80.8 \pm 17.3\%$ ) for EMT at 75%. HD patients had fewer ( $p<0.05$ ) swallows ( $4.22 \pm 0.97$ ) for the same amount of water ingestion than controls ( $5.06 \pm 0.98$ ). **Discussion** Decreases in submental muscle activity were not evident at early to mid stage of HD except during EMT at 75%. The between group difference at EMT 75% suggests that some degree of submental muscle weakness is seen only at a high intensity task. It might be that submental muscle function is more affected at later stages of the disease. The fewer number of swallows on the water intake for HD patients compared with controls suggests that the impulsiveness leading to coughing, choking and aspiration of a bolus into the airway is present during deglutition (2). Given that EMT tasks induced significantly greater submental muscle activity than water and swallowing tasks, EMT could be used as a therapeutic and/or prophylactic modality to ameliorate the risk of aspiration pneumonia in HD individuals. **References** 1) Gil JM, Rego AC. *Eur J Neurosci*. 27:2803-20,2008. 2) Heemskerk AW, Roos RA. *Dysphagia*.26:62-6,2011.

## THE SWEDISH PHYSICAL ACTIVITY AND FITNESS COHORT STUDY : THE RELATIONSHIP BETWEEN PHYSICAL CAPACITY AND LUMBO-PELVIC MOVEMENT CONTROL IN MIDDLE-AGED MEN AND WOMEN

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**Aim** This study investigates whether physical capacity and low back pain are related to movement control in the lumbopelvic region in men and women at the age of 52 years. **Background** Optimal movement patterns ensure that functional tasks can be performed in an efficient way. Further, identifying aberrant movement patterns is fast becoming a cornerstone of rehabilitative neuromusculoskeletal practice since individuals with nociceptive pain often have uncontrolled movements. At present there is, however, little published literature relating uncontrolled movements in the lumbo-pelvic area to pain or to physical performance in a general population. **Subjects and Methods** In 1974 muscular endurance and strength, flexibility, height and weight, were measured in randomly selected 16-year old students (n=425). In 1992 and 2010, the same individuals (1992: men n=157, women n=205, 2010: men n=113, women n=98) were followed up with the same tests. In 2010 the follow-up was supplemented with two tests of lumbo-pelvic movement control: standing Trunk Lean Test (TLT) and supine Double Bent Leg Lower test (DBLLT). These tests assess whether the individual is able to correctly control the movements of the lumbo-pelvic region in flexion and extension, respectively. Univariate logistic regression analyses were performed with TLT and DBLLT as dependent variables and physical performance as independent variables. Chi-square tests were performed to investigate the associations between low back pain during the last 12 months (yes/no) and performance of the TLT and the DBLLT, respectively. The Regional Ethical Review Board in Umeå, Sweden, approved the study. **Results** At the age of 52, significantly more women (65%) than men (44%) performed the TLT correctly (p=0.0039). About 20% of the men and 30% of the women performed the DBLLT test correctly (p=0.073). A higher number of the men without low back pain during the last 12 months, compared to those with back pain, correctly performed the DBLLT (p=0.041). Likewise, women without low back pain during the last 12 months, compared to those with pain, tended to correctly perform the TLT (p=0.068). Among both men and women positive associations were found between lumbar flexion control and hamstrings flexibility, and between extension control and lift strength. Among women, flexion control was also associated with high aerobic capacity and low BMI. A high performance in bench-press in 1974, 1992 and 2010, respectively, was also associated with extension control in 2010. Interestingly, among the men, a high BMI was associated with extension control in a supine position. **Discussion** In a general population of middle-aged men and women, the presence of uncontrolled movements in the lumbo-pelvic area seems to be related to physical performance and having periods of low back pain. Therefore, classifying the site and direction of uncontrolled movements and relating assessment findings to restrictions and disability might be beneficial in rehabilitative neuromusculoskeletal practice.

## EXERCISE HEMODYNAMICS IN PARKINSON'S DISEASE

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Non-motor features are very common in Parkinson's disease (PD), including autonomic nervous system dysfunction. Cardiovascular autonomic dysfunction can result in precipitous reductions in upright blood pressure (e.g., orthostatic hypotension (OH)) and/or various symptoms, e.g., cognitive impairment, fatigue and fainting. Exercise is a common therapy for PD. Exercise can threaten blood pressure during and/or after exercise however, especially in other autonomic disorders (e.g., Multiple System Atrophy). It is unclear, however, if blood pressure increases appropriately or if exercise accentuates OH in PD patients with autonomic dysfunction. The aim of this study was to examine hemodynamic responses to exercise in PD patients with autonomic dysfunction. Twenty patients (71±7 yr, 7 females) with a confirmed PD diagnosis who were referred to our Autonomic Units during 2008-2012 with suspected autonomic dysfunction performed a supine cycling exercise test (3 min at 25, 50 and 75 watts) with a 5 min stand test pre- and 10 min post-exercise. Blood pressure and heart rate were intermittently recorded using upper arm sphygmomanometry. The group mean supine systolic/diastolic blood pressure was 140±17/77±9 mm Hg, respectively (heart rate; 66±10 beats.min<sup>-1</sup>). Systolic blood pressure (SBP) fell during pre-exercise stand (-34±27 mm Hg, P<0.001), while heart rate (HR) increased (+13±7 beats.min<sup>-1</sup>, P<0.001). The group mean SBP (141±19 vs 161±22 mm Hg, P<0.001) and HR (65±10 vs 94±12 mm Hg, P<0.001) increased during exercise. There was a wide variation in the exercise responses however; SBP increased in 13 patients (INC; +30±14 mm Hg) and either did not change or decreased in 7 patients (DEC -5±7 mm Hg, P<0.001 vs INC). A similar trend was evident for diastolic blood pressure (DBP, +6±12 vs -1±7 mm Hg, P=0.11). The increase in HR was not different between these sub-groups (30±12 vs 25±12 beats.min<sup>-1</sup>, INC vs. DEC, P=0.40). The size of the pre-exercise stand SBP reduction was greater in DEC vs INC (-60±23 (7 out of 7 had OH) vs -19±16 (7 out of 13 had OH) mm Hg, P<0.001). The same was evident for DBP (-21±8 vs -5±6 mm Hg, P<0.001), whereas the HR elevation was not different (13±8 vs 13±5 beats.min<sup>-1</sup>, DEC vs INC, P=0.92). The post-exercise stand SBP reduction for the whole group (-24±26 mm Hg) was not greater (but was in fact smaller) relative to pre-exercise stand (P=0.017). Post-exercise supine SBP/DBP was lower for the whole group compared to pre-exercise supine (133±15/74±10 mm Hg, P<0.05). Similar results were evident for INC and DEC sub-groups. These data indicate that 1) the magnitude of the exercise blood pressure response in PD patients with autonomic dysfunction is related to the severity of their cardiovascular autonomic dysfunction (as indexed by their OH) and 2) exercise does not appear to worsen OH in this sample of PD patients but lowers resting blood pressure. These findings have implications for clinicians and their management of PD patients, as well as therapists using exercise interventions in PD.

## EMG OF PARAVERTEBRALIS MUSCLES IN DIFFERENT EXERCISES AND APPARATUS USED IN THE PREVENTION AND THERAPY OF BACK PAIN

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**ELECTROMIOGRAPHY OF PARAVERTEBRALIS MUSCLES IN DIFFERENT EXERCISES AND APPARATUS USED IN THE PREVENTION AND THERAPY OF DIFFUSE BACK PAIN** **Introduction** The "Diffuse Back Pain" (DBP) is a chronic and unspecific pathology affecting 70-80% of the industrialized countries population. There's a consent to relate the fatigability of the trunk extensors muscles measured with EMG, as an important factor of the DBP. **2,3 Methods** **Subjects:** 4 physical education students, 22.0 ± 2.4 years of age, 75 ± 5.2 kg and 170.4 ± 6.8 cm, volunteered to participate in this study signing an informed consent. **Materials:** to measure the bilateral EMG signal of the muscles: neck extensors, dorsalparaspinal, erectorspinal and multifidus, we utilized the ME 6000 EMG system (Mega electronics, Kuopio, Finland) with surface electrodes (Ag/Ag Cl) and gel conductor (Ambu Blue Sensor, M-00-S, Denmark). **Protocol:** to evaluate the muscles fatigability, the amplitude of the EMG signal was normalized with an isometric contraction force > 30% of the MVC. The exercises studied were: 1/ From

orthostatic position: maximal ankles extension. 2/ Lying facing the floor with flexed knees: trunk extension with extended elbows and hands entwined. 3/ Sitting in the Back EFS with flexed trunk: 45° trunk extension. 4/ Lying facing the floor with flexed knees and belly against the T-Bow: trunk extension with extended elbows and hands entwined. 5/ In the Orthopod, with trunk flexed: 45° extension. Results Except for the multifidus, the EMG signal of the muscles studied in the exercises performed in the T-Bow and Orthopod, was higher ( $p < 0,001$ ). The multifidus EMG signal on exercise 2 ( $190,5 \pm 65,9 \mu\text{V}$  &  $231,2 \pm 85,5 \mu\text{V}$ , left & right) was more intense than the obtained with the T-Bow ( $77,5 \pm 12,4 \mu\text{V}$  &  $33,5 \pm 6,2 \mu\text{V}$ ); Back EFS ( $69,3 \pm 12,6 \mu\text{V}$  &  $73,2 \pm 21,6 \mu\text{V}$ ) and Orthopod ( $63,8 \pm 24,1 \mu\text{V}$  &  $26,2 \pm 8,2 \mu\text{V}$ ). In the exercise 1, the intensity was much lower:  $6,8 \pm 2,5 \mu\text{V}$  &  $15,1 \pm 5,0 \mu\text{V}$ . Discussion/conclusion Despite the DBP is normally only related to the lumbar area, we strongly believe that any muscular/structural problem in the neck, especially in the atlas-axis joint, will worsen this pathology. Therefore, for the prevention and therapy of the DBP is necessary to analyze the action of the different paravertebralis muscles on the different parts of the spine. References 1.- Bulletin of the World Health organization 2003: 81-89 2.- Candotti C.T., Loss J.F., Pressi A.M.S., et al. (2008). EMG for assessment of pain in low back muscles. *Physical Therapy*, 88 (9): 1061-1067. 3.- Jubany J., Vallejo L, Barbany J.R. (2011). "Lumbalgia crónica inespecífica. Tests físicos para detectarla. Prueba piloto". *Apunts Educación Física y Deportes*, 106 (4°):18-25

### COGNITIVE FUNCTIONAL THERAPY FOR THE MANAGEMENT OF LOW BACK PAIN IN ADOLESCENT MALE ROWERS: A RANDOMIZED CONTROLLED TRIAL

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Introduction Contemporary low back pain models propose that the pain is a result of interactions of bio-psycho-social factors, supporting the need for a multidimensional approach for effective management (O'Sullivan, 2011). With research supporting a high prevalence of low back pain in adolescent rowers (Perich, 2011), the aim of this study was to determine the efficacy of cognitive functional therapy to reduce pain and disability in male adolescent rowers. Methods The cognitive functional therapy intervention group (n=19) received an 8-week classification-based program targeting: education regarding pain mechanisms, movement training directed to provide the rowers with alternative movement strategies to minimize pain during rowing (with the use of feedback) and rowing specific conditioning exercises. The control group (n=17) received their usual coaching with no input from the treatment physiotherapist. The primary outcomes of this study were; pain - as measured by Numeric Pain Rating Scale (NPRS) during each minute of a 15-minute ergometer trial pre/post-intervention, and disability - measured by Patient Specific Functional Scale (PSFS) and Roland Morris Disability Questionnaire (RMDQ) pre/post intervention and at 12-week follow-up. The secondary outcomes, measured pre/post intervention, were isometric muscle endurance of the back extensors and quadriceps muscles, and hip, pelvis and trunk kinematic data collected using a 3D electromagnetic device during the 15-minute ergometer row and during static sitting positions. Multilevel linear mixed models were used to estimate group differences in outcomes, adjusting for baseline measures. Results Rowers in the intervention group had significantly less overall pain and less increase in pain compared to the control group over the 15-min ergometer trial following the intervention (NPRS diff for 15th min: -3.6,  $p < 0.001$ ). Furthermore, the intervention group had significantly less disability both immediately post-intervention and at 12 weeks (PSFS diff 12-wks: 4.0,  $p = 0.014$ ; RMDQ diff at 12-wks: -1.4,  $p = 0.013$ ), and also significantly better quadriceps endurance (diff: 20.9,  $p = 0.031$ ). No group differences were found in hip, pelvis and trunk kinematics during rowing, although the intervention group postured their lower lumbar region in more extension in static sitting post-treatment (diff: -9.60,  $p = 0.007$ ). Discussion Adolescent male rowers receiving cognitive functional therapy demonstrated reduced pain and disability, and improvements in quadriceps muscle endurance and habitual sitting posture, in comparison to a control group. However, this study did not detect a treatment benefit for spinal kinematics during rowing. O'Sullivan P (2011). *BJSM* 46 (4), 224-227 Perich (2011). *KSSTA* (19), 20-28

### EFFECT OF TWO-MONTH HOME EXERCISE PROGRAMME ON RANGE OF MOTION, PAIN AND MUSCLE TONE IN PATIENTS WITH HALLUX VALGUS

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Introduction Hallux Valgus (HV) is a foot deformity, which causes pain, inflammation and decreased joint mobility in the big toe. There is no universally accepted protocol for treating advanced phase HV (Schuh et al., 2009). The purpose of this study was to assess the effects of two month home exercise programme (HEP) on joint mobility and pain of the first metatarsophalangeal joint (MTP-joint) and muscle tone in calf muscles in women with advanced phase HV deformation. Methods Ten women with mean age ( $\pm$ SD)  $55.5 \pm 2.7$  years with advanced phase HV deformation (first MTP-joint angle more than 20 degrees) who were scheduled for surgery participated in the study. Foot function using modified Foot Function Index (FFI) (Agel et al., 2005) and passive range of motion (PROM) of flexion and extension of the first MTP-joint were assessed. Calf muscle tone (tibialis anterior (TA), extensor digitorum longus, peroneus longus (PL) and gastrocnemius medial head (GM)) was measured in lying and standing position at rest and contraction using hand-held myotonometer Myoton 3 (Müomeetria Ltd, Estonia). All measurements were taken before and after two-month HEP, which consisted of fifteen exercises derived from postoperative and mild phase HV physiotherapy (Schuh et al., 2009, Bayar et al., 2011). Results A 33% increase ( $p < 0.001$ ) in the PROM extension of the first MTP-joint after HEP was noted compared with the joint mobility before HEP, also PROM flexion increased considerably but no significant difference was noted. FFI pain score decreased by 41% ( $p < 0.01$ ) after HEP. Patients demonstrated a significant increase ( $p < 0.01$ ) of GM muscle tone as well as decrease ( $p < 0.05$ ) of TA:GM and PL:GM muscle tone ratio in lying position at rest. Discussion In advanced phase HV two-month HEP was an effective therapeutic approach for increasing first MTP-joint mobility and reducing foot pain. Also, the imbalance of muscle tone in antagonist muscles of the calf was reduced. The exercises in HEP were oriented to improve mobility and proprioception of the foot and to strengthen the muscles of foot and calf. Positive results show the importance of including mobilization and muscle strengthening exercises to HV rehabilitation. References Agel J, Beskin JL, Brage M, Guyton GP, Kadel NJ, Saltzman CL, Sands AK, Sangeorzan BJ, SooHoo NF, Stroud CC, Thordarson DB. (2005). *Foot Ankle Intern.* 26 (11), 962-967. Bayar B, Erel S, Şimşek IE, Sümer E, Bayar K. (2011). *Turk J Med Sci.* 41 (3), 403-409. Schuh R, Hofstaetter SG, Adams Jr SB, Pichler F, Kristen K-H, Trnka H-J. (2009). *Phys Therapy.* 89 (9), 934-945.

08:30 - 10:00

## Oral presentations

### OP-BN06 Biomechanics [BM] 6

#### INFLUENCE OF A FORCE-CONTROLLED BITING TASK ON BODY SWAY AND LOWER EXTREMITY KINEMATICS DURING ONE-LEGGED SQUATS

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**Introduction** Deficits in postural control represent an important risk factor for falls (Granacher et al., 2010). The risk of sustaining falls is particularly high in seniors. Considering the demographic changes in Europe an increased prevalence of fall-related injuries and higher medical treatment costs must be expected (Stevens et al., 2006). In the recent years numerous studies revealed a neuroanatomical and functional integration of the craniomandibular system (CMS) into the postural control of the human body (Borojerdi et al., 2000). However, the nature of this interrelation could not be clarified yet. Therefore, the aim of this study was to investigate whether force-controlled biting tasks could influence body sway and lower extremity kinematics during one-legged squats, as it was shown for upright bipedal stance (Hellmann et al., 2011). **Methods** To assess the effects of oral motor activity on the balancing behavior, twelve healthy subjects performed one-legged squats under four experimental conditions (biting and non-biting, on the dominant and non-dominant leg, respectively). The bite forces were measured by the use of a hydrostatic system and the current force was visualized in form of a numeric real-time feedback. In addition to common equilibrium parameters (i.e. sway area, length, velocity) various kinematic variables of the lower extremities were calculated via a biomechanical motion analysis. For each condition three valid trials were included in the evaluation. **Results** The results showed that force-controlled biting significantly reduced the COP path length in medio-lateral direction. Furthermore, descriptive statistics revealed smaller values for the other posturographic parameters during the submaximum biting task. Changing the supporting leg had no effects on body sway and joint kinematics. **Discussion** The reduced COP path length in the medio-lateral direction is a further proof of the functional coupling of the CMS and the human postural control. Possible reasons for the lack of additional significant effects might exist in the small sample group and the squat itself, which in comparison to the bipedal stance is a rather voluntary controlled motion and therefore maybe inappropriate for posturographic evaluations. To quantify the influence of dental occlusion on the balance ability and in order to elucidate the efficiency of oral devices to prevent falls further research is necessary. Future studies should concentrate on the assessment of more trivial movement tasks in larger samples. **References** Borojerdi B, Battaglia F, Muellbacher W, Cohen LG (2000). Clin Neurophysiol, 111, 988-993. Granacher U, Muehlbauer T, Gollhofer A, Kressig RW, Zahner L (2010). Geron, 57, 304-315. Hellmann D, Giannakopoulos NN, Blaser R, Eberhard L, Schindler HJ (2011). J Oral Rehab, 38, 1-8. Stevens JA, Corso PS, Finkelstein EA, Miller TR (2006). Inj Prev, 12, 290-295.

#### BODY BALANCE IN HEALTHY ELDERLY: DIFFERENCES BETWEEN YOUNGER OLD AND OLDEST OLD

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**Introduction** In elderly people body balance is necessary to maintain physical function and to prevent falls. It is widely accepted that body balance deteriorates with age, especially in the last decades of life. Differences between young adults and elderly are more prominent in the medial-lateral direction. However, elderly people comprise a wide range of age and balance between the younger old (YO) and the oldest old (OO) has not been examined to our knowledge. Therefore, the aim of the present study was to compare the body balance by age in healthy elderly participants. **Methods** A sample of 55 participants was divided according to age in YO group (61-71.8 years, n=27) and OO group (72.3-87 years, n=28). We assessed the sway of the centre of pressure (CoP) with a force platform (Dinascan IBV, model 600M) at a frequency of 500Hz. Data were collected across three conditions: quiet standing with eyes open (EO), with eyes closed (EC) and dual task with an additional cognitive task (DT) that consisted in counting backwards by threes. Three 20-second trials were collected per condition. The balance variables were: maximal distance, peak velocity, and trajectory of the CoP in the anterior-posterior (AP) and medial-lateral (ML) directions. All measurements were normalized by the base of support. Two (age groups) by three (balance conditions) ANOVAs were used for all variables. **Results** Balance was better with EO in comparison to EC or DT ( $p < .001$ ) for all variables in both sway directions, and for both groups. When considering all balance conditions together, peak velocity and trajectory was statistically different between age groups only in the AP direction ( $p < .05$ ). The OO group presented higher AP peak velocity (22%) and AP trajectory (32%) than the YO group. However, there were no differences between age groups in any of the ML direction variables. **Discussion** Our results are consistent with existing findings that reported worse balance with eyes closed or dual task than eyes opened in the elderly. Unlike ML direction defining balance difference between young adults and elderly or between elderly fallers and elderly non-fallers (Rogers and Mille, 2003), our findings showed that AP discriminates between the YO and the OO. Similar findings with dynamic balance were observed when comparing new-walkers with experienced-walkers in toddlerhood (Looper et al., 2006). We suggest exercise interventions focused on the oldest old should include exercises to improve body balance in the AP direction. **References** Looper J, Wu J, Angulo Barroso R, Ulrich D, Ulrich BD (2006). J Mot Behav, 38(5), 367-372. Rogers MW, Mille ML (2003). Exerc Sport Sci Rev, 31(4), 182-187.

#### INFLUENCE OF EXPERTISE AND PLAYING POSITION ON POSTURAL CONTROL OF YOUNG AND ADULT ELITE SOCCER PLAYERS

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**Introduction** In soccer, balance represents a key factor to achieve an optimal performance level and reduce the risk of lower limb injuries. In particular, it has been demonstrated that soccer players exhibit, due to the specific training, superior postural control in unipedal stance conditions with respect to either untrained subjects or athletes of other disciplines (Matsuda et al, 2008, 2010). Nevertheless, the effects of playing position and expertise have been scarcely investigated (Bizid and Paillard, 2006, Paillard et al., 2006). Therefore, the aim of this study was to assess the possible changes in postural control performances in young and adult elite soccer players according

to their age (and thus expertise) and playing position. Methods A total of 83 adult and young athletes who compete in national tournaments, were recruited for the study. In particular we tested players of Italian first league (Serie A, n=23) and youth leagues (Under 19, n=19, Under 17, n=26, Under 15, n=15). Using a pressure platform, time series of center of pressure (COP) position were acquired under bipedal (BP) and unipedal (UP) conditions. Data processing allowed to calculate Sway Area (SA), COP Path Length, COP displacements in Antero-Posterior (AP) and Medio-Lateral (ML) directions, as well as COP velocity. Results Under BP conditions, no statistically significant differences were observed between the teams or different playing positions. For the single leg stance, no effect of limb was detected, while playing position influenced all the considered variables except COP velocity in ML direction, and team was responsible for changes in SA only. In particular, post-hoc analysis revealed that midfielders achieved the best performances and defenders the poorest. Also, youngest players of Under 15 team were characterized by SA values significantly higher than both Under 19 and Serie A team. Discussion An interesting result of this study is represented by the superior balance performance exhibited by the midfielders, probably due to their habit to handle the ball for longer times during a match. It is also noticeable that the effect of age on postural control is evident only in UP stance, being the youngest athletes characterized by the worst postural control. Our data also suggest that BP tests might not be sensitive enough to investigate balance in soccer players. Consistently with previous studies, no differences in postural sway were found between dominant and non-dominant limb. References Matsuda S, Demura S, Uchiyama M. (2008) *J Sports Sci*.26(7), 775-779 Matsuda S, Demura S, Demura T. (2010) *Percept Mot Skills* 110(3), 751-760 Bizid R, Paillard, T. (2006) *Science & Sports* 21(1), 23-25 Paillard T et al. *J Athl Train* (2006) 41(2), 172-176

## AGE-RELATED NEUROMUSCULAR FUNCTION AND DYNAMIC BALANCE CONTROL DURING SLOW AND FAST DYNAMIC BALANCE PERTURBATIONS

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INTRODUCTION It has been shown previously that static postural control in man is connected to efficient synaptic transmission between afferent and efferent pathways (H-reflex) at spinal level (Koceja et al. 1995). There is also evidence that fast force production capability is related to good balance control (Piirainen et al. 2010). Therefore, the purpose of this study was to investigate whether H-reflex response, measured during standing balance perturbation and isometric rapid force production are connected to dynamic balance control in young and elderly males. METHODS Totally 19 healthy young (Y; N=9, 27±3 years) and elderly (E; N=10, 68±3 years) males participated in this study. Standing balance perturbation was measured using custom build balance measurement device in SLOW (max velocity 15cm/s) and FAST (max velocity 25cm/s) conditions, in anterior and posterior direction and in horizontal plane. H-reflex (H/M20%) was measured 30ms after the onset of anterior and posterior perturbations in both SLOW and FAST conditions. Rapid torque production (peak torque at 200ms) was measured during maximal isometric knee extension. RESULTS In SLOW perturbation E showed larger peak displacement after anterior perturbation (15%, p<0.05), whereas in FAST no differences were observed. However, in FAST Y showed a trend (37% p=0.086) for faster recovery after the perturbation. No differences were observed in posterior direction on either velocity. H/M20% was significantly lower in E during FAST perturbation (anterior, -50% p<0.05; posterior, -51% p<0.05). In SLOW, only a trend for age-related (anterior, -40% p=0.069; posterior, -37% p=0.098) differences were observed. E showed significantly lower isometric rapid knee extension torque (Y 310±31 Nm; E 176±46 Nm, p<0.001). When both groups were combined, rapid torque production (r=-.536 p<0.05; r=.494 p<0.05) and H/M20% (r=-.510 p<0.05; r=-.580 p<0.05) correlated negatively with anterior SLOW peak displacement and positively with anterior FAST peak recovery, respectively. DISCUSSION According to these results age-related differences in balance control were more evident in anterior than in posterior direction perturbations. Decreased H-reflex sensitivity in E may be caused by lower activity from sensory receptors or increased pre-synaptic inhibition (Koceja & Mynark, 2001). Correlation analysis revealed that both rapid torque production and high reflex sensitivity are important factors for good dynamic balance control. REFERENCES 1. Koceja DM, et al. 1995. *Electroencephalogr Clin Neurophysiol*. 97(6):387-93. 2. Piirainen JM, et al. 2010. *Eur J Sport Sci*. 10(1): 69-79 3. Koceja DM & Mynark RG. 2001. *J Appl Biom*. 17:188-203

## CHANGES IN POSTURE AND BALANCE PERFORMANCE DURING FIVE DAYS OF WOBBLE BOARD TRAINING

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CHANGES IN POSTURE AND BALANCE PERFORMANCE DURING FIVE DAYS OF WOBBLE BOARD TRAINING Granerud, E. & Federolf, P. Norwegian School of Sport Sciences, Oslo, Norway Introduction Human postural control is facilitated through postural movements such as ankle-, hip-, or multi-joint strategies (Winter, 1995). Principal component analysis (PCA) applied to kinematic marker offers a novel approach study the structure of postural movements by identifying and quantifying correlated segment motion (Federolf et al. 2012, in press). This study investigated if the structure of the postural movements changes as subjects learn to master a balance task (standing on a wobble board). It was hypothesized that the relative contribution of principal components quantifying the main types of body sway (e.g. ankle strategy) to the whole postural movements would decrease as subjects improved in performance, while the contribution of higher-order movement components might increase. Methods Eleven healthy male volunteers (age 25.1±1.7, weight 77.2±5.8 kg, height 1.80m±0.07) conducted a total of 25 120-second quiet stance trials on a wobble board, 5 trials per day during 5 consecutive days. The subjects' postural movements were recorded with a standard 3D-camera system (ProReflex, Qualisys INC., Gothenburg, Sweden) using 45 reflective markers distributed over all major body segments. For each timeframe, a 135-dimensional posture vector was defined that included all marker coordinates. The posture vectors of all trials of a subject were normalized and assembled into an input matrix for the PCA. The structure of a subject's postural movements were then characterized by calculating the relative contribution (RC) of the first 10 principal movement components (PCs) to the entire postural variation in one trial. For each trial, a "balance score" was calculated by totalling the standard deviation of the vertical position of 4 markers placed on the wobble board. A repeated measures ANOVA (Sidak correction) was conducted to determine differences in RC or balance score between trials. Results Balance performance on the wobble board improved over the first 2-3 test days with the balance score decreasing from 52.1±11.0 in the first trial to levels below 34.2±6.1 in all trials of the 4th and 5th day (mean±stdev). This change was significant (F(1,24)=11.17, p<0.001). However, no changes were observed in the structure of the postural movements as quantified by the first 10 PCs: F(1,24)<1.42, p>0.98 in the RC calculated for the first 10 PCs. Discussion The hypothesis was not confirmed. The results of this study suggest that the improvement in performing the wobble-board balance task was not related to changes in the structure or organization of postural movements as quantified by PCA-RC. References Federolf P, Roos L, Nigg B (2012). *Footwear Science*, 4:2, 115-122. Federolf P, Reid R, Gilgien M, Haugen P, Smith G (in press) *Scan J Med Sci Spor*. Winter DA (1995) *Gait Posture*, 3, 193-214.

**NEUROMOTOR CONTROL IN CHILDREN WITH AND WITHOUT CEREBRAL PALSY WHILE HOLDING A LOAD**

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Introduction Spastic cerebral palsy (CP), the result of an insult to an immature central nervous system, has a primary adverse effect on neuromotor control and movement patterns characterized by slow and stiff movements. The upper extremities (UE) are more involved in postural control in CP than children with typical development (TD). However, little is known about the effects of UE holding a load on neuromotor control in children with CP and with TD. Methods 43 children participated in the study, 21 with spastic diplegic cerebral palsy (SDCP) (9,37±2,90 yr) and 22 with TD (9,11±2,55 yr). Both groups were matched for age and sex. The total sample also was subdivided into 3 age groups (5-7; 8-10; 11-13 yr). Children were instructed to maintain quiet stance for 30 seconds in 3 different conditions: Arms free or baseline (B); Holding a tray (T); Holding a load equivalent to 4% of body weight (W). 3 valid trials were registered per condition. The center of pressure (CoP) was computed with a force platform (Kistler 9286BA) and BTS systems software, sampling at a frequency 140Hz and filtered with a cutoff frequency of 10Hz. The variables analyzed were the position (POS), path length (LEN) and peak velocity (PkV) of the CoP in the anterior/posterior (AP) and medial/lateral (ML) directions. 2 (SDCP, TD) x 3 (age groups) x 3 (conditions) ANOVAs with repeated measures in conditions were conducted. Results A significant group effect was found in 5 of the 6 variables (all  $p < .05$ ), indicating that POS was more anterior and to the left in SDCP than TD group. Furthermore, PkV in AP and ML, and LEN in AP, were larger in SDCP than TD group. Significant or tendencies to significant age effect were also found in 5 of the 6 variables (all  $p \leq .08$ ), with POS in AP becoming more anterior, and LEN and PkV in AP and ML decreasing with age. For condition, only POS in AP had a tendency to be more anterior in W compared to B conditions ( $p = .06$ ). None of the group x condition interactions was significant. Discussion Our data confirmed that neuromotor control is worse in children with SDCP than TD but we provided the new knowledge of no differential group effects in the CoP characteristics when the upper extremities held up to an equivalent load of 4% of body weight. As expected, data confirmed the developmental progression of neuromotor control regarding CoP characteristics. Based on these results, we suggest that rehabilitation intervention including bimanual activities holding a load up to 4% of the body weight may be adequate in SDCP, since this manipulation had no impact in the neuromotor control of their static balance control. However, possible conditions effects should be examined at the cinematic and muscular pattern level.

**08:30 - 10:00****Oral presentations****OP-PM39 Rehabilitation [RE] 2****MOMENT-KNEE ANGLE RELATIONS AND GAIT ANALYSIS IN FEMALES 10 YEARS POST TOTAL KNEE ARTHROPLASTY**

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Introduction The implantation of total knee arthroplasty (TKA) is a standard clinical procedure at the final stage of gonarthrosis (McClelland et al., 2007). Despite the clinical success of TKA, profound limitations of neuromuscular capacities and biomechanical gait patterns were reported in patients several months post TKA (Valtonen et al., 2009). However, limited information exists about possible long-term reductions of neuromuscular capacities in TKA patients. Methods Ten years post surgery 9 female TKA patients (64 years, mobile-bearing knee inlay, LINK, Germany) and 10 age-matched controls were tested in this study. The unilateral maximal voluntary isometric knee angle relations of knee extensors and flexors and the EMG knee angle relation of m. vastus medialis and m. vastus lateralis were studied using an isokinetic dynamometer with synchronized surface EMG. Lower extremity sagittal plane kinematics during treadmill-walking at 2km/h were recorded using an active-infrared motion analysis system (Lukotronic-Gaitlab AS 200, Steinbichler GmbH, Innsbruck, Austria). Plantar pressure distribution was analyzed at individual walking speeds using a pressure-platform (zebris-FDM, zebris Medical GmbH, Isny), Germany). Results Compared with controls, TKA patients reached significant lower absolute and body mass normalized knee extension and knee flexion moments at all tested knee angle positions. However, no significant group effects were detected in the normalized [% Max.] moment knee angle relations for both muscle groups. The normalized [% Max.] EMG-knee angle relation of the knee extensors was also without significant group differences. Compared with controls, TKA patients demonstrated several functional reductions of their biomechanical gait pattern and significant alterations of their plantar pressure profiles. Discussion The current findings indicate that 10 years post surgery, TKA patients demonstrate significant reductions in maximum voluntary force production capacities and biomechanical gait parameters. Long-term controlled strength training might be important in the rehabilitation process with TKA patients. References McClelland, JA, Webster, KE, Feller, JA. (2007). The Knee, 14, 253-263. Valtonen, A, Poyhonen, T, Heinonen, A, Sipilä, S. (2009). Physical therapy, 89, 1072-1079.

**DUAL-TASK EXERGAMING IMPROVES BALANCE AND GAIT IN PATIENTS WITH MULTIPLE SCLEROSIS AS MUCH AS CONVENTIONAL BALANCE TRAINING**

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Background: Multiple sclerosis (MS) normally entails various restrictions of the patients' everyday life and quality of life. One of these restrictions is the increased fall risk due to balance problems. Conventional balance training rehabilitation programs usually improve balance scores in the short run. However, long-term improvements can seldom be achieved due to a lacking adherence to the exercise program outside the physiotherapy or rehabilitation clinic. In addition, the results of recent studies suggest that balance training with an additional cognitive or motor task – so-called dual-task (DT) training - might be more relevant than conventional single-task (ST) training, as DT situations have a much higher fall risk (Granacher 2010). The aim of the present study was to assess if a balance training based on DT and serious gaming would increase compliance and improve balance and gait in MS patients more than ST training. Methods: 63 MS patients were divided into 3 training groups; the first group took part in conventional balance training (CTG), the second group underwent

a DT serious gaming program (playing exergames on an unstable platform)(DTG), and the third group performed exercises on the same unstable platform without exergames (STG). All participants trained for 3 weeks, with a total of 9 training sessions lasting 30' each. Before and after the training period, they performed 11 balance tests (7 on a force plate and 4 on the unstable surface) and a gait analysis under ST and DT. In addition, after the training period they were asked to fill out a questionnaire about the training program. Results: All three groups showed improved balance and gait scores ( $p < 0.05$ ), but there was no significant group x time effect. However, in contrast to the other two groups, the DTG reported that they would have trained longer than 30' per training session and that they intended to continue the training at home. Conclusions: Playing serious games on an unstable surface improved balance and gait as much as ST balance exercises on an unstable platform or a conventional balance rehabilitation program. Although the group x time interaction effect did not reach significance level, the DTG scored higher in most of the DT balance and gait tests than the STG and the CTG, suggesting that DT exergaming might indeed be beneficial in DT situations, but that this effect was masked by the high day-to-day performance variability observed in MS patients. Provided that the increased compliance with the training program translates to a higher adherence, the integration of serious games should be beneficial for the long-term effectiveness of rehabilitation programs. References: Granacher U et al. (2010). *Int J Sports Med*, 31, 353–358.

### THE PSYCHOLOGICAL RESPONSE TO COMBINED STRENGTH AND AEROBIC TRAINING IN A GROUP OF CARDIAC PATIENTS.

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Abstract ECSS, Barcelona 2013 The psychological response to combined strength and aerobic training in a group of cardiac patients. Introduction Combination of strength and endurance training has recently been suggested to be superior to endurance training to improve health in elderly subjects. The effect of training with combined endurance and strength training has mainly focused on physiological health parameters. However, psychological wellbeing is also an important aspect of quality of life. Aim: The aim of this study was to investigate the hypothesis that intensified training, consisting of two strength training session with heavy loads and two high intensity spinning interval weekly, would improve psychological wellbeing more than a moderate training consisting of two endurance training sessions and one circuit training session weekly. Methods: Twenty nine coronary patients (aged: 50-72 years; 23 males and 6 females) were recruited from Fredrikstad Cardio-Club (Club for cardiac patients after hospital treatment) and stratified to intensified training or continuation of normal training. One group performed intensified training (INT) exercised four days a week: two aerobic exercises (spinning) of 60 minutes and two days of strength training during 10 weeks. The control group (CON) exercised 45 minutes aerobic training two days a week and one day of strength circle training. Questionnaire based on self-determination theory was used to evaluate psychological wellbeing. Results Both groups reported subjective improvement in physical capacity. This agrees with objective measurements of increase in maximal oxygen uptake and muscle strength. The group performing intensified training reported higher motivation, satisfaction and happiness. Furthermore, the group performing intensified training reported higher score on health benefits of training than the group who conducted moderate intensity training. Discussion: Both groups reported improved physical capacity on questionnaire, which agreed with the objective measurements. It is of note that the cardiac patients who conducted four training sessions reported higher satisfaction and subjective than the group continuing with moderate intensity training. Both the control and intervention group increased maximal oxygen similarly. However, the group with intensified training increased muscles strength in leg muscles more than CON. The ability to complete very intense training sessions was satisfying, and we speculate that participation in high intensity training and increased muscles strength improved self-confidence. Conclusion: Intensified training and inclusion of strength training may be beneficial for psychological wellbeing in middle-aged and elderly cardiac patients.

### SKILLING-UP EXERCISE FOR DECONDITIONED NURSING HOME DWELLERS

Rogan, S.1, de Bruin, E.D.2

Discipline Physiotherapy

1: Discipline Physiotherapy, Bern University of Applied Sciences Bern, Switzerland 2: Institute of Human Movement Sciences and Sport, ETH Zurich, Zurich, Switzerland. Introduction Because frail older adults have often been excluded from research little is known about the effects of exercise in these individuals [1]. Frailty and impaired muscle functioning are closely associated [2]. Dynapenia describes age-associated loss of muscle strength and power leading to increased risk for functional limitations and disability [3,4]. The nervous system's ability to fully activate skeletal muscle voluntarily seems impaired in dynapenia, which might be trained through vibration exercise [5] and video games [6]. This study determined the effects of an 8 weeks stochastic resonance whole-body vibration (SR-WBV) and video game training in nursing home dwellers. Methods 29 frail elderly ( $87.1 \pm 8.7$  years) randomly assigned to intervention (INT) and control (SHAM). INT performed 5 sets SR-WBV lasting 5 minutes, with 1 minute rest between sets (base frequency 3 Hz up to 6 Hz, Noise 4) during 5 weeks. From weeks 5 to 8 a video dance game 3 times per week was added. SHAM performed a five-set SR-WBV program lasting five minutes, with 1 minute rest (1 Hz, Noise 1). From week 5 to 8 trampoline exercise 3 times per week was added. Outcomes were the Short physical performance battery (SPPB). A two (groups) x three (time points) ANOVA with Bonferroni correction, with repeated measures on the last factor, was used for analysis ( $p \leq 0.05$ ). Results The within subject test indicated a significant time effect for the SPPB parameter:  $F(2,46) = 16$ ,  $p < 0.001$ . The between groups test indicated that the variable Training reached significance in SPPB  $F(2,46) = 21.23$ ,  $p < 0.001$ . Where SHAM remained unchanged with SPPB values pre/post =  $4.1 \pm 1.8 / 3.9 \pm 1.3$  points INT shows large improvements  $2.8 \pm 1.5 / 6.8 \pm 3.5$  points. Conclusions The findings of this study contrast previous reports showing that physical exercise programs for frail older people are less effective on disability outcomes [7]. These findings encourage further examination of the effect of strength exercise training types that specifically focus on aspects of neuromuscular functioning in frail elderly. References [1] Ferrucci et al. (2004) *JAGS* 52:625-634 [2] Mühlberg & Sieber. (2004) *Z Gerontol Geriat* 37:2–8 [3] Clark & Manini. *Nutrition*, 2012. 28(5): 495-503 [4] Manini & Clark. *J Gerontol A Biol Sci Med Sci*, 2012. 67(1): 28-40 [5] Cochrane. *Int J Sports Med* 2011; 32: 75– 99 [6] Pichierri et al. *BMC Geriatr*. 2011;11:29 [7] Daniels et al. *BMC Health Serv Res* 2008, 8(1):278

**08:30 - 10:00****Oral presentations****OP-PM34 Physiology [PH] 11****ACUTE AND CHRONIC EFFECTS OF RESISTANCE TRAINING COMBINED WITH VASCULAR OCCLUSION OR HYPOXIA ON HORMONAL RESPONSE.**

Hamlin, M.J.1, Manimmanakorn, A.2, Manimmanakorn, N.2, Draper, N.3, Billaut, F.4, Shearman, J.P.5

*1:Lincoln University (Christchurch, NZ), 2:Khon Kaen University (Thailand), 3:University of Canterbury (Christchurch, NZ), 4:Institut national du sport du Québec (Canada), 5:CPIT (Christchurch, NZ)*

**Introduction** Low-load resistance training (20-50% of one repetition maximum, 1-RM) combined with vascular occlusion or hypoxia produces similar performance gains as traditional high-intensity resistance training (70-85% 1-RM), however, the underlying physiological mechanisms behind such improvements are controversial. Therefore, the aim of this study was to investigate the hormonal response to acute and chronic low-load resistance training combined with either vascular occlusion or normobaric hypoxic exposure. **Methods** In a randomised controlled trial, 30 well-trained team-sport athletes took part in a 5-week training of knee flexor/extensor muscles in which low-load resistant exercise (20% 1-RM) was combined with either a) an occlusion pressure of ~230 mmHg (KT, n = 10), b) hypoxic air to generate an arterial blood oxygen saturation of ~80% (HT, n = 10), or c) no additional stimulus (CT, n = 10). The training was of the same intensity and amount in all groups. Serum growth hormone (GH) was measured before and after (1-2, 15, 30 min post) the first and last training bouts. Strength (3-s maximal voluntary contraction [MVC3]) and cross-sectional area (CSA) of the quadriceps and hamstrings were measured before and after training. **Results** Compared to CT, both HT and KT showed a substantial increase in GH release 1-2 min after the first training bout (by approximately 3- to 4-fold). GH release continued to be substantially elevated in the KT group compared to CT and HT groups up to 30-min post the first training bout. After 5 weeks of training, however, the release of GH post exercise was substantially reduced and similar in all groups. Relative to CT, KT and HT increased MVC3 ( $11.0 \pm 11.9\%$  and  $15.0 \pm 13.1\%$  respectively, mean  $\pm$  90% CI) and CSA ( $7.6 \pm 5.8$  and  $5.3 \pm 3.0\%$ ) by the end of training. **Discussion** Performance gains (in particular strength and hypertrophy) from low-load resistance training combined with vascular occlusion or hypoxia are likely related to the heightened acute release of growth hormone found after such training. Importantly, the training must be continuously adapted to the improvement in strength as growth hormone release diminishes over time with similar intensity training bouts.

**INFLUENCE OF SMOKING STATUS ON MUSCULOSKELETAL INJURY RISK IN BRITISH ARMY INFANTRY TRAINEES**

Siddall, A., Bilzon, J., Thompson, D., Izard, R., Greeves, J., Stokes, K.

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Cigarette smoking is the most widely reported independent risk factor for training-related injuries in military personnel (Knapik et al., 2001). Despite this, smoking prevalence in military populations is typically higher than in the general population (Klesges et al., 2001). We examined injury incidence during British Army infantry training to determine whether habitual smoking influences injury risk. After obtaining written informed consent, a lifestyle questionnaire was administered to trainees (aged 18-33) at entry to training (n=1810) to determine current smoking behaviours. Data on lower limb and lumbar spine injuries over 26 weeks of training were obtained retrospectively from military medical records. Injury type, anatomical site and training time lost were recorded for all training-induced injuries and categorised as either traumatic or overuse in nature. The sample comprised 49% smokers (>1 cigarette•day<sup>-1</sup>) and 33% non-smokers with the remainder either former or occasional smokers. Training-related injury incidence for the sample was 58% and time-loss training injury incidence was 32% where median (IQR) training days lost was 14 (43) days per time-loss injury. Odds ratios (95% CI) for training injury (1.22 [1.12-1.34]), time-loss training injury (1.23 [1.06-1.44]) and overuse training injury (1.38 [1.11-1.72]) showed greater risk in smokers (p<0.01). Smokers exhibited higher incidence (95% CI; p<0.01) of training injuries (60 [57-63]% vs. 55 [51-59]%), time-loss training injuries (34 [31-38]% vs. 30 [26-34]%) and injuries attributed to overuse (22 [19-25]% vs. 17 [14-20]%), but not traumatic training injuries. Additionally, average duty days lost (95% CI) to time-loss training-injuries per 1000 trainee-days was significantly greater in smokers (132 [120-144]) than non-smokers (104 [92-116]; p<0.01). The most prevalent training-related and time-loss injuries were non-specific soft tissue injury (51% of injuries) and the most common anatomical sites were knee (25%), foot (24%) and ankle (17%), with injuries to the lower leg comprising >75% of all lower body injuries, with similar patterns observed for smokers and non-smokers. Smokers have a greater risk of training-related injury than non-smokers in this British Army infantry training population, though univariate analyses cannot demonstrate that smoking per se is the cause of this difference. The greater number of training days lost per 1000 trainee-days suggests that smokers either suffer more severe injuries and/or may not recover from injuries as quickly or effectively as non-smokers. References Klesges, RC., et al. (2001). *Tob Control*. 10(1): 43-7. Knapik, JJ., et al. (2001). *Med Sci Sports Exerc*. 33(6): 946-54.

**HIF-1A IS NOT INVOLVED IN THE SKELETAL MUSCLE REGENERATION PROCESS AFTER AN ACUTE INJURY**

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**Introduction** Skeletal muscle is a dynamic tissue with a remarkable regenerative capacity. The critical role of macrophages (MPs) and the corresponding inflammatory response associated to the muscle repair process has been recently highlighted<sup>1</sup>. Although it has been well acknowledged that Hypoxia Inducible Factors (HIF) act as an oxygen sensor, recent studies have demonstrated that HIF-1 $\alpha$  could play a key role in inflammation<sup>2,3</sup>. On that basis, one could expect an impaired or delayed muscle regeneration process as a result of HIF-1 $\alpha$  deletion in MPs. We aimed at investigating strictly noninvasively, using multimodal Magnetic Resonance Imaging (MRI) including T2 mapping and Diffusion Tensor Imaging (DTI), the effects of an acute injury in a mouse model specifically deleted for HIF-1 $\alpha$  in MPs<sup>2</sup>. **Methods** Acute muscle injury was induced by the i.m. injection of the myotoxin cardiotoxin (CTX) in the tibialis anterior muscle. MRI experiments were performed in a mouse model specifically deleted for HIF-1 $\alpha$  in MPs (i.e., *LysM-Cre;HIF-1 $\alpha$ /fl*; n=7)<sup>2</sup> and the wild-type littermates (WT; n=6) mice before and 1, 2, 3, 7 and 21 days after CTX injection. Ultra-high field MR experiments were performed on a 11.75 T vertical MRI system. DTI metrics, including diffusivities ( $\lambda_1$ ,  $\lambda_2$  and  $\lambda_3$ ), and T2 values were measured. **Results** Both DTI metrics and T2

values were significantly modified as a result of CTX injection.  $\lambda_2$  and  $\lambda_3$  peaked at D1 (+38-57%) and remained elevated at D2 (+32-53%) and D3 (+7-18%). These parameters were further reduced at D7 (-11-13%) and returned to the baseline values at D21.  $\lambda_1$  increased at D1 (+14%) and D2 (+11%) and returned to the baseline values at D3. T2 values were significantly elevated at D1 (+98%), peaked at D2-D3 (+126-133%), remained elevated at D7 (+34%) and recovered at D21. Interestingly, all these MRI changes were similar for both WT and LysM-Cre;HIF-1 $\alpha$ /fl mice. Discussion We demonstrated that CTX injection led to similar MRI changes in both LysM-Cre;HIF-1 $\alpha$ /fl and WT groups, suggesting that HIF-1 $\alpha$  is not involved in the muscle regeneration process resulting from an acute injury. Interestingly, the CTX injection affected the MRI parameters i.e. DTI metrics and T2 values with a different time-frame, thereby indicating that the corresponding indices likely reflect different physiological processes. Multimodal MRI might be considered as a suitable diagnostic tool for monitoring skeletal muscle injury and repair processes. References 1. Arnold L, Henry A, Poron F et al. (2007). *J Exp Med*, 204, 1057-1069. 2. Cramer T, Yamanishi Y, Clausen BE et al. (2003). *Cell*, 112, 645-657. 3. Peyssonnaud C, Cejudo-Martin P, Doedens A et al. (2007). *J Immunol*, 178, 7516-7519.

### MUSCLE DISUSE REDUCES POST-PRANDIAL MUSCLE PROTEIN SYNTHESIS RATES IN YOUNG MEN

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Muscle disuse leads to a substantial loss of skeletal muscle tissue and, therefore, numerous negative health consequences. While it has been established that muscle disuse atrophy is mechanistically underpinned by a decline in basal (post-absorptive) muscle protein synthesis rates, it is currently unclear whether a parallel reduction in postprandial muscle protein synthesis also occurs. In the present study, we assessed post-prandial muscle protein synthesis rates before and after a period of disuse in humans. Twelve healthy, young (23.8 $\pm$ 1.0 y) men underwent a 14 day period of one-legged knee immobilization by way of a full leg cast. Before and after the immobilization period, quadriceps cross sectional area (CSA), muscle strength and skeletal muscle protein synthesis rates were assessed. Continuous infusions with L-[ring-2H5]phenylalanine were applied to assess mixed muscle protein fractional synthetic rates (FSRs) following the ingestion of 20 g dietary protein. Immobilization led to an 8.4 $\pm$ 2.8 % (P<0.001) and 22.9 $\pm$ 2.6 % (P<0.001) decrease in quadriceps muscle CSA and strength, respectively. Post-prandial muscle protein synthesis rates declined by 31.0 $\pm$ 12.5 % following immobilization (0.046 $\pm$ 0.004 to 0.032 $\pm$ 0.006 %·h<sup>-1</sup>; P<0.05). In conclusion, this is the first study to demonstrate that muscle disuse atrophy is accompanied by a reduced muscle protein synthetic response to the ingestion of a meal like amount of dietary protein. Anabolic resistance to nutritional stimuli contributes to the loss of muscle tissue during a period of disuse.

### REGULAR PHYSICAL ACTIVITY FAVOR SKELETAL MUSCLE REGENERATION AFTER TOXIC INJURY

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Introduction Skeletal muscle regeneration (SMR) is a highly complex process that involves coordinated recruitment of a wide range of cells, meticulous interactions with the inflammatory system and ends either with proper regeneration of fibres or fibrotic tissue (FT) formation[2]. The aim of this experiment was to determine the possible preventive role that physical activity (PA) may play in the skeletal muscle post-injury regeneration. Methods Twelve male Wistar rats, 2 months old, were either housed in cages with running wheel (RW)(Ex;n=6) or in cages without RW (Sed;n=6) during 8 weeks. At the end of this protocol the right tibialis anterior (TA) muscle of all rats was injected with 30 $\mu$ L of 20 $\mu$ M cardiotoxin (CTX). Three animals from each group were sacrificed 7 days (Ex7 and Sed7 groups) after CTX injection and the remaining following 15 days (Ex15 and Sed15 groups). Skeletal muscle fibres cross-sectional area (CSA), percentage of central nucleated fibres (CNF), and FT were analyzed, within the area classified as damaged or regenerating[1], by histomorphometry following H&E and Picrosirius Red staining, respectively. Results During the 8 weeks the Ex group registered a mean running distance of 3.2Km per day. The mean fibre CSA in Ex7 (240 $\pm$ 92  $\mu$ m<sup>2</sup>) was smaller than the Sed7 (308 $\pm$ 150  $\mu$ m<sup>2</sup>), p<0.01. However, the mean fibre CSA in Ex15 (677 $\pm$ 367  $\mu$ m<sup>2</sup>) was higher than the Sed15 (337 $\pm$ 219  $\mu$ m<sup>2</sup>), p<0.01. The percentage of CNF in Ex7 (35.2%) and Sed7 (33.7%) fibres did not differ. Nonetheless, CNF in Ex15 (5.2%) were less abundant than in Sed15 (27%), p<0.01. Both Ex7 (24.6 $\pm$ 4.6 mm<sup>2</sup>) and Ex15 (11 $\pm$ 4.3 mm<sup>2</sup>) had less FT area than Sed7 (37.6 $\pm$ 11 mm<sup>2</sup>) and Sed15 (21.4 $\pm$ 5.5 mm<sup>2</sup>), respectively, p<0.01. Discussion Evidence that augmented contractile activity during SMR may have a therapeutic effect in the full recovery of muscle mass has been verified by others[3]. Our results suggest that physical inactivity may negatively influence the SMR towards a more dysfunctional phenotype, i.e., increasing FT deposition and compromising the overall SMR. Our data, although preliminary, seems to indicate that voluntary RW PA may be effective in enhancing the SMR process. Acknowledgements FCT project (PEst-OE/SAU/UI0617/2011) and FCT PhD grant (SFRH/BD/76740/2011) References 1. Koh TJ, Bryer SC, Pucci AM et al. Mice deficient in plasminogen activator inhibitor-1 have improved skeletal muscle regeneration. *Am J Physiol Cell Physiol* 2005; 289: C217-223 2. Moyer AL, Wagner KR. Regeneration versus fibrosis in skeletal muscle. Current opinion in rheumatology 2011; 23: 568-573 3. Richard-Bulleau H, Serrurier B, Crassous B et al. Recovery of skeletal muscle mass after extensive injury: positive effects of increased contractile activity. *Am J Physiol Cell Physiol* 2008; 294: C467-476

### EFFECT OF ECCENTRIC VERSUS CONCENTRIC TRAINING ON METABOLIC MEASURES FOLLOWING ECCENTRIC EXERCISE INDUCED MUSCLE DAMAGE

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*University of Gloucestershire*

Introduction Repeated eccentric based exercise initiates a protective adaptation so that replicating the same eccentric exercise at a later date results in reduced symptoms of damage compared to the initial bout (Clarkson et al., 1992). Following an acute initial bout of eccentric exercise, an increase in the muscle Pi / PCR occurs (Hughes et al. 2010), but it is not known if this indirect measure of intracellular metabolism is attenuated by repeated exposure to eccentric exercise. Methods Using 31P-MRS the purpose of this study was to examine the effect of a bout of EEIMD on intramyocellular phosphate metabolism in skeletal muscle which had been concentrically (ConTr) versus eccentrically (EccTr) trained. Six participants (35  $\pm$  7 yrs mean  $\pm$  SD; 174.5  $\pm$  7.2 cm and 70.9  $\pm$  7.1 kg body mass) performed six training sessions on an isokinetic dynamometer (5 x 10 reps) on each leg; one leg was trained eccentrically and the other concentrically. Following the training period participants undertook a bout of eccentrically biased exercise, which had previously been shown to induce EEIMD. This involved 300 unilateral, maximal, isokinetic, eccentric contractions (EE) (30°·s<sup>-1</sup>) using the quadriceps of both legs on an isokinetic dynamometer. Unlocalised 31P-MRS was used to assess resting quadriceps [PCr], [Pi], [ADP], pH, and MRI utilized to measure muscle volume. Results Significant increases in isometric MVC (P < 0.05) were evident following both training conditions (pre 231  $\pm$  43Nm to post 265  $\pm$

45Nm; pre  $235 \pm 58$ Nm to post  $276 \pm 64$ Nm in ConTr and EccTr respectively), though the ConTr leg experienced a significant decrease in MVC after EE ( $276 \pm 64$  to  $197 \pm 21$ Nm). A main effect of trial was evident for muscle volume, which was significantly greater following EE in the ConTr leg compared to the EccTr leg ( $P = 0.045$ ). Pi / PCr was greater than 0.19 in both ConTr and EccTr at both time points, which is consistent with EEIMD in both legs. However, there were no significant differences in resting [PCr], [Pi], [ADP], pH or Pi / PCr between ConTr or EccTr conditions following EE (all  $P > 0.05$ ). Discussion These findings indicate that increases in skeletal muscle phosphate metabolism typically associated with muscle damage are not attenuated by prior exposure to repeated bouts of EE. Therefore, decrements in force generating capacity of muscle due to EEIMD may be mediated by more central factors. Further, prior eccentric exercise attenuates the muscular swelling which occurs in the period after unaccustomed eccentric exercise. References Clarkson, Nosaka & Braun. (1992). *Med Sci Sport Ex*, 24, 512-520. Hughes, Johnson, Brown, Sachinwalla, Walton, & Stannard. (2010). *Eur J Appl Physiol*, 110(6), 1135 - 1141.

## 08:30 - 10:00

### Oral presentations

#### OP-PM50 Training and Testing [TT] 4

##### VARIATIONS IN NEUROMUSCULAR ACTIVITY OF THIGH MUSCLES DURING WHOLE-BODY VIBRATION IN CONSIDERATION OF DIFFERENT BIOMECHANICAL VARIABLES

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*University Clinic Tuebingen*

**Introduction** In the last ten years, whole-body vibration (WBV) has become a steadily increasing field of interest in sports science and research. In fact, previous studies have shown that WBV exercises have positive effects in men (Cardinale&Wakeling, 2005). However, limitations of previous studies are different training procedures with regard to the biomechanical variables (vibration frequency, vibration amplitude, and joint angle) affecting the intensity of neuromuscular activation. Few studies have investigated the responsiveness of different muscles in different exercises during vibration stimulus, only regarding two of three biomechanical variables (e.g. Roelants et al., 2006; Cardinale&Lim, 2003). The intention of this study was to systematically analyze the impact of all biomechanical variables on thigh muscle activity during exposure to WBV. **Methods** 51 healthy men and women (age  $54.9 \pm 8.1$  years) voluntarily participated in the study and were randomly allocated to five different vibration-frequency groups. Each subject performed 9 static squat positions (3 amplitudes x 3 knee angles) on a side alternating vibration platform (Galileo Fitness, Novotec Medical GmbH, Pforzheim). Surface electromyography (EMG) was used to record the neuromuscular activity of the quadriceps femoris and hamstring muscles. Maximal voluntary contractions (MVCs) were performed prior to the measurements to normalize the EMG signals. Results WBV exercises lead to an increase in quadriceps femoris and hamstring muscle activity. Depending on the biomechanical variables, EMG muscle activity ranged between 18.2 and 74.1 % MVC in the quadriceps femoris muscle and between 5.2 and 27.3 % MVC in the hamstring muscles during WBV. Especially in the quadriceps femoris muscle, a frequency of 30 Hz and an amplitude of 4 mm led to a significant increase in muscle activity compared to the other tested frequencies and amplitudes. However, it seems that knee angle is only relevant for the quadriceps femoris muscle. **Discussion** The highest levels of muscle activation were found at high frequencies and large amplitudes, which also correspond to the findings of Krol et al. (2011). Roelants et al. (2006) investigated leg muscle activity during different squat exercises with subjects standing on a synchronous vibrating platform. They showed an increase in muscle activity during WBV while increasing the knee angle as we confirmed for the quadriceps femoris in our present study. The results of our study should give more information for developing individual training protocols in consideration of all biomechanical variables for WBV treatment in different practical applications. **References** Cardinale, M, Lim, J (2003). *J Strength Cond Res* 17: 621-624. Cardinale M, Wakeling, J. (2005). *Brit J Sport Med* 39: 585-589. Roelants, M, (2006). *J Strength Cond Res* 20: 124-129. Krol, P, (2011). *J Sports Sci Med* 10: 169-174.

##### EFFECT OF PROGRESSIVE-OVERLOAD WHOLE BODY VIBRATION TRAINING AS PART OF OFF-SEASON STRENGTH TRAINING IN FEMALE ATHLETES

Jones, M.T.

*George Mason University*

**Introduction** Use of whole body vibration (WBV) as an intervention method for athletic development in trained women has been inconclusive. Bodyweight WBV (Jones et al., 2011) and externally loaded WBV (Preatoni et al., 2012) training in conjunction with conventional strength training (ST) showed the inclusion of WBV had no apparent benefit over ST, yet there was little change in the protocol. Therefore, the aim of this study was to analyse the effect of a periodized, progressive-overload WBV+ST protocol on strength and power. **Methods** Lacrosse athletes ( $n=18$ ,  $19.6 \pm 1.2$  yr,  $167.37 \pm 8.34$  cm,  $66.10 \pm 7.13$  kg) with  $> 1$  year of ST, but no prior WBV training, completed the 15-week (wk) study. Random assignment to Group 1 (GP1) or 2 (GP2) followed pre-tests (wk1) of seated medicine ball throw (SMBT), single leg hop for each leg (LSLH, RSLH), countermovement vertical jump (CMVJ), 3-RM front squat (FS), pull-up (PU), bench press (BP), and %body fat (BF). WBV was two 3-wk phases of dynamic and static-hold bodyweight exercises administered 2 days/wk in team ST sessions. The 15-wk training included Phase I (wk2-4): WBV1+ST1 (GP1) or WBV1sham+ST1 (GP2), Phase II (wk5-7): WBV1+ST1 (GP2) or WBV1sham+ST1 (GP1), post-test 1 (wk 8), Phase III (wk9-11): WBV2+ST2 (GP1) or WBV2sham+ST2 (GP2), Phase IV (wk12-14): WBV2+ST2 (GP2) or WBV2sham+ST2 (GP1), and post-test 2 (wk15). WBVsham+ST and WBV+ST were identical exercise protocols minus the WBV. Total WBV exposure was 6 min broken into 30-sec bouts with 60-sec rest for a 1:2 work relief ratio. Exercises, frequency and amplitude progressed in intensity from the first 3-wk (Phase I,II) to the second 3-wk (Phase III,IV) training phase. Five  $2 \times 3$  repeated measures analyses of variance (ANOVA) were used to analyze SMBT, CMVJ, LSLH, RSLH and FS, and three  $2 \times 2$  repeated measures ANOVAs were used for %BF, PU and BP. Alpha level was set at  $p < 0.05$ . Results FS (38%), LSLH (12%), and RSLH (15%) increased ( $p=0.001$ ) from pretest to post-test 2. FS (9%) increased from post-test 1 to post-test 2. %BF (4%) decreased ( $p=0.04$ ) and PU (27%) increased ( $p=0.008$ ) from pretest to post-test 2. SMBT (3%) and BP (4%) showed a trend of increased performance from pretest to post-test 2 ( $p=0.10$ ). **Discussion** Two 3-week phases of periodized, progressive-overload WBV+ST training elicited gains in upper- and lower- body strength (FS, PU), power (LSLH, RSLH), and %BF during a 15-wk off-season program in trained female athletes. No differences existed between GP1 and GP2, indicating the timing of WBV (Phase I,

Phase III (GP1) or Phase II, Phase IV (GP2)] had no effect. Greatest improvements in performance tests occurred in the initial WBV phase. References Jones, MT, et al. (2011). *J Strength Cond Res* 25(9), 2434-2441. Preatoni, E, et al. (2012). *J Strength Cond Res* 26(9), 2495-2506.

### HIGH-INTENSITY, VELOCITY, ACCELERATION, AND DECELERATION RUNNING EFFORTS DURING TENNIS MATCHES IN YOUNG MALE PLAYERS

Hoppe, M.W., Baumgart, C., Bornefeld, J., Pieper, S., Sperlich, B., Freiwald, J.

*Research Center for Performance Diagnostics and Training Advice, University of Wuppertal, Germany*

**Introduction** In field sports, a new definition of high-intensity running incorporates both running with high-velocity and/or high-acceleration (Dwyer & Gabbett, 2012). Since tennis players perform a lot of running with high-deceleration (Fernandez-Fernandez et al., 2009), the aim of this study was to analyze the high-velocity, high-acceleration, and high-deceleration running efforts during tennis matches in young male players. **Methods** 20 young male tennis players (13±1 years, 7±2 years tennis experience) performed a training match (two winning sets with a match-tiebreak) on clay courts. Running velocity was measured via global positioning system at 10 Hz (Catapult Innovations, MinimaxX S4, Melbourne, Australia). The acceleration and deceleration data were calculated from the measured velocity data. The thresholds for high-velocity, high-acceleration, and high-deceleration running efforts were 3 m/s, 2 m/s<sup>2</sup>, and -2 m/s<sup>2</sup>, respectively. All running efforts were expressed as relative values per minute match play (1/min). Descriptive data (mean±SD) were calculated after checking for normality with the Kolmogorov-Smirnov Test. Pearson-product-moment correlation coefficients were used to determine the common variance (R) between the different high-intensity running efforts. Statistical significance was set to p<.05. Results Per minute match play, young male tennis players performed 0.2±0.1 1/min high-velocity, 0.6±0.2 1/min high-acceleration, and 0.6±0.2 1/min high-deceleration running efforts. The common variance between the high-velocity, high-acceleration, and high-deceleration running efforts was R=.27 (p>.05), R=.24 (p>.05), and R=.66 (p<.01), respectively. Discussion During tennis matches, young male players perform threefold more high-acceleration and high-deceleration than high-velocity running efforts. The common variances revealed that high-acceleration and high-deceleration are independent from high-velocity running efforts, and therefore, obtain additional information. Based on these observations, high-intensity running should be defined using velocity, acceleration, and deceleration data. This approach should be included when assessing high-intensity running efforts in young male tennis players. References Dwyer, D.B. & Gabbett, T.J. (2012). Global positioning system data analysis: velocity ranges and a new definition of sprinting for field sport athletes. *J Strength Cond Res*, 26(3), 818-824. Fernandez-Fernandez, J., Sanz-Rivas, D. & Mendez-Villanueva, A. (2009). A Review of the Activity Profile and Physiological Demands of Tennis Match Play. *Strength and Conditioning Journal*, 31(4), 15-26.

### EASY METHOD FOR QUANTIFYING FATIGUE IN HANDBALL TEAM PLAYERS

Galdeano Llinares, P.1, Suárez-Parra, I.1, Alarcón-Torrecillas, S.1, Barba-Moreno, L.1, González-Hernández, J.M.2, Cuadrado-Peñafiel, V.3, Ortega-Becerra, M.A.4

1: Catholic university of San Antonio, Murcia, España 2: UAX (Madrid, Spain), 3: UJA (Jaen, Spain), 4: Pablo de Olavide University (Seville, Spain)

**Introduction** In handball team, the possession or not of the ball it determines the own player's behaviors, existing a constant relation offensive - defense that takes place during the game. This correlation implies that the actions players realize are characterized by rapid direction changes, accelerations, sprints, jumps and throws, all of them performed to high intensity and opposite to an opponent what implies that the handball team players develop high degrees of fatigue specially in muscles' legs (Ronglan, Raastad, & Borgesen, 2006). Therefore the aim of this study is acquiring more specific knowledge regarding development of fatigue following real handball matches. Such sport specific knowledge may facilitate the adjustment of more adequate training and competition procedures within elite handball. **Methods** Sixteen male players from Spanish First Division (age 25.6 ± 4.4 yr, body mass 86.3 ± 7.9 kg, height 184.4 ± 14.6 cm; body fat 12.7 ± 8.2%) participated in this study. They performed 5 countermovement jumps (CMJ) and 10-m sprint test just after finishing warm-up and before match, these measures were repeated at the half time of match and at the end of match. Results CMJ height and 10-m sprint time were collected during four official matches. CMJ height loss pre-post session were significant for all matches (p<0.001) and 10-m sprint time loss was significant too (p<0.01). Speed losses produced presented a high relation with CMJ height losses (r=0.83). Furthermore, these differences also were found between first and second half of matches. Discussion Habitual actions in elite handball (rapid direction changes, accelerations, sprints, jumps and throws) induce a fatigue degree that can be evaluated with some usual tests (Ronglan, Raastad, & Borgesen, 2006). Therefore, in this study, the high correlation found between mechanical (speed and CMJ height losses) measures of fatigue highlight the utility and validity of using CMJ to monitor training load. Thus, it is possible to conclude that the use of the CMJ and 10-m sprint time are valid and reliable tools for estimating the neuromuscular fatigue produced (Jiménez-Reyes et al, 2012). References •Jiménez Reyes P, Cuadrado-Peñafiel V, Pareja-Blanco F, Ortega-Becerra MA, González-Badillo, JJ. (2012). *Medicine & Science in Sports & Exercise*, S582, Vol 44 (5). •Ronglan LT, Raastad T, Borgesen A. (2006). *Scandinavian Journal of Medicine and Science Sports*. 16, 267-273.

### EFFECTS OF 1 YEAR OF WHOLE BODY VIBRATIONS TRAINING IN POSTMENOPAUSAL WOMEN.

Tillaar, R.

*University College of Nord Trøndelag*

**Introduction** As the world population is getting older, occurrence of osteoporotic fracture is an increasingly important public health problem. Increase in strength, balance and power can help older women against falling and thereby against possible osteoporotic fractures. Therefore the aim of our study was to investigate the effect of 1 year of whole body vibration (WBV) training in postmenopausal women on strength, balance and power. **Methods** 98 postmenopausal women (age 61.5 ± 6.3 years, mass 69.1 ± 11 kg, height 1.67 ± 0.05 m) participated in this study. Static and dynamic strength of the knee extensors and flexors was tested as peak force in a dynamometer. Balance was tested while standing on 1 and 2 legs over 10 seconds on a force plate. Power was measured by peak jump velocity and height during a CMJ with and without arm swing. After the pretest, two groups trained WBV training. The first group (n=27) trained on a WBV platform that only conducted horizontal vibrations (Nordic Vibroplate II, Nordic Fitness AS, Norway), while second group (n=55) trained on a tilting WBV platform (Galileo Fitness, Novotec Medical GmbH, Germany). The third group was a control group (n=16) that did not train WBV. Each training group trained 3 times per week, 8\*1 minute squatting per session on their platform according to the principle of overload. Results Both training groups increased their peak force significantly in flexion (11.4 %) and extension (4.3%) of the knee and in the isometric strength (11.2%) of the knee extensors, while the control group had a decrease in extension (-12%) and isometric strength (-

11%). No significant difference between the two training groups was found. No significant ( $p > 0.05$ ) changes in jump height and peak velocity (power) and balance were found after 1 year of training. However, post hoc comparison showed that the control group significantly decreased peak velocity, while the training groups did not. Discussion The increased strength after WBV training in our study was in line with earlier studies (e.g. Bogaert et al., 2007; 2009). However, no changes were found in balance and power as in these studies. This was probably caused by the used protocol. To stimulate the different body properties (Rittweger, 2010) we used different frequencies (5-6, 12-14, 18, 22-26 Hz) and a lower amplitude (2-4mm) than in earlier studies. Due to this, the impact on the muscles was not high enough to stimulate balance and power enough. It could only help to minimise the natural decrease in power. It was concluded that both horizontal and tilting induced WBV training can help postmenopausal women with increasing their leg strength but not balance and power. References Bogaerts AC. et al. (2007). *J Gerontol A Biol Sci Med Sci*, 62, 630-635. Bogaerts AC. et al. (2009). *Age Ageing*, 38, 448-454. Rittweger J. (2010). *Eur J Appl Physiol*, 5, 877-904.

## 08:30 - 10:00

### Oral presentations

#### OP-SH02 Physical Education and Pedagogy [PP] 1

##### THE ROLE OF SELF MOTIVATION IN THE AFFECTIVITY OF HUNGARIAN STUDENTS AGED 11-18 FOR PHYSICAL EDUCATION AT SCHOOL

Hamar, P.1, Versics, A.1, Volák, A.1, Karsai, I.2, Soós, I.3

*1Semmelweis University Budapest, HU, 2University of Pécs, HU, 3University of Sunderland, UK*

**Introduction** An important factor of school education is motivating and motivation (Csapó, 2000; Szabó, 2004). During this presentation, rather than considering it as a primarily psychological phenomenon, we are going to investigate motivation as a pedagogical question of school teaching and learning as well as that of physical education at school. By using self motivation questionnaires familiar from psychological tests we are endeavouring to find a reinforcement to our first hypothesis that during the process of acquiring physical education at school a dominant role is played by factors which motivate students such as achievement orientation, determination, perseverance, reliability, love of comfort, a desire to relax, the search for entertainment and avoiding risks as well as to our second hypothesis that the aforementioned factors are interrelated. A further hypothesis of ours states that the abovementioned motivation factors, which play a significant role during physical education classes, manifest themselves typically in relation to sex and age. **Methods** The sample tested comprised 2840 students between the ages of 11-18 with an approximately equal distribution between the sexes: 1367 boys and 1473 girls. The method of the cross-section testing was a survey based on questionnaires. The questionnaire on self motivation consisted of 36 questions, in which the subjects tested had to assess the statements in the questions in relation to themselves on a five-level Likert-scale. The 36 questions in the questionnaire were used to form six factors (F). Following basic statistical calculations we made a two-sample analysis of variance ( $2 \times 4$  between – subjects ANOVA) and we used the Bonferroni Post Hoc test to examine the differences between the sexes (female, male) and age groups (students in the age groups of 11-12, 13-14, 15-16, 17-18). To investigate the distribution of factor values (Fv, Fc, Fs, Fp, Fr and Fbr) among the individual groups we used the Kolmogorov Smirnov test while homogeneity among groups was determined with the Leven's test. **Summary** Our test hypotheses have been validated because during the process of acquiring physical education at school a dominant role is played by the factors examined by us and they are interrelated. In addition, motivating factors playing a significant role in physical education classes manifest themselves typically in relation to sex and age. To illustrate this, the youngest age group deviates from older age groups in nearly every respect. **References** Csapó, B. (2000): A tantárgyakkal kapcsolatos attitűdök összefüggései. *Magyar Pedagógia*, 100: 3. 343-366. Szabó, M. (2004): Megismerőfolyamatok szerepe a környezettel való kapcsolatban. *Motiváció*. In: *Pszichológia pedagógusoknak*. Edited by N. Kollár, K. & Szabó, É. Osiris Kiadó, Budapest. 169-191.

##### DOES ENHANCED PHYSICAL ACTIVITY INCREASE COGNITIVE PERFORMANCE AMONG YOUNG PEOPLE?

Collard, D.C.M., Scholten, A.M., Schokker, D.F., Preller, L., Wisse, E.A., Sabel, J., Alpay, L., van Empelen, P.

*Mulier Institute*

**Introduction** Various reviews report positive associations between physical activity and cognitive performance in youth. These findings are generally based on correlational data. Previous review studies do not provide clear answers on the causal relationship between physical activity and cognition in youth. Therefore, we aimed to conduct a systematic review of studies that investigated the causal relation between physical activity and cognition among the general population of young people (4-18 years). Key questions that were addressed are 'Does current evidence support a causal positive relationship between physical activity and cognition?' If so, 'can the effect be related to type, quality or setting of the intervention studies?'. **Method** Eligible intervention studies, published between 2007 and 2012, were identified through the PubMed and PsycINFO database. Other eligible articles published before 2007 and after 1990 were selected from (systematic) reviews published between 2010 and 2012, which evaluated the relationship between physical activity and cognitive performance in youth. Relevant articles, published between 1990 – 2012, were examined against the inclusion criteria. Finally, 22 articles were included and divided in school-based interventions and experiments. Data were extracted and methodological quality was rated. All outcome variables in the studies were coded as 'positive', 'negative' or 'none' based on their relation between physical activity and cognition. **Results** The twenty-two selected intervention studies were described. The studies varied widely in terms of study quality, sample size, type and number of cognitive tests reported. In total 94 cognitive indicators were examined. Of those 94 indicators, 30 indicators (32%) showed favourable changes, 62 indicators (66%) did not change, and 2 indicators showed negative changes in cognitive performance as a result of the physical activity intervention. Only in 6 (27%) studies the number of positive effects outweighed the number of non-effects. **Discussion** In agreement with earlier findings we conclude that physical activity does not harm cognitive development of young people. However, the results of the review neither support popular (policy) beliefs about a positive causal relation between physical activity and cognitive performance among youth. More final conclusions are still seriously hampered by low quality and small sample sizes of the studies.

**THE EFFECTS OF AN INTERVENTION IN PHYSICAL EDUCATION ON CHILDREN'S EXECUTIVE FUNCTIONS**

Schmidt, M.1, Jäger, K.2, Conzelmann, A.1, Roebers, C.2

*University of Bern*

Introduction Executive functions (EF) are understood as an individual's ability to initiate, adapt, regulate, monitor and control information processes. They are very important in everyday life and they are predictive for academic and professional achievement (Blair & Diamond, 2008). Physical activity seems to be one potential factor which can affect EF throughout lifespan, as existing studies indicate short-term as well as long-term effects of physical activity on EF for adolescents, adults and elderly people (Chang et al., 2012). However, empirical findings in children's population are rare. According to Best (2010), cognitively-engaging exercise at a moderate level appears to be the most promising intervention type for enhancing children's EF-performance through physical activity. Therefore, the aim of the present study was to investigate the acute effects of a specifically designed sport lesson on the EF of primary school children. Methods A total of 100 second grade primary school children (M=7.98 years, SD=.39) from 9 classes participated in the study. The intervention group (n=50) underwent a specifically designed intervention (20 min) integrating cardiovascular-stimulating tasks with executive demands. Meanwhile, the control group (n=50) listened to a storybook. Before and after the intervention, respectively control condition, an n-back task to measure updating and Flanker task to measure inhibition and cognitive flexibility was used. In order to determine the effects of the intervention on children's EF, methods for the analysis of variance (with repeated measures) were used, as usual in experimental designs. Results The significant interaction between time and group ( $F(1,98) = 5.56, p = .01, \eta^2 = .05$ ) indicates that the investigated physical education intervention had a positive effect on the inhibition of primary school children. In working memory and cognitive flexibility, however, no effects could be found. Discussion Overall, results support the assumption that physical activity in the school setting can positively affect cognitive performance in children. Specifically, an intervention in PE, integrating cardiovascular and executive demanding tasks, seems to be suitable to enhance inhibition. Whether the improvement in inhibition is caused by the physical activity, the cognitive load of the intervention or the combination of the two components needs to be examined in further studies. References Best, J. R. (2010). Effects of physical activity on children's executive function: Contributions of experimental research on aerobic exercise. *Developmental Review, 30*, 331-351. Blair, C., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology, 20*, 899-911. Chang, Y. K., Labban, J. D., Gapin, J. I., & Etnier, J. L. (2012). The effects of acute exercise on cognitive performance: A meta-analysis. *Brain Research, 1453*, 87-101.

**THE HORSE AS AN "ENABLER" IN HORSEBACK RIDING – THE HISTORY OF THERAPEUTIC HORSEMANSHIP**

Hedenborg, S.

*Malmö University*

The purpose of this paper is to explore and analyse the history of therapeutic horsemanship in Sweden. Sports used as therapy have a long history. This paper will focus on therapeutic horse riding since WW2 up until today. Therapeutic riding started in Sweden in the late 1950's, influenced by the Olympic rider Liz Hartel (Hedenborg 2009). Today therapeutic riding is the largest sport for disabled. The number of horse has grown significantly in recent years (Hedenborg 2011). The growth can be connected to the fact that horses are important in new ways related to the unique partnership forged between horses and humans. In this paper exploring questions like when were the organisation for therapeutic riding established; how many people have been and are members of the organisations, who - sex, age and social class - is a member; and what kind of activities are offered in the organisations will be posed and the results will be analysed from a gender perspective as well as a perspective in relation to disability research and the post human turn.

**08:30 - 10:00****Oral presentations****OP-SH13 Sport Management [SM] 1****THE TRANSFORMATION OF CHINA'S NATIONAL FITNESS POLICY: FROM A MAJOR SPORTS COUNTRY TO A WORLD SPORTS POWER?**

Tan, T.C.

*National Taiwan Normal University*

Introduction The paper locates the transformation of the PRC's 'national fitness policy' after an official speech addressed by the president of the PRC, Hu Jintao who, for the first time, mentioned about getting "from a major sports country to a world sports power" after 2008 Beijing Olympic Games. Thus, in this study, we try to combine the five policy indicators (including organization, statutes, budget, personnel, and media) developed by Hogwood and Peters (1983), as well as Zhuang (2003) to assess the extent of China's national fitness policy change. Besides, through elite theory, we explore the motivation and driving force behind the governing elites taking part in the national fitness policy making process. Methods Data were collected from a number of sources including official government documents, news media, and a series of 23 interviews from China's sport administrative system including General Administration of Sport (GAS), three national sport associations and 7 Chinese sports academics from inside and outside China in 2011 and 2012. Results As regards the extent of China's national fitness policy change, it has been reflected in 1) establishing new department in GAS, 2) promulgating "Regulations on National Fitness" by the State Council, 3) increasing funding from national and local level, 4) raising the seniority of leaders in charge of national fitness policy, and 5) increasing interest in the media, especially from the media owned by GAS. There are two driving forces to push sport for all further up the agenda, which are external and internal forces. As for the external one, China was feeling the pressure to look for models in those successful Olympic countries which have relevantly high-levels of sport participation. Regarding the internal one, the national fitness policy is part of the economic motives about stimulating domestic consumption and reducing national medical cost. Discussion To a large extent, Chinese governing elites seemed to be a rebalancing of the policy after Beijing Games in 2008, not necessary a rejection of the elite sport, but a great priority given to sport for all. The evidences of the scale of change could be illustrated by the five dimensions mentioned above and the changing the law being the most obvious one. From this research, it seems

like those Chinese governing elites were pushing by both external and internal forces to fulfill their new collective goal, "from a major sports country to a world sports power", by transforming China's National Fitness Policy. References Hogwood, B. W., & Peters, B. G. (1983). *Policy dynamics*. New York, NY: St. Martin's Press. Juang, W.J. (2003). *Policy Systems and Policy Change: The Case Study of the Fourth Nuclear Power Plant Policy Discontinuity* (Unpublished PhD Thesis). National Chengchi University, Taipei.

### EVALUATING THE DEVELOPMENT OF ELITE SPORTS POLICY IN TAIWAN

Chen, S., Bairner, A.

*LOUGHBOROUGH UNIVERSITY, SPORT, EXERCISE AND HEALTH SCIENCES*

**Introduction** Over the last few decades, the value of international sporting success has attracted the attention of many national governments. This has led to an increasing interest in countries such as Australia, Canada, China, Japan and the UK in the development of elite sport systems. It is recognized by some academics that the elite sports systems of sporting superpowers converge towards similar models but with local variations. Thus, it is interesting to evaluate whether the elite sports systems of countries such as Taiwan which are less successful in international sporting events share similarities in terms of sport policy formulation. **Objectives** The main aim of the current study is to explain and evaluate elite sport policies over time in three sports (baseball, taekwondo and tennis) through the application of the Advocacy Coalition Framework (ACF). **Research Methods** The study adopts a qualitative case-study approach based on documentary analysis and semi-structured interviews. The selection of semi-structured interviewees has involved purposive and snowball sampling and is based on the ACF which refers to potential policy actors within the policy sub-system from five different domains. In total, 26 interviews were conducted. The data were transcribed and thematic coding method adopted. **Results & Discussion** The initial research results are as follows: First, successive Taiwan governments have been aware of the value of international sporting success and in particular potential political benefits. Although the government had strongly intervened in the development of elite sports since the 1950s, this became more obvious after the establishment of the Sports Affairs Council (SAC). However, it does not invest sufficient amounts of money in development. Second, the development of sports policy conforms to the institutional features of a welfare regime. Third, important influences and constraints affect the actors within the sports policy subsystem. Fourth, the relationships between the SAC and the NGBs are top-down as the former provides funding to the latter. Fifth, the study reveals that the elite sports systems of the three selected sports are converging towards a model similar to that which operates in other countries, including the development of elite level facilities, identification of sports talent, the provision of competition opportunities for elite athletes both domestically and internationally, the provision of coaching and sports science support, the emergence of full-time athletes, and support for elite athletes' post-career. However, there are local variations. **References** Esping-Andersen, G. (1990). *The Three Worlds of Welfare Capitalism*. Cambridge: Polity Press. Green, M. and Houlihan, B. (2005). *Elite Sport Development: Policy Learning and Political Priorities*. London: Routledge. Sabatier, P. A. and Weible, M. (2007). *The Advocacy Coalition Framework: Innovations and Clarifications*. In P. A. Sabatier (Ed.), *Theories of the policy process* (2nd ed.) (pp. 189-222). Boulder, CO: Westview Press.

### SPORT POLICY FACTORS LEADING TO SPANISH INTERNATIONAL SPORTING SUCCESS. ATHLETES' AND MANAGERS' PERCEPTION

Inglés, E., Marín, A., Vilanova, A.

*INEFC*

**Introduction** This study is part of an international project that aims to compare sports policies from different countries to determine their factors leading to international sporting success. 14 countries are involved. The analysis is based on the theoretical model of De Bosscher et al. (2006) that classifies its influential factors in 9 pillars. Our aim is to show the comparison between the perception of top-level athletes and sports federations managers in Spain (Vilanova, 2011) in relation to the following factors: financial support (P1), sports policy organization and structure (P2), talent identification and development system (P4), athlete support (P5), national and international competitions (P8). **Methods** The method used were standardized surveys to athletes and managers. The sample of athletes was determined based on the National Sports Council (CSD) database (universe=528). By means of systematic probabilistic sampling and using the calculation for finite population (<100,000) our sample consisted of 166 athletes (confidence level 95%, p=q=0.5, max. error 6.5%). Furthermore, a different survey was submitted to 28 managers. **Results** P1. Investment in sports from the government (CSD) is 0.04% of the total national budget. 60.1% of athletes consider that the amount they receive is enough to live and 23.5% consider that it is insufficient. Federations assign 66.6% of its budget to top-level sport. P2. The organization of sports policy in Spain is complex because of its multilevel structure, and the information comes to the athletes by the federations (30.2% of them consider that it is insufficient). P4. Athletes admit to be satisfied with the support received from their clubs (45.1%), while a 26,8% consider the support received from the federations as good. 30.7% of managers consider that their system of talents identification is worse than the one from the leading countries in their sport. P5. The PROAD (Program for the attention to high-level sportspeople) offers individualized attention to athletes. 22.6% consider that the support they receive is excellent, and 17.6% consider that it is insufficient. P8. Most of the top level athletes consider that the frequency of international sports events hosted in Spain is insufficient (72.3), whilst a 61.54% of managers consider that it is satisfactory. **Discussion** We consider that it is crucial to know athletes' and managers' opinion about the current situation, because they are its direct actors. The combination of the perception of athletes and managers with the analysis of the real situation allowed us to make a precise diagnosis of the sports policy system in Spain. **References** De Bosscher, V., De Knop, P., Van Bottenburg M, Shibli, S. (2006). A conceptual framework for analysing Sports Policy Factors Leading to international sporting success. In *European Sport Management Quarterly*, 6 (2), 185-215. Vilanova, A. (Dir.) (2011). *Memoria Científico-Técnica. Factores de la política deportiva española que conducen al éxito deportivo internacional*. Madrid: Consejo Superior de Deportes.

### PROFILING RECREATIONAL AND SPORTING USERS IN NATIONAL AND NATURAL PARKS AND WILDERNES AREAS IN CATALUNYA - SPAIN

Farias Torbidoni, E., Monserrat-Revillo, S.

*Consultoria Socioambiental Ecogestion - INEFC (GISEAFE)*

**Introduction** Natura 2000 areas play an important role in tourism, sport and recreation in addition to their primary purpose of nature conservation. Researchers haven't paid much attention to study what are the most important factors relating the use of these protected areas by different segments of the population. In this study we analyse the results of a survey made in eight different natural areas in Catalonia, all of them included in Natura 2000 net, in order to gain a better understanding of the use of this natural spaces and especial-

ly their physical or sporting use. Methodology This study was carried out in eight Natura 2000 natural areas, specifically in one National Park, one Natural Park and six Wilderness Areas belonging to Catalunya Fundation – La Pedrera, along 11 years, from 2001 to 2012. The data used in this study is based on a total of 3676 on-site structured interviews distributed proportionally in all natural areas. Results The results obtained revealed that the profile of the visitors were: male (65.5%), with an average age of 43.1 years (54.2% between 32 and 51 years old), had finished university (46.3%), currently lived in Barcelona area (58.4%). More than 80% had high level of knowledge about the protection status of visited area. They were not staying in any accommodation during their trip (47.8%) and were visiting the protected area as their first time (38.7%). They went with friends (31.6%). More than 73% were visiting the natural area for half a day (from 30' to 6 hours) and about the 69% of visitors do some physical activities in the protected areas: recreational hiking - walking more than ½ hour - (16.8%), hiking - walking more than 1 hour - (38.1%), snow activities (5.1%), mountaineering (4.9%), climbing (3.9%) and mountain biking (4%). These figures show an increase of 10% comparing to previous research (Fariás 2005 and 2011) Discussions The analysis of 3676 questionnaires indicates that users of recreational areas in Catalonia have a higher average of education and knowledge of Natura 2000 net than European and Spanish population (Eurosat, 2012). Natural areas users were typically enthusiastic about some particular outdoor activities or sporting recreation, like hiking and mountaineering. According to previous studies carried the results obtained in this study can be used to promote physical or sporting activities in protected areas, improving the experience of the visitors and also optimising resources in the Park. References Eurosat (2012). Eurobarómetro Atitudes of Europeans towards the issue of biodiversity: [http://ec.europa.eu/public\\_opinion/flash/fl\\_219\\_en.pdf](http://ec.europa.eu/public_opinion/flash/fl_219_en.pdf) Fariás E, Grau HR, Camps A (2005) Trai Preferences and Visitor Characteristics in Aiguestortes i Estany Sant Maurici National Park, Spain. Mountain Research and Development 25(1):51-59. Fariás E.I (2011) Managing for recreational experiences opportunities: the case of hikers in protected areas in Catalonia, Spain. Environmental Management, Vol. 47, Núm. 3. Pàg. 482-496.

### ASKING QUESTIONS ABOUT ATHLETE WELFARE: PIUTTING THE PERSON BACK TOGETHER

Saunders, J., Pink, M.

*Australian Catholic University*

Introduction The growth of sport science within professional sport in Australia has been characterised by an emphasis on seeking competitive advantage through optimising physiological, technological and to a far lesser extent psychological potential. Such approaches have been largely taken in isolation from each other. The overall outcome has been to view the athlete as a quantifiable commodity. However from an ethical perspective an increasing number of people have shown concern for the value of considering the athlete as a person within a longer term perspective. The study reported here is part of an ongoing initiative sponsored by the AFL research board aimed at increasing understanding of the value in supporting and encouraging the continuing personal development of players away from the competition field. Methods This case study of an individual club involved over two weeks of immersion in the club environment. Data compiled included observations, interviews and document analysis Findings A conceptual framework was developed drawing on Schein's model for organisational culture to provide a basis for understanding players' non-football engagements and their relationship to their football performance. Seven dimensions of the club environment were identified as influencing non-football engagements. Six types of engagement were reported and five criteria which contributed to the quality of those engagements as perceived by the players Discussion Findings about the relationship of players' off-field engagements with respect to their performances as footballers can only be interpreted in the context of the individual and the characteristics of the setting provided by his club. This case study involved a club that provided institutional support for players' lives off the field through a player development department. At least two of the dimensions of the club environment were directly related to this formal level of support provided. The importance of personal relationships with respected staff of the club is just one element that will be evaluated further in the ongoing enquiry. However, it reinforces the need to consider the experience of the individual within the culture of his own club before meaningful conclusions can start to be drawn about player behaviour. The significance of this larger project and the support it is receiving from sections of the football community can be taken as heartening evidence of increased awareness of the value of seeing the athlete as a whole person. References Pink, M (2013) The relationship between off-field engagement and on-field performance among elite Australian Rules football players. PhD study in progress. Australian Catholic University Schein, E.H.(1990) Organisational culture. American Psychologist, 45(2) , 109-111

### PROMOTING PARTICIPATION: IS ELITE SPORT A REMEDY OR AN OBSTACLE?

Seguí, J., Inglés, E.

*INEFC-Lleida*

Introduction The relationship between elite sport and sport-for-all is an important and very topical subject. Policy practice and academic literature is full of examples of the role of elite sport on the promotion of sport participation. This assumption is based on the so-called double pyramid theory, in which a trickle-up and trickle-down effect exists between sport-for-all and elite sport (IOC, 2000). The trickle-up effect assumes that the broader the base, the greatest number champions. In the other side, the trickle-down effect assumes that successful elite sport performances stimulate people's participation: "viewing" leads to "doing" (Wan, 2000). The assumption of the reliability of these effects, in many cases, legitimates governments to invest in the elite sport policies (top of the pyramid) or in the sport-for-all policies (base of the pyramid), to make the opposite side of the pyramid improve, respectively. The trickle-down hypothesis has been rarely rigorously tested. So the aim of our study is to verify the existence of the effects of the double pyramid in the case of Spain. Methods The method of our study has been the analysis of content of the existing documentation on: a) the sports licenses of the 66 Spanish sports federations since 1980; and b) the participation and success of the national teams in world championships and Olympic Games during this period. The rigorous empirical study consisted of the comparison of the evolution of those data in each of the analyzed sports and its correlation. Based on this correlation (evolution of sports licenses – top-level sporting success), we are able to verify the existence or non-existence of the trickle-down effect in the Spanish case. Results Results show that there's not a general correlation between the sporting success in world championships or Olympic Games and the growth in the number of sports licenses. We can observe some cases where a great national sporting success has led into a growth in the number of sports licenses of this discipline, but these are only punctual cases and not a general tendency. Discussion As some other previous studies in other countries have shown (Van Bottenburg, 2002), we can confirm that, in some punctual cases, the trickle-down effect exists, but we can not define it as a general tendency in the Spanish sports participation since 1980. Therefore, elite sport can not be considered a "magical" remedy nor an obstacle for sport participation promotion. Consequently, we think that the public investment on elite sport development with the aim of promoting participation is not totally justified. In the Spanish case, "viewing" do not necessary lead to "doing". References IOC (2000). Sport for All/Sport pour Tous, Lausanne: International Olympic Committee. Van Bottenburg, M. (2002). Sport for all and Elite Sport: Do they Benefit One Another? At: IX

World Sport for All Congress, Netherlands, October 2002. Wann, D.L., (2001). Sport Fans. The Psychology and Social Impact of Spectators. New York (etc.): Routledge.

**10:20 - 11:50**

## Oral presentations

### OP-PM54 Training and Testing [TT] 8

#### **PREDICTING AND MONITORING CYCLING PERFORMANCE IN TRAINED TO ELITE CYCLISTS; PRACTICAL IMPLICATIONS FOR USING THE LSCT.**

Lamberts, R.P.

*University of Cape Town*

Complaints of painful and powerless legs due to hard training are common in professional cyclists. Although that most of these symptoms can be explained by a high training load, in some cases these symptoms are caused by iliac blood flow restrictions. Being able to predict, monitor and reflect pathologies such as restricted iliac blood flow are important to optimize training adaptation. The main aim of this study was to establish the predictive value of a novel submaximal cycle test (LSCT) for Peak Power Output (PPO), VO<sub>2</sub>max and 40km time trial (40-km TT) performance (n=82, VO<sub>2</sub>max range: 46.5-74.8 ml/min/kg). In addition, actual and predicted cycling performances (LSCT) in a professional cyclist with bilateral iliac blood flow restrictions, before and after surgical intervention, were compared to the dataset of the 82 symptom free cyclists. Good correlation were found between the LSCT and PPO (r=0.96), VO<sub>2</sub>max (r=0.92) and 40km TT time (r=0.96), in the 82 symptom free cyclists. Meaningful differences were found between predicted and actual 40km TT time in the 2 tests before the surgical intervention (2:51 and 2:55 (min:s), respectively), which disappeared after the surgical intervention (0.02 (min:s)). No differences were found between predicted and actual PPO and VO<sub>2</sub>max. This finding suggests that kinking of the iliac artery is likely to mainly impair endurance capacity and not PPO and VO<sub>2</sub>max. In conclusion, the LSCT can accurately predict cycling performance in trained to well-trained and elite cyclist. Discrepancies between actual and predicted cycling performance shows potential as an early screenings tool for deteting iliac bloodflow restrictions.

#### **SECULAR TRENDS OF PHYSICAL FITNESS IN JUNIOR AUSTRIAN COMPETITIVE SKI RACERS: A COMPARISON BETWEEN 1996-2003 AND 2004-2011 TIME PERIODS**

Raschner, C., Starker, T., Patterson, C., Platzer, H.P., Mueller, L., Hildebrandt, C.

*University Innsbruck*

**Introduction** There is evidence that physical fitness of young people has declined across all age groups during the last decades. Limited scientific information is available concerning secular trends of junior athletes and no research has assessed physical fitness of junior ski racers over time. Therefore the aim of this study was to compare fitness data from adolescent ski racers from 1996 to 2003 (group 1) with those from 2004 to 2011 (group 2). **Methods** Through cooperation with the Skigymnasium Stams all 14-18 year old female (F) and male (M) ski racers underwent anthropometric measurements (body height and weight) and fitness tests (Coopertest, isometric leg extension strength, counter movement jump, drop jump and agility) annually (Raschner et al. 2012). Group 1 included 807 athletes (F=352, M=455), group 2 712 athletes (F=317, M=395). Group differences of 14, 15, 16, 17 and 18 year old ski racers were calculated separately with the Mann-Whitney U-test. Statistical significance was set at p<0.05. **Results** For anthropometric data, significant differences between group 1 and group 2 were found in body weight. F (14-16 years) and M (14, 15 and 17 years) ski racers of group 2 were heavier compared with the age matched athletes of group 1. F and M ski racers of group 2 had significantly lower endurance (F: 15-18 years, M: 14-17 years), isometric leg extension strength (F: 15-18 years, M: 14-18 years) and jump height (F: 15-18 years, M: 14-18 years) compared to athletes of group 1. Reactive strength and agility results were statistically better in group 2 for all age groups except 14 year old M athletes. **Discussion** Strength, power, agility, and aerobic/anaerobic training (with varied emphasis) have been included in age-appropriate training programs of young Austrian ski racers for decades. Due to the constant evolution of ski equipment and environmental factors training focus has changed. For example young slalom ski racers must be more agile and reactive between the gates now, so more time is spent with agility and reactive strength training. High volume endurance training and strength endurance training were emphasized in group 2. In spite of this, the decline of endurance, strength and power performance is in line with results of secular trends of high school pupils. Ski racing demands a multitude of physical abilities but there is still no one single physiological variable that can determine success (Turnbull et al. 2009). **References** Raschner C., Platzer HP., Patterson C., Werner I., Huber R., Hildebrandt C. (2012). Br J Sports Med, 46, 1065-1071. Turnbull, J.R., Kilding, A.E., Keog, J.W. (2009). Scand J Med Sci Sports, 19, 146-155.

#### **THROWING PERFORMANCE PRIOR TO OLYMPIC FEMALE WATER POLO COMPETITION**

Freeston, J., Smith, S., Rooney, K., O'Meara, D.

*The University of Sydney*

**INTRODUCTION:** Throwing ability is critical to successful water polo performance, requiring a high degree of speed and accuracy (Vila et al, 2011). Despite its importance, throwing speed and accuracy of elite female water polo players has not yet been described in detail, nor examined under different game-like conditions. Furthermore, changes in throwing performance over time have not been described for any throwing population. Consequently, the aim of this study was to provide a detailed description of shooting performance in elite female water polo players under a range of different shooting conditions, on multiple occasions in the lead up to Olympic competition. **METHOD:** Ten Olympic female water polo players were tested eight, six and four months prior to Olympic competition for maximal throwing speed and accuracy towards three different target locations, with and without a goalkeeper present. **RESULTS:** Maximal throwing speed remained consistent (p = 0.41), while Hit Percentage improved (p < 0.001) across the three testing sessions. No overall location effects were observed, such that throwing speed and accuracy were similar across the different target locations however, throwing speed (p < 0.05), hit percentage (p < 0.05) and horizontal accuracy (p < 0.05) were reduced in the presence of a goalkeeper. **DISCUS-**

SION: These athletes consistently demonstrated elite levels of throwing performance in the lead up to Olympic competition, achieving higher maximal throwing speeds than any values previously reported for female water polo players (Elliott & Armour, 1988), with an average error of just 20.7 cm. Despite the elite nature of the playing group however, speed and accuracy were reduced in the presence of a goalkeeper. We attribute this to differences in technique (baulking) and strategy (decision-making in response to GK movements). While maximal speed remained consistent, accuracy (Hit %) improved significantly over time. The mechanism for this is unclear however; we propose that future investigations should explore the effect of training volume on throwing performance. CONCLUSION: Elite female water polo players demonstrated a high degree of throwing speed and accuracy, yet suffered reduced performance with a goalkeeper present. We recommend that water polo testing and training should simulate game-like conditions where possible, in order to minimise this negative goalkeeper effect. Elliott, B. C., & Armour, J. (1988). The penalty throw in water polo: a cinematographic analysis. *J Sports Sci*, 6(2), 103-114. Vila, H., Abalde, J. A., Alcaraz, P. E., Rodriguez, N., & Ferragut, C. (2011). Tactical and shooting variables that determine win or loss in top-level water polo. *Int J Perform Anal Sport*, 11, 486-498.

### THE OFFENSIVE AND DEFENSIVE DEMANDS OF COMPETITIVE AMATEUR BOXING: A COMPARISON OF ELITE AND NON-ELITE PERFORMANCES

Thomson, E., Lamb, K., Nicholas, C.

*University of Chester*

**Introduction** Whilst performance analysis has been applied to several combat sports, little attention has been paid to amateur boxing. The limited research to-date has considered performance (in terms of offensive and defensive actions) with respect to contest outcome (win/lose) only (El-Ashker, 2011; Davies et al., 2012), failing to address differences that may exist owing to other factors, such as ability level and contest duration. Thus, the purpose of the study was to elucidate the offensive and defensive demands of competitive amateur boxing with respect to boxer ability and contest duration. **Methods** With ethical approval, 42 boxing contests (3 x 3 minute Elite (E) contests: n = 17; 3 x 2 minute Non-elite (NE) contests: n = 25) across 11 weight categories (48 – 91+ kg) were recorded and analysed for 47 offensive and 53 defensive performance indicators using Dartfish TeamPro (Version 4.0, Switzerland). **Results** Analysis revealed that the absolute offensive demand was higher in the E than the NE contests (mean  $\pm$  95% Confidence Limits: Punches performed: E: 218  $\pm$  30 vs. NE: 166  $\pm$  14; standardised ES: -0.47; Duration attacking: E: 98  $\pm$  13s vs. NE: 73  $\pm$  6s; standardised ES: -0.48) across each round of boxing. However, expressed relative to the contest duration, most differences in offensive performance were reduced or rendered unclear (Punches performed (per min): E: 25  $\pm$  3 vs. NE: 26  $\pm$  2; standardised ES: 0.27; Duration attacking (per min): E: 11  $\pm$  1s vs. NE: 12  $\pm$  1s; standardised ES: 0.24). Similarly, E contests were characterised by a higher absolute defensive demand (Defences performed: E: 88  $\pm$  10 vs. NE: 64  $\pm$  6; standardised ES: -0.6) in each round. However, differences in defensive performance were rendered unclear when expressed relative to the contest duration (Defences performed (per min): E: 10  $\pm$  1 vs. NE: 10  $\pm$  1; standardised ES: 0.09). Differences in technical performance (% of offensive/defensive actions deemed successful/unsuccessful) were also declared unclear (standardised ES: -0.19 to 0.37). **Discussion** The findings highlight a higher absolute offensive and defensive demand in Elite compared to Non-elite boxing contests, indicating the need for enhanced levels of conditioning. However, the demands of each minute of competition and technical performance were analogous, implying it is the ability to maintain comparable efforts for longer (9 min vs. 6 min) that distinguishes Elite from Non-elite contests. Coaches and boxers should adopt tailored training regimes cognisant of this ability disparity in contest demands. **References** Davies, P., Wittekind, A. Beneke, R. (2012). *Int J Sports Physiol and Perf*, 8, 84-91. El-Ashker, S. (2011). *Int J Perf Analysis in Sport*, 11, 356-364.

### CROSS-COUNTRY SKIING: SPECIFIC STRENGTH TRAINING FOR ENDURANCE SUCCESS

Shishkina, A., Tarbeeva, N.

*Urals Federal University*

**Introduction** Strength training in elite sports has to provide a hypertrophy of muscles providing competitive activity (principle of specificity) and biomechanical sportive technique compliance and be aimed on necessary type of strength abilities. **Methods** For specificity: the determination of skiing sports technique important elements allowed to define leading muscles groups and to pick up strength exercises for their enhancement. For biomechanical proximity: the order of performance of strength exercises corresponded to sequence of inclusion of muscles in work (1), angular and dynamic characteristics agree with those in skiing classical and/or skating styles. For the proper orientation of x-country skiers strength training: for increasing of actually strength abilities (a hypertrophy of slow muscular fibers) low intensive strength training (2) with the principle of the isolated training (one group of muscles –in one training day) was chosen. Thus, 4 independent strength complexes of 4 basic exercises in each for skiers-racers were formed: for muscles of arms, for a press and a back, 1 for legs in classical style and 1- for legs in skating style. The strength training session for E-group (10 males and 5 females highly skilled skiers aged 17-23) was distributed as 1-1-3-4-4 series per week with 3 sets in each. 3 different complexes (arms, press+back, legs) were fulfilled once a week. Rest period between complexes was 5-7 days, between series was 10 min, between sets 30 s. Members of C-group (10 males and 5 females) were trained three times a week according to the classical scheme of strength training. Before and after 5 weeks strength session strength and physical workability were tested by step increasing speed roller skiing with Garmin Forerunner 305 monitoring. **Results** The analysis of results of ski roller testing of E-group allowed to define decreasing of heart rate at low speed roller skiing (V=8 km/h), increasing of physical working capacity (speed at HR=170 beats per min) and the maximum speed of skiing while the results of C-group were opposite. It proves effectiveness of strength complexes both for strength and for endurance. Moreover, the research of athletes hemodynamic changes after low intensive strength session revealed a considerable growth of cardiac output (from 95,8 $\pm$ 14,7 to 135 $\pm$ 17,8 ml), increasing of minute blood volume from 5,7 $\pm$ 0,34 to 7,4 $\pm$  0 ,74 l and final diastolic volume from 174,1 $\pm$ 8.9 to 226.3 $\pm$ 15,4 ml. All above mentioned hemodynamic changes were caused by specifics of low intensive strength training and connected with endurance. **References** 1. Godic M (1980). Training and competition load control 2. Seluyanov V (2001). Training of middle distance runners

### CHANGES IN PRO/ANTIOXIDANT BALANCE IN PROFESSIONAL MALE PLAYERS THROUGHOUT A SOCCER SEASON

Le Moal, E., Groussard, G., Chaory, K., Plantet, K., Pincemail, J., Zouhal, H.

*Movement Sport Sciences and Health Laboratory (M2S)*

**Introduction** Physical exercise is associated to an increase of reactive oxygen species (ROS) production by skeletal muscle. Exercise-induced ROS production presents beneficial effects by up-regulating antioxidant enzyme activity. However, intense training can be asso-

ciated to oxidative stress occurring when ROS production exceeds antioxidants defenses (Machefer et al 2007). There are few data concerning the longitudinal follow-up of pro/antioxidant balance in highly trained soccer players and, to our knowledge, no one have been associated to training period. The aim of this study was to analyze changes in pro/antioxidant balance related to training period in professional soccer players. Methods Eight professional soccer players (18.3±0.6 years, 179.4±6.2cm, 73.0±6.2kg) participated in this study. They performed six training sessions and one game a week. Five blood samples were collected throughout the season: in July (T1), September (T2), December (T3), January (T4) and May (T5). These time-points allowed us to frame crucial periods of training during the season: the preseason training (T1-T2), the championship period (T2-T3 and T4-T5), and winter break (T3-T4). Several markers of the pro/antioxidant balance (Vitamin E, Beta-carotene; activity of glutathione peroxidase (GPx), superoxide dismutase (SOD) and GSH/GSSG ratio) have been measured. Dietary intakes were also assessed. Results GSH/GSSG ratio was increase significantly in T4 compared to other time-points suggesting that winter break allows restoring GSH/GSSG after an intense period of competition ( $p<0.05$ ). The activity of GPx showed a significant down-regulation toward the end of the season (T5) compared to other time-points ( $p<0.05$ ). In contrast, SOD activity presented a large increase after winter break and toward the end of the season (T4 and T5) compared to other time-points ( $p<0.05$ ). Furthermore, there were no changes concerning vitamin E and dietary intakes throughout the season. Discussion These results show changes in pro/antioxidant balance throughout a season. These changes can be related to training periods. No changes were observed according to preseason training period consisting in large volume of aerobic moderate to high intensity running. A large increase in GSH/GSSG ratio observed in T4 suggests that winter break is important in order to encompass deleterious effects associated to intense training. Surprisingly, antioxidant enzymes activities present a different pattern during the second part of the season (T4 & T5). To conclude, training periods (preseason vs. championship) induce changes of pro/antioxidant balance throughout a season in male professional soccer players. References Machefer G et al., (2007). *J Am Coll Nutr* 26(2): 111-20.

## 10:20 - 11:50

### Oral presentations

#### OP-PM29 Physiology [PH] 6

##### THE IMPACT OF MAINTAINED AND INCREASED PLASMA VOLUME ON CARDIAC FUNCTION FOLLOWING PROLONGED EXERCISE

Stöhr, E.J.1,2, Low, D.A.2,3, Eldridge, L.2, Nicholas, G.1, Newcombe, D.1,4, Stembridge, M.1, Bassett, K.1, Nio, A.Q.X.1, Shave, R.1,2

1: Cardiff Metropolitan University; 2: Brunel University; 3: Imperial College London; 4: Oxford Brookes University

Introduction Acute reductions in cardiac function, including left ventricular (LV) twist and strain ('LV mechanics'), have been reported following prolonged exercise. However, previous findings may have been influenced by dehydration and a consequential reduction in plasma volume impacting upon preload of the heart. To date, a controlled laboratory study examining the influence of altered plasma volume during prolonged exercise on post-exercise cardiac function is missing. The aim of this study was to manipulate fluid intake during prolonged exercise, to either maintain or increase plasma volume, and thus examine the effects of hydration status upon post-exercise cardiac function. Methods Eight healthy male cyclists (age 31±4 years) completed two 6-hour cycling challenges at 20% below lactate threshold (power output= 169±26 Watts). During one cycling challenge, dehydration was prevented by regular ingestion of 500 ml / hour of a carbohydrate-electrolyte fluid (EUHY), during the other cycling challenge hydration status was matched to maintain body mass (measured hourly), a method which is known to acutely increase plasma volume (EXPANS). Venous blood samples were taken before and during exercise to monitor changes in plasma volume. Before, immediately after and 24 h post-exercise a comprehensive cardiac ultrasound examination was performed for assessment of LV volumes, diastolic function and LV mechanics (i.e. strain and twist). Data were analysed with two-way repeated measures ANOVA. Statistical significance was accepted at  $p<0.05$ . Results Plasma volume was maintained during EUHY cycling and increased during EXPANS cycling (Main hydration effect:  $p=0.006$ ). Similar to previous reports, cardiac filling decreased as evidenced by reduced end-diastolic volume and early filling velocity ( $p<0.0001$ ). This was accompanied by a significant reduction in SV ( $p=0.0009$ ). Circumferential strain at the base was mildly reduced following 6h cycling but all other strain and twist indices were maintained following prolonged EUHY exercise ( $p>0.05$ ). All post-exercise changes in LV function returned to baseline 24 h later. There were no differences in any cardiac parameters between EUHY and EXPANS ( $p>0.05$ ). Conclusions Following prolonged exercise with maintained plasma volume LV twist and strain are maintained, suggesting that reduced filling and stroke volume may be caused by peripheral factors. Plasma volume expansion through enhanced fluid ingestion during prolonged exercise does not appear to further alter post-exercise cardiac function.

##### COMPARISON OF CARDIOVASCULAR STRUCTURE AND FUNCTION IN ATHLETES WITH AND WITHOUT MYOCARDIAL INFARCTION

Maessen, M., Eijsvogels, T., Dijk, A., Hansen, R., Korte, C., Thijssen, D., Hopman, M.

Radboud University Nijmegen Medical Centre

Background Although regular exercise training protects against future cardiovascular events, occurrence of myocardial infarction (MI) has been reported in apparently healthy, life-long athletes. Possibly, differences in cardiovascular structure and function may contribute to the development of MI. The aim of this study was, therefore, to compare cardiovascular structure and function between post-MI life-long male athletes and their healthy peers. We hypothesize that post-MI athletes have a lower cardiovascular structure and function compared to a healthy control group. Methods A cross-sectional design was used to compare cardiovascular characteristics between post-MI ( $n=11$ , 61±4 years) and healthy controls (C) ( $n=12$ , 64±8 years). All subjects were life-long athletes (>20 years >6 h/week moderate-to-high intensity endurance exercise). A maximal cycling test was performed to determine physical fitness level. Echocardiography measurements included the assessment of ejection fraction (EF), cardiac output (CO), left ventricular end-diastolic (LVEDM), and end-systolic mass (LVESM). Radial and circumferential strain of the carotid and superficial femoral artery were assessed using multiple beam steered angles. Strain was quantified using 2D cross-correlation based coarse-to-fine estimation strategy. Results We found no differences be-

tween post-MI and C in peak oxygen consumption (MI  $40.4 \pm 6.2$  vs. C  $43.2 \pm 10$  mL/min/kg), workload (MI  $260 \pm 35$  vs. C  $288 \pm 54$  Watt), heart rate (MI  $167 \pm 12$  vs. C  $161 \pm 15$  bpm), and exercise history (all  $p > 0.05$ ). Echocardiography revealed no difference between post-MI and C for EF (MI  $59 \pm 7$  vs. C  $60 \pm 6\%$ ), CO (MI  $3.7 \pm 0.7$  vs. C  $3.4 \pm 1.0$  L/min), LVEDM (MI  $158 \pm 20$  vs. C  $161 \pm 30$  gr), and LVESM (MI  $160 \pm 22$  vs. C  $159 \pm 25$  gr) (all  $p > 0.05$ ). Post-MI showed significantly lower radial strain of the carotid (MI  $12.0 \pm 6.7\%$  vs. C  $22.0 \pm 11.9\%$ ) and femoral artery (MI  $11.7 \pm 4.9\%$  vs. C  $18.0 \pm 11.5\%$ ) compared to C ( $p = 0.005$ ). Circumferential strain in the carotid artery (MI  $-22.3 \pm 8.2\%$  vs. C  $-31.7 \pm 12.2\%$ ) and femoral artery (MI  $-19.5 \pm 8.3\%$  vs. C  $-28.8 \pm 13.2\%$ ) was significantly decreased in the post-MI group compared to C ( $p = 0.006$ ). Conclusion Whilst both groups demonstrate similar fitness levels and cardiac structure and function, post-MI life-long athletes demonstrate an impaired conduit artery function in both carotid and femoral artery compared to their healthy peers. Although speculative, these differences between both groups may have influenced the development of atherosclerosis and cardiovascular diseases.

### HEART RATE COMPLEXITY CHANGES DURING BICYCLE ERGOMETRY

Berskiene, K.1, Navickas, Z.2, Vainoras, A.3

*Lithuanian University of Health Sciences*

Introduction Over the past decade, the non-linear dynamics methods based on deterministic chaos and the complex system theories to analyse the complex physiological systems have been introduced. The traditional methods based on self-regulation and statistics appear to be insufficient for the analysis of non-linear and non-stationary signals generated by the living organism. The main feature of the physiological systems – their complexity is ‘hidden’ in the biomedical signals. Human body adaptation to physical load is an actual task of sports and clinical medicine. During bicycle ergometry work we can evaluate the functionality of the human body. The main task was to find the complexity measure for ECG RR interval, which could integrally evaluate body reaction to physical load. Methods There were used the standard stress test method of provocative incremental bicycle ergometry work. For evaluation of cardiovascular system reactions the ECG analysis system “Kaunas – Load” was used. The investigated contingent consisted of 21 asymptomatic women (20-50 years old), participating in aerobics exercise program. We divided these group according age (20-30 years old group, 11 women, and 31 – 50 years old group, 10 women), analyzed load and recovery data separate. We used RR intervals (ms) during every cardio-cycle, divided data to the same size intervals and calculated averages and variances. We hypothesized that the algebraic form of the dependence variance (average) is the power function. All our data satisfied this hypothesis ( $p < 0.05$ ). The relation between averages and variances is called allometric. The slope of logarithmic dependence we called the allometric complexity measure. According to Bruce J. West, we hypothesized, that if the absolute value of the slope is less than 1, the complexity of the process is low and body reaction to load is inadequate, if more than 1 – the complexity is high- the higher value of complexity means better adaptation to physical load. Results For all tested women RR interval allometric complexity absolute value was higher than 1 ( $p < 0.05$ ). We showed that RR interval complexity for young women was significant higher ( $p < 0.05$ ). It means, that young women body adaptation to physical load is better. Comparing the results during load and recovery, complexity measures were higher during recovery for young women ( $p < 0.05$ ), but the values didn’t differ for another group. Discussion We can conclude, that the slope of ECG RR interval allometric relation could be the complexity measure, which defines all body adaptation to physical load. This generalized complexity measure is suitable for long signal (algorithm needs no less than 100 points). It was estimated, that RR interval complexity measure was higher ( $p < 0.05$ ) of healthy and better physical state persons. References Bruce, J. W. Where Medicine Went Wrong. Rediscovering the Path to Complexity. Studies of Nonlinear Phenomena in Life Science. World Scientific, 2006. 335 p.

### SIGNIFICANT IMPROVEMENT IN HEMODYNAMIC RESPONSES TO METABOREFLEX ACTIVATION AFTER ONE YEAR TRAINING IN SPINAL CORD-INJURED HUMANS

Crisafulli, A.1, Milia, R.1, Roberto, S.1, Marongiu, S.1, Olla, S.1, Sanna, I.1, Angius, L.1, Bassareo, P.2, Pinna, M.1, Tocco, F.1, Concu, A.1

*university of Cagliari*

Introduction Spinal cord injured (SCI) individuals show an altered control over the circulation during the muscle metaboreflex (Crisafulli A. et al. 2009). This altered control is due to the absent peripheral vasoconstriction below the level of the spinal lesion, which reduces the capacity to vasoconstrict the arterial and the venous vessels and impair cardiac pre-load and after-load. Exercise training was found to enhance circulating catecholamines in response to exercise in SCI subjects (Bloomfield SA et al. 1994). Therefore, training would result in an enhanced capacity to vasoconstrict the circulation. This study aimed at testing the hypothesis that one year training improved the hemodynamic response to the metaboreflex in SCI patients. Methods Nine SCI patients took part in this study. They underwent a metaboreflex activation test at the beginning of the study (T0) and after one year training consisting in three to five hours/week of arm-cranking at 60% of maximum (T1). Hemodynamics were assessed by impedance cardiography and echocardiography at both T0 and T1. Results Results show that there was an increment in cardiac output gain due to metaboreflex activity at T1 as compared to T0 ( $545.4 \pm 683.9$  ml•min<sup>-1</sup> vs.  $220.5 \pm 745.4$  ml•min<sup>-1</sup>). Moreover, ventricular filling rate gain was higher at T1 ( $51.7 \pm 50.1$  ml•s<sup>-1</sup>) than at T0 ( $15.1 \pm 35.3$  ml•s<sup>-1</sup>). Similarly, end diastolic volume gain were increased after training ( $7.2 \pm 22.2$  ml at T0 and  $25.7 \pm 19.3$  ml T1 respectively). Discussion Data from the present investigation provides evidence that in SCI subjects a period of training, together with an increased physical capacity, can also successfully improve the hemodynamic response to the muscle metaboreflex activation. In fact, after the training period there was a higher cardiac output during the metaboreflex with respect to baseline. This result was likely the consequence of an ameliorated ventricular filling rate and end-diastolic volume, which were probably due to an improved capacity to vasoconstrict the venous beds, thereby reducing venous pooling and increasing venous return. It remains to be elucidated if this cardiovascular adaptation to training was to be ascribed to an augmented level of circulating catecholamines or it was due an enhanced myogenic response to transmural pressure at venous level or to both phenomena. References Bloomfield SA, Jackson RD, Mysiw WJ (1994). Med Sci Sports Exerc 26: 1213-1219. Crisafulli A, Milia R, Vitelli S et al. (2009). Eur J Appl Physiol 106: 525-533.

### CARDIOPROTECTION AFFORDED BY BETA-BLOCKADE IS MAINTAINED DURING ISOMETRIC MUSCLE CONTRACTIONS

Thomas, D.P.1, Ng, A.V.2, Sissons, M.3, Nagle, F.3, Rockey, S.1, Conviser, J.M.4

*1: U. Wyoming (USA) 2: U. Marquette (USA) 3: U. Wisconsin (USA) 4: JMC Healthcare & Assoc. (USA)*

Introduction Whether or not the cardio-protective effect of beta<sub>1</sub>-, or beta<sub>1,2</sub>-adrenergic blockade on rate-pressure product (RPP), a widely accepted measure of myocardial oxygen consumption (MVO<sub>2</sub>), is retained during static exercise has not been evaluated. Therefore the purpose of this study was to measure the hemodynamic and metabolic responses during isometric contractions involving hand-

grip (HG), single leg-extension (LE) and two-legged dead-lift (DL) under placebo control, beta1(ATEN) and beta1, beta2 (PROP) conditions. Methods Eleven male subjects performed HG, LE, or DL at 30 percent of maximal voluntary isometric contraction (MVC) for 3 min during which time HR, SBP, DBP, RPP, cardiac output (Q), SV (stroke volume) VO<sub>2</sub>, VCO<sub>2</sub>, and TPR were either measured directly or calculated under control, ATEN or PROP conditions. Results While not preventing the pressor response normally seen with isometric exercise, both ATEN, and PROP adrenergic blockade similarly and significantly reduced HR, SBP and their product, RPP during 30% MVC. This cardio-protective effect was more pronounced with the largest muscle mass involvement (DL), and highest HR, SBP and RPP measured. Discussion Most importantly this protection exists under exercising conditions that normally increase oxygen requirements for the heart by some three-fold compared to the resting state. References Seals DR, Washburn RA, Hanson PG, Painter PL, Nagle FJ (1983) J. Appl. Physiol. 54:434-437. Nagle FJ, Seals DR, Hanson PG (1988) Int. J. Sports Med. 9:313-315. Krzeminski K, Cybulski G, Ziemia A, Nazar K (2012) Eur. J. Appl. Physiol. 112:1315-1325. Pellingier TK, Halliwill JR. (2007) J. Physiol. 583:797-809.

## 10:20 - 11:50

### Invited symposia

#### IS-PM05 Obesity, diabetes and exercise: new developments \*

##### EFFECTS OF EXERCISE AND DIET ON MUSCLE FAT METABOLISM AND INSULIN ACTION

Horowitz, J.

*University of Michigan*

Insulin resistance is among the most pervasive metabolic complications associated with obesity, and it is linked with the development of chronic diseases, such as type 2 diabetes and cardiovascular disease. Weight loss is known to attenuate and even reverse insulin resistance, and adding an endurance exercise training program to a calorie restricted diet has been proposed to augment the improvements in insulin action. However, differentiating the effects of exercise training from the effects of weight loss can be rather challenging. As such, the precise mechanisms that mediate improvements in insulin sensitivity after a combined weight-loss/exercise training intervention are poorly defined. It is well known that excessive systemic fatty acid availability, a hallmark of obesity, can induce insulin resistance. Within skeletal muscle, accumulation of fatty acid intermediates (e.g., long-chain acyl-CoA [LCACoA], diacylglycerol [DAG], and ceramide) and subsequent activation of pro-inflammatory pathways (e.g., c-jun N terminal kinases [JNK] and nuclear factor- $\kappa$ B [NF- $\kappa$ B]) are thought to be a major contributor to obesity-related insulin resistance. This presentation will focus primarily on the effects of exercise and weight loss on changes in muscle lipid metabolism, the activation of pro-inflammatory pathways, and the subsequent effects on insulin action.

##### EXERCISE TREATMENT OF TYPE 2 DIABETES

Van Loon, L.J.C.

*Maastricht University Medical Centre*

Estimates of global diabetes prevalence indicate that type 2 diabetes has reached epidemic proportions. The latter can only partly be attributed to changing population demographics, as epidemiological data show diabetes incidence to increase particularly in the young and middle-aged. The latter implies that type 2 diabetes related complications will be experienced more frequently at a much earlier age. Postprandial hyperglycemia forms a direct, independent risk factor for the development of type 2 diabetes complications. Continuous glucose monitoring (CGMS) shows that type 2 diabetes patients experience hyperglycemia (blood glucose >10 mmol/L) throughout the greater part of the day. The latter despite the fact that such patients receive standard primary care and use oral, blood glucose lowering medication and/or exogenous insulin therapy. Clearly, additional therapeutic interventions are warranted to lower post-prandial blood glucose excursions. A single bout of moderate-intensity exercise lowers the prevalence of hyperglycemia by more than 40% during the subsequent 24 hour period. In accordance, regular physical exercise is now generally prescribed for the prevention and treatment of type 2 diabetes. However, more detailed information on the preferred type, intensity, duration, and/or frequency of exercise to maximize the benefits of exercise on glycemic control is presently unavailable. This lecture will define some of the characteristics that constitute the most effective and applicable exercise regimen to improve glycemic control in type 2 diabetes. Based on our current work more practical guidelines will be formulated to assist healthcare professionals and their type 2 diabetes patients to implement exercise interventions as an effective and applicable tool in the prevention and treatment of type 2 diabetes.

##### EXERCISE ADAPTATIONS IN MUSCLE LEPTIN SIGNALING.

Guadalupe Grau, A.

*University of Las Palmas de Gran Canaria*

Leptin is a 16 kDa hormone primarily released from adipocytes and the systemic levels increase in direct proportion with increasing adiposity. Leptin has been highlighted as a promising anti-obesity therapeutic target because of its central role in food intake and body weight control. Pleiotropic effects have also been attributed to leptin due to the expression of leptin receptors (OB-Rs) in several peripheral tissues, such as skeletal muscle. In addition to its locomotive function, skeletal muscle accounts for the majority of the basal metabolic rate and is the primary tissue responsible for whole body glucose metabolism. Leptin stimulates fatty acid oxidation, reduces the accumulation of intramuscular fat and increases glucose uptake and energy expenditure in skeletal muscle, but the intracellular mechanisms leading to these effects are not completely understood. Therefore, the aim of this talk will be to address the research on the effects of different life styles (i.e. long term training, obesity, physical inactivity) on the amount of leptin receptors as well as its intracellular pathways in human skeletal muscle. We will focus on mechanisms leading to intramuscular leptin resistance, as well as on acute interventions that induce activation of leptin signaling in human skeletal muscle, like severe acute energy restriction and exercise.

10:20 - 11:50

## Invited symposia

## IS-PM10 Dietary nitrate as an ergogenic aid \*

**MECHANISTIC BASES FOR DIETARY NITRATE AS AN ERGOGENIC AID**

Bailey, S.

*University of Exeter*

Dietary supplementation with inorganic nitrate has been shown to improve exercise tolerance during severe-intensity constant-work-rate exercise and incremental exercise tests, and to improve cycling time trial performance over 4 km, 10 km and 16.1 km. Recent data also demonstrate that dietary nitrate supplementation might be effective at improving intermittent exercise performance. The purpose of this presentation is to discuss the potential mechanistic bases for the improved exercise performance after dietary nitrate supplementation. Ingested inorganic nitrate is transported, via the entero-salivary circulation, to the salivary glands for secretion into the oral cavity. Lingual anaerobes reduce salivary nitrate to nitrite, which is swallowed and can be reduced to nitric oxide and other reactive nitrogen intermediates within the acidic environment of the stomach. However, it is also clear that ingested nitrite increases the circulating nitrite stores. Nitrite can undergo a one-electron reduction to nitric oxide in a reaction that is independent of oxygen and potentiated by acidosis. The increase in nitrite and/or nitric oxide bioavailability after nitrate supplementation is believed to be responsible for eliciting physiological responses conducive to exercise performance enhancement. Initial studies showed that dietary nitrate supplementation might be ergogenic by lowering the oxygen cost of exercise. Further studies have shown that nitrate can improve exercise efficiency by lowering the ATP cost of muscle force production and increasing the mitochondrial P/O ratio. A blunting in muscle phosphocreatine hydrolysis and lower accumulation of intramuscular [inorganic phosphate] and [adenosine diphosphate], and extracellular [potassium], might also contribute towards the improved exercise performance after nitrate treatment. Recent animal experiments have suggested that nitrate supplementation might preferentially enhance physiological responses in type II muscle fibres; specifically, contractile force, rate of force development and calcium release were improved only in type II muscle fibres in mice supplemented with nitrate, while nitrate supplementation was shown to increase muscle blood flow with a greater blood flow distribution to type II muscle fibres in rats. Therefore, while the mechanistic bases for the ergogenic effects of nitrate supplementation have not been completely resolved, it appears that the step-wise reduction of nitrate to nitrite and then nitric oxide augments a number of physiological responses that converge to enhance exercise performance. Indeed, improvements in excitation-contraction coupling, muscle perfusion and the efficiency of oxidative metabolism, and a blunting in muscle metabolic perturbation, are likely candidate mechanisms for the enhanced exercise performance after nitrate treatment.

**APPLICATION OF DIETARY NITRATE AS AN ERGOGENIC AID IN ATHLETES**

Cermak, N.

*Maastricht University Medical Centre+*

Chronic supplementation (3-15 d) of dietary nitrate, using nitrate-rich beetroot juice (6-8 mmol NO<sub>3</sub><sup>-</sup> per dose) has been demonstrated to reduce pulmonary oxygen uptake during submaximal exercise, reduce the metabolic cost of force production and improve exercise tolerance during more intense work rates. As such, these works proposed that dietary nitrate may contain ergogenic properties, prompting the direct investigation of the effect of dietary nitrate supplementation on exercise performance. Six days of supplementation with dietary nitrate-rich beetroot juice (8 mmol NO<sub>3</sub><sup>-</sup>·d<sup>-1</sup>) significantly improved 10 km time trial performance in trained cyclists, and acute supplementation (6.2 mmol NO<sub>3</sub><sup>-</sup> 2.5 h prior to exercise) significantly improved 4 and 16.1 km cycling time trials. These findings suggest that dietary nitrate ingestion can be applied as a potent ergogenic aid. However, in follow-up studies, no improvements in longer (1 h and 50 mile) time trial performances were observed after acute supplementation (6.2-8.1 mmol NO<sub>3</sub><sup>-</sup> 2.5 h prior to exercise). Consequently, the ergogenic properties of nitrate supplementation may be dependent on the duration and/or intensity of the exercise, the supplementation period and/or the elevation in plasma nitrite. Recently, dietary nitrate supplementation (28.7 mmol NO<sub>3</sub><sup>-</sup> consumed intermittently over ~30 h prior to exercise) significantly improved intermittent-type running exercise, supporting the suggestion that some ergogenic effects may be intensity driven. Moreover, data from rodents indicate that dietary nitrate supplementation improves vascular control and elevates skeletal muscle oxygen delivery during exercise in predominantly type II muscles. In this presentation, the evidence for nitrate supplementation as an ergogenic aid will be discussed and practical questions that need to be addressed in future research will be defined.

**APPLICATION OF DIETARY NITRATE AS AN ERGOGENIC AID IN CLINICAL POPULATIONS**

Allen, J.D.

*Duke University*

Athletes use ergogenic aids to enhance an already elevated performance level and gain a competitive advantage. In clinical populations performance enhancement is usually an attempt to minimize a deficit and hopefully address an acute or chronic maladaptation. This talk will mainly focus on the role of dietary nitrate in the vaso-occlusive condition of peripheral artery disease (PAD). PAD is a form of cardiovascular disease caused by atherosclerosis which leads to arterial obstruction and decreased blood flow to the lower extremities. The most frequent clinical symptomatic manifestation of PAD is intermittent claudication defined as, pain in 1 or both legs during exercise that is relieved with rest. This inability to match oxygen delivery to tissue demands during physical activity severely debilitates subjects with PAD such that approximately 1/3rd have pain ambulating in their home. These patients suffer a markedly impaired quality of life and a high perception of disability. Although measures of conduit vessel and gross limb blood flow are used to diagnose PAD, they show a poor relationship with functional capacity. It appears that the key to increasing functionality in IC patients may lie at the resistance arteries, arterioles and capillaries that serve the skeletal muscle tissue distal to the site of stenosis. These are the vessels which are responsible for much of the oxygen delivery and become hypoxic during the increased demands for perfusion accompanying physical exertion. In this talk we discuss the role of endogenous and exogenous nitrate, nitrite, and nitric oxide pathways and their impact to; (a) acutely improve

oxygenation to areas of ischemia and; (b) chronically increase vessel growth to these ischemic areas. This promising therapy may allow for greater exercise tolerance, ease the burden of exercise compliance and facilitate greater improvements in function and quality of life in PAD patients.

## 10:20 - 11:50

### Invited symposia

#### IS-BN10 Evidence Based Sports Physiotherapy: Core stability in sports – myth or reality

##### FUNCTIONAL ASSESSMENT OF CORE STRENGTH

Zemkova, E.

*Faculty of Physical Education and Sport, Comenius University*

The importance of function of core musculature for stabilization and force generation in many sports activities is being increasingly recognized. Despite of widespread use of core exercises in sport training, their efficiency in improvement of performance is questionable. This may be corroborated by no significant correlations between core stability and functional movement variables indicating no strong predictor of performance. One explanation for moderate to weak correlations may be the use of isometric and isokinetic measures of strength and isometric tests of muscle endurance for the core strength assessment, whereas the performance involves dynamic movement. Therefore, there is a need for new valid tests of core strength that assess multiple aspects of function and correlate well to sport performance. Particularly, transverse and rotational movements are often neglected in the assessment of core musculature in spite of the fact that many sports involve movements in the sagittal, frontal, as well as transverse planes. Additionally, maximal strength is usually evaluated, whereas power represents better characteristic of muscle contraction in dynamic movements. To avoid these drawbacks, one should use functional tests close to sport specific movements for the assessment of strength capabilities and efficiency of core training. Introduction of novel methods for functional assessment of core strength and their application in sport practice will complement the presentation.

##### MYTH OR REALITY - DOES IT MATTER?

Verhagen, E.

*EMGO-Institute/VU University medical center*

Core stability has been a trending topic in sports and sports medical research in recent years. Core stability is currently a generally accepted training principle to increase performance, prevent injury and rehabilitate from various musculoskeletal complaints. Parallels can be drawn with the stretching trend that started few decades ago, another athletic common good surrounded by controversy. When it concerns core stability though, there are a lot of important factors still ill described. Amongst these there is yet no uniform definition of core stability. Let alone, that we agree upon which muscles adjoin to core stability, what the optimal strategy is, or how to even measure the concept core stability. In the absence of consensus the core stability notion remains elusive. Yet, does it matter we are not fully clear on what core stability is? Instead of looking from the top down we may be able to build our ideas bottom up. Are there any clinical benefits when we train the 'core' according to current standards and beliefs? If so, these clinical outcomes may provide valuable clues to solve ruling puzzles around core stability.

##### THE EFFECT OF CORE EXERCISES ON LUMBAR RANGE OF MOVEMENT AND CORE STABILITY

Solana-Tramunt, M., Cabedo, J., Morales, J.

*Ramon Llull university, research group on health, physical activity and sport*

Introduction: Core exercises are often used to improve core strength or related on core stability in many of the general strength programmes in sport. It's accepted that these have to respect the functional characteristics of the technical movement that we would like to improve (Lederman, 2009), but not all core exercises performance the same joints position or movement. Although core exercises pretend to increase core stability by core muscle stiffness it doesn't contribute to other soft tissue stability function, related on its proprioception (Hodges et al., 1997,2003; Lephart and Fu, 2000; Tsao and Hodges, 2008). The purpose of this study was to determine the effect of 3 core exercises in sagittal plane on lumbar range of movement (ROM) in the same plane on professional swimmers. Methods: A sample of 37 professional swimmers, 21 males and 16 females (20.7±3.3 yrs), participated in the study. They were randomly divided in 21 swimmers for the experimental group (EG) and 16 swimmers for the control group (CG). EG fulfilled 3 core exercises, 6 days a week during 11-weeks. All subjects underwent the same type of training in parallel with the experimental group intervention and signed informed consent. The exercises consisted of performing maximum lumbar extension and recover underwater gliding body position, repeated at slow pace of 10 breaths. ROM was measured by an electrogoniometer attached on the skin, its cranial arm over T12-L1 spinous process, line up to L3 level, and lower arm over S1-S3 surface. The evaluation consist of measuring lumbar ROM from maximal flexion to maximal extension degrees, in 3 consecutive trials separated by 20s, sitting over a Swiss ball keeping hips and knees between 80° and 90° of flexion, the back straight, the sight to the front and both hands over the knees on a relaxed position. The test position allowed easy lumbar movements on sagittal plane. It has been measured the mean of each flexion and extension trial and calculated the total ROM from the maximal extension mean to maximum flexion mean degrees. ROM comparisons between pre-test and post-test were made using paired samples t-Test. The results are expressed by the mean, SD and significant differences (p<0.05) before and after the experimental period. Results: Lumbar ROM changed on EG from 34.4±12.9° to 44.7±14.3° (p=0.000) and on CG from 34.7±11.9° to 35.9±12.5° (p=0.22). Conclusions: The results suggest that to repeat maximal lumbar extension movement increase its ROM in sagittal plane, changing the soft tissue stiffness and its proprioceptive sensibility. Accordingly, not all kind of core exercises contribute positively on core stability.

10:20 - 11:50

## Oral presentations

### OP-BN08 Biomechanics [BM] 8

#### THE USE OF SPRINGS IN SPORTS FOOTWEAR, THE NEXT BIG THING OR REINVENTING THE WHEEL?

Richards, J., Lindley, S., Sutcliffe, M., Selve, J.

*University of Central Lancashire*

**Introduction** It has been estimated that up to 70% of runners will sustain an overuse injury during any one year period (Caspersen et al, 1984). Repetitive and abnormal loading of the lower limb with high loading rates has been shown to increase the occurrence of overuse injuries, such as tibial stress fractures (Milner et al, 2006). Therefore much emphasis has been placed upon achieving optimum shock absorption through specially designed running shoes. The introduction of springs in footwear is not a new idea, however the recent development of micro-spring technology now allows a higher density spring configuration. This study explored the effectiveness of high density micro-springs in reducing impact forces and vertical loading rates during running. **Methods** Three-dimensional kinematics and kinetics were recorded from 11 healthy recreational heel striker runners during overground running in a Movement Analysis Laboratory. Two versions of a branded running shoe were tested; one pair remained unmodified and the other was modified with 30 high density micro-springs. Test conditions were blinded and randomised. Each subject completed 5 running trials of approximately 20 m under each test condition at a self-selected speed. A paired t-test was conducted to determine the changes in biomechanics between the two conditions. **Results** No significant differences were seen in the peak vertical ground reaction force, the anterior push off force or the contact time. However, the introduction of the high density micro-springs showed a significant reduction in the vertical loading rate of 7.3 body weights per second or 10.4% ( $p=0.02$ ) compared with the unmodified shoe and a significant reduction of 0.048 N/BW or 18% in the peak posterior ground reaction force at impact ( $p=0.012$ ). **Discussion** The similarity in the contact time and the peak vertical loading force indicate similar propulsion performance. However the reduction in the vertical loading rate and posterior ground reaction forces acting with the high density micro-springs may make clinically important differences which could help runners who report overuse running injuries. The balance between the spring stiffness and surrounding damper materials of the sole is worthy of further exploration for different sports and recreational footwear. **References** Caspersen CJ, Powell KE, Koplak JP, Shirley RW, Campbell C, Sikes RK. (1984). The incidence of injuries and hazards in recreational and fitness runners. *Medicine and Science in Sport and Exercise* 16, pp.113–114 Milner, C.E., Ferber, R., Pollard, C.D., Hamill, J. & Davis, I.S. (2006) Biomechanical factors associated with tibial stress fracture in female runners. *Medicine and science in sports and exercise*, 38 (2), pp.323–8.

#### LUMBAR KINETICS IN THE ELITE ADOLESCENT MALE TENNIS SERVE: A LINK TO LOW BACK PAIN

Reid, M.1,3, Campbell, A.2, O'Sullivan, P.2, Elliott, B.3, Straker, L.2

*1. Tennis Australia, 2. Curtin University, 3. University of Western Australia*

**Introduction** Male tennis players are at significant risk of developing low back pain (LBP) coincident with lower lumbar pathology, with data verifying that 37.5% of the 2012 elite Australian players, who missed training owing to LBP, also had L4 or L5 stress reactions (Tennis Australia, 2012). Anecdotal evidence points to a mechanical aetiology, yet lumbar spine kinematics/kinetics have not previously been explored. This study aimed to quantify and compare lumbar region kinetics in kick and flat serves performed by elite, adolescent male players with and without a history of LBP. Lumbar region kinematics, as well as racquet velocity and the position of the ball at impact, were described to facilitate kinetic data interpretation. **Methods** Twenty Tennis Australia adolescent male players participated; 7 with a history of disabling LBP and confirmed L4/L5 injury, and 13 controls matched for age, height, mass and performance. Racquet, upper limb, trunk and lumbar movement were recorded using a VICON motion analysis system during three 'flat' and three 'kick' serves. A customised mathematical model calculated lumbar region kinetics/kinematics, racquet velocity and ball position at impact and were reported as if all players were right-handed. A series of 2x2 mixed model analyses of variance were utilised to compare between pain/no pain and kick/flat serves. **Results** There was no significant difference in racquet velocity or ball position at impact between pain groups or serve types. Midway through the drive phase of the tennis serve the lumbar region reaches simultaneous peak extension/lateral flexion, whilst absorbing large peak left lateral flexion (2–4\*bodyweight) and compression forces (10\*bodyweight). The players with a history LBP/injury reported significantly greater peak left lateral force than the control group (mean difference: 1.5 N.kg<sup>-1</sup>). **Discussion** The lumbar region undergoes substantial loading during both the kick and flat tennis serves, including lateral flexion forces up to 8 times those experienced during running. Both large lateral flexion forces (Ferdinands et al., 2009) and coupled movements (Glazier, 2010) have each been reported in populations where LBP is similarly pervasive. Given that the pain group reported left lateral flexion forces that were approximately 50% greater than the control group, and these were demonstrated to occur concurrent to peak compression force, extension and right lateral rotation, this may represent an important mechanism for low back pain mechanism in this population. **References** Ferdinands R, Kersting U, Marshal R. *J Biomech.* (2009), 42, 1616–21. Glazier P. *Sports Med.* (2010), 40, 809–815. Tennis Australia. Unpublished Musculoskeletal Injury Reports. (2012).

#### THE USE OF GLOBAL POSITIONING SYSTEM TRACKING DEVICES TO ASSESS MOVEMENT DEMANDS AND IMPACTS IN UNDER-19 RUGBY UNION MATCH PLAY

Opperman, E., Opperman, S., Venter, R.E.

*Stellenbosch University*

**The use of Global Positioning System (GPS) tracking devices to assess movement demands and impacts in under-19 rugby union match play** **Introduction** In order to develop specific conditioning programs and recovery strategies for rugby players, it is essential to have a thorough understanding of the unique demands of different playing positions. This is now possible by tracking players during matches by the use of portable global positioning system (GPS) devices. The aim of the study was to use GPS technology to determine movement patterns, as well as impacts from collisions, in elite under-19 rugby union forward and back players. **Methods** Seventeen under-19 semi-professional male rugby players were studied during five Super League A (SLA) rugby matches. The players were divided into four groups

based on the assumption that they have the same on-field requirements (Duthie et al., 2003). Participants were tracked using GPS devices (SPI Pro; GPSports Systems, Canberra, Australia). Data used included distance, speed and player impacts as measured in "g" force. Data from the first 30 minutes of each half were analyzed. Results Players covered on average  $4469.95 \pm 292.25$  m during the games. Players spent  $72.32 \pm 4.77\%$  of the total game time either standing or walking. Of the total game time, the outside backs spent on average significantly more time walking ( $60.34 \pm 3.92\%$ ) ( $p < 0.05$ ) than the front row forwards ( $42.1 \pm 9.99\%$ ). Back row forwards had the highest total amount of impacts during the games ( $683.4 \pm 295.04$ ). The inside backs experienced the highest amount of severe impacts ( $>10g$ ) ( $12.16 \pm 3.18$ ) per match. Discussion Similar to our study, Cuniffe et al. (2009) reported that players were standing or walking 72% of the total time. Cuniffe et al. (2009) also found that forwards spent less time standing and walking than backs ( $66.5$  vs.  $77.8\%$ , respectively). Props and locks spent more time jogging than the outside backs. This might be as a result of the nature of the game where forwards are continuously moving to get into position (Bompa & Claro, 2009), while the backs are typically walking, standing or waiting for the ball to be delivered from the contest (Duthie et al., 2003). While back row forwards had the highest total amount of impacts during the games, the inside backs experienced the highest amount of severe impacts. To our knowledge, this is the first study to quantify impacts from collisions between players. Results thus emphasized the need for individualized conditioning and recovery programs, based on position-specific movements and impacts. References Duthie, G., Pyne, D. & Hooper, S. (2003). Sports Medicine, 33(13), 973-991. Cuniffe, B., Proctor, W., Baker, J. S. & Davies, B. (2009). J Strength Cond Res, 23(4), 1195-1203.

### ACUTE EFFECTS OF SMALL CHANGES IN SADDLE HEIGHT ON PEDALLING EFFICIENCY AND LOWER LIMB KINEMATICS

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Introduction Proper bicycle configuration reduces aerodynamic drag, improves cycling efficiency and may prevent overuse injuries (Bini et al. 2011). Saddle height is an important factor in correct bike fitting. The aim of the present study was to assess the acute effects of small changes in bicycle saddle height on pedalling efficiency and lower-limb kinematics. Methods Well-trained cyclists ( $n=14$ ) performed three randomized sets of 6 min with the preferred saddle height, 2% higher and 2% lower at submaximal pedalling intensity ( $\sim 70$ -75% of the  $\dot{V}O_{2max}$ ) and at constant cadence (90 rpm). Physiological parameters were continuously measured breath-by-breath by a computerized gas analyser (Jaeger Oxycon Mobile, Germany). A two dimensional video analysis system (Peak Motus, Version 9.2.0; Vicon Motion System; Centennial, USA) was used for video recording, digitizing, processing and analysing the lower limb kinematics. Results Gross efficiency (GE) was significantly lower when raising the saddle ( $GE = 19.9 \pm 1.5\%$ ) than when lowering it ( $GE = 20.4 \pm 1.3\%$ ). A significant effect of the small changes in saddle height on lower limb kinematics was observed ( $p < 0.05$ ). The differences between lower and higher saddle positions, in hip, knee and ankle joints were an increase of extension ( $\sim 4$ , 7 and  $8^\circ$ , respectively), a decrease of flexion ( $\sim 3$ , 4 and  $4^\circ$ , respectively) and, consequently, an increase of the range of movement ( $\sim 1$ , 3 and  $4^\circ$  respectively). Discussion Findings of the present study may have a certain relevance because it is well known that variation in GE explains  $\sim 30\%$  of the variation in power output during cycling time-trials (Jobson et al; 2012). Previous studies showed differences in cycling efficiency and lower limb kinematics due to greater modifications in saddle height, between 4 to 10% of trochanteric height. Nevertheless, these modifications are too wide to be applied by experienced cyclists. Conclusions The results indicate that small changes in saddle height ( $\sim 1.5$  cm) affected GE and lower limb kinematics. The observed changes in lower limb kinematics could justify, in part, the GE changes. Further research should evaluate long-term effects of these small modifications in the seat height on GE and lower limb kinematics. References Bini R, Hume PA, and Croft JL. Effects of Bicycle Saddle Height on Knee Injury Risk and Cycling Performance. Sports Med 41: 463-476, 2011. Jobson SA, Hopker JG, Korff T, and Passfield L. Gross efficiency and cycling performance: a brief review. J Sci Cycling 1: 3-8, 2012.

### CHANGES IN THE APONEUROSIS WIDTH INDUCED BY RESISTANCE TRAINING: IMPLICATIONS FOR A HYPERTROPHIC MODEL OF PENNATE MUSCLE

Wakahara, T., Ema, R., Miyamoto, N., Kawakami, Y.

Waseda University

Introduction Muscle fibers of a pennate muscle attach to the aponeurosis at a certain angle (pennation angle). The pennation angle has influence on the force transmission from muscle fibers to tendon (Alexander & Vernon 1975). It has been shown that the pennation angle increases after resistance training (Kawakami et al. 1995). The increase in the pennation angle has been considered as a strategy for more contractile materials to be packed for a given attachment area of aponeurosis. On the other hand, the attachment widths and areas of the aponeuroses of hypertrophied muscles are larger than those of normal muscles (Abe et al. 2012). This cross-sectional observation points to a possibility that the attachment area of aponeurosis increases with resistance training, which prompts us to reconsider the hypertrophic model of pennate muscle. The purpose of this study was to examine longitudinally the changes in the aponeurosis width and muscle architectural parameters induced by resistance training. Methods Eleven young men completed a resistance training program of unilateral knee extension for 12 weeks. Before and after the training program, the aponeurosis width and muscle anatomical cross-sectional area (CSA) were measured with magnetic resonance imaging, and the pennation angle and fascicle length were determined with ultrasonography at the belly of the vastus lateralis. By using the relative changes in CSA and the pennation angle before training, a theoretical change in pennation angle by resistance training was calculated on an assumption of constant aponeurosis width, and compared with experimentally determined value. Results and Discussion There were significant increases in the aponeurosis width, CSA and pennation angle after the training, whereas no significant change was found in the fascicle length. The increase in the aponeurosis width supports the previous finding (Abe et al. 2012). The relative change in aponeurosis width ( $1.9 \pm 3.1\%$ ) was significantly smaller than the square root of relative change in CSA ( $5.2 \pm 3.6\%$ ). In addition, the experimentally determined pennation angle after the training ( $19.9 \pm 2.5^\circ$ ) was not significantly different from the corresponding value calculated with the constant aponeurosis width ( $19.9 \pm 2.3^\circ$ ). These results indicate that, although the aponeurosis width is increased by resistance training, it does not substantially affect on the training-induced increase in the pennation angle. References Abe T, Kumagai K, Bembem MG (2012). J Trainol, 1(2), 23-27. Alexander RM, Vernon A (1975). J Hum Mov Stud, 1, 115-123. Kawakami Y, Abe T, Kuno SY, Fukunaga T (1995). Eur J Appl Physiol Occup Physiol, 72(1-2), 37-43.

## THE INFLUENCE OF ACUTE VARIABLE RESISTANCE LOADING ON SUBSEQUENT FREE-WEIGHT MAXIMAL SQUAT PERFORMANCE.

Mina, M.A.1, Giakas, G.2, Blazevich, A.J.3, Kay, A.D.4

1: UoD (Derby, UK), 2: UoT (Thessaly, Greece), 3: ECU (Perth, WA), 4: UoN (Northampton, UK)

**Introduction** Elastic bands attached to a loaded barbell during a squat exercise create a variable resistance (VR), thus changing the mechanical loading and stress placed through the musculoskeletal system. Preconditioning the neuromuscular system using near-maximal or maximal voluntary contractions (MVC) can induce a phenomenon known as post-activation potentiation (PAP) to enhance performance to 'supramaximal' levels. However, the potentiating effects of VR on subsequent free-weight resistance (FWR) squat performance have not been examined. Thus, the aim of the present study was to examine the influence of VR exercise using elastic bands on subsequent FWR squat performance. **Methods** Sixteen recreationally active men (age =  $26.0 \pm 7.8$  yr, height =  $1.7 \pm 0.2$  m, mass  $82.6 \pm 12.7$  kg) experienced in squatting (>3yr) volunteered for the study after giving written informed consent; ethical approval was granted from the University of Northampton. Subjects' 1-RM were determined then on two subsequent days either a 3-RM FWR (control) or a 3-RM VR (experimental) squat exercise was performed at 85% 1-RM (35% of the load generated from band tension in the VR condition). Five minutes later, motion analysis recorded knee joint kinematics during a subsequent FWR 1-RM squat, with vastus medialis, vastus lateralis, rectus femoris and semitendinosus electromyograms (EMG) simultaneously recorded. Paired t-tests were used to determine significance, accepted at  $p < 0.05$ . **Results** A significant increase in 1-RM (7.7%;  $p < 0.01$ ) and a decrease in peak and average eccentric (16-19%;  $p < 0.05$ ) and concentric knee velocities (12-21%;  $p < 0.05$ ) was found in the VR condition compared to the FWR condition. No change in knee flexion angle (1.8%;  $p > 0.05$ ) or EMG amplitude (5.9%;  $p > 0.05$ ) occurred. No subjects increased 1-RM in the FWR condition, however 13 of 16 (81%) increased 1-RM by ~10% following VR. **Discussion** Preconditioning the neuromuscular system using VR significantly increased 1-RM without changes in knee extensor muscle activity or knee flexion angle, however eccentric and concentric velocities were reduced. Thus, VR can potentiate the neuromuscular system to enhance subsequent maximal lifting performance. The lack of change in EMG suggests that changes in muscle activity were small or non-existent, which may be explained by force-velocity effects (slower movement = larger forces). Alternatively a greater activation of hip musculature (not measured in the present study) may allow a greater total lower limb force to be developed. Regardless, as 1-RM increased greater lower-limb loading occurred, thus VR potentiated the neuromuscular system and could enhance training stimuli.

**10:20 - 11:50**

## Oral presentations

### OP-BN11 Motor Learning [ML] 2

#### MENTAL IMAGERY AND MOVEMENT OBSERVATION OF BALANCE TASKS: ACUTE EFFECTS ON BRAIN ACTIVITY AND FUNCTIONAL LONG-TERM ADAPTATIONS

Keller, M.1, Leukel, C.1,2, Mouthon, M.2, Annoni, J.M.2, Taube, W.1

1: SMS (Fribourg, Switzerland), 2: IFS (Freiburg, Germany)

**Introduction** Immobilization is often related to impaired postural control and increased risk of falling (1). Therefore, alternative training regimes are needed as countermeasures during long periods of immobilization when no physical training is possible. Mental imagery and movement observation may constitute such countermeasures. Therefore, the present study evaluated its effects twofold: In Experiment 1, brain activity was assessed by means of fMRI during imagination as well as active and passive observation of different postural tasks. In Experiment 2, long-term behavioral effects on postural control of non-physical balance training were analyzed before and after 4 weeks of training. **Methods** Experiment 1: fMRI data were recorded in 16 healthy subjects ( $27 \pm 4.8$  years). The experiment contained three different parts: a) active observation, b) passive observation, and c) mental imagery. In contrast to passive observation, subjects were instructed to interpret the acting person in the video in a first person perspective during active observation. In each of the three conditions, two tasks were evaluated: i) static standing on solid ground and ii) medio-lateral perturbation on an instable surface. Experiment 2: Balance performance and H-reflexes were measured before and after a training program of 4 weeks. Subjects ( $n=35$ ) were assigned either to a mental (MBT) or an active observational balance training (OBT) group or served as controls. **Results** Experiment 1: Our results indicate that I) motor imagery and active motor observation activate brain regions important for balance control (Putamen, Cerebellum, Supplementary and pre-motor Area), II) subjects displayed higher brain activation in the more challenging (dynamic) postural task, III) passive observation was not able to induce significant activity in brain areas responsible for balance control. Experiment 2: After training, we observed a significant interaction of TIME \* GROUP. Post-hoc tests revealed significant reductions in sway path for both the mental and the observational group. No changes were observed for the H-reflex. **Discussion** Experiment 1 suggests that motor imagery and active but not passive movement observation represent suitable tools to activate brain regions, which are associated with postural control. This assumption was indirectly confirmed in Experiment 2, showing improved postural control after MBT and OBT. As the training was purely non-physical, it seems unlikely that spinal circuitries were activated during training. Therefore, one might suggest that the improved postural control is a result of supraspinal adaptations. **References** (1) Visschedijk J et al (2010). J Am Geriatr Soc 58, 1739-48

#### FACTORS INVOLVED IN THE ADOPTION OF A PREFERRED GAIT AROUND THE WALK-RUN TRANSITION: EFFECTS OF LEARNING RACEWALKING

Heugas, A.M., Majed, L., Siegler, I.A.

Univ Paris-Sud, UR CIAMS, EA4532, Orsay, France

**Introduction** Why do humans shift between walking and running at a preferred transition speed (PTS)? Many theories have been put forward. Among them, the metabolic optimization theory, transition is believed to occur when a critical metabolic level is reached. Hreljac (1995) has pointed out the role of mechanical constraints in transition triggering. Recently, Ziv and Rotstein (2009) showed that racewalkers have a higher PTS than a control group. The aim of this study was to better understand the factors underlying gait transitions

by studying the effect of learning racewalking on PTS and its metabolic aspects. **Methods** Nine participants ( $22.9 \pm 5.2$  years) with a good aerobic fitness performed two tests of PTS determination; before (pre-test) and after (post-test) 7 sessions of a racewalking learning protocol (Majed et al., 2012). A gas analyzer (Cortex Metamax 3B, Germany) was used to determine metabolic cost of transport (MCT expressed in  $\text{mlO}_2 \cdot \text{kg}^{-1} \cdot \text{km}^{-1}$ ). Kinematic data (60 Hz) were recorded (VICON370, Oxford Metrics, UK) to determine stride frequency (Sf) and amplitude of the vertical displacement of the upper body (Dz). **Results** During the post-test, 77.8% participants used racewalking between walking and running therefore delaying the transition to running ( $9.53 \pm 0.61 \text{ km} \cdot \text{h}^{-1}$  vs  $8.04 \pm 0.73 \text{ km} \cdot \text{h}^{-1}$  during pre-test). At these speeds, racewalking shared the same Sf as running, significantly higher than that used in walking. Furthermore, racewalking produced significantly lower Dz compared to both running and walking. However, the walk-racewalk transition resulted in a significant increase in MCT compared to the walk-run transition. **Discussion** At the post-test, racewalking was spontaneously adopted by a majority of participants as an intermediate gait, replacing running at the slowest running velocities (between 7.4 and 8.7  $\text{km} \cdot \text{h}^{-1}$ ). The new learned pattern did not seem to exhibit any advantages on a metabolic level at the tested speeds around transition. However, racewalking seemed more advantageous on a mechanical level, possibly allowing participants to improve mechanical efficiency and/or to stabilize head in space. These two factors could play an important role in triggering the walk-run transition rather than metabolic factors. **References** Hreljac A. (1995). *Hum Mov Sci*, 14, 205-216. Ziv G, Rotstein A. (2009). *Med Sci Sports Exerc*. 41, 797-804. Majed L, Heugas A-M., Chamon M, Siegler I.A. (2012). *Hum Mov Sci*, 31, 1598-614.

### EXAMINING THE ASSOCIATION BETWEEN HYPOTHESIS-TESTING AND WORKING MEMORY DURING MOTOR LEARNING

Buszard, T.1, Farrow, D.1, Reid, M.2, Zhu, F.F.3, Masters, R.S.W.3

1: Victoria University, 2: Tennis Australia, 3: University of Hong Kong

**Introduction** Traditional motor learning theories suggest that hypothesis testing is a necessity for learning. However, implicit motor learning theory argues that acquiring motor skills without testing hypotheses is not only possible but leads to performance advantages (Masters & Poolton, 2012). Hypothesis testing uses working memory, the system responsible for storage and manipulation of task-related information in the mind (Baddeley, 2012). We hypothesized that the likelihood of hypothesis testing during skill acquisition would be associated with the amount of working memory capacity available to the learner. Two experiments were conducted to examine the relationship between working memory and hypothesis testing when performing a basic tennis skill task. **Methods** The first experiment investigated hypothesis testing in children (6 – 11 y), whereas the second investigated young adults (17 – 26 y). Both experiments employed the same methodological design. Two measures of hypothesis testing were used: (1) the number of alterations made to technique, and (2) the number of task-related rules or hypotheses reported. Working memory capacity was assessed using the Automated Working Memory Assessment (Alloway, 2007). This measured both verbal and visuospatial components of working memory. **Results & Discussion** Regression analyses indicated that hitting accuracy and verbal working memory capacity were the most significant predictors of hypothesis-testing in both children and adults. People with lower hitting performance and larger verbal working memory capacity tested more hypotheses. The number of alterations to technique and the number of task-related rules reported were significantly correlated with each other; although, young children (6-7 years) had greater difficulty than older children (10-11 years) verbalising the alterations that they made to their technique. **Conclusion** The findings increase our understanding of hypothesis testing in the context of motor learning, and provide support for implicit motor learning approaches that seek to inhibit working memory engagement during practice by limiting the commission of errors (i.e., poor performance). **References** Alloway, T. A. (2007). *Automated Working Memory Assessment*. London, UK: Pearson Assessment. Baddeley, A. (2012). Working memory: theories, models, and controversies. [Review]. *Annual Review of Psychology*, 63, 1-29. Masters, R. S. W., & Poolton, J. (2012). Advances in implicit motor learning. In N. J. Hodges & A. M. Williams (Eds.), *Skill acquisition in sport: Research, theory and practice* (2nd ed., pp. 59-75). London, UK: Routledge.

### PROMOTING OBJECT CONTROL SKILLS BY SUPPRESSING ERRORS DURING LEARNING INCREASES PHYSICAL ACTIVITY ENGAGEMENT OF CHILDREN WITH DISABILITY

Capio, C.M.1, Poolton, J.M.1, Eguia, K.F.2, Sit, C.H.P.3, Masters, R.S.W.1

1: University of Hong Kong; 2: KU Leuven, Belgium; 3: Chinese University of Hong Kong

**Introduction** Fundamental movement skills (FMS), consisting of locomotor and object control skills, contribute to accrual of sufficient physical activity (PA) in children (Barnett et al., 2008). Developmental disability impairments generate a negative impact of FMS proficiency on PA participation (Wrotniak et al., 2006). This research tested a reduced-errors approach to remediation of object control skills in children with disability, with the aim to promote greater PA engagement. **Methods** In Study 1, a training program that either reduced outcome errors (error-reduced) or allowed errors to freely accumulate (error-strewn) was implemented to train the object control skill of overhand throwing in children with intellectual disability. In Study 2, an error-reduced training program targeted three skills (overhand throwing, catching, kicking) in children with cerebral palsy. A control group of children with cerebral palsy underwent their usual physiotherapy program. Using a pretest-posttest study design, product-oriented measures (e.g., throwing accuracy) and process-oriented assessment (Test of Gross Motor Development-2) evaluated object control proficiency. The impact on PA was inferred from the frequency of overhand throwing in free play (Study 1), and from PA monitoring using an accelerometer (Study 2). **Results** Children with intellectual disability in the error-reduced program improved process-oriented FMS proficiency to a greater extent than the error-strewn program. Error-reduced learners also maintained throwing accuracy when engaged in a secondary cognitive task. Moreover, the error-reduced program facilitated a greater increase in free play throwing activity. Children with cerebral palsy in the error-reduced program displayed improved object control proficiency while those in the control group did not. No changes in weekday PA were found but increased moderate to vigorous physical activity and decreased sedentary time during weekends was found in the error-reduced group. **Discussion** The findings support the use of a reduced errors approach in remedial movement training of children with disability, suggesting that such approach improves performance and heightens movement engagement in free play. The findings also contribute to the growing evidence base that suggests improved FMS proficiency contributes to PA engagement in children with disability. **References** Barnett LM, Van Beurden E, Morgan PJ, Brooks LO, Beard JR. Does childhood motor skill proficiency predict adolescent fitness? *Med Sci Sports Exerc* 2008;40:2137-44. Wrotniak BH, Epstein LH, Dorn JM, Jones KE, Kondilis VA. The relationship between motor proficiency and physical activity in children. *Pediatrics* 2006;118: e1758-65.

## THE EFFECT OF STIMULUS INTENSITY ON RESPONSE TIME AND ACCURACY IN DYNAMIC, TEMPORALLY CONSTRAINED ENVIRONMENTS

Causer, J.I, McRobert, A.P.1, Williams, A.M.2

1: LJMU (Liverpool, UK); 2: Brunel University (London, UK)

**Introduction** The ability to make accurate judgments and execute effective skilled movements under severe temporal constraints are fundamental to elite performance in a number of domains including sport, military combat, law enforcement, and medicine. The speed and accuracy of these judgments can be affected by the strength of sensory information available (Klein, 2001). Researchers (cf. Klein, 2001) have reported high stimulus strength to facilitate a decrease in response time and an increase in response accuracy in laboratory-based tasks. Conversely, low stimulus strength has been demonstrated to increase response times and response accuracy. In two experiments, we examine the effect of stimulus strength on response time and accuracy in a temporally constrained, real-world, decision-making task. **Method** We examined the effect of low stimulus intensity (black) and high stimulus intensity (sequin) uniform designs, worn by teammates, to determine the effect of stimulus strength on the ability of soccer players to make rapid and accurate responses. In both laboratory- (experiment 1) and field-based (experiment 2) scenarios, professional soccer players viewed developing patterns of play and were required to make a penetrative pass to an attacking player. Results Significant differences in response accuracy between uniform designs were reported in laboratory- (black = 77.1%; sequin = 90.6%) and field-based (black = 77.1%; sequin = 88.5%) experiments. Response accuracy was significantly higher in the sequin compared with the black uniform condition. Response times only differed between uniform designs in the laboratory-based experiment (black = 2597.58ms; sequin = 2288.68ms). **Discussion** This novel approach to investigating decision making and performance by manipulating uniform designs provides a valuable insight into the application of increasing stimulus strength to increase performance and paves the way for future research in the area. The data presented extends the theory behind stimulus intensity and its relationship to stimulus-driven attentional control into an ecologically valid, dynamic task. The results demonstrate the effectiveness of stimulus strength as a method of increasing the ability of performers to pick up visual cues, which may subsequently facilitate improvements in response time and accuracy. These findings highlight the practical utility of using manipulations to playing uniform design to positively influence performance in sport and other fields of activity. **References** Klein, S. A. (2001). Percept Psychophys, 63 (8), 1421–1455.

## VECTOR SUMMING IN THE CONTROL OF MULTI-SEGMENT UPPER LIMB MOVEMENTS

Han, J., Adams, R., Waddington, G., Anson, J.

University of Canberra

**Introduction** In overhead sports, proprioception plays a crucial role in accurate catching and releasing when visual information about the hand is not available. However, the mechanism for using proprioceptive information in multi-segment upper limb movement control remains unclear. Although it has been hypothesised that movement is controlled by proprioceptive information arising from specific receptors, it is possible that a higher-order form of control exists whereby each vector of a complex movement is summed by an automatically-executed algorithm, in a process known as vector summing (Franklin & Wolpert, 2011). Thus multiplanar movements to overhead targets could either worsen final hand position accuracy by an overload of proprioceptive information from multiple joints, or be accurately culminated by vector summing. The aim of this study was to compare uniplanar and multiplanar arm raising to an overhead target in terms of accuracy of judgment of the final hand position. **Methods** Sixteen healthy young adults (8M, 8F, mean 21 years of age, range 19 to 24) volunteered. The Active Movement Extent Discrimination Apparatus (AMEDA) for the shoulder was employed to generate the end positions for arm-raising to 5 different overhead targets to be identified (Whiteley et al., 2008). Standing against the overhead-positioned AMEDA, participants used two different arm raising patterns to get to the overhead targets: uniplanar arm flexion in the sagittal plane, or arm unfolding upwards in 3 dimensions. To obtain separate movement discrimination scores for the two arm movement patterns, the mean pair-wise Area Under the Curve (AUC) were obtained using SPSS software. The two movement patterns were compared using ANOVA, and Pearson correlations between the discrimination scores were determined. **Results** A significant positive correlation between the scores for the two patterns was observed ( $r = 0.70$ ,  $p = 0.003$ ) however there was no significant difference between them in terms of discrimination accuracy ( $F(1, 15) = 0.50$ ,  $p = 0.49$ , partial  $\eta^2 = 0.03$ ). **Discussion** Vector summing for movement control is supported because multiplanar movements were performed as accurately as uniplanar arm movements to overhead targets. The significant relationship between performances with the two techniques suggested that the same computational mechanism for tracking a limb through space to an unseen target could have been used for both arm-raising patterns. **References** Franklin, D. W. & Wolpert, D. M. (2011). Computational Mechanisms of Sensorimotor Control. *Neuron*, 72 (3), 425–442. Whiteley, R. J., Adams, R. D., Nicholson, L. L., & Ginn, K. A. (2008). Shoulder proprioception is associated with humeral torsion in adolescent baseball players. *Physical Therapy in Sport*, 9(4), 177-184.

10:20 - 11:50

## Invited symposia

### IS-SH07 Sport sciences to improve dance performance and participation, an interdisciplinary proposal

#### QUALITY OF PARTICIPATION AND DANCER'S HEALTH

Quested, E., Woodcock, C., Norfield, J., Cumming, J., Duda, J.L.

University of Birmingham

It is well established that social-psychological factors play an important role in nurturing high quality participation and optimizing health among those that engage in performance-related pursuits. In 2002, the application of psychology techniques in the context of dance was described as in its' infancy (Hays, 2002). However, in the past decade the field has witnessed a notable growth in studies that have applied theories and research evidence from sport psychology for the benefit of dancers. This presentation will give an overview of our multi-method and multi-approach research that has contributed to the knowledge base concerning the social and psychological pro-

cesses operating in vocational dance contexts. One dominant line of work has been the role of motivational processes in accounting for differences in health-related outcomes among dancers. Studies have consistently supported the self-determination theory (Deci & Ryan, 2000) based hypothesis, that when dancers feel a sense of autonomy, competence and relatedness with regard to their participation, their state emotional (e.g., anxiety) and biological (e.g., cortisol) responses and enduring indicators of optimal vs. compromised functioning (e.g., self-evaluative tendencies, burnout) are likely to be more adaptive. Research findings with elite and recreational samples have highlighted the important role of the teacher in creating an adaptive motivational climate, conducive to basic need satisfaction. The field has also progressed with regard to our understanding of dancers' use of psychological skills and techniques, and the correlates of such usage. Findings highlight dancers use such skills and techniques and value their importance. Importantly, results also indicate that the systematic use of effective psychological techniques and skills does not develop naturally. Rather, as we have seen in sport, psychological skills training programmes for the dancers and their instructors are required. This body of work highlights the great potential for theory and evidence based intervention studies in dance. In the case of teachers, it would be advantageous to explore whether it is possible to modify the motivational climate created by teachers via systematic training. In the case of dancers, intervention research could identify the effectiveness of embedding psychological skill and technique training within the dance curriculum. With respect to both complimentary lines of work, it would be prudent to examine whether interventions also impact upon the health, well-being and sustained engagement in dancers as well as the quality of their performances. Deci, E. L., & Ryan, R. M. (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11, 227-268. Hays, K. F. (2002). The enhancement of performance excellence among performing artists. *Journal of Applied Sport Psychology*, 14, 299-312.

### EXPERT LOOKING: PERCEPTUAL, PSYCHOPHYSIOLOGICAL, AND NEURAL RESPONSES TO DANCE BY DANCERS

Christensen, J.1, Calvo-Merino, B.2

<sup>1</sup> University of the Balearic Islands; <sup>2</sup> Complutense University of Madrid and City University of London

**INTRODUCTION** Dancers are a special type of motor experts. They are trained both in highly athletic motor actions, and in endowing their movements with artistic quality. Due to the requirement of this complex set of skills, recently, Cognitive Neuroscience has started to explore how dance expertise modulates neural, perceptual and psychophysiological processes in the dancer's brain. Neuroimaging studies show that dancers have a stronger motor resonance in the so-called mirror neuron system when viewing dance movements of their area of expertise. Behavioral research suggests different perceptual strategies (configural/analytical) when dancers watch dance, as compared to non-dancers. In a series of studies, we have now further investigated the perceptual and psychophysiological responses of dance experts to dance, and interestingly, these responses were related to the aesthetic experience associated to dance appreciation. **METHOD** Two groups, expert dancers and non-dancers, carried out two visual tasks. An initial task measured which processing strategy (configural/analytical) was adopted while viewing dance positions. To do this, participants performed a computerized match-to-sample task, where picture-pairs were presented one after the other. After each pair, participants had to state whether the two pictures were the same or different. Importantly, in half of the total number of trials, the stimuli were presented upright and in the other half, the same stimuli were presented up-side-down. To assess which processing strategy is adopted, psychologists calculate the inversion effect. The inversion effect is the difference in performance (accuracy) between upright vs. inverted displays. As stimuli, we used 24 pairs of dance positions and 24 pairs of control stimuli (scrambled). In a second task, participants stated their personal aesthetic preference for each stimulus on a visual analogical scale, by mouse-clicking on a bar between 0 (not at all) to 100 (a lot). **RESULTS** Accuracy in the perceptual task showed a main effect of stimuli. Accuracy was higher for upright dance positions than for inverted displays, while no such difference was found for the control stimuli. Moreover, correlational analyses were performed on the accuracy data and the subjective aesthetics ratings. These analyses revealed that the more configurally a stimulus was processed, the more it was liked. This confirms conjectures of cognitive ergonomics in that we find visually pleasing what is easy to process for our visual system. **CONCLUSION** We relate these findings to previous literature on dance expertise, and draw future avenues of research on the relation between visual processing, expertise and aesthetic appreciation.

### THE BEAUTY OF KINEMATIC DANCE PARAMETERS

Morey-Klapsing, G.1, Castañer Balcells, M.2, Torrents Marín, C.2, Jofre Marín, T.1

1. INESCOP, 2. INEFC

**Introduction** This presentation approaches the beauty of kinematic dance parameters from two different perspectives. Part A - When analysing art in general and particularly contemporary dance, the performance parameters are anything but evident. A technically perfect interpretation is not necessarily the best one. In a study utilising a mixed methods approach the relationship between biomechanical parameters and the perceived beauty was analysed. Part B - Turning things around, in interactive art and from a biomechanical perspective, a dancer can be seen as a generator of kinematic signals. These signals are used for artistic creation in almost any thinkable way. Here a simple case utilising a 3D accelerometer is presented. **Methods** Part A - Four experienced contemporary dancers performed three repetitions of four dance-related motor skills. Motion was captured by a VICON-MX system as well as by conventional video. The resulting 48 animations and videos were viewed by 108 sports students that judged beauty using a semantic differential. The data were then subjected to multiple factor analysis (MFA). Part B - A 3D-accelerometer attached to the dancers body sends its signals via wifi utilising the OSC (Open Sound Control) protocol. These signals are then used to create and modulate sound as well as to generate graphic output using OpenFrameworks and PureData. The result is an interactive loop where the performer directly influences the music he is dancing to. In order to achieve better musicality an electronic musician can coordinate the whole creation. **Results** Part A - A strong association between beauty scores and certain kinematic parameters (especially amplitude related ones) was found. Animations and real videos led to similar results. Part B - On one hand we get the artistic performance as a product to be shown. On the other, we get a whole new way of creating, giving the dancer new roles arising from the interaction with the technology which nourishes from biomechanics. **Discussion** In spite of being subjective, it has been often tried to identify parameters related to the perception of beauty. In this study several kinematic parameters describing four isolated contemporary dance elements proved to be related to subjective beauty scores, suggesting that, to some extent and for a given population, in contemporary dance the perceived beauty can be parametrised. Being so such parameters could be intentionally utilised during the creative process and even teaching or training. In case B, the beauty relies on the transformation of biomechanical parameters (3D accelerations) into part of the creation itself. The dancer is not only "dancing to the music" but she/he is actively intervening in the soundscape he's immersed in. This kind of work demands new skills to the dancer which possibly might become part of the curricula of future dance studies. **References** Brown WM, Cronk L, Grochow K, Jacobson K, Popović Z, Trivers R (2005). *Nature*, 438 1148-1150. Neave N, McCarty K, Freynik J, Caplan N, Hönekopp J, Fink B (2010). *Biology Letters*, (7)221-224.

10:20 - 11:50

## Oral presentations

## OP-PM18 Neuromuscular Physiology [NP] 5

**ACUTE EFFECTS OF WHOLE-BODY VIBRATION ON 3KM CYCLING TIME TRIAL PERFORMANCE**

Bhambhani, Y., Fernandes, I.A., Gomes, P.S.C.

*University of Alberta*

**Introduction** Whole-body vibration (WBV) is frequently used by athletes to enhance competitive performance (Alvelar et al., 2012; Ronnestad et al., 2012). Near infrared spectroscopy (NIRS) evidence (Coza et al., 2011; Games and Sefton, 2011) has demonstrated that WBV administration acutely induces muscle hemodynamic changes (increases in (HbO<sub>2</sub>-HHb) difference and total blood volume (Total Hb)) in the lower extremities. This study tested the hypothesis that acute WBV would significantly improve 3KM cycling time trial (TT) performance due to improvements in muscle hemodynamics. **Methods** Thirteen recreationally competitive male cyclists (age: 33±9; height: 175±6cm and mass: 76±11Kg) completed a simulated 3KM TT in two randomly ordered sessions without (CON) and with WBV administration. In the WBV session, athletes assumed a squat position (≈110° of knee flexion) on the WBV platform and completed three 1-min exposures (interspersed by 1-min rest) at a frequency–amplitude combination of 45 Hz and 5 mm. In the CON session, the cyclists stood on the platform in the same posture. Subjects performed the 3KM TT on a mountain bike mounted on a frictionless roller interfaced with TACx software (TACx Fortius, Netherlands). Cardiorespiratory responses were recorded using a metabolic measurement cart (VMax, SensorMedics, CA) and muscle NIRS variables were measured using a dual wave instrument (Artinis Medical Systems, Netherlands) on the right Vastus Lateralis. Finger prick blood lactate [La] was measured prior to and 2 min post race. The mean values for the entire trial were calculated and used for analysis. **Results** When compared to CON, WBV did not significantly alter 3KM TT performance (Time: WBV 19.04 vs. CON 19.2 min, P<0.05), the associated cardiorespiratory (HR: 163 vs. 165 bpm, VO<sub>2</sub>: 2.73 vs. 2.89 L/min, P<0.05), and muscle NIRS responses (HbO<sub>2</sub>-HHb difference: 3539 vs. 2784 μmol, Total Hb: 2002 vs. 1346 μmol, P<0.05). Finger prick blood lactate concentrations (Delta [La]: WBV 5.10 vs. CON 5.15 mmol/L, P<0.05) also did not differ between sessions. **Discussion** All the athletes completed the simulated 3KM TT in a typical racing manner with a final burst towards the last 2 min of the race. Contrary to our hypothesis, WBV did not significantly enhance 3KM TT time or the associated cardiorespiratory and muscle hemodynamic responses. These findings are in contrast to previous observations, which demonstrated significant improvement in high intensity cycling (Alvelar et al., 2012) and muscle power (Ronnestad et al., 2012) induced by WBV at similar doses. This discrepancy could be due to the type of performance investigated: aerobic endurance vs anaerobic or muscle power. **References** Avelar NC, et al. *J Strength Cond Res.*, 2012 (epub). Coza A, Nigg BM, Dunn JF. *Med Sci Sports Exerc.*, 43:509-15, 2011. Games KE, Sefton JM. *Scand J Med Sci Sports*, 2011. Ronnestad BR, et al. *J Strength Cond Res.*, 26:531-9, 2012. Do not insert authors here

**NEUROMUSCULAR FACTORS AFFECTING PLANTARFLEXOR TORQUE AFTER INTERMITTENT VS. CONSTANT MUSCLE STRETCH**

Trajano, G., Seitz, L., Nosaka, K., Blazevich, A.

*Edith Cowan University*

**Introduction:** Prolonged muscle stretching can have a detrimental effect on maximal force production, and changes in both central drive and muscular properties (i.e. peripheral changes) are the two most likely candidates to explain the force loss. One difficulty in determining the mechanisms underpinning this phenomenon is that different effects may be elicited by different stretch protocols, and in particular the effects of intermittent (i.e. repeated stretch-relax cycles) and constant stretch protocols might be dissimilar. The purpose of this research was to examine the contributions of central and peripheral factors on force-loss after constant and intermittent stretch protocols of equal duration and intensity. **Methods:** Eighteen men randomly performed three conditions: 1) one 5-min stretch (constant stretch; CS); 2) five 1-min stretches (intermittent stretch, IS) and a resting (control) condition, on three separate days at the same time of day. Constant-torque ankle stretches were performed on an isokinetic dynamometer. Measures of isometric peak torque (PT), percent voluntary activation (%VA; interpolated twitch technique), soleus sEMG normalized to the Mmax (sEMG/M; tibial nerve stimulation), first volitional wave (V-wave) and excitation-contraction (E-C) coupling efficiency (i.e. ratio between 20 and 80 Hz tetanic stimulations) were taken before, immediately, and 15 and 30 minutes after each condition. **Results:** Voluntary PT decreased significantly more immediately after IS (-23.8%) than CS (-14.3%) (p=0.033). PT reduction was fully recovered by 15 min after CS, but still remained depressed by -5.7% (p=0.037) and -5.6% (p=0.036) at 15 and 30 min, respectively, after IS. sEMG/M (-29.1%, p=0.004) and %VA (-15.9%, p=0.039) were reduced only immediately after IS. The decrease in PT after CS was correlated with changes in sEMG/M (r=0.63; p=0.006), %VA (r=0.78; p=0.001) and V-wave (r=0.51; p=0.036). Moreover, changes in PT after IS were correlated with changes in sEMG/M (r=0.90; p=0.000), %VA (r=0.93; p=0.000) and V-wave (r=0.52; p=0.028). Tetanic PT was depressed immediately after CS (20 Hz = 10.7%; 80 Hz = 6.6% [p<0.01]) and IS (20 Hz = 13.5%; 80 Hz = 6.9% [p=0.01]), however the 20:80 Hz ratio was not different between conditions. **Conclusion:** These results suggest that: (1) torque production is more compromised after intermittent than continuous stretch, and (2) the torque loss caused by both protocols immediately after stretch seems to largely result from a reduced central drive rather than peripheral changes such as impairments in E-C coupling. Nonetheless, the prolonged torque loss caused by IS could not be explained by central factors and might be at least partly of peripheral origin.

**PRIOR FATIGUING ARM EXERCISE ALTERS PERIPHERAL EXCITABILITY AND VOLUNTARY DRIVE TO THE KNEE EXTENSORS**

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1. *Sports and Health Sciences, Exeter University, EX1 2LU*; 2. *Physical Education and Sports Science, Democritus University of Thrace, Greece*; 3. *Applied Science, London South Bank University, SE1 0AA*

**Introduction** After intense arm exercise, pH is lowered and interstitial potassium elevated in knee extensor muscles, resulting in earlier onset of fatigue during subsequent knee extensor exercise (Nordsborg et al., 2003). We investigated whether changes in peripheral and

corticospinal excitatory output and voluntary activation caused by the altered intramuscular ionic balance underpin the premature fatigue development. Methods On 2 occasions separated by 2 weeks, 8 healthy active young men (weight, height, age) performed 4 x 1 min and 1 x 1.5 min intense arm crank exercise with 30 s rest intervals followed by a 4.5 min rest interval and a final 1 min all-out arm exercise. On one occasion quadriceps 31P-MRS scans were performed to quantify pH and high energy phosphate kinetics pre and post exhaustive arm exercise. On another occasion electrical stimulation of the femoral nerve and transcranial magnetic stimulation of the quadriceps cortical motor area were applied during knee extension maximum voluntary contractions (MVC) pre and post arm exercise to quantify voluntary activation (VA) and peripheral (M-wave) and cortical (MEP) evoked responses in m. vastus medialis (VM). Venous blood samples were taken at regular intervals throughout. Data were analysed by paired t-tests. Results Fatiguing arm exercise resulted in significant reductions in blood (pre:  $7.38 \pm 0.01$ , post:  $7.13 \pm 0.02$ ,  $p < 0.001$ ) and quadriceps muscle pH (pre:  $7.04 \pm 0.01$ , post:  $6.95 \pm 0.02$ ,  $p = 0.003$ ), but there was no reduction in knee extension MVC force. During MVC, VM M-wave peak-to-peak amplitude was significantly reduced ( $-17.6 \pm 7.3\%$ ,  $p = 0.034$ ) and there was a significant shortening of the cortical silent period (pre:  $227.0 \pm 26.6$ , post:  $215.4 \pm 27.6$ ; ms;  $p = 0.019$ ), but MEP amplitude was unaffected by prior arm exercise. Voluntary activation of the maximally contracting knee extensors was significantly enhanced by the prior arm exercise (pre:  $82.9 \pm 2.8$ , post:  $87.5 \pm 2.9\%$ ,  $p = 0.045$ ). Discussion Maximal isometric knee extensor force generating capacity was preserved after fatiguing arm exercise despite the reductions in blood and muscle pH and peripheral excitability. This was achieved through increased voluntary drive perhaps via decreased intracortical inhibition as evidenced by decreased duration of the cortical silent period. References Nordsborg N., Mohr M., Pedersen L.D., Nielsen J.J., Langberg H., Bangsbo J. (2003) *Am J Physiol* 285: R143-R148.

### APPROACH OF A NEW NON-LINEAL MODEL OF STRENGTH DECREMENT DUE TO FATIGUE DURING INTERMITTENT HANDGRIP CONTRACTIONS

Marina, M.1, Rios, M.2, Torrado, P.1, Busquets, A.1, Angulo-Barroso, R.1

1: INEFC, GRCE-UB (Barcelona, Spain), 2: Facultad Biología-UB (Barcelona, Spain)

Introduction: Force can decrease exponentially over the maximum rate of decline (Bigland-Ritchie, et al., 1983). Therefore, the relationship between force and time to exhaustion can be described by hyperbolic functions (Burnley, 2009), and support the idea of non-linear force loss with exercise duration (Millet & Lepers, 2004). We check the hypothesis that force loss during an IFP, can be best modeled by a non-linear function. Method: 40 male road racing motorcycle riders ( $27.6 \pm 6.8$  years) participated in the study. A static structure was built to simulate the overall position when the rider is piloting a racing motorcycle (Marina et al., 2012). To measure the force exerted against the brake lever a gauge was connected to the Muscle-Lab system 4000e. The IFP rounds were composed by a succession of submaximal voluntary contractions (%MVC) of different intensities and durations (30%, 100% and 50% MVCs of 5 s, 3 s and 10 s durations respectively). Recoveries of 5 s and 1 min were allowed before the 30%–100% and 50% MVCs respectively. The adjustment of the force fatigue model (FFM) was obtained by the "Method of least squares" and the coefficient of determination  $R^2$  was computed. Residual analysis and normality of errors were examined. Results Force Fatigue Model =  $A - B \cdot \ln(C + D \cdot T) / (C - T)$  Equation 1: A: Force exerted during MVC in basal condition; B: related to the slope of the curve, C: related to the duration of the test, D: related to the moment of the second inflexion of the curve, T: relative duration with respect to the total performance (number of rounds accomplished) At the end of the IFP, NMVC has decreased 40% in comparison to MVCbasal and confirmed the trend observed with MVCraw. Using the best seeds (A, B, C and D) for each individual, and for instance after obtaining the "best interaction" between the FFM and the measured values,  $R^2$  was 0.977 (typical error of the residuals: 0.066; averaged  $\sum$ squares: 0.104). Conclusion The approach of our non-linear MVC model of fatigue proved to be well adjusted in comparison to the values measured for all subjects throughout the IFP. This non-linear model has the advantage of representing not only the hyperbolic functions (Bigland-Ritchie, et al., 1983; Burnley, 2009), but also the three stages fatigue proposed by Allen (2009). References: Allen, D. G. (2009). *J Appl Physiol*, 106, 358-359. Bigland-Ritchie, B., Johansson, R., Lippold, O. C., & Woods, J. J. (1983). *J Neurophysiol*, 50, 313-324. Burnley, M. (2009). *J Appl Physiol*, 106, 975-983. Marina M.; Torrado P.; Busquets, F.; Rios, J.G.; Angulo-Barroso R. (Accepted August 2012). *J Electromyogr Kinesiol. Millet, G. Y., & Lepers, R. (2004). Sports Med*, 34, 105-116.

### IMPAIRED NEURO-MECHANICAL CHARACTERISTICS INDUCED BY A REPEATED ANAEROBIC RUNNING SPRINT TEST IN PROFESSIONAL SOCCER PLAYERS

Brocherie, F., Millet, G.P., Girard, O.

Faculty of Biology and Medicine, University of Lausanne

Introduction This study aimed to determine changes in spring-mass model characteristics and quadriceps muscles activity induced by a repeated anaerobic running sprint test in soccer-specific conditions; i.e. on synthetic grass with soccer shoes. Methods Eight members of the Qatar national soccer team, performed 6 x 35 m sprints interspersed with 10 s of active recovery. Stride temporal parameters were obtained from insoles worn in the players' shoes, which allowed spring-mass behaviour to be estimated (three consecutive steps at 30 m distance interval). Surface electromyographic activity was monitored for vastus lateralis (VL), rectus femoris (RF), and biceps femoris (BF) muscles. Results Sprint time, contact time, total stride duration and swing time lengthened from the first to the last repetition (+17.4, +20.0, +17.0 and +16.6%; all  $P < 0.05$ ), while the increase in flight time was not significant (+14.9%;  $P > 0.05$ ) and stride length remained constant ( $P > 0.05$ ). Stride frequency decreased significantly across repetitions (-13.9%;  $P < 0.001$ ). Center of mass vertical displacement increased (+45.7%;  $P < 0.001$ ), together with unchanged (both  $P > 0.05$ ) peak vertical force (+2.8%) and leg compression (+5.3%). Vertical stiffness decreased (-27.2%;  $P < 0.001$ ) across trials, whereas leg stiffness change was not significant (+1.5%;  $P > 0.05$ ). Decreased root mean square EMG activity occurred over sprint repetitions for RF and BF (-18.7 and -18.1%;  $P < 0.01$  and  $P < 0.001$ , respectively), but not VL (-1.2%;  $P > 0.05$ ), muscles. Discussion In professional soccer players, repeated sprinting when performed in an ecological test setting impairs leg-spring behavior towards impaired vertical stiffness and less efficient stride characteristics. Similar changes in sprinting mechanics have been observed when soccer players completed 6 x 20 m with 20 s of passive recovery (Girard et al. 2011). With a larger sprint decrement observed here compared to Girard et al. (2011) (9.5% vs. 2.8% from the first to the last sprint), however, the magnitude of fatigue-induced neuro-mechanical adjustments in general was also larger. Those changes were also accompanied by reductions in RF and BF, but not VL, muscle activation. Training routines that aim at preserving sprinting efficiency when soccer players experience temporary fatigue during a game are encouraged. References Girard O, Racinais S, Kelly L, Millet GP, Brocherie F (2011) Repeated sprinting on natural grass impairs vertical stiffness but does not alter plantar loading in soccer players. *Eur J Appl Physiol* 111: 2547-2555

10:20 - 11:50

## Oral presentations

### OP-SH03 Physical Education and Pedagogics [PP] 2

#### EMERGING CREATIVE BEHAVIOURS UNDER ECOLOGICAL CONSTRAINTS IN CONTACT IMPROVISATION DANCE

Ric, A.1, Torrents, C.1, Hristovski, R.2, Aceski, A.2

*1:INEFC-UdL (Lleida-Spain) 2:Sts. Cyril and Methodius University (Republic of Macedonia)*

Introduction Contact improvisation (CI) dance generates different ways of moving and a varied use of motor creativity depending on the constraints acting on the system (Torrents et al. 2010). Under these constraints, some movement configurations are more likely to occur and some are unlikely, breaking system's replica symmetry (Hristovski et al. 2011). The aim of this study was to analyse the hierarchical structure and softly-assembled dynamics of a couple of improvisers dancing CI under specific task constraints manipulations. Methods Three contact improvisers were video-recorded while dancing 480 seconds duets in three trials with different conditions: a) free dance; b) constraint 1: try to maintain both pelvis as close as possible; c) constraint 2: try to maintain both pelvis as far as possible. Resulting trials from one dancer were sequentially observed using an observational instrument with 49 categories. The data obtained were then analysed using a soft-assembled hierarchy model analysis by means of three statistical analyses: a Hierarchical Principal Components Analysis (HPCA), calculation of Hamming distances (HD) between binary vectors and the calculation of dynamic overlap order parameter  $q$  to determine the structure of the potential landscape of the dancer and its dynamic properties. Results HPCA revealed 8 primary PCs for free dance, 8 for constraint 1 and 11 for constraint 2 accounting for more than 80% of the total variance. These PC typically formed a few higher order PCs pointing to a hierarchically self-organized dynamics. The elevations (motor acrobatic skills that characterize CI dance) appear most frequently in the dance with constraint 1, and less in the dance with constraint 2. The diffusion of these configurations vectors was 0,37 for free dance, 0,36 for constraint 1 and 0,39 for constraint 2. HD revealed higher potential barriers between the different configurations that appeared with constraint 1, because of the abrupt changes of configurations that produce the elevations. The dynamic overlap formed statistically different plateaus for each condition, being 0,45 for free dance, 0,48 for constraint 1 and 0,42 for constraint 2. Discussion Configurations are modified depending on the constraint, but the exploratory rate and plateau values show a higher exploratory behaviour when the system is constrained in a specific way (pelvis far). Constraining the system can enhance creativity, but also force the system to train specific techniques or movement patterns, i.e. elevations in CI dance. References Hristovski R, Davids K, Araujo D, & Passos P (2011). Nonlinear Dynamics, Psychology & Life Sciences, 15, 2, 175-206. Torrents C, Castañer M, Dinusová M, & Anguera MT (2010). Journal of Creative Behavior, 44(1):45-61.

#### CONTRIBUTIONS OF THE PHYSICAL EDUCATION TO THE CIRCUS ARTS

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INTRODUCTION From the second half of 20th century, by the circus schools arise, a new education process and knowledge exchange are added. In the European scenario they act in four education levels: leisure, artistic basis, professional/higher education, carry on education. In Brazil, it's also pointed in four levels: leisure/fitness, carry on education/informal, vocational training school, educational projects. Besides, these arts have also been implemented in the content of the formal education (DUPRAT; DARIDO, 2012) and also as extracurricular activities (TAKAMORI et al., 2010), mainly in the physical education classes (ONTAÑÓN; DUPRAT; BORTOLETO, 2012). In this context, different researches have been carried out by physical education professionals who seek, mainly, the possibility of pedagogical relations inherent in the circus activities. METHODOLOGY It's a theoretical study, carried out through the documental analysis of specialized literature. DISCUSSION The opening of circus schools allowed that new persons could come into the circus professional sphere. It has also allowed that many physical education professors/teachers could act in the circus scope, as an artist, physical trainer, coach, or professor/teacher. In Brazil, as there aren't any higher educational courses in circus art, many artists have been looking through the physical education course as a way to improve their academic formation. There are also records of physical education students who find out in both pedagogical possibility and artistic from experiences gained through their higher education. Thus, the relation between the circus and the physical education is now a reality, provoking an important increase of the academic production (ONTAÑÓN; DUPRAT; BORTOLETO, 2012), mainly on the pedagogical aspects, technical procedures, as well as, experience reports in the scholar scope. We conclude that the physical education and the Science of Sport can help discussing new specific teaching methodologies in relation to the pedagogical approaches and safety (LONG; AMBEGAONKAR; FAHINGER, 2011); helping out in the technical development and in the physical training roles for the amateurs and circus artists. To make this possible it's very important that the physical education courses fully value the circus arts, developing programs which address such knowledge, improving and deeping the researches. REFERENCES DUPRAT, R.M., DARIDO, S. (2012). 7th FIEP European Congress, Spain. ONTAÑÓN T, DUPRAT R, BORTOLETO M. (2012). Revista Movimento, v. 18, n. 2, 149-168. TAKAMORI F et al. (2010). Revista Pensar a Prática, UFG, v. 13, 1, 1-16. LONG A, AMBEGAONKAR J, FAHINGER P. (2011). Med. Problem. Perform Art. Dec, 26 (4): 200-5.

#### SHOULD CIRCUS ACTIVITIES COMPOSE THE PHYSICAL EDUCATION UNDERGRADUATE COURSE?

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Introduction Nowadays, circus activities are being more widely worked and discussed in the Physical Education context principally due to the increase of its pedagogical experiences (ONTANON, DUPRAT, BORTOLETO, 2012). Although the circus activities compose a new demand on the work market, there still is an insubstantial academic response, where only few undergrad courses have incorporated specific disciplines about this subject. Nevertheless, there are expressive results shown by the universities which have included the circus activities on their curricular grid (BORTOLETO, CELANTE, 2011). Based on these assumptions, this research intends to discuss the accessibility and the specific teaching characteristics of circus activities in the Physical Education undergrad. Methods This study is a theoretical essay, grounded upon the specialized literature. Results Although the circus activities are constituted of practices that are easy to imple-

ment in the Physical Education classes, the undergrad courses must attend to its proper pedagogical processes, such as security procedures and corporal groundwork, aiming on developing professionals who can work adequately with this knowledge (MATEU, 2010; HAUW, 2010). The approach to this matter should include a thorough discussion about the historical, social, ethical, aesthetical and technical aspects of these practices (FOUCHET, 2006), supporting a contextualized comprehension of the circus arts and the necessary adjustments for its inclusion as a Physical Education content. Discussion The incipience of this theme and the constant growing of the demand for its practices have generated a great quantity of short-term courses (intensive), as well as the appearance of proposals with shallow pedagogical grounding, mainly established on the reproductive model (empirical). That shows a reductionist approach to the circus arts as an expressive language, which can be incorporated to the academic development of the Physical Education professionals as a significant resource. References BORTOLETO, M. A. C.; CELANTE, A. R. (2011) O ensino das atividades circenses no curso de educação física: experiências na universidade pública e privada. Anais do III Seminário de Inovações Curriculares. Campinas: UNICAMP. FOUCHET, A. (2006) Las Artes del Circo: una aventura pedagógica. Buenos Aires: Stadium. HAUW, D. (Coord.) (2010) "L'Acrobatie" Paris: Revue EPS. 128 p. MATEU, M.S. (2010) "Observación y análisis de la expresión motriz escénica: estudio de la lógica interna de los espectáculos artísticos profesionales: Cirque du Soleil". Tese de doutorado, Universidade de Barcelona. ONTANON, T., DUPRAT, R., BORTOLETO, M.A.C. (2012) "Educação Física e atividades circenses: o estado da arte" Movimento, Porto Alegre, v. 18, n. 02, p. 149-168.

### **MOTOR SKILLS OBSERVATIONS AND MARKS I PHYSICAL EDUCATION; VALIDATION OF MOTORISK UTVECKLING SOM GRUND FÖR INLÄRNING OBSERVATION CHECKLISTS**

Ericsson, I.

*Malmö University*

Introduction Fundamental motor skills may be of importance in motivation for being physically active and take part in social physical play. Children with Developmental Coordination Disorder (DCD) spend less time in formal and informal team play (Smyth & Anderson, 2000). More children and young people would play sport and be physically active if they had better motor skills (Brown, Walkley & Holland, 2004). Aim The aim was to study relationships between motor skills and marks in Physical Education (PE). Another aim was to develop and validate checklists for motor skills observations. Method The study was hypothetic-deductive and had two hypotheses: The Motorisk Utveckling som Grund för Inläring (MUGI) checklists will fulfill criteria of validity and reliability; There are significant correlations between motor skills and marks in PE. All pupils at two schools were studied from school year 1 through 9. In total 263 of 265 pupils participated, 49% boys and 51% girls. To study development of motor skills MUGI checklists were used, measuring two components: balance/bilateral coordination and eye-hand coordination (Ericsson, 2008a; 2008b). Exploratory factor analyses were conducted for validation, Cronbach's alpha for test of reliability. To examine correlations between motor skills and marks in PEH Spearman rank correlations were used. Results Significant correlations were found between motor skills and marks in PE. Pupils with good motor skills had significantly higher marks than students with deficits in motor skills. The MUGI observation checklists were found to fulfill criteria of validity and reliability. Discussion The results indicate that motor skill deficits do not disappear by themselves. Motor skills observations at school start could bring about valuable information for planning motor training and individual programs of motor remediation. The results indicate the possibility to predicate marks in PE from motor skills observations at school start. References Brown, L., Walkley, J., & Holland, B. (2004). Relationships between Physical Activity and Fundamental Motor Skill Proficiency in Victorian Children. ACHPER National Conference Proceedings, University of Wollongong. Ericsson, I. (2008a). Motor skills, attention and academic achievements - an intervention study in school year 1-3. The British Educational Research Journal, 34(3), 301-313. Ericsson, I. (2008b). To measure and improve motor skills in practice. International Journal of Pediatric Obesity, 3(1), 21-27. Smyth M. M., & Anderson H. I. (2000). Coping with clumsiness in the school playground: Social and physical play in children with coordination impairments. British Journal of Developmental Psychology, (18), 389-413.

### **CONSTRUCTION, VALIDATION AND STANDARDIZATION OF AN ORIGINAL PHYSICAL EDUCATION TEST BATTERY FOR THE EVALUATION OF FUNDAMENTAL MOTOR SKILLS OF 2ND, 5TH AND 8TH GRADE STUDENTS: PILOT STUDY**

Iancu, H.D.1, Picard, Y.2, Bélanger, M.3,1, Richard, J.F.4

*1: SKR-UM (Moncton, Canada), 2: FE-UM (Moncton, Canada), 3: DFM-US (Sherbrooke, Canada), 4: SP-UM (Moncton, Canada)*

Introduction A key role of quality school physical education is to enable children to learn and master motor skills, which are crucial for the adoption of an active lifestyle. The identification and assessment of fundamental motor skills therefore become essential. A review of the literature shows there is a lack of measurement tools for assessing students' fundamental motor skills (Tremblay and Lloyd, 2010). Accordingly, we have developed an original battery of 24 tests for the evaluation of fundamental motor skills. A pilot study of this battery began in September 2012 in six schools (N = 700 students) of New Brunswick, Canada, in order to verify the feasibility, validity and reliability of these tests. Methods The battery has been designed according to the development steps of psychomotor tests suggested by Morrow, Jackson, Disch & Mood (2010). Specifically, our group of experts: 1) identified the motor skills to be assessed, 2) developed evaluation parameters for each skill by focusing on the performance process (quality) rather than the product (Scallan, 2000), and 3) determined the tests procedures. Then, other experts evaluated the face and content validity of the battery of tests. Each test has been subsequently applied in targeted age groups of students (2nd, 5th and 8th grade) to assess the feasibility of the tests and to refine the evaluation parameters. Preliminary results Following our first visits, we modified the instructions for some tests to improve clarity and we adjusted the estimated time of administration and procedures for some grade levels. The majority of the adjustments have been made and applied on site. At the same time, the physical education teachers used the assessment forms and gave us a first opinion on the test parameters (examples will be presented during the congress). Discussions The first steps of this process suggest that the development of a battery of tests to assess fundamental motor skills of students is promising. The next steps include assessing reliability (inter-judge, intra-judge and test-retest) and validity. A process of establishing standardized norms will also be implemented. This battery of tests could become a standard measure for assessing the objectives of physical education within school curriculums (Durand & Chouinard, 2006). References Durand, M.J., & Chouinard, R. (2006). L'évaluation des apprentissages : de la planification de la démarche à la communication des résultats. Montréal, QC : Hurtubise HMH. Morrow, J., Jackson, A., Disch, J., & Mood, D. (2010). Measurement and evaluation in human performance. Champaign, IL: Human Kinetics. Scallan, G. (2000). L'évaluation formative. Saint-Laurent, QC : Éditions du Renouveau pédagogique. Tremblay, M., & Lloyd, M. (2010). Physical literacy measurement - The missing piece. Physical and Health Education Journal, 76(1), 26-30.

## ADVANTAGES OF APPLYING ITEM RESPONSE THEORY METHODOLOGIES WHILE ANALYSING STUDENTS' MOTOR TEST DATA

Holzweg, M.

*Stellenbosch University*

Introduction Testing and reporting students' competencies is integral to the field of (school) education. In education there were several large (comparative) studies conducted in the last decade testing certain student competencies (e.g. IAE, 2008; OECD, 2012). Today, there is wide consensus in psychometrics as well as in education that IRT methodologies have several advantages compared with classical test theory methodologies (compare Rost, 1996). Nevertheless there hardly exist any studies in Physical Education and Sport Pedagogy employing those IRT methodologies (compare Strauß et al., in press). Methods The aim of the study is to exemplarily compare two different evaluation processes (uniformly distributed and normally distributed judgment scheme) for analysing data of the German Motor Test (DMT 6-18). The data includes a random sample of 749 five to fifteen-year-old German students from Berlin (366 female, 383 male with an average age of 9.63 years and a standard deviation of 3.27 years) showing their measuring characteristics (sum score, test information and test error). In contrast to the analysis described by Bös et al. (2009) using classic test theory methodologies, the author analyses the data using IRT methodologies based on the Rasch Model (Rasch, 1960) in order to describe advantages and disadvantages of the two different evaluating processes and to present consequences for the test interpretation. Results The results of this study show that the test error and the distribution of the sum score differ considerably, depending on the chosen judgment scheme. This has some crucial consequences for the test interpretation. Conclusions The research findings derived from the motor testing example can be easily generalised and transferred to studies related to assessments of student competencies in wider Physical Education and Sport Pedagogy contexts. References Bös, K., Schlenker, L., Büsch, D., Lämmle, L., Müller, H., Oberger, J., Seidel, I., & Tittlbach, S. (2009). Deutscher Motorik-Test (DMT 6-18) [German Motor Test (DMT 6-18)]. Hamburg: Czwalina. International Association for the Evaluation of Educational Achievement, IAE (2008). TIMSS 2007 technical report. Retrieved from: [http://timss.bc.edu/timss2007/PDF/TIMSS2007\\_TechnicalReport.pdf](http://timss.bc.edu/timss2007/PDF/TIMSS2007_TechnicalReport.pdf) Organisation for Economic Co-operation and Development, OECD (2012). PISA 2009 technical report. Retrieved from: <http://www.oecd.org/pisa/pisaproducts/pisa2009/50036771.pdf> Rasch, G. (1960). Probabilistic models for some intelligence and attainment tests. Chicago: University of Chicago Press. Rost, J. (1996). Lehrbuch Testtheorie – Testkonstruktion [Textbook test theory – test construction]. Bern: Huber. Strauß, B., Büsch, D., & Tenenbaum, G. (in press). Rasch-modeling in sports. In G. Tenenbaum, A. Kamata, & M. Bar-Eli (Eds.), Handbook of measurement in sport and exercise psychology. New York: Human Kinetics.

**10:20 - 11:50**

## Oral presentations

### OP-SH12 Sociology [SO] 2

#### GENDER BIAS IN THE FIELD OF SPORTS MEDICINE – A CASE OF RELEVANCE?

Hartmann-Tews, I., Rulofs, B.

*German Sport University Cologne*

Introduction There is growing consensus in society and health sciences about the necessity to improve excellence in scientific research by incorporating the categories sex and gender into the research design (Holdcroft et al., 2011). i.e. ignorance towards the relevance of sex and gender issues, in sport-related health research. Our research questions are, if there is any gender bias in the field of clinical and academic sports medicine and if so, what kind of social structures foster, stabilize or impede gender bias in research. Methods 1. A content analysis of abstracts of all journal publications in sports medicine published by German researchers during a four-year-period of 2005 to 2008 (N=2922). The content analysis was done by four researchers with an interrater-reliability of CR=0,9. 2. An in-depth content analysis of a sample of publications in sports medicine based on the above results (n=82). The content analysis was done by three researchers with an interrater-reliability of CR=0,9. 3. Interviews with central stakeholders of the scientific community of sports medicine, e.g. members of editorial boards, reviewers, funding institutions (n=17). Results Referring to those abstracts of journal articles that focus a research question relevant for both sexes (n= 2829) we identified that the studies focus more often on male test persons than on females. Thus an androcentric perspective is favored by sports-medical research. Only 7% of all abstracts were identified as "gender-sensitive", i.e. provide information on potential gender issues (either differences or similarities between men and women). The longitudinal analysis does not reveal any significant change with respect to these findings. The expert-interviews document that women are still constructed as the "second" and "more complex gender" by researchers whereas men are idealized as the "perfect test persons" in the field of sports medicine. This construction of an unequal gender order is even more stabilized by the increasing pressure to acquire research grants and to publish ("publish or perish"). Discussion Our studies document that gender bias occurs in clinical as well as in academic sports medicine. To understand the conceptual driving force of this situation we refer to the model of Risberg et al. (2009) who suggest that gender bias in medicine arises from assuming sameness and/or equity between women and men when there are genuine differences to consider and vice versa, assuming differences between women and men when there are none. References Holdcroft, A. Suidvongs, S. & Berkley, K. J. (2011). Incorporating Gender and Sex Dimensions in Medical Research. *Interdisciplinary Science Reviews*, 36 (2). 180 - 192. Risberg, G., Johansson, E. & Hamberg, K. (2009). A theoretical model for analysing gender bias in medicine. *International Journal for Equity in Health*, 8 (28), 1-8.

#### EXAMINING GENDERED IDENTITIES IN YOUNG PEOPLE'S MEDIA CONSUMPTION OF BRITISH WOMEN OLYMPIC ATHLETES.

Curtis, H.

*Canterbury Christchurch University*

Introduction: The Olympic Games is one of the most significant events presented in various media forms (Roche, 2000). Sports media is an important resource for young people as they develop their identities (Bruce and Saunders, 2005; Lines, 2000). Young people's read-

ings of sports stars has been gender differentiated (Lines, 2001). This research considers the intersections of gendered identities for understanding young people's mediated consumption. The feminist concept of intersectionality is utilised to understand how identities interconnect to shape multiple representations of women in sport. Methods: Focus groups were conducted with young people, aged 11-18. Participants were asked to view and evaluate BBC Olympic media coverage of British women Olympic athletes. These provided, "an appropriate research tool for studying the construction of collective identity" (Munday, 2006:89). The researcher investigated participants' meanings and ways of understanding (Lunt and Livingstone, 1993). Qualitative content analysis noted construction of meaning and gendered themes. Results: Multi-layered identities were constructed and negotiated in young people's mediated consumption. Stereotypical assumptions of gendered identities were reinforced, negotiated and resisted. These were contingent on intersections of identity including nation, ethnicity and ability. Discussion: Dominant gendered identities reinforced traditional feminine aesthetics that excluded female athleticism. However, mediated Olympic consumption also offered opportunities to negotiate and resist notions of female appropriateness. The potential for emphasis on performance, athletic and tactical skill were intersected and contingent on affiliation to the nation. Further challenges should be made to dominant, stereotypical conceptions of Olympic women athlete identification. It is vital to address the message-sender-receiver dynamic of media messages for understanding young people's reception and conceptions of Olympic women. References: Bruce, T. and Saunders, R. (2005) Young People, Media Sport and the Physical Education Curriculum. *Journal of Physical Education New Zealand*, 38, 5-66. Lines, G. (2000). Media sport audiences – Young people and the Summer of Sport '96: Revisiting frameworks for analysis. *Media, Culture & Society*, 22, 669-680. Lines, G. (2001) Villains, fools or heroes? Sports Stars as role models for young people. *Leisure Studies*, 20, 285-303. Lunt, P. & Livingstone, S. (1993) Rethinking the focus group in media and communications research. *Journal of Communication* 46 (2), 79-98, Oxford University Press. Munday, J. (2006) *Identity in Focus: The Use of Focus Groups to Study the Construction of Collective Identity*, Sociology, 40: 89-105. Roche, M. (2000) *Megaevents and modernity: Olympics and Expos in the growth of global culture*. London: Routledge.

### **GENDER ISSUES IN SPORTS ORGANISATIONS – ATTITUDES OF THE OFFICIALS**

Diketmüller, R.

*University of Vienna*

GENDER ISSUES IN SPORTS ORGANISATIONS – ATTITUDES OF THE OFFICIALS Introduction Gender mainstreaming as a strategy was implemented in Austrian's sports organizations in 2001. Nevertheless the situation of women in leading positions has not changed yet. The project 'frau-aktiv-vernetz' (connected women) aims to empower women as officials and to create more women-friendly structures for leadership positions within the sports organizations in one Austrian federal state. Based on the results of a baseline study, where the situation of women in leadership positions in sports clubs on the one hand and the attitudes of the officials towards measures of gender mainstreaming and women's promotion were analyzed, specified interventions were developed in a participatory process. Methods The baseline survey was delivered in an online questionnaire to ~1000 officials of two sports organizations and their sports clubs. The return rate was quite low (n=189) and indicates a low interest in the topic in general (Diketmueller, Hausmair & Urch, 2012). Results The results indicate that women's and gender-issues are not considered of high value. On the one hand gender-issues are regarded to be important, while on the other hand there were nearly no specific reported measures. In addition, female officials rate their situation in sports organizations significantly worse than their male colleagues. While both, men and women, remain skeptical about the implementation of quotas, men refuse this strategy significantly higher. As a key barrier for more female officials in sports organizations the aspect of transparency in the process of personnel recruitment as well as in decision-making processes in general was argued, mostly by women. There were also complaints that offers especially for girls' and women's interests and needs are missing. Discussion In summary, it can be seen that officials are highly skeptical about gender-issues and have low experiences in implementing gender mainstreaming within the sports organizations. In addition only a small number of officials offers expertise in this field. To implement this European strategy of gender mainstreaming in a sustainable way (Dahmen & Hartmann-Tews, 2007), it is necessary to focus on the individuals and their expertise as well as on the level of organization and structures. References Dahmen B, & Hartmann-Tews I. (Red.) (2007). *Organisationsentwicklung und Gender Mainstreaming in Sportverbänden*. Düsseldorf, LandesSportBund NRW. Diketmüller, R., Hausmair, T. & Urch, M. (2012). *Frau-aktiv-vernetz. Evaluationsbericht*. Wien.

### **HIT AND TELL - THE SWEDISH CONTEXT**

Radmann, A.

*Malmö University*

Hooligans telling their own story represent a new voice in the sports narrative: the hooligan memoir. While this is a comparatively new phenomenon in Sweden, this literary genre has a long and productive history in England under the name Hit and tell. The purpose of this article is to expound on the pop-cultural expressions of hooliganism in Sweden, as epitomised by four hooligan memoirs. The article explores football culture, hooliganism, violence, masculinity and media in Sweden, as it is imperative to the understanding of hooliganism that it is analysed in the contexts in which it occurs. Research has demonstrated that hooliganism and violence in football and supporter culture have become increasingly visible in popular culture over the last few years. The article shows how hooligan culture is created in dynamic interaction between media, political reactions and cultural praxis, arguing that the cultural praxis of hooliganism is manifested through actual fights and, to an even greater extent, the various media narratives surrounding the hooligan subculture presented in the four memoirs.

12:00 - 13:15

## Plenary sessions

### PS-PL04 Rehabilitation through exercise \*

#### EXERCISE AS PREVENTION AND TREATMENT OF KNEE OSTEOARTHRITIS

Roos, E.

*University of Southern Denmark*

The two most common questions from patients with osteoarthritis are if it is OK that it hurts when exercising, and if exercise will wear the joint down. Recent research suggest that it is OK if it hurts when exercising, and exercise therapy seem not to wear the joint down, if anything small pilot studies suggest the opposite. Our joints need mechanical load to work well, and the cartilage needs mechanical stimuli to produce the building blocks needed. Because of joint pain and varying structural changes of the joint exercise must be adapted to suit this patient group. Systematic reviews of data from randomized controlled trials from many thousands of patients show that both aerobic exercise and strength training are associated with substantial pain relief and improved physical function. Therefore exercise is recommended as first line treatment, together with education and weight loss, for patients with knee osteoarthritis. In many countries initiatives are taken to offer educational classes, exercise and weight loss programs for patients with knee osteoarthritis. Less is however known about the optimal exercise program, but 12 or more supervised sessions are associated with twice the effect compared to less than 12 sessions. The role of exercise in OA prevention in groups at increased risk of knee OA is currently under study. Patients having had treatment because of an injury to the anterior cruciate ligament or to the menisci constitute such easily identified highrisk groups where preventive measures may be possible. Neuromuscular exercise programs have been developed for these groups to improve their symptoms and function and dynamically stabilize the joint. Time will show if these strategies are able to reduce or slow OA development.

#### THE ROLE OF MUSCLE STEM CELLS IN COUNTER-FIGHTING SARCOPENIA BY EXERCISE

Mackey, A.

*University of Copenhagen and Bispebjerg Hospital*

Satellite cells are the resident stem cells of skeletal muscle and have the potential to repair and maintain skeletal muscle throughout adult life. They also maintain their own cell pool through the process of self-renewal, thereby theoretically providing the muscle with a non-exhaustible source of stem cells. However whether ageing muscle is characterised by a reduction in satellite cell number is still questionable, as some reports in the literature provide evidence for a maintained satellite cell pool size up to the eighth decade of life, while others document a reduced pool size. In addition, whether the absolute number of cells is important remains to be investigated. Since it has been shown that healthy elderly individuals can undergo hypertrophy and produce strength gains in response to resistance training, it is possible that the size of the satellite cell pool is not crucial to muscle adaptation. It appears however that satellite cells of elderly individuals, when compared to younger counterparts, are not as easily activated in vitro and in vivo, although there is some disagreement in the literature on this topic. Furthermore, the environment of the satellite cells also undergoes changes with ageing, which likely impacts cell activity. The potential of the satellite cell to influence the onset and progression of sarcopenia is not yet known, although it seems clear that the muscle of healthy elderly individuals does not respond as quickly, and perhaps not to the same extent, as young individuals, both in response to exercise training and muscle injury.

14:00 - 15:00

## Mini-Orals

### PP-PM31 Nutrition [NU] 5

#### DIET INFLUENCE UPON BRAIN CREATINE CONTENT: A CROSS-SECTIONAL STUDY WITH VEGETARIANS AND OMNIVOROUS

Solis, M.Y.1, Painelli, V.S.1, Otaduy, M.C.1, Lancha Jr, A.H.1, Artioli, G.G.1, Gualano, B.1

*1. University of Sao Paulo (Sao Paulo, Brazil)*

Introduction Creatine (Cr) is endogenously produced (approximately 1g/d) as well as ingested (approximately 1 to 5g/d), mostly via meat intake. It has been generally accepted that vegetarians show lower tissue Cr content when compared to omnivores. This assumption particularly holds true in regard to skeletal muscle; however, it is yet unknown whether diet can affect brain Cr content. The aim of this study was to explore the influence of diet on brain Cr content by comparing vegetarians (who consume virtually no Cr in diet) vs. omnivorous. Methods This is a cross-sectional study in which healthy vegetarians (n = 8; 3 women and 5 men, age = 29.63 ± 5.10 years; BMI = 23.98 ± 2.77 Kg/m<sup>2</sup>; schooling = 16.33 ± 2.42 years) were compared with age-, BMI- and gender-matched omnivorous individuals (n = 8; 3 women and 5 men, age = 30.83 ± 9.37 years; BMI = 24.33 ± 2.91 Kg/m<sup>2</sup>; schooling = 19.80 ± 3.74 years). Brain Cr content was assessed at the occipital lobe by in vivo proton magnetic resonance spectroscopy (1H-MRS) using a whole body 3.0T MRI scanner (Achieva Intera, Philips, Best, The Netherlands). Dietary Cr intake was assessed by 3-day food recalls. Differences between groups were evaluated by unpaired T-tests and significance level was previously set at p < 0.05. Results As expected, vegetarians had lower dietary Cr intake than omnivores (0.042 ± 0.01 vs. 1.869 ± 0.745 g/d, respectively, p = 0.05). However, vegetarians and omnivorous displayed comparable brain Cr content (4.38 ± 0.60 and 4.15 ± 0.74 a.u.; p = 0.50). Discussion The main finding of this study is that dietary Cr intake has no influence upon brain Cr content in apparently healthy subjects. Previous studies have shown that oral Cr intake can benefit cognitive function in vegetarians rather than in omnivorous individuals, suggesting that the former may show a deficit in brain Cr content, like

occur in skeletal muscle. However, this study refutes this notion and reinforces previous speculation that brain Cr content mostly rely on endogenous synthesis, whilst dietary intake has a minor, if any, role in brain Cr pool in healthy individuals under no stressing condition (e.g.: sleep deprivation, exhausting exercise, mental disorders). In conclusion, dietary Cr content did not impact brain Cr content in adult healthy individuals.

### **INFLUENCE OF CALCIUM INTAKE ON BONE MASS IN ADOLESCENT SWIMMERS. PRELIMINARY RESULTS.**

Julian Almarcegui, C., Gomez-Cabello, A., Gonzalez-Aguero, A., Gomez-Bruton, A., Matute-Llorente, A., Casajus, J.A., Vicente-Rodriguez, A.

UNIVERSIDAD DE ZARAGOZA

Introduction Inadequate calcium (Ca) intake in adolescence might diminish peak bone mass with adverse implications later in life (Abrahams SA, 2011). Spanish Ca requirements could not be adequate to achieve good bone health (Mesías M et al., 2011). Swimmers might have low bone mass due to the non-osteogenic activity. Therefore, the aim of our study was to describe the Ca intake of adolescent swimmers and study its possible influence on bone mass. Methods 22 adolescent swimmers (11 females;  $14.68 \pm 1.73$  y) from Zaragoza (Spain) were evaluated by the Helena-DIAT (Dietary Assessment Tool) to register their daily Ca intake. Participants were classified as being under or over daily Ca intake recommendations. Dual energy X-ray absorptiometry (DXA) was used to evaluate bone mineral content (BMC) and density (BMD) at subtotal (whole body-head), trochanter, interthrocanter, femoral neck, Wards triangle, total hip and lumbar spine sites. Relationship between Ca intake and bone-related variables was examined by Pearson's bivariate correlation analyses. Differences between under Ca and over Ca groups for bone-related variables were tested by ANCOVA analyses controlling for age, height and subtotal lean mass. Results 55% of swimmers were over and 45% under Ca recommendations. No significant correlations were found between Ca intake and bone-related variables. After adjustments for age, height and subtotal lean mass, no significant differences were found in none of the bone-related variables between under and over Ca recommendations groups. Conclusion About half of the studied adolescent swimmers did not reach the dietary Ca intake recommendations. No association between Ca intake and bone mass related variables was observed. Not-meeting Ca intake recommendations seem not to be associated with lower BMC or BMD in this specific population. Further studies, with higher sample size, are needed to corroborate these preliminary findings. References Abrahams SA. (2011). *Curr Opin Clin Nutr Metab Care*, 14, 605-9. Mesías M, Seiquer I, Navarro MP. (2011). *Crit Rev Food Sci Nutr*, 51, 195-211.

### **CAN GLUTAMINE SUPPLEMENTATION ATTENUATE THE IMMUNOSUPPRESSION INDUCED BY RAPID WEIGHT LOSE ?**

Jesus de Cillo, M.E.1, Tritto, A.C.C.1, Figueiredo, N.C.C.1, Mendes, S.H.C.C.1, Amano, M.2, Oliveira, V.A.2, Lancha Jr, A.H.1, Gualano, B.1, Roschel, H.1, Camara, N.O.S.2, Artioli, G.G.1

University of Sao Paulo

Introduction In order to qualify for competing in a lighter weight class, many combat athletes reduce weight rapidly using a combination of methods (i.e., energy restriction and increased exercise) that may lead to an immunosuppression (Artioli et al., 2010; Yaegaki et al., 2007; Kowatari et al., 2001). Knowingly, both exercise and energy restriction reduces plasma glutamine, which is essential for the metabolism of immune cells. This suggests that reduced plasma glutamine may play a role in weight loss-induced immunosuppression. Therefore, we sought to investigate whether glutamine supplementation is able to attenuate this consequence. Methods For this double-blind, placebo-controlled, randomized, parallel group study, we recruited 39 athletes. Those who needed to reduce weight to compete were randomly allocated in 3 groups: glutamine supplementation (20 g.day<sup>-1</sup>, n=12), isonitrogenated placebo (albumin 26 g.day<sup>-1</sup>, n=11) and isocaloric placebo (dextrose 20 g.day<sup>-1</sup>, n=8). A 4th group of athletes who did not lose weight was also assessed (n=8). Athletes were assessed for monocyte and neutrophil phagocytic activity 21 days before (normal weight), 1 day before (weight loss) and 5 days after a real competition (recovered weight). Supplementation period was of 10 days, commencing on the 5th day before the competition. Results Rapid weight loss significantly reduced the phagocytic activity in monocytes, but not in neutrophils. However, no supplement has shown any significant effect on phagocytic activity, indicating that glutamine did not attenuate the immunosuppression. Discussion In this study, we confirmed that rapid weight loss negatively impacts selected parameters of the innate immune function, as it was previously shown (Yaegaki et al., 2007; Kowatari et al., 2001). Importantly, all 3 experimental groups responded similarly to weight loss, demonstrating that glutamine supplementation is not able to counteract the negative effects of weight loss on these parameters. Possibly, depletion of plasma glutamine is not the link between rapid weight loss and immunosuppression. References Artioli, G.G., et al., Prevalence, magnitude, and methods of rapid weight loss among judo competitors. *Med Sci Sports Exerc*. Yaegaki, M., et al., Change in the capability of reactive oxygen species production by neutrophils following weight reduction in female judoists. *Br J Sports Med*, 2007. 41(5): p. 322-7. Kowatari, K., et al., Exercise training and energy restriction decrease neutrophil phagocytic activity in judoists. *Med Sci Sports Exerc*, 2001. 33(4): p. 519-24.

### **DIETARY NUCLEOTIDE SUPPLEMENTATION PREVENTS THE OXIDATIVE STRESS OF LYMPHOCYTES AFTER STRENUOUS EXERCISE IN A COLD ENVIRONMENT**

Riera, J., Pons, V., Ferrer, M., Mestre, A., Martinez-Puig, D., Tur, J., Pons, A.

1. *Universitat de les Illes Balears*, 2. *Centre d'Alt Rendiment GIRSANE*, 3. *BIOIBERICA S.A*

PURPOSE: The aim of the present study was to test the impact of a specific nucleotide formulation (Immunactive®, Bioiberica, Spain) on the oxidative stress of lymphocytes of athletes after a heavy exercise bout in cold conditions. METHODS: Twenty male taekwondo athletes with a mean (±SD) age, height, weight, percent body fat, of  $21.4 \pm 6.3$  years,  $178.1 \pm 8.5$  cm,  $73.86 \pm 12.6$  kg,  $12.53 \pm 3.2$  % were included in a double-blind placebo-controlled trial. Two weeks before the test, all the subjects performed a cycling maximal incremental test to determine his maximal oxygen uptake (VO<sub>2</sub>max). The subjects were randomly divided into two groups of 10 subjects and were supplemented with placebo (P) or Immunactive (I) at 600mg/day during a period of 30 days. On day 0 and on day 30 each subject undertook an exhaustion exercise test using a cycloergometer. Immediately before, 30 minutes and 150 minutes after the test, blood samples were obtained for determination of blood cell concentrations and for the activity of the antioxidant enzymes glutathione reductase (GRd), glutathione peroxidase (GPx), catalase and superoxide dismutase (SOD) in lymphocytes. Malonaldehyde levels were also determined as a marker of lipid peroxidation. 24h after the exercise test blood samples were obtained for lymphocyte total proliferation. RESULTS: The exercise test induced an increase in leukocyte and neutrophil counts and a decrease in lymphocytes in both groups. Supplementation with dietary nucleotides during a period of 30 days resulted in a 60% reduction on the activity GRd as compared to placebo (124 vs 203 nkat/109 cells;

$p < 0.05$ ). After the exercise test a reduction on the activity of GPx and GRd was detected for the nucleotide group as compared to placebo. Differences were significant at 30 min after the exercise for GPx ( $p < 0.05$ ) and at 150 min for GRd ( $p < 0.05$ ). The MDA levels were numerically reduced in lymphocytes both before ( $0.419 \pm 0.063$  vs  $0.742 \pm 0.130$ ) and after the exercise test ( $0.464 \pm 0.034$  vs  $0.825 \pm 0.300$ ) for the nucleotide group as compared to placebo suggesting a trend towards the reduction of the oxidative damage. After the supplementation the rate of lymphocyte proliferation decreased at 24h after the exercise test in the placebo group but not in the Immunactive group ( $-15.34 \pm 5.25$  vs  $13.15 \pm 4.97$ ,  $p < 0.01$ ). CONCLUSIONS: These findings suggest that supplementation with a nucleotide-based product during 4 weeks could exert an antioxidant effect on lymphocytes as shown by a reduction on the glutathione dependant antioxidant enzymes and by a trend towards a reduction on the oxidative damage. The antioxidant response has been simultaneous to maintenance of the lymphocyte proliferation rate after exercise, suggesting a protective effect of dietary nucleotides.

### INFLUENCE OF TRAINING STATUS ON PERFORMANCE IN RESPONSE TO B-ALANINE.

Saunders, B.1,2, Painelli, V.S.1, Sale, C.2, Harris, R.C.3, Solis, M.Y.1, Roschel, H.1, Artioli, G.G.1, Lancha Junior, A.H.1

1: USP (São Paulo, Brazil), 2: NTU (Nottingham, UK), 3: Junipa Ltd (Newmarket, UK)

Introduction: The body of evidence surrounding the ergogenic effects of  $\beta$ -alanine (BA) supplementation is increasing, although the majority of studies showing an effect have used recreationally active participants. The effects of BA on trained athletes remain unclear and some authors speculate that athletes might be less responsive to its supplementation (Bellinger et al., 2012). It is possible that the true effect of BA on trained athletes might be mediated by differences in muscle buffering capacity between trained and untrained individuals (Sahlin and Henriksson, 1984). Therefore, the aim of this study was to investigate whether training status influences the ergogenic effect of BA supplementation on repeated Wingate performance. Methods: Forty males were allocated into a trained group (T; age:  $32 \pm 9$  years; body mass:  $70.4 \pm 7.8$  kg; height:  $1.80 \pm 0.05$  m) and an untrained group (NT; age:  $25 \pm 4$  years; body mass:  $75.1 \pm 9.5$  kg; height:  $1.77 \pm 0.07$  m) and both were further randomly allocated to a BA or matching placebo (PL) group. This provided four experimental conditions: NTPL, NTBA, TPL, TBA. Participants ingested BA (6.4 g/day) or PL for 4 weeks, with participants completing four 30-seconds lower-body Wingate bouts, separated by 3 minutes, before and after supplementation. All data are presented as mean  $\pm$  1SD and statistical significance was accepted at  $P < 0.05$ . Results: Total work done was significantly increased following supplementation in both NTBA ( $+1349 \pm 1411$  kJ;  $P = 0.03$ ) and TBA ( $+1978 \pm 1508$  kJ;  $P = 0.002$ ), and significantly reduced in NTPL ( $-1385 \pm 2815$  kJ;  $P = 0.03$ ) with no difference for TPL ( $-219 \pm 1507$  kJ;  $P = 0.73$ ). Compared to pre-supplementation, post-supplementation mean power output (MPO) was higher in bout 4 for NTBA ( $P = 0.0004$ ), while MPO was higher in bouts 1, 2 and 4 ( $P \leq 0.05$ ) for TBA. No differences were observed in MPO for NTPL and TPL. Discussion: Four weeks of BA supplementation was effective at improving repeated high-intensity cycling performance in untrained and trained individuals. Despite suggestions that trained individuals would not benefit from BA supplementation due to higher initial muscle buffering capacity, BA improved performance to a similar extent in both the untrained ( $2.52 \pm 2.64\%$ ) and trained ( $3.64 \pm 2.87\%$ ) participants. These data highlight the efficacy of BA as an ergogenic aid for high-intensity exercise regardless of the training status of the individual. References: Bellinger PM, Howe ST, Shing CM, Fell JW. (2012). Med Sci Sports Exerc, 44(8), 1545-1551. Sahlin K, Henriksson J. (1984). Acta Physiol Scand, 122(3), 331-339.

### INDICES OF BONE MINERAL STATUS IN OVERWEIGHT AND OBESE ADULTS ARE IMPROVED FOLLOWING VITAMIN D SUPPLEMENTATION DURING RESISTANCE TRAINING

Carrillo, A.E.1, Flynn, M.G.2, Markofski, M.M.3, Pinkston, C.3, Jiang, J.3, Donkin, S.S.3, Teegarden, D.3

1: Chatham University (Pittsburgh, PA, USA), 2: College of Charleston (Charleston, SC, USA), 3: Purdue University (West Lafayette, IN, USA)

Introduction Evidence is accumulating to support that vitamin D recommendations should be increased to achieve optimal bone health. Bone health has also been found to be maintained or improved following resistance exercise training. The purpose of the current study was to investigate the effects of vitamin D supplementation during resistance training on bone mineral status (i.e. bone mineral density and bone mineral content) in overweight and obese adults. Methods In a 12-week, double-blind, placebo-controlled trial, twenty-three overweight and obese (age:  $26.1 \pm 4.7$  years; BMI:  $31.3 \pm 3.2$  kg/m<sup>2</sup>) adults were randomized into a vitamin D supplementation (VitD 4000 IU/day; female 5, male 5) or placebo (PL, female 7; male 6) group. Both the VitD and PL groups performed 12 weeks of resistance exercise training. Parathyroid hormone and bone mineral status were assessed prior to and following the 12-week intervention. Bone mineral status was determined using dual energy X-ray absorptiometry. Results No differences in absolute levels of bone mineral density (BMD) or bone mineral content (BMC) were detected at any of the measured sites between groups at baseline or at 12 weeks ( $P > 0.05$ ). During the intervention, however, android and leg BMC as well as spine BMD were significantly increased in the VitD group only ( $P < 0.05$ ). Furthermore, the change in spine BMD was significantly different between the VitD ( $0.047 \pm 0.033$  g/cm<sup>2</sup>) and PL ( $-0.001 \pm 0.045$  g/cm<sup>2</sup>) groups ( $P = 0.011$ ). For VitD and PL groups combined, PTH was negatively correlated with pelvis ( $r = -0.625$ ;  $P = 0.002$ ), trunk ( $r = -0.505$ ;  $P = 0.02$ ), and spine BMD ( $r = -0.540$ ;  $P = 0.012$ ) at baseline. After the 12 week intervention, PTH was negatively correlated with trunk ( $r = -0.475$ ;  $P = 0.026$ ) and spine BMD ( $r = -0.534$ ;  $P = 0.01$ ) as well as android BMC ( $r = -0.514$ ;  $P = 0.014$ ). Discussion Vitamin D and resistance exercise training have been shown to independently produce small gains in BMD particularly at the hip and spine. In the current study, vitamin D supplementation during resistance training enhanced exercise-induced changes in android and leg BMC as well as spine BMD in healthy overweight and obese participants.

### MUSCLE PROTEIN SYNTHESIS AND MOLECULAR EVENTS UNDERPINNING CHANGES IN TISSUE METABOLISM WITH WHEY AND SOY INGESTION IN ENERGY RESTRICTION IN OVERWEIGHT/OBESE ADULTS

Marcotte, G.1, Hector, A.1, Churchward-Venne, T.1, Breen, L.1, Murphy, C.1, Von Allmen, M.1, Baker, S.1, Phillips, S.1

McMaster University

1: Exercise Metabolism Research Group \*Both authors contributed equally Introduction Diet-induced weight loss results in the loss of fat and lean body mass (1); however, increased protein intake during a hypoenergetic diet can improve fat mass loss and lean mass retention (2). This may be attributed to increased muscle protein synthesis (MPS) rates, which are more effectively stimulated by dairy-based proteins such as whey compared to soy (3). The aim of this study was to evaluate the mechanisms by which whey and soy proteins promote fat mass loss and lean mass retention during a hypoenergetic diet. Methods In a double blind investigation, adult men and women ( $n=40$ , BMI 28-40) underwent a 14 day hypoenergetic diet supplemented with whey (WHY) or soy (SOY) protein, or a carbohydrate (CHO) control. Pre and post diet intervention testing included a primed constant infusion of L-[ring-13C6] phenylalanine with skeletal muscle biopsies to measure MPS in the postabsorptive state and following WHY, SOY, or CHO ingestion. Changes in total fat and fat free

mass were measured by DEXA and immunoassay was used to measure cortisol, TNF- $\alpha$ , IL-6, CRP, IGF-1, glucose and insulin. Results The self-reported energy deficit for WHY, SOY and CHO averaged ( $\pm$  SEM)  $-680 \pm 37$ ,  $-750 \pm 38$  and  $-832 \pm 39$  (kcal/d) respectively, with a significant ( $P < 0.05$ ) difference between WHY and CHO. WHY and SOY consumed significantly ( $P < 0.01$ ) more protein ( $1.26 \pm 0.03$ ) (g/kg\*d) than CHO ( $0.75 \pm 0.02$ ). Daily carbohydrate ( $215 \pm 10$  g/d) and fat ( $47 \pm 2$  g/d) intake, total weight loss ( $-2.29 \pm 0.18$  kg), fat mass loss ( $-1.19 \pm 0.16$  kg) and lean mass loss ( $-0.81 \pm 0.24$  kg) did not significantly differ between groups. No group or time effects were observed for pre- to post-intervention concentrations of TNF- $\alpha$ , IL-6, CRP, and IGF-1. Plasma cortisol was unchanged in WHY but increased significantly ( $p < 0.05$ ) in SOY and CHO. Discussion Regardless of dietary intervention all individuals lost fat and lean mass. The lack of a treatment effect on body composition may be due to the acute nature of the study. Given that cortisol is a signal for muscle proteolysis, the lower levels in WHY may provide one potential mechanism for a lean mass sparing effect. We hypothesize that a group effect will be further reflected in the more sensitive measurements of MPS, protein signaling and gene expression. 1) Weinheimer EM, Sands LP, and Campbell WW (2010). *Nutr Rev* 68.7: 375-388 2) Krieger JW, Sitren HS, Daniels MJ, Langkamp-Henken B (2006). *Am J Clin Nutr* 3:260-274 3) Tang JE, Moore DR, Kujbida GW, Tarnopolsky MA, & Phillips SM (2009). *J App Physiol* 107(3): 987-992

## THE EFFECTS OF TWO DIFFERENT DOSES OF CALCIUM LACTATE ON HIGH-INTENSITY INTERMITTENT PERFORMANCE

Artioli, G.G., Painelli, V.S., Silva, R.P., Oliveira Jr, O.M., Oliveira, L.F., Benatti, F.B., Rabelo, T., Guilherme, J.P.L.F., Lancha Jr, A.H.

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Introduction Studies suggest that lactate supplementation may enhance high-intensity exercise performance by increasing extracellular buffering capacity (Van Montfoort et al., 2004; Morris et al., 2011). However, evidence is limited and optimal dosage is not known. Thus, we aimed to examine the ergogenic effects of two different doses of calcium lactate. Methods 12 male individuals underwent performance evaluation trials in 4 different occasions: familiarization, 90 min after ingesting 150 mg.kg<sup>-1</sup> calcium lactate (LOW), 90 min after ingesting 300 mg.kg<sup>-1</sup> calcium lactate (HIGH), and 90 min after ingesting 150 mg.kg<sup>-1</sup> calcium carbonate (placebo - PL). High-intensity intermittent performance was assessed by 3 bouts of the 30-s Wingate Test for upper body (0.4 kp.kg<sup>-1</sup>; 3 min recovery between bouts). The study was conducted in a double-blind, cross-over, counterbalanced design. Venous blood samples were collected before and 90 min after capsule ingestion, and immediately after exercise for bicarbonate and pH determination. Results Pre- and post-exercise blood bicarbonate was not affected by calcium lactate, regardless the dose ingested. Similarly, calcium lactate did not elicit any significant change in blood pH as well as in performance (total work done (J): LOW:  $26252 \pm 2666$ ; HIGH:  $25600 \pm 2271$ ; PL:  $25496 \pm 2679$ ;  $F = 0.30$ ,  $p = 0.74$ ). Discussion A few studies have suggested that lactate ingestion is beneficial for high-intensity exercise performance, since the excess of blood lactate could be oxidized or converted into glucose. In both cases, the overall net balance of reactions would result in the removal of free H<sup>+</sup> ions, which could ultimately elevate blood pH and bicarbonate levels. Van Montfoort et al. (2004) showed a ~1% increase in performance after ingesting 0.36 mosmol.kg<sup>-1</sup> sodium lactate. A remarkably larger performance improvement (+17% in TWD) was observed by Morris et al. (2011) after the ingestion of 120 mg.kg<sup>-1</sup> of lactate. In our study, neither a similar dose (150 mg.kg<sup>-1</sup>) nor the double dose (300 mg.kg<sup>-1</sup>) of calcium lactate was capable of increasing blood bicarbonate and blood pH. Exercise capacity was also unaffected, despite the use of a very acidotic exercise protocol, which was previously shown to be sensitive to detect performance improvements caused by alkalinising agents (Artioli et al., 2007). References Artioli GG, Gualano B, Coelho DF, Benatti FB, Gailey AW, Lancha AH Jr (2007). *Int J Sport Nutr Exerc Metab*, 17:206-17. Morris DM, Shafer RS, Fairbrother KR, Woodall MW (2011). *Int J Sport Nutr Exerc Metab*, 21:311-7. Van Montfoort MC, Van Dieren L, Hopkins WG, Shearman JP (2004). *Med Sci Sports Exerc*, 36:1239-43.

## SUBOPTIMAL VITAMIN D INTAKE IN FEMALE ELITE SPANISH GYMNASTS

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Introduction: Gymnasts usually train indoor reducing time to sun exposure. In Madrid (latitude 40°) at least in fall and winter period, vitamin D synthesis associated to sun exposure could be compromised. Furthermore, low caloric intake in gymnastics could lead to low micronutrient consumption. Recently established dietary allowance (RDA) for vitamin D (FNB, 2011) are still controversy discussed for being insufficient (Heaney & Holick, 2011). Therefore the aim was to compare different nutritional patterns in gymnasts and examine the relationship between energy and micronutrient intake derived from food group in order to propose nutritional advice to reach recent RDA recommendations. Methods: Energy intake was analysed in 40 Spanish elite gymnasts -23 rhythmic (R) and 17 artistic (A) - age  $15.5 \pm 1.9$ ,  $15.5 \pm 2.2$  yrs and weight  $48.0 \pm 6.7$ ,  $44.6 \pm 4.7$  Kg respectively. Diet composition was estimated by food weighing (Mettler-Toledo  $\pm$ lg) for a 5-day period. An open database of Spanish food items (Dial Alce®) was used to determine nutrient intakes. Meanwhile gymnasts completed a 24h activity questionnaire to estimate energy expenditure. Results: Energy intake ( $1862 \pm 398$  vs.  $1560 \pm 270$  Kcal/d) was higher ( $p < 0.01$ ) in R. Additionally energy distribution was lower in CH (48% vs 54%,  $p < 0.05$ ) and higher in lipids 35% vs 30% ( $p < 0.05$ ). Vitamin D intake was insufficient ( $6.9 \pm 2.9$  vs.  $5.6 \pm 1.7$   $\mu$ g/d) and no gymnast reached RDA recommendations for vitamin D (15  $\mu$ g/d). Diet vitamin D density was similar in both groups and correlated to energy derived from fish ( $r = 0.495$ ) and cereals ( $r = 0.377$ ). Calcium intake was marginal in both groups ( $991 \pm 300$  vs.  $1047 \pm 226$  mg/d) and only 3 gymnasts reached calcium RDA (1300mg/d). Nevertheless, diet calcium density (mg Ca/1000Kcal) was lower ( $p < 0.01$ ) in R. Calcium intake was correlated to energy derived from dairy ( $r = 0.578$ ) and cereals ( $r = 0.516$ ). Magnesium and vitamin E intake were suboptimal in both groups and only 6 gymnasts reached RDAs. Energy derived from fruit intake was greater ( $p < 0.05$ ) in A. In contrast, group A consumed less energy intake, which comes from meat ( $p < 0.01$ ), fish ( $p < 0.01$ ) and fat ( $p < 0.05$ ) and could explain lower cholesterol intake in this group ( $p < 0.01$ ). Discussion/Conclusion: Nutritional intervention in order to increase the intake of skimmed dairy, white fish, and varied fortified vitamin D and/or calcium products could improve diet composition in these gymnasts. Likewise vitamin D and calcium supplementation could be recommended for these young elite gymnasts. FNB. (2011). Dietary Reference Intakes for calcium and vitamin D. Washington DC: National Academies Press. Heaney, R. P., & Holick, M. F. (2011). Why the IOM recommendations for vitamin D are deficient. *J Bone Miner Res*.

14:00 - 15:00

## Mini-Orals

## PP-PM38 Physiology [PH] 5

**IMPACT OF INTERMITTENT HYPOXIC EXPOSURE SESSION ON RECOVERY FROM CYCLING IN HEAVY INTENSITY DOMAIN**

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**INTRODUCTION** The intermittent hypoxia exposure (IHE) is a mode of administration of hypoxia already used in ergogenic programs applied to high performance athletes. Generally, coaches consider the 60-minute sessions carried out 5 times per week for 3 weeks as compatible with the normal training. However, it is not known the impact of an IHE session in a subsequent training session. Our aim is to identify the effect of a session of IHE in exchanges of ventilatory gases, testing the hypothesis that IHE decreases overall aerobic efficiency during exercise in the heavy intensity domain and augments the "O<sub>2</sub> debt". The question is relevant in human physiology of hypoxia and has potential to transfer to coaches's practice. **METHODS** We conducted a research study in which we assessed eight triathlon athletes in exercise, before and after the completion of a IHE session correspondent to 4500 m ("Hypoxia"). Each IHE session consist of 5 min of hypoxic administration by facial mask and 5 min of breathing normoxic air. The study was controlled by unilateral occlusion of the exposure condition. So the volunteers athletes performed another evaluation session of exercise before and after normoxic exposition in which the set up for IHE was applied but with an O<sub>2</sub> % of 20.9 ("Normoxia"). Exercise intensity in cycloergometer was normalized to 40% of delta VO<sub>2</sub>, correspondent to heavy domain intensity determined after a maximal incremental test. The intensity was kept constant during each bout and was the same for all the exercise bouts. VO<sub>2</sub>, VCO<sub>2</sub> and ventilation (VE) in exercise and in the first 5 recovery min were recorded breath by breath. Significance was set at p≤0.05. **RESULTS** In this study we find a 4% decrease in mean CO<sub>2</sub> production during exercise but no significant difference in O<sub>2</sub> production or VE in exercise. Otherwise, we find a 8% VO<sub>2</sub> increase during recovery of exercise bouts after hypoxic exposition. **DISCUSSION** The increase in VO<sub>2</sub> during recovery due to the previous hypoxic exposition represents an increase in the "VO<sub>2</sub>-debt". The aerobic efficiency during exercise was not affected. Although the low impact of a single IHE session in subsequent exercise in normoxia, coaches must be aware of the impact in recovery. **REFERENCES** Bailey, S. J., A. Vanhatalo, et al. (2009). *J Appl Physiol* 107(6): 1743-1756. Burnley, M., J. H. Doust, et al. (2006). *J Appl Physiol* 101(5): 1320-1327.

**EFFECT OF PEDAL CADENCE ON THE HETEROGENEITY OF MUSCLE DEOXYGENATION DURING MODERATE EXERCISE**

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*University of Paris Sud*

This study examines the effect of pedal cadence on the heterogeneity of muscle deoxygenation during exercise of moderate intensity. Twelve healthy subjects performed six minutes of cycling at 40 and 100 rpm at 80% of the workload corresponding to the gas exchange threshold. Gas exchanges were measured breath-by-breath during each exercise. Muscle deoxygenation (HHb i.e. O<sub>2</sub> extraction) and blood volume (tHb) were monitored continuously by near-infrared spectroscopy at eight sites on the vastuslateralis. The heterogeneity of HHb and tHb was assessed using the relative dispersion of the signal measured at the eight sites (i.e. 100 x standard deviation/mean). HHb and tHb were not altered by the pedal cadence, while pulmonary V'O<sub>2</sub> was higher at 100 than at 40 rpm (p < 0.001). The relative dispersion of HHb was significantly higher at 100 rpm compared to 40 rpm (p < 0.001) whereas no significant difference was shown for the relative dispersion of tHb. These results indicate that the pedal cadence has no effect on O<sub>2</sub> extraction but that an elevated cadence would increase muscle V'O<sub>2</sub>, suggesting an increase in muscle blood flow. Elevated cadence also induced greater heterogeneity of the muscle's V'O<sub>2</sub>/Q'O<sub>2</sub> delivery ratio, suggesting impairment in the adequacy between O<sub>2</sub> demand and O<sub>2</sub> delivery in some regions of active muscle.

**ARTERIAL DESATURATION IN BLACK AND WHITE RUNNERS IN NORMOXIC AND HYPOXIC CONDITIONS**

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**Introduction** It has been hypothesized that early life factors in African runners can influence their cardiopulmonary function, reducing the degree to which arterial saturation (SpO<sub>2</sub>) drops during high-intensity exercise. Consequently, this may contribute to the development of a later life phenotype optimized for physical performance (1). Since this hypothesis has never been investigated, the main purpose of this study was to examine SpO<sub>2</sub> in Black and White runners under normoxic and hypoxic conditions at different exercise intensities. **Methods** Eight well-trained Black South African (23.7 ± 3.2 years and 33.4 ± 0.4 min 10-km race time) and six White (21.5 ± 1.7 years and 33.5 ± 0.8 min) runners participated in this study. VO<sub>2</sub>max and peak treadmill speed (PTS) were measured using a progressive test. Submaximal physiological responses (including SpO<sub>2</sub> via pulse oxymetry) were measured at 64, 72, 80, and 88% of PTS in normoxic and hypoxic (FI<sub>O2</sub>≈14%) conditions. Skeletal muscle enzyme activities (citrate synthase, phosphofructokinase, 3-hydroxyacetyl CoA dehydrogenase and lactate dehydrogenase) and muscle fibre composition were also determined. **Results** Black runners were shorter (171.4 ± 2.4 vs. 181.2 ± 2.4 cm, p<0.05) and had lower maximal minute ventilation (VE) than the White runners (137.4 ± 7.9 vs. 162.3 ± 5.4 L/min, p<0.05), but they did not present any other difference in maximal parameters, including VO<sub>2</sub>max. Black runners displayed higher SpO<sub>2</sub> than the White runners when running at 80% of their PTS in hypoxic conditions (81.3 ± 11.2 vs. 70.1 ± 7.1%, p<0.05), but not in normoxia. No differences in the enzyme activity and muscle fibre composition were found. **Discussion** The present study provides evidence that Black runners are less susceptible to hypoxia than White runners, especially with regard to exercise-induced hypoxaemia. It has previously been reported that a low arterial saturation may imply a reduced muscle O<sub>2</sub> supply (2). Additionally, it is known that performance is seriously impaired when the SpO<sub>2</sub> drops below 87% (3). Therefore, results of this study may imply that outstanding running performance in Black runners is attributable, at least when running under hypoxic conditions, to less severe exercise-induced hypoxaemia. **References** 1. Carrillo AE, Koutedakis Y, Flouris AD. Early life mammalian biology and later life physical performance: maximizing physiological adaptation. *B J*

Sports Med 2011;45: 1000-1 2. Calbet JA. Oxygen tension and content in the regulation of limb blood flow. *Acta Physiol Scand* 2000;168:465-72 3. Koskolou MD, McKenzie DC. Arterial hypoxemia and performance during intense exercise. *Eur J Appl Physiol* 1994;68:80-6

### EFFECTS OF CONVENTIONAL ALTITUDE TRAINING ON TOTAL HAEMOGLOBIN MASS IN FEMALE KAYAKERS

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Do not insert authors here Introduction Total haemoglobin mass (tHb-mass) is one of the key factors contributing to aerobic performance [2]. Conventional altitude training can bring about an increase in tHb-mass although the reported results are often controversial [1,4]. Furthermore, little research has focused on the persistence of tHb-mass after descending from altitude, especially after a prolonged stay there [3]. The aim of this study was to examine the impact of 3-week classical altitude training on tHb-mass and to evaluate its stability after 24 days of residing at the sea level. Material and Methods Five elite female kayakers (age: 20.5±7.8 years, height: 1.67±0.04 cm, body mass: 65.7±7.57 kg) stayed at 2000 m and trained at about 2400 m above the sea level for 21 days. The tHb-mass (optimised CO-rebreathing method), haemoglobin concentration (Hb) and hematocrit (Ht) were measured in venous blood (Advia 120) and plasma volumes were computed. All measurements were taken at baseline and at two points after training camp, i.e. one and 24 days later. Differences in mean changes between consecutive measures were analysed using Wilcoxon's signed-rank test ( $p < 0.05$ ). Results After training camp, the tHb-mass increased, on average, by 2.2% but individual responses of that index varied from -1.6% to +8.9%. Haemoglobin concentration and hematocrit increased significantly ( $p < 0.05$ ) by 8.3% (0.7 – 14.1%) and 4.7% (1.8 – 8.6%), respectively; 24 days after the training camp, tHb-mass decreased significantly ( $p < 0.05$ ) by 1.6% (-0.6 to -4.0%). Significant decreases in Hb concentration and Ht value were also observed. Mean value of Hb decreased by 12.6% (-8.2 to -16.3%) and mean Ht value by 9.0% (-7.5 to -11.3%). Conclusions The tHbmass responds to training under hypoxia conditions to a variable degree but decreases significantly upon the return to the sea level. Marked changes in plasma volume support the theory that Hb concentration and Ht value are not reliable in assessing changes in the total amount of haemoglobin in blood under hypoxia conditions or immediately after the return to normal conditions. References 1. Frese F, Friedmann-Bette B. (2010) *Int J Sports Med* 31: 382-388. 2. Kanstrup IL, Ekblom B. (1984) *Med Sci Sports Exerc* 16: 256-262. 3. Pottgiesser T, Garvican LA, Martin DT, Featonby JM, Gore CJ, Schumacher YO. (2012) *Int J Sports Physiol Perform* 7:79-83. 4. Robertson EY, Saunders PU, Pyne DB, Aughey RJ, Anson JM, Gore CJ. (2010) *Med Sci Sports Exerc* 42: 394-401.

### INTERMITTENT HYPOXIC TRAINING IMPROVES SEA LEVEL PERFORMANCE IN TEAM SPORT ATHLETES

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Introduction Altitude training has been used extensively by endurance athletes, however less is known on the efficacy of this method for enhancing team-sport (TS) athlete performance. Intermittent hypoxic training (IHT), improves glucose and glycogen handling, and pH regulation.1-3 Such adaptations may positively influence TS performance. This study therefore investigated whether IHT is superior to normoxic training to improve TS athlete performance at sea level. Methods: Twenty-one Australian footballers volunteered for the study, were matched for Yo-Yo intermittent recovery test level 2 performance (Yo-YoIR2), and assigned to either the IHT (n=10) or control (n=11). The IHT group performed 11 40-min IHT sessions over 4 weeks at 2500 m simulated altitude consisting of 3 to 4, 5-min cycling intervals separated by 2.5 min. The control group performed 2 bike sessions per week in normoxia, while the IHT group was removed from portions of normal squad training to ensure training load was matched based on session RPE. The Yo-YoIR2 was performed on both groups at baseline, after 3, 6, and 11 IHT sessions, and 30 and 44 days post intervention. Haemoglobin mass (Hbmass) was measured in the IHT group at baseline, after 3, 6, 9 and 11 IHT sessions. No Hbmass measures were obtained from the control group. Differences were assessed using effect size and magnitude based inferences. Results Training was not clearly different between groups (ES -0.35±0.69). Baseline Yo-YoIR2 was not different, yet IHT improved, 15% (ES 0.44±0.63) more than control after just one week, 28% (ES 0.77±0.57) after two weeks and this was maintained until 30 days post training. This enhancement was likely independent of Hbmass change as this did not change from pre-training until week 2. Discussion Three IHT sessions increased Yo-YoIR2 performance in TS athletes over control with matched training load. Further improvement in Yo-YoIR2 was evident after 2 weeks of IHT, and this was maintained until 30 days post training. Short-term IHT is therefore an effective strategy to enhance team sport athlete performance. References 1. Dufour SP, Ponsot E, Zoll J, et al. *J Appl Physiol* 2006; 100(4):1238-1248. 2. Melissa L, MacDougall J, Tarnopolsky M, et al. *Med and Sci Sports Exerc* 1997; 29(2):238-243. 3. Vogt M, Puntchart A, Geiser J, et al. *J Appl Physiol* 2001; 91(1):173-182.

### EFFECTS OF EXERCISE TYPE PERFORMED UNDER HYPOBARIC HYPOXIC CONDITIONS ON BLOOD PRESSURE AND VASCULAR ADAPTATIONS

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Introduction Recently, we have observed that aquatic exercise in hypobaric hypoxia could induce beneficial vasculature adaptations, such as a decrease in blood pressure and arterial stiffness, and an increase in flow mediated vasodilation (FMD) response, within a relatively short training period (Ogita 2011). However, it has not been clarified whether such vascular adaptations can be also obtained by another type of exercise. Therefore, the present study aimed to examine the effects of exercise type performed under hypobaric hypoxic conditions on vascular adaptations. Methods Thirty-eight healthy male adults (24±3 yrs) were matched for baseline measurements into groups of 4 and then randomized to 1) aquatic exercise in normobaric normoxia (N-AE, n=10), 2) in hypobaric hypoxia (H-AE, n=10), 3) cycling exercise in normobaric normoxia (N-CE, n=8), or 4) in hypobaric hypoxia (H-CE, n=10). The exercise training was done at the intensity of 50%VO<sub>2</sub>max for 30 minutes/training session for consecutive 5 days. H-AE and H-CE were done in the hypobaric hypoxic conditions corresponding to 2500m above sea level, and they were exposed to the conditions for 2 hours/session. Before and after the training, systolic (SBP), diastolic (DBP) and mean blood pressure (MBP) were determined at rest and during cycling exercise at 50%VO<sub>2</sub>max. FMD was evaluated by determining the change in popliteal artery diameter during reactive hyperemia, which was measured by ultrasound imaging system. Also, arterial stiffness was assessed by brachial-ankle pulse wave velocity (baPWV). Results After the training, no significant changes were observed in all measured values for N-AE, N-CE, and H-CE. Blood pressure at rest did not change significantly in H-AE, either, however, SBP and MBP during moderate exercise decreased significantly after the training ( $P < 0.05$ ). The popliteal artery diameter during reactive hyperemia significantly increased ( $P < 0.01$ ), and consequently, %FMD significantly increased ( $P < 0.01$ ). Furthermore,

baPWV significantly decreased ( $P < 0.01$ ). Discussion Our findings suggest that exercise in hypobaric hypoxia induces a decrease in blood pressure and arterial stiffness, and also an improvement of endothelial function within a relatively short period more effectively than exercise in normoxia, and that the induced vascular adaptations might vary with the exercise type. Reference Ogita, F., et al. (2011) Effects of intermittent hypobaric hypoxic exercise of 5 days on blood pressure and vascular adaptations. Book of Abstracts, 16th Annual Congress of ECSS: 546.

### **SYNERGISTIC EFFECTS OF ENDURANCE TRAINING AND INTERMITTENT HYPOBARIC HYPOXIA IN THE DECREASE OF BODY WEIGHT, FOOD INTAKE AND OXYGEN CONSUMPTION IN RATS**

Torrella, J.R., Ascensão, A., Rizo, D., Pagès, T., Viscor, G., Magalhães, J.

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We aimed to analyze the effects of combined protocol of endurance training (ET) and chronic-intermittent hypobaric-hypoxia (IHH) on body and heart weight, food and water intake, and oxygen consumption in rats. Twenty-eight young-adult male rats were divided into four groups ( $n=7$ ): normoxic sedentary (NS), normoxic exercised (NE), hypoxic sedentary (HS) and hypoxic exercised (HE). Trained animals ran 1 h/day in a treadmill during 5 weeks at a speed of 25 m/min (0% gradient) and hypoxic animals were exposed for 5 weeks, 5 h/day, 5 days/week to a simulated atmospheric pressure of 493 hPa (6,000 m). Body weight and food and water intake were controlled individually every three days. The oxygen consumption was measured before and after the protocol in a sealed chamber connected to a multichannel pump air supply unit and to an oxygen gas analyzer. Both hypoxic groups showed significant decreases in body weight from the twelfth day of exposure, reaching final 10% (HS) to 17% (HE) differences when compared to the control group (NS). ET normoxic rats (NE) also showed a significant weight reduction after the ninetieth day of training with a decrease of 7% at the end of the protocol. Since heart weight was not altered between groups, the ratio heart-to-body weight was significantly greater in both hypoxic groups. The decrease in hypoxic animals' body weight was related with significant hypophagia elicited by IHH exposure, (from 8% to 10%). In contrast, ET had no effect on food ingestion. Total water intake was not affected by hypoxia but was significantly increased in exercised animals. Data regarding oxygen consumption (expressed as mean mL O<sub>2</sub>/kg/min  $\pm$  SEM) exhibit two interesting findings. First, there is a significant decrease in both hypoxic groups after the protocol (HS,  $21.7 \pm 0.70$  vs.  $19.1 \pm 0.78$  and HE,  $22.8 \pm 0.80$  vs.  $17.1 \pm 0.90$ ). Second, a significant difference was found between NE ( $21.3 \pm 0.77$ ) and HE ( $17.1 \pm 0.90$ ). These results demonstrate a synergistic effect of ET and IHH in the decrease of body weight that could open new insights regarding weight control strategies. Moreover, our study provides evidence that rats underwent a hypometabolic state after being exposed to an IHH program.

### **EFFECTS OF HYPOXIA AND ACCLIMATION ON THE ENZYMATIC ACTIVITY OF MATRIX METALLOPROTEINASES 2 AND 9 IN RAT LUNG**

Rizo, D., Coimbra, D., Ríos-Kristjánsson, J.G., Núñez, C., Pagés, T., Torrella, J.R., Viscor, G.

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Introduction: Matrix Metalloproteinases (MMPs) are zinc-dependent endopeptidases (always synthesized as proenzymes) able to degrade the endothelial basal lamina, thus increasing vascular permeability. Because of vascular permeability alteration seems to be involved in the origin of High Altitude Pulmonary Edema (HAPE), to study the effects of hypoxia on MMPs activity could improve our knowledge about the molecular and physiological mechanism of HAPE. The aim of this study was to determine the response of MMP-2 and MMP-9 to an acute normobaric hypoxia bout and the possible benefit of an intermittent hypobaric hypoxia exposure (IHHE) program as pre-acclimation protocol. Methods: Thirty Sprague-Dawley male rats ( $250 \pm 13$  g) were randomly divided into five groups. Three groups (H0, H24 and H48) were exposed to 6 hours of 7% oxygen concentration (deep normobaric hypoxia) and then euthanized after 0, 24 or 48 h. Another group (Acl) was acclimated with an IHHE protocol consisting of 8 sessions (one per day) of 4 hours at an equivalent altitude of 4000m and then exposed to an acute hypoxia bout. The last group (Ctr) was used as control. Rats were anesthetized with an i.p. injection containing ketamine (60 mg/Kg) and xylazine (7.5 mg/Kg). Lungs were excised, frozen in liquid N<sub>2</sub> and stored at  $-80^{\circ}\text{C}$ . The pro- and active forms of MMP-2 and MMP-9 were analyzed by gelatine zymography. Results: In H0 group pro- and active MMP-2 and proMMP-9 activities were increased by 2, 1.8 and 3.6 fold, respectively ( $P < 0.05$  vs Ctr). ProMMP-2 maintained the same levels after 24 and 48 h, while its active form continued increasing until reaching a 2.7-fold increase in H48 group ( $P < 0.05$  vs H0), and proMMP-9 decreased its levels in H48 group ( $P < 0.05$  vs H0). In the Acl group the proMMP-2 and the proMMP-9 increase was significantly smaller than in the non-acclimated group ( $P < 0.05$  and  $P < 0.001$  vs H0, respectively), while the active MMP-2 form remained at the basal level. Conclusions: These data demonstrate that MMP-2 is more sensitive to normobaric hypoxia than MMP-9. Although both proforms are quickly increased by hypoxia, the active form was only significantly increased in MMP-2. Regarding the acclimation, these results show that IHHE can be a useful tool to avoid the increase in matrix metalloproteinases levels and, consequently, to reduce the risk of HAPE.

### **INFLUENCE OF CARBON MONOXIDE BOLUS AND HYDRATION ON THE ROBUSTNESS OF TOTAL HAEMOGLOBIN MASS MEASUREMENT**

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Introduction The optimised carbon monoxide (CO) rebreathing method (oCOR-method) (Prommer and Schmidt, 2007) is used routinely to measure total haemoglobin mass (tHbmass). Altitude exposure can typically elicit 5-8% increases tHbmass, which may lead to improvements in endurance performance. However, the tHbmass measure is subject to error of  $\sim 2\%$ , mostly from the precision of carboxyhaemoglobin (HbCO) measurement. We sought to establish the robustness of the tHbmass measure in relation to differences in the bolus of CO administered during the oCOR-method and under different states of hydration. Methods Twelve physically active, healthy subjects (10 males and 2 females; age  $27 \pm 6$  yr, height  $177 \pm 11$  cm, weight  $73.9 \pm 12.1$  kg) completed the oCOR-method in a randomised order. Study 1 ( $n = 7$ ) investigated the influence of hydration status (hypohydrated; HYPO, hyperhydrated; HYPER and euhydrated; EU), whilst administering a CO bolus of 1.0 ml/kg. Study 2 ( $n = 12$ ) investigated size of CO bolus (LOW: 0.6 ml/kg; MED1: 1.0 ml/kg and HIGH: 1.4 ml/kg). To determine the repeatability of MED1, a second trial was conducted (MED2). Hbmass was calculated from three replicates of carboxyhaemoglobin concentration (%HbCO) at each time point of the oCOR-method. Results The %TEM ( $\pm$  confidence intervals) for tHbmass measure with a MED bolus was  $0.8\% (\pm 2.3\%)$ . ANOVA revealed no significant differences ( $p > 0.05$ ) between tHbmass measured in HYPO ( $757 \pm 135$  g), EU ( $769 \pm 138$  g) and HYPER ( $768 \pm 149$  g) states. tHbmass was found to be significantly less in the HIGH CO bolus ( $776 \pm 148$  g) when compared to the LOW CO ( $791 \pm 149$  g) or MED CO ( $787 \pm 149$  g) trials. Discussion Altering hydration status when

completing the oCOR-method did not affect the measurement of tHbmass. However, the derived tHbmass value was slightly different when using the HIGH CO bolus, being 1.4% less compared to MED1 and 3.2% less compared to LOW. In the absence of a gold standard comparison, but given that the TEM of the oCOR-method in the current study was 0.8%, the bolus administered during the test is meaningful. An adequate CO dose is particularly important if estimating %HbCO levels with commercial CO-oximeters that display readings only to a single decimal place (usually  $\pm 0.1\%$ ). Therefore, with progressively lower doses of CO, a 0.1% difference in the %HbCO is associated with a substantial increase in the measurement error of tHbmass (Burge and Skinner, 1995). In the elite athlete setting where identifying marginal increases in tHbmass is important, consistency in the CO bolus administered is critical. References Prommer N, Schmidt W. (2007) Eur J Appl Physiol, 100, 383-91 Burge CM, Skinner SL. (1995). J Appl Physiol, 79, 623-31

### EFFECT OF HIGH-INTENSITY INTERMITTENT TRAINING IN HYPOXIA ON REPEATED PEDALING PERFORMANCE IN FEMALE ATHLETES

Kasai, N., Ishimoto, S., Sakamoto, E., Maruta, M., Mizuno, S., Goto, K.

*Ritsumeikan University*

**Introduction** Until now, advantage of hypoxic training on endurance capacity has been widely acceded among long distance athletes. Recently, a growing evidence suggests the favorable effect of high-intensity training at a simulated altitude on improvement of anaerobic capacity. However, little information is available regarding impact of high-intensity training in hypoxia among female athletes. Therefore, the purpose of this study was to determine the effect of intermittent hypoxic training in female ball game players. **Methods** Thirty-two college female athletes were randomly assigned to either normoxic training group (NOR, n=16) or hypoxic training group (HYPO, n=16). The HYPO group conducted 2 sessions of 10x7s maximal pedaling (30s rest between sets) under normobaric hypoxic condition (FIO<sub>2</sub>:14.5%), whereas the NOR group performed equivalent training under normoxic condition (FIO<sub>2</sub>:20.9%). Each training session was repeated twice per week for 4 week. Before and after the training period, power output during intermittent maximal pedaling (10x7s maximal pedaling) and VO<sub>2</sub>max were determined. **Results** The HYPO group showed a significant increase in maximal power output during intermittent maximal pedaling test after the training period (P<0.05), whereas no change was observed in the NOR group. Both groups showed significant increases in average power output after the training period (P<0.05). However, the percentage change between before and after the training period was significantly greater in the HYPO group (9.7 $\pm$ 0.9%) than in the NOR group (6.0 $\pm$ 0.8%, P<0.05). There was no significant change in VO<sub>2</sub>max after the training period in either group. **Discussion** To our knowledge, this is the first study that focused on effect of high-intensity training in hypoxia among female ballgame players. In the present study, the HYPO group showed further increases in maximal power output and average power output during intermittent maximal pedaling compared with the NOR group. The mechanism for augmented anaerobic capacity remains unclear, but increases in muscle glycogen content and lactate metabolism capacity might be involved. **Conclusion** Hypoxic training causes further increases in maximal and average power output during intermittent maximal pedaling test compared with the equivalent training under normoxic condition in female athletes. However, it did not affect the improvement of VO<sub>2</sub>max. References Dufour et al. J Appl Physiol 100: 1238-1248, 2006. Hamlin et al. Scand J Med Sci Sports: 20: 651-661, 2010.

### IS HYPOXIA-DECREASED FAT OXIDATION ATTRIBUTED TO THE INTRAMYOCYELLULAR LIPID OXIDATION?

Takuya, O., Arimitsu, T., Takahashi, H.

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**Introduction:** Intramyocellular lipids (IMCL) are mostly adjacent to mitochondria, and utilized as an important energy source, especially during prolonged exercise. Similar to free fatty acids (FFA), the IMCL utilization is largely related to whole-body fat oxidation (FO), but it was recently reported that the change of FO was not always parallel to that of the IMCL utilization (van Loon et al., 2005, Stellingwerff et al., 2010). FO during exercise is attenuated in hypoxia. Although previous studies have reported a decrease of FFA uptake in hypoxia (Roberts et al., 1996), the possibility that the IMCL utilization was also inhibited could not be excluded. The aim of this study was to test whether the IMCL oxidation was inhibited under hypoxic conditions, in comparison with both the same absolute and relative intensities. **Methods:** After peak O<sub>2</sub> uptake under normoxic (FIO<sub>2</sub> = 0.209, VO<sub>2</sub>peak\_N) and hypoxic conditions (FIO<sub>2</sub> = 0.148, VO<sub>2</sub>peak\_H) of six male runners (age, 25  $\pm$  3 yr) were assessed, they ran for 90 min under hypoxic conditions (167  $\pm$  16 m/min, 65%VO<sub>2</sub>peak\_H; HH) or under normoxic conditions matched to the same absolute (167  $\pm$  16 m/min, 65%VO<sub>2</sub>peak\_H; NH) or relative velocity (192  $\pm$  16 m/min, 65%VO<sub>2</sub>peak\_N; NN). FO was calculated by respiratory gas exchange. Before and after 90-min running exercise, venous blood samples were taken, and IMCL at the soleus muscle was non-invasively evaluated by proton magnetic resonance spectroscopy. **Results:** Hypoxia tended to decrease FO at the 90th min (NN: 619  $\pm$  183 mg/min, NH: 531  $\pm$  90 mg/min, HH: 693  $\pm$  115 mg/min). Hence, plasma growth hormone, stimulating triglyceride breakdown, in HH tended to be higher than NN, and was significantly higher than NH, but plasma FFA was similar among the three conditions. On the other hand, the IMCL content was significantly decreased in all conditions after exercise, and the IMCL degradation was significantly lower in HH than NN and NH (NN: 3.64  $\pm$  1.56 mmol/kgww, NH: 3.74  $\pm$  1.66 mmol/kgww, HH: 2.27  $\pm$  1.09 mmol/kgww). **Discussion:** Our findings indicate that the IMCL degradation may be impaired under hypoxic conditions, despite a directly used energy source in mitochondria, in comparison with not only the absolute, but also the relative intensities. Furthermore, these results suggest that a decrease of FO in hypoxia is partly ascribed to the inhibition of the IMCL oxidation. References: Van Loon LJ, Thomason-Hughes M, Constantin-Teodosiu D, Koopman R, Greenhaff PL, Hardie DG, Keizer HA, Saris WH, Wagenmakers AJ. (2005). Am J Physiol Endocrinol Metab, 289, E482-E493. Stellingwerff T, Boon H, Gijzen A, Stegen JH, Kuipers H, van Loon LJ. (2010). Pflugers Arch, 454(4), 635-647. Roberts AC, Butterfield GE, Cymerman A, Reeves JT, Wolfel EE, Brooks GA. (1996). J Appl Physiol, 81(4), 1762-1771.

### ERYTHROPOIETIN RESPONSES TO MODERATE NORMOBARIC HYPOXIA AND HYPEROXIA IN HEALTHY HUMANS

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**Introduction** It is well-known that decreased renal tissue O<sub>2</sub> partial pressure (PO<sub>2</sub>), i.e. absolute renal tissue hypoxia, triggers de novo of erythropoietin (EPO) synthesis in humans. Even short periods (90–120 min) of hypoxic exposure have been well documented to induce to EPO production. Interestingly, the “normobaric O<sub>2</sub> paradox” (NOP theory) (Balestra et al. 2004, 2006) proposes that relative changes in PO<sub>2</sub> from hyperoxia to normoxia may also induce de novo EPO synthesis; however, this point is open to debate. We examined the effect of absolute and relative changes in PO<sub>2</sub> on serum EPO concentration following short-term moderate normobaric hypoxia and hyperoxia exposures. **Methods** Eight healthy male volunteers, aged 21-22 yr, participated in this study. Blood samples were drawn to establish

subjects' baseline EPO concentrations one week before experimental trials. Subjects were exposed to 3 h of normobaric hypoxia (14.5% O<sub>2</sub>) and/or normobaric hyperoxia (27.4% O<sub>2</sub>) inside a tent. The order of exposure was randomized and trials were spaced by exactly one week to control for circadian effects. Serum erythropoietin (EPO) concentration was measured before, immediately and 3 hours after each trial. Venous PO<sub>2</sub> was measured during normoxia, hypoxia and hyperoxia exposure to assess relative change in PO<sub>2</sub>. Results  $\Delta$ PO<sub>2</sub> from hyperoxia to normoxia (17.4 $\pm$ 8.2 mmHg) was similar to that from normoxia to hypoxia (15.5 $\pm$ 5.6 mmHg). A 23% increase in serum EPO was observed 3 h after normobaric hypoxia (20.8 $\pm$ 2.4 vs 25.4 $\pm$ 1.9 mU/mL,  $p < 0.05$ ). In contrast, a slight, non-significant decrease in serum EPO was observed 3 h after normobaric hyperoxia (19.8 $\pm$ 2.7 vs 18.8 $\pm$ 1.7 mU/mL). Conclusion Short-term absolute normobaric hypoxia increased serum EPO concentration, but the relative hypoxia induced by the change from normobaric hyperoxia to normoxia did not affect EPO concentration, despite a similar change relative PO<sub>2</sub>. Further studies with greater levels of hyperoxia are needed to confirm whether relative changes in PO<sub>2</sub> (hyperoxia to normoxia) can increase serum EPO concentrations before normobaric O<sub>2</sub> breathing could be suggested as a new training or clinical strategy.

### NOT ALL HIGH INTENSITY INTERVAL TRAINING PROTOCOLS IMPROVE VO<sub>2</sub>MAX

Hindsø, M., Dohlmann, T., Larsen, S., Dela, F., Helge, J.W.

*University of Copenhagen*

Introduction VO<sub>2</sub>max improvements after low-volume HIT varies from 1.5% (non-significant) to 21% in the literature. However, direct comparisons are somewhat difficult since both the work to rest ratio, interval duration, total work volume and workload intensity differs markedly between the studies. The aim in this project was to study VO<sub>2</sub>max and time to exhaustion after 6 weeks of HIT and to register the relative intensity of the training (%HRmax and %VO<sub>2</sub>max). Methods Subjects (n = 9) were healthy sedentary overweight men and women between 18-50 years of age. VO<sub>2</sub>max was measured on two separate occasions prior to training and 3 days after the last training day using an incremental test with 25W increments every 3 min until voluntary exhaustion and a brief confirmation ramp test. All subjects completed 18 training sessions over 6 weeks. A session consisted of 2 min warm up followed by 7x1 min of high intensity cycling (95-105% VO<sub>2</sub>max) separated by 1-min recovery periods. During session 6, 12 and 17 VO<sub>2</sub> and HR were recorded. VO<sub>2</sub> was measured using breath by breath method (COSMED, Quark CPET). Heart rate was monitored using telemetry (Polar T31). Exercise was performed on a cycle ergometer (Lode Corival). Results are means  $\pm$  SD. Baseline VO<sub>2</sub>max and time to exhaustion values are taken from the pretest that yielded the VO<sub>2</sub>max. Results VO<sub>2</sub>max was not significantly improved (~3%; pre 2474  $\pm$  408 ml/min vs post 2555  $\pm$  501 ml/min,  $p = 0.225$ ). Time to exhaustion improved by ~17% (pre 701  $\pm$  234 s vs post 818  $\pm$  245 s,  $p = 0.002$ ). Peak and average values for HR and VO<sub>2</sub> during session 6, 12 and 17 were not different. At session 17 (exclusive warm up) HRpeak was 94.0  $\pm$  4.0 %, HRaverage was 82.5  $\pm$  6.5 %, VO<sub>2</sub>peak was 99.5  $\pm$  10.4 % and VO<sub>2</sub>average was 78.1  $\pm$  9.8 % of baseline HRmax and VO<sub>2</sub>max, respectively. Discussion The intensity of the training was achieved as planned (VO<sub>2</sub>peak  $\approx$  100% baseline VO<sub>2</sub>max) and yet there was no improvement in VO<sub>2</sub>max. We observed a large individual variation in relative HR and VO<sub>2</sub> responses during training, thus highlighting the importance of the initial determination of training workloads for HIT protocols. The ~17% improvement in time to exhaustion with only a small non-significant change in VO<sub>2</sub>max, could be due to a learning effect. However, at the two pretests there was no difference in time to exhaustion (pre1 710  $\pm$  189 s vs pre2 695  $\pm$  158 s) and therefore a more likely explanation is that 6 weeks of HIT improved the capacity to tolerate and perform high intensity exercise. Further experiments, where the interval workload intensity or the work to rest ratio is increased, are needed to demonstrate a VO<sub>2</sub>max improvement in sedentary subjects following a 15-min 3 times a week HIT protocol. The project is funded by the EU FP7

**14:00 - 15:00**

### Mini-Orals

#### PP-PM43 Physiology [PH] 10

##### THE PHYSIOLOGICAL AND PERCEPTUAL EFFECTS OF PLANT EXTRACTS DURING SUSTAINED EXERCISE

Sallam, M.A., Baxendale, R.H.

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The chewing of khat leaves (*Catha Edulis* Forsk) is widely practised in southern Saudi Arabia, such as Jazan region for their central stimulant properties. These effects are due to cathinone which is present in khat leaves. The aim of this study was to investigate the effect of consuming 45g of khat during sustained exercise. The study protocol was approved by the Ethical Committee of Medical Research Center in Jazan University. 21 healthy male volunteers were recruited to a double-blind random order study. Each volunteer visited the lab three times. During the first visit: volunteers were familiarized with the tests after they performed 10 km on a cycle ergometer. On the second visit, one hour before experiment subjects asked to orally ingest either 33ml of fruit juice or juice with 45g of ground khat leaves filtered to remove particles. At the last visit they ingested the other drink. On the Second and Third visits participants performed 10 Km cycling on an ergometer. Heart rate, tympanic temperature and perceived exertion were measured every 5 minutes of cycling and at fatigue. In addition to, record the time to complete 10 km cycling. All volunteers completed the experiment without any ill effect. Analysis showed that the baseline study variables were not significant different on both test days. Heart rate and tympanic temperature were significantly higher and time to complete 10 km cycling was significantly quicker after khat consumption when compared with the placebo after injection (heart rate  $p < 0.001$ , tympanic temperature  $p < 0.005$ , and time trail  $p < 0.005$ ) perceived exertion did not differ significantly. These results confirm that 45 g of khat leaves contributed to higher exercise which caused to reduce time trail, increase heat rate and tympanic temperature in healthy young men level in Jizan district.

## THE EFFECT OF A WEIGHT-BEARING PHYSICAL ACTIVITY INTERVENTION ON BONE HEALTH IN PRE-PUBERTAL SOUTH AFRICAN BLACK CHILDREN

Meiring, R.M., Norris, S.A., Avidon, I., McVeigh, J.A.

*Exercise Physiology Laboratory, School of Physiology, Faculty of Health Sciences, University of the Witwatersrand*

Bone fractures in the South African Blacks (a population historically thought to be better protected from low bone mass) could soon pose a significant problem on an overburdened health care system as the population continues to age and partake in less physical activity. The effects of physical activity on bone health in Black children have been largely overlooked and while numerous studies have examined the role of physical activity interventions in White and Asian children to the best of our knowledge, none have set out to determine whether a weight-bearing physical activity intervention improves measures of bone mass and structure in a pre-pubertal Black cohort. Two groups of children between the ages of 9-11 participated: EX (n=12) and CON (n=11). DXA was used for whole-body and site-specific measurements of bone mineral content (BMC). Peripheral quantitative computed tomography at 4, 14, 38 and 65% of the length of tibia was performed for measurements of bone structure. Urinary levels of cross-linked N-telopeptides of Type I collagen (NTX) were analysed as a measure of bone resorption. The intervention consisted of a 20 week weight-bearing exercise program performed twice a week for 45 minutes per session. CON children continued their regular activities. The EX group showed a greater change in total hip and intertrochanteric BMC compared to the CON group ( $p=0.02$ ). Peripheral QCT measures of bone mass (vBMC), area and strength showed greater changes occurring in the EX compared to the CON group at all sites measured along the tibia ( $p<0.05$ ). Change in tibial periosteal circumference ( $p = 0.04$ ) and cortical thickness ( $p = 0.03$ ) was greater in the EX group than in the CON group. The EX group had a lower concentration of NTX after the intervention compared to before the intervention ( $p=0.04$ ). Black pre-early pubertal South African children who undertook a 20 week weight-bearing exercise intervention had greater gains in bone mineral content at the hip as well as in bone geometry and strength measures at trabecular and cortical sites along the length of the tibia compared to children who did not take part in the exercise intervention. Bone resorption was also decreased in the intervention children. Similar to studies in White children, this novel intervention can be used as a model for further research into the best methods as to how to maximise bone strength in childhood in order to offer protection of bone health into adulthood.

## DIETARY PROTEIN INTAKE MODULATES SATELLITE CELL MYOSTATIN EXPRESSION FOLLOWING A BOUT OF RESISTANCE EXERCISE

Snijders, T.I, Verdijk, L.B.1, McKay, B.R.2, Parise, G.2, Greenhaff, P.3, van Loon, L.J.C.1

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**Introduction:** Skeletal muscle satellite cells (SCs) play a significant role in the myogenic adaptive response to exercise. It remains to be established whether nutrition plays a role in SC activation and/or signaling in response to exercise. In the present study we assessed whether dietary protein alters the SC response to a single bout of resistance-type exercise. **Methods:** Twenty healthy young ( $21\pm 2$ y) males were randomly assigned to consume a controlled diet that provided either  $1.2 \text{ g protein} \cdot \text{kg BW}^{-1} \cdot \text{d}^{-1}$  (normal protein diet; NPD) or  $0.1 \text{ g protein} \cdot \text{kg BW}^{-1} \cdot \text{d}^{-1}$  (low protein diet; LPD). On the second day of the controlled diet, subjects performed a single bout of resistance-type exercise. Muscle biopsies from the vastus lateralis muscle were collected prior to exercise and after 12, 24, 48, and 72h of post-exercise recovery. Muscle fiber type-specific SC content and activation status were determined using immunohistochemical staining. In addition, myostatin protein expression was determined at the different time points using western blotting. **Results:** The number of SCs per muscle fiber increased significantly by  $26\pm 8$  and  $23\pm 12\%$  (NPD) and  $39\pm 6$  and  $26\pm 8\%$  (LPD) following 72h of post-exercise recovery in type I and type II muscle fibers, respectively ( $P<0.05$ ), with no difference between groups. The number of myostatin+ SCs decreased significantly at 12, 24 and 48h after exercise cessation ( $P<0.05$ ), with no difference between groups. Yet, whereas the number of myostatin+ SCs returned to baseline in the type II muscle fibers on the NPD after 72h of recovery, the number remained low on the LPD. Myostatin protein expression remained unchanged at 12 and 24h after the single bout of resistance exercise, in both groups. However, at the 48 and 72h time point myostatin protein expression was elevated  $\sim 2$  fold on the NPD ( $P<0.05$ ), whereas no change was observed on the LPD. **Conclusion:** Dietary protein intake modulates SC activation and myostatin expression following a single bout of exercise in humans. This is the first study to demonstrate that nutrition may modulate the regulation of SCs.

## TRUE IDENTITY TO MOVE THE FOOT QUICKLY

Kinugasa, R., Ishikawa, M., Yamamura, N., Taniguchi, K., Fujimiya, M., Katayose, M., Edgerton, V.R., Sinha, S.

*Kanagawa University/RIKEN*

**Introduction** During muscle contraction, curvature of the tendon (1) suggests that posterior movement of the Achilles tendon (AT) is constrained, even though there does not appear to be any definitive anatomical structure. Such a constraint would increase the proximo-distal excursion of the calcaneus relative to excursion of the AT above the ankle (2). This curvature, referred to as the AT inflection point, remains largely unexplored. We therefore investigated the predominant mechanisms and mechanical significance of the AT inflection point using imaging modalities and mathematical modeling. Our working hypothesis is that the AT inflection point arises from the differences in mechanical properties between the most distal edges of the soleus muscle (Sol) and the fat tissue just below it. **Methods** For six young volunteers, tissue displacement was determined during active plantarflex contraction using velocity-encoded phase-contrast (VE-PC) MR techniques. Further, small amounts of Sol from its most distal edge, were dissected from eight human cadavers. The position of inflection point was then determined before and after the Sol dissection. We modeled how the inflection point impacted generated force in the AT and calcaneus movement velocity. **Results** VE-PC imaging revealed that during plantarflex contraction, the distal portions of the Sol moved rapidly in the proximal direction, but fat tissue remained almost static. The distance from the calcaneus to the AT inflection point was significantly longer after the Sol dissection than before, suggesting that AT inflection point moved proximally after the Sol dissection. Mathematical simulation reveals that the force generated is lesser with the presence of an inflection point than without it; however the calcaneus movement velocity is faster with inflection point than without. **Discussion** AT inflection point was observed to be outlined by the boundary region of the Sol and fat tissue, and was moved proximally after Sol dissection, suggesting that the appearance of inflection point has a possibility of originating from the difference in the mechanical properties of Sol and fat tissue. In addition, AT inflection point is instrumental in causing greater movement of the calcaneus by small displacement of the muscular tissue (2), but would decrease the generated force at the AT due to a shorter AT moment arm (3). On the other hand, AT inflection point can cause quicker movement of the calcaneus, since a deformation time is shortened due to the shortening of the distance to pull the AT. It is suggested

that terminal part of a joint such as fingertip of the foot or hand is responsible for quicker movement with inflection point but necessitate larger force exertions. References 1. Maganaris et al. Eur J Appl Physiol 2000 2. Hodgson et al. J Morphol 2006 3. Sinha & Kinugasa Achilles Tendon 2012

### **EFFECT OF WHOLE-BODY MICROTITANIUM-TREATED GARMENTS ON METABOLIC COST OF EXERCISE 48-H FOLLOWING STRENUOUS HILL RUNNING**

Rowlands, D., Graham, D., Fink, P., Wadsworth, D., Hughes, J.

*Massey University*

**Introduction** A previous report (Wadsworth et al., Med Sci Sports Exerc 2010, 42(12):2273) provided evidence that wearing sports garments treated with microscopic titanium particles (AQUA TITAN) during a 48-h period of recovery from strenuous running may benefit subsequent running economy. Therefore, the purpose of this study was to determine if the effect size of AQUA TITAN-treated garments was worthwhile for recovery, as measured by the magnitude of restoration of running economy during subsequent exercise. **Methods** A double-blind crossover was used to determine the effect of AQUA TITAN on running metabolic cost in 10 healthy men. Participants performed 40 min of treadmill running comprising 2 times (10 min at 5% and 10 min at -10% grade), followed by random allocation to skin-tight nylon-polyurethane AQUA TITAN treated or non-treated placebo control garments covering the torso, limbs, and feet. Garments were worn continuously throughout the next 48-h, during which time participants rested (day 2) then completed a graded treadmill run to determine metabolic outcome (day 3). Body-weight normalised running metabolic cost was evaluated by indirect calorimetry and the effect size referenced against the smallest meaningful change in economy (0.9%) for improvement in distance running performance. **Results** The fatigue effect while wearing control garments on metabolic cost at 48-h was small (2.2% 95%CL +/-1.2%). In contrast, AQUA TITAN garments most certainly reduced running metabolic cost (-3.1% +/-0.9%) vs control. Additionally, AQUA TITAN increased the respiratory exchange ratio (0.011 +/-0.005) and lowered minute ventilation at intensities below the ventilatory threshold (-4.0% +/-0.9%). **Discussion** AQUA TITAN garments worn during recovery from strenuous exercise improved subsequent running economy to a magnitude likely to restore endurance performance. Future research should verify the magnitude of garment effects on performance outcomes, and on identifying the acute or passive neural, musculotendinous or metabolic mechanisms responsible.

### **EFFECT OF POSTURE AND MODE OF EXERCISE ON PLASMA FIBRINOGEN CONCENTRATION: THE ROLE OF PLASMA VOLUME CHANGES**

Omar, A., El-Sayed, M., Hadida, M.

*University of Tripoli, Faculty of Physical Education and Sport Sciences*

**Introduction:** Cycling and running at the same intensity may produce different physiological responses. However, the combined effects of posture and exercise modality on plasma volume and fibrinogen are not known and discrepancy still exists over the interaction between plasma volume and alterations in fibrinogen levels in exercise. **Aims** To examine the effect body posture and mode of exercise performed at similar fraction of maximal oxygen consumption on fibrinogen in healthy moderately trained subjects. **Investigating** the effect of exercise-associated haemoconcentration on plasma fibrinogen changes following alterations in body posture and after exercise. **Methods:** Fifteen subjects performed two exercise trials at approximately 70% VO<sub>2</sub> max for 30-min with one week intervening. One trial was performed on a treadmill at an intensity corresponding to 70%VO<sub>2</sub> max, while the other was performed on bicycle ergometer at similar intensity. In the cycling trial subjects stood for 30-min, followed by sitting for 30-min then cycled for 30-min at 70%VO<sub>2</sub> max. In the treadmill trial, subjects sat for 30-min followed by standing for 30-min then ran on the treadmill for 30-min at 70% VO<sub>2</sub> max. Blood samples were taken at the end of each 30-min period and analysed for lactate, haematocrit, and haemoglobin and fibrinogen. Plasma volume changes were estimated according to Dill and Costill, 1974. **Results:** There were significant changes in blood lactate, hemoglobin, hematocrit and fibrinogen in response to changes in posture and following exercise. Data also revealed a significant interaction effect of trial and time on blood lactate and plasma fibrinogen. Post hoc analysis showed similar blood lactate pre-exercise between trials, followed by an increase during both cycling and running. During recovery, blood lactate, plasma volume contraction and fibrinogen returned rapidly to baseline, with no significant difference between trials. Changing body posture prior to exercise from standing to sitting and vice versa were associated with opposite variations in haematocrit and haemoglobin and consequently estimated plasma volume and these alterations mirrored the changes in plasma fibrinogen. In addition, exercise at the same relative intensity, irrespective of its modality, transiently increased fibrinogen mainly due to exercise-associated haemoconcentration. **Conclusion:** Concurrent assessment of plasma volume and plasma fibrinogen shed some light on the mechanism responsible for posture and exercises related changes in fibrinogen. Exercise at the same fraction of maximum oxygen consumption, irrespective of its modality, transiently increased plasma fibrinogen and that can mainly be attributed to exercise associated haemoconcentration. Plasma volume changes mirrored the alterations in plasma fibrinogen in response to postural modifications and following exercise. **References:** Dill D.B and Costill D.L, Calculation of percentage changes in volumes of blood, plasma, and red cells in hydration, 272 Journal of Applied Physiology 37 (1974), 247–248.

### **COMPARISON OF METHODS FOR ASSESSMENT OF EXERCISE-INDUCED MECHANICAL HYPOALGESIA**

Grancharska, K., Pencheva, N.

*South-West University*

**Introduction** Methodologies for evaluation of mechanically-induced hypoalgesia related with physical loading are less investigated. The aim of this study was to compare and to assess advantages and disadvantages of the following methods for experimental pain assessment, applied before and after exercise: - tourniquet algometry (TA); - hand-held algometry (HHA); and - computer-controlled cuff pressure algometry (CA). **Methods** Pressure pain threshold (PPT) and pain tolerable threshold (PTT) in healthy, untrained males were determined, before and after incremental test to exhaustion. The TA was applied with blood pressure apparatus to 10 subjects (19.1±1.2 years) and assessed with verbal scale (VS). Algometer Somicid was used for HHA. It was applied to five points upon m. gastrocnemius-soleus (GS) in 11 subjects (22.3±1.1 years) and assessed with VS. The experimental setup for CA, according to Stoilov et al., 2009 was applied to 12 males (23.7±3.4 years), consisted of an electro-pneumatic regulator (0-2 kPa/s range) with a tourniquet cuff, electronic visual analogue scale and quantitative evaluation of pressure-time-pain curves. **Results** The hypoalgesia after exercise, was established with: - TA, although in some subjects the PTT values were underestimated; - HHA in GS the PPT (kPa/cm<sup>2</sup>) for lateral and medial head, before or after exercise were: 464.8±148.3 or 676.0 ± 166.4 and 399.9±133.9 or 521.5± 90.6, respectively. The differences between values (kPa) of PPT and PTT, obtained with CA, and calculated before and after exercise, were 4.8 and 7.4, respectively. The similar tendency was proved

with compression rates of 0.25, 0.50 and 1.00 kPa/s. The pressure – time and pain –time curves were linear with different slope. Discussion Although, the TA is an easy way to evaluate changes in pain perception, it did not allow assessment of manifested hypoalgesia, especially in trained males after exercise to exhaustion (Koltyn, 2000). HHA allows evaluation of PPT in different points of the muscle tested, but it is not suitable for PTT and has high variability (Giburm et al., 2011). The advantages of CA, as a novel experimental technique, is the precise quantitative evaluation of stimulus-response pressure-pain function (Jespersen et al., 2007), but it is not suitable for specific location of the muscle and for field application. References Giburm P, Chan W K, Si Bog P, Mi Jung K, Seong H J. (2011). *Ann Rehabil Med*, 35, 412-417. Jespersen A, Dreyer L, Kendall S. et al. (2007), *Pain* 131, 57–62. Koltyn K F. (2000). *Sports Med* 29 (2), 85-98. Stoilov A, Pencheva N, Ivanov K. (2009), *SRJ of SWU*, 2 (1), 21-28. Acknowledgement. The research was supported by the Internal Funding of Regulation 9 of South-West University projects, Group B (YMCIHIA).

## SERUM CONCENTRATIONS OF ESSENTIAL TRACE ELEMENTS IN SPORTSMEN OF DIFFERENT METABOLIC MODALITIES

Crespo, C., Llerena, F., Robles, M.C., Iglesias, P.J., Maynar, M., Caballero, M.J.

UNIVERSITY OF EXTREMADURA

Introduction Changes in trace element concentrations are of especially vital importance. The homeostatic balance of chemical elements in an organism is the basic requirement of good health (Kabata-Pendias and Mukherjee, 2007). Methods This study was performed on 31 active subjects as control group (24.72±6.06 yrs) and 80 high level sportsmen. The sportsmen were divided into three groups according to sport type: 28 aerobic sportsmen (21.03±3.71 yrs), 24 anaerobic (16.65±1.22 yrs) and 28 aerobic-anaerobic (21.04±3.98 yrs). Analysis of serum samples was carried out in an ICP-MS Nexion model 300D (PerkinElmer, Inc., Shelton, CT). The validity of the methodology was checked by the biological certified reference material. We used the Student t test for comparison of independent groups (differences between control group and sportsmen of different metabolic patterns and these together). Results The results indicated that the concentrations (µg/L) of essential trace elements were different in serum samples of control group and different sports types. Aerobic sportsmen have significantly higher serum concentrations than the control group (p<0.001), of Cr (3.435±4.103 vs 0.155±0.207), Mn (2.545±1.747 vs 1.104±0.413), Mo (0.873±0.835 vs 0.319±0.108), Ni (2.876±2.954 vs 0.471±0.438). Anaerobic sportsmen have significantly higher serum concentrations than the control group (p<0.001), of Cr (0.442±0.242 vs 0.155±0.207), Mo (2.083±0.674 vs 0.319±0.108), Ni (1.110±0.356 vs 0.471±0.438). Sportsmen aerobic have significantly higher serum concentration (p<0.001) of Cr, Mn and Zn than the sportsmen anaerobic and sportsmen aerobic-anaerobic: Cr (3.435±4.103 vs 0.442±0.242 vs 0.708±0.504), Mn (2.545±1.747 vs 0.819±0.246 vs 1.027±0.392) and Ni (2.876±2.954 vs 1.110±0.356 vs 1.008±0.695). All concentrations are in the normal range in terms of reference levels found. Discussion Aerobic exercise has shown the ability to increase the serum concentration of Cr, Mn and Zn. These elements are associated with metabolism of insulin and Glucose Tolerance Factor, the response antioxidant (Bicer et al., 2011) and enzyme activity, respectively. References Bicer M, Akil M, Sivrikaya A, Kara E, Baltaci AK, Mogulkoc R (2011) Effect of zinc supplementation on the distribution of various elements in the serum of diabetic rats subjected to an acute swimming exercise. *J Physiol Biochem*; 67(4):511-7. Kabata-Pendias A, Mukherjee AB (2007) Trace elements from soil to human. Springer.

## TIBIAL AND RADIAL BONE STRUCTURE AND GEOMETRY IN ROAD CYCLISTS, MOUNTAIN BIKERS AND SEDENTARY CONTROLS.

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The high risk nature of cycling predisposes participants to fractures. Traditionally road cycling has been thought to not be osteogenic. Mountain biking may impose a greater osteogenic stimulus than road cycling, however much of the data for cyclists has been obtained from DXA scans, which provide two dimensional information of the bone. Little is known about the structural and geometric properties of the tibia and radius in road cyclists and mountain bikers. Ten sedentary (SED) controls (27.1 ± 5.2yr) and 20 trained male (23.9±3.9yr) road cyclists (RC(n=10)), mountain bikers (MB(n=10)) were compared for radial and tibial bone geometry, area, content (BMC), density (BMD), and estimates of strength using pQCT. pQCT was used to assess volumetric BMC (vBMCtot, mg/mm<sup>3</sup>), area (Ar.tot, mm<sup>2</sup>), cortical bone area (Ar.ct, mm<sup>2</sup>), and vBMC (vBMC.ct, mg/mm<sup>3</sup>), periosteal circumference (mm), bending strength (polar strength strain index (SSIp), mm<sup>3</sup> and bone strength index (BSI)) at the proximal (66%) radius and tibia and distal (4%) radius. Variables were adjusted for body size differences. RC had less vBMCtot, Ar.tot and Ar.ct (-12% to -17%, p<0.05) than MB and smaller periosteal circumferences than MB (-8%, p<0.05) at the proximal radius. RC had smaller vBMCtot, Ar.Tot and BSI than MB (-10% to -21%, p<0.05) at the distal radius. No differences were noted at the tibia between RC, MB or SED. MB had more favourable bone geometry at the radius, when compared to RC. Interestingly, RC who are known to have lower bone mass, particularly at the lumbar spine compared to sedentary controls, displayed a structurally similar tibia to MB and SED.

## EFFECT OF DIFFERENT SET CONFIGURATIONS OF HIGH-INTENSITY SQUAT ON ACUTE HEMODYNAMIC RESPONSE

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1: UDC (A Coruña, Spain), 2: UCB (Brasília, Brazil)

Introduction Blood pressure (BP) rises with successive repetitions within a set and with each subsequent set (Gomides et al., 2010; McCartney, 1999). Similarly, heart rate (HR) increases with the number of repetitions and sets, thus further increasing the rate-pressure product (i.e. HR x SBP). The rate at which BP rises is related to both intensity and length of the set, which are two load parameters that could be easily manipulated. The introduction of pauses between intra-set repetitions has been suggested as an alternative to traditional set configuration in order to improve mechanical performance (Haff et al., 2003; Iglesias-Soler et al., 2012). This type of set configuration has been termed Cluster Training (CT). During CT, higher mechanical performance is observed, in association with a shorter time of muscle contraction. Therefore, a decrease in time of mechanical compression of the skeletal muscle vasculature is expected. This may allow lower acute increases in BP. Methods Ten male subjects completed a session of three sets to failure (FS) of parallel squat with 4 repetitions maximum (4RM), and a rest of 180 seconds between sets (total resting time of 360 s). At least 72 hours after, subjects performed a cluster session (CS) with the same volume (load x repetitions) and total resting time but distributed between each repetition. SBP and RPP were obtained at the end of each set during FS, and at the end of each repetition in CS. Beat-to-beat HR was recorded before, during, and after sessions. Results Mean SBP and mean RPP were higher in FS (147±24 mmHg; 17886±3394 bpm x mmHg) respect to CS (133±21 mmHg; 15025±3598 bpm x mmHg) (p=0.016 and p=0.01 for SBP and RPP, respectively). Differences between sessions were observed for volumes corresponding to set 2 (p=0.019, Cohen's d= 0.62; p=0.009, Cohen's d= 0.93 for LnSBP and RPP, respectively), and

set 3 ( $p=0.03$ , Cohen's  $d=0.68$ ;  $p=0.028$ ,  $d=0.78$  for LnSBP and RPP, respectively). Discussion The main finding of this study was that set configuration employed in CS induced lower intra-session cardiovascular stress with respect to FS, as reflected by the SBP and RPP responses. Lower cardiovascular response observed during CS could be partially caused by reduced involvement of central command, a lower pressor response from muscle metaboreflex or a reduced time and magnitude of mechanical compression of the skeletal muscle vasculature and, consequently, a lower increment of peripheral resistance. Gomides RS, Dias RM, Souza DR, Costa LAR., Ortega, KC, Mion D, Tinucci T, et al. (2010). *Int J Sports Med*, 31(8), 590-5. Haff GG, Whitley A, McCoy LB, O'Bryant HS, Kilgore JL, Haff EE, Pierce K, Stone MH. (2003). *J Strength Cond Res*, 17(1), 95-103. Iglesias-Soler E, Carballeira E, Sanchez-Otero T, Mayo X, Jimenez A, Chapman ML. (2012). *Int J Sports Med*, 33(5), 351-8. McCartney N. (1999). *Med Sci Sports Exerc*, 31(1):31-7.

### INCREASED TIBIAL DENSITY AND CROSS-SECTIONAL AREA ASSESSED BY pQCT FOLLOWING 12 WEEKS OF ACADEMY FOOTBALL TRAINING

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Increased tibial density and cross-sectional area assessed by pQCT following 12 weeks of academy football training 1 BLHS Research Centre, Nottingham Trent University, UK. 2 Norwich Medical School, University of East Anglia, UK. 3 Department of Occupational Medicine, HQ Army Recruiting and Training Division, UK. Introduction: Football-specific training has been shown to increase bone density, geometry and cross sectional area at different tibial sites when measured using peripheral computed tomography (pQCT) (Nilsson et al., 2012). Little is known about the effects of large increases in football specific training volume in adolescent bone. Therefore, the aim of this study was to investigate changes in bone following acute increases in training volume in adolescent academy footballers. Methods: Thirty-five male full time academy footballers from four football clubs (age  $16\pm 0$ ; height  $1.76\pm 0.07$  m; body mass  $69.6\pm 7.6$  kg) volunteered to take part. Whole bone scans of the tibia were performed immediately before (baseline) and following 12 weeks of full time training using pQCT (XCT2000L, Stratec Pforzheim, Germany). Scans were obtained at the 4%, 14%, 38% and 66% sites measured from the distal end plate of the self-determined dominant leg. Trabecular density (mg/cm<sup>3</sup>), cortical density (mg/cm<sup>3</sup>), cortical area (mm<sup>2</sup>), cortical thickness (mm) and strength strain index (mm<sup>3</sup>) were estimated. Differences in bone were analysed using two-sample t test. All data are presented as mean $\pm$ 1SD and statistical significance was set at  $P<0.05$ . Results: Participant training time significantly increased following full-time academy induction ( $6.4\pm 3.9$  to  $12.4\pm 1.1$  hr/wk;  $P>0.05$ ). Significant increases in trabecular density (mg/cm<sup>3</sup>) were observed at the distal tibia (baseline:  $289.7\pm 34.6$  to;  $295.1\pm 33.2$ ;  $P>0.05$ ). Cortical density (mg/cm<sup>3</sup>) increased at the 14% (baseline:  $1056.6\pm 40.0$  to;  $1063.8\pm 35.5$ ), 38% (baseline:  $1109.6\pm 34.25$  to;  $1115.8\pm 30.0$ ) and 66% site (baseline:  $1072.9\pm 29.5$  to;  $1077.8\pm 3$ ) ( $P>0.05$ ). Cortical cross-sectional area (mm<sup>2</sup>) increased along the tibial diaphysis (14%: baseline:  $210.8\pm 23.6$  to;  $212.8\pm 22.5$ ; 38%: baseline:  $357.7\pm 38.9$  to;  $360.9\pm 35.8$ ; 66%: baseline:  $822.9\pm 89.2$  to;  $828.4\pm 88.6$ ) ( $P>0.01$ ). Bone strength strain index (mm<sup>3</sup>) also increased (14%: baseline:  $1094.3\pm 155.8$  to;  $1113.2\pm 154.2$ ; 38%: baseline:  $1294.1\pm 257.3$  to;  $1310.9\pm 257.4$ ). Conclusion: Significant improvements in bone density of the tibial metaphysis and diaphysis, cortical area and tibial strength strain index were observed with acute increases in football-specific training in adolescent boys. The osteogenic benefits of training may be derived from training volume, from the nature of football-specific activities, or a combination of both. These changes may have implications for strategies aimed at bone accrual and football-specific training. References: Nilsson M, et al. (2012). *Osteo Int*, DOI 10.1007/s00198-012-2142-3

### MATCH RUNNING PERFORMANCE OF YOUNG SOCCER PLAYERS IN WARM AND COOL CONDITIONS

Gurr, S.I, Al Haddad, H.2

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Introduction Environmental conditions are likely to affect match running performance in elite adult soccer players. Authors has consistently reported a decrease in total distance covered, with a maintenance of high intensity activity, during the second half of the match (Ozgunen et al., 2010; Mohr et al., 2010). Given the differences in thermoregulatory mechanisms in adolescents (Falk, 2008), it's unclear whether the same strategy would be observed in youth soccer players. Therefore in this study we compared the match running performance and sweat response of adolescent soccer players during matches played in warm and cool conditions. Methods Starting players from two teams (U13 and U14) were monitored during eleven matches lasting 70-75 minutes. Match running performance was measured using GPS (GPSports, 15Hz). total distance covered per minute played and distance at high intensity running ( $>14.4$  km/h) per minute played were collected. Heat Index (HI) was used as a marker of environmental conditions. Matches were grouped based on the environmental conditions; warm (HI -  $34.6\pm 3.6^{\circ}\text{C}$ , 5 matches, 30 players, age:  $13.1\pm 0.8$  y; weight:  $46.3\pm 7.6$  kg) and cool ( $19.6\pm 2.0^{\circ}\text{C}$ ; 6 matches, 47 players, age:  $13.2\pm 0.6$  y, weight:  $43.6\pm 8.0$  kg). Sweat loss was assessed from the change in body mass after correction for fluid intake and urine losses. Cohen's effect size (ES) was used to assess the differences between the two conditions. Results There was no clear difference (ES=0.03, 90% confidence interval  $[-0.24; 0.30]$ ) in the total distance covered in either the first (cool:  $114\pm 14.4$  m/min vs. warm:  $113.6$  m/min) and or the second halves  $[[0.22[-0.05; 0.49]]$  (cool:  $105.2\pm 13.8$  m/min played vs. warm:  $102.1\pm 13.8$  m/min played). There was no clear difference in the at high intensity running distance in either the first (warm:  $21.9\pm 8.0$  m/per min played vs. cool:  $19.2\pm 12.6$  m/per min played)  $[-0.26$  (-0.01; 0.53)] or second (warm:  $18.4\pm 7.8$  m vs. cool:  $16.8\pm 10.3$  m/per min played)  $[-0.18$  (-0.09; 0.45)] halves. There was a moderate difference  $[-0.43$  (0.16; 0.70)] in sweat losses (warm:  $12.3\pm 3.7$  ml/per min played vs. cool:  $10.2\pm 6.3$  ml/per min played) between the conditions. Discussion In contrast with previous studies conducted with elite adult soccer players, there was no difference in total distance covered and high intensity running distance between matches played in warm and cool conditions in youth. While tactical differences and other specific requirements are placed on players in each game, this study suggests that game running patterns in young soccer players is not different between games played in warm and cool environments. References Mohr M et al. (2010) *Scand J Med Sci Sp*, 20 (suppl 3), 125-32. Ozgunen, K. T. et al. (2010). *Scand J Med Sci Sports*, Suppl 3, 140-147. Falk, B. (2008). *Appl Physiol Nutr Metab*, 33 (2), 420-27.

14:00 - 15:00

## Mini-Orals

## PP-PM49 Physiology [PH] 17

**METABOLIC SPECIALIZATION IN YOUNG FOOTBALLERS**

Noite Mendes, J.1,2, Costa, F., Fernandes, R.2, Rodrigues Ferreira, M.A.1,2, Vences Brito, A.M.2

*1: University of Madeira (Funchal, Portugal); 2: Escola Superior de Desporto de Rio Maior, IPS (Rio Maior, Portugal)*

Introduction It is noticeable that high level athletes have a higher level of specialization, whether in a morphologically or neuromuscular manner, cognitively, and energetically (by means of a more effective use of the aerobic and anaerobic systems) (Bar-Or & Rowland, 2004). However, some studies indicate that there is a strong tendency in children to present good performance levels in aerobic tasks and good results in anaerobic ones (Matos & Winsley, 2007; Rowland, 2005), contrarily to what is seen in elite athletes, raising, henceforth, the hypothesis that pre-pubescent children might not be metabolically specialized (Rowland, 2002). Methods Eleven trained (T) footballers (age:  $11.3 \pm 0.5$  yr.) and another eleven without any formal sports training (NT) (age:  $10.9 \pm 0.3$  yr.). Both groups were matched for Tanner Maturity Test stage I. Using modified Balke protocol with direct gas analysis (KOSMED K4B2, Rome) and a treadmill, the absolute and relative peak  $\dot{V}O_2$  ( $\dot{V}O_{2Abs}$  e  $\dot{V}O_{2Rel}$ ) were evaluated, as well as the ventilation (VE) and the heart rate (HRB). Using the Wingate Anaerobic Test for anaerobic parameters (Monark 894E), the relative and absolute peak power ( $PPAbs$  e  $PPRel$ ) were calculated, as well as the absolute average and relative average power ( $APPAbs$  e  $APPRel$ ), the drop power (DP) and the heart rate (HRW). Results Results were analyzed using PASW (18.0) for both groups and significant differences in the HRB were observed between the groups (T:  $193.7 \pm 7.11$  b •  $\text{min}^{-1}$ ; NT:  $104.5 \pm 5.97$  b •  $\text{min}^{-1}$ ),  $PPAbs$  (T:  $333.2 \pm 39.0$  W; NT:  $288.6 \pm 59.4$  W), and  $APAbs$  (T:  $210.5 \pm 22.1$  W; NT:  $183.5 \pm 31.8$  W) variables. Results showed a strong correlation between  $\dot{V}O_{2Abs}$  and  $PPAbs$  (T:  $p = .8$ ; NT:  $p = .7$ ) and  $APAbs$  (T:  $p = .8$ ; NT:  $p = .6$ ) and between  $\dot{V}O_{2Rel}$  and  $PPRel$  (T:  $p = .8$ ; NT:  $p = .7$ ) and  $APRel$  (T:  $p = .9$ ; NT:  $p = .7$ ) for both groups. Discussion It is expected that, contrarily to adults, children that run faster are also able to run for a longer period of time at an elevated speed. As such, the collected data suggests that individuals who obtained higher and better performances in one test, also achieved better results in the other test, either absolutely or relatively. The results of the present study may suggest that no metabolic specialization occurs in trained nor untrained prepubescent boys. References Bar-Or, O., & Rowland, T. (2004). *Pediatric Exercise Medicine*. Champaign: Human Kinetics. Matos, N., & Winsley, R. (2007). *Journal of Sports Science and Medicine*, 6, 353-367. Rowland, T. (2002). *Pediatric Exercise Science*, 14, 315-320. Rowland, T. (2005). *Children's Exercise Physiology*. Champaign: Human Kinetics. Keywords: Metabolic Specialization, Pre-Pubertal, Football

**SERUM CONCENTRATIONS OF TOXIC ELEMENTS IN SPORTSMEN OF DIFFERENT METABOLIC MODALITIES**

Crespo, C., Llerena, F., Robles, M.C., Iglesias, P.J., Maynar, M., Caballero, M.J.

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Introduction. Environmental and occupational exposure to toxic elements is of growing concern as large quantities of toxic and carcinogenic elements, due to human activities, are released to the environment polluting air, soil or water in certain areas being a health risk for the population living in that same area (Kabata-Pendias and Mukherjee, 2007). Methods. This study was performed on 31 active subjects as control group ( $24.72 \pm 6.06$  yrs) and 80 high level sportsmen. The sportsmen were divided into three groups according to sport type: 28 aerobic sportsmen ( $21.03 \pm 3.71$  yrs), 24 anaerobic ( $16.65 \pm 1.22$  yrs) and 28 aerobic-anaerobic ( $21.04 \pm 3.98$  yrs). Analysis of serum samples was carried out in an ICP-MS Nexion model 300D (PerkinElmer, Inc., Shelton, CT) (Sarmiento-González et al., 2005). The validity of the methodology was checked by the biological certified reference material. We used the Student t test for comparison of independent groups (differences between control group and sportsmen of different metabolic patterns and these together). Results. The results indicated that the concentrations ( $\mu\text{g/L}$ ) of toxic elements were different in serum samples of control group and different sports types. Aerobic sportsmen have significantly higher serum concentrations than the control group ( $p < 0.001$ ), of Be ( $0.075 \pm 0.034$  vs  $0.036 \pm 0.011$ ), Cd ( $0.079 \pm 0.039$  vs  $0.037 \pm 0.010$ ), Pb ( $1.763 \pm 2.033$  vs  $0.119 \pm 0.238$ ). Anaerobic sportsmen have significantly higher serum concentrations than the control group ( $p < 0.001$ ), of Be ( $0.070 \pm 0.028$  vs  $0.036 \pm 0.011$ ), Pb ( $2.634 \pm 1.591$  vs  $0.119 \pm 0.238$ ); ( $p < 0.05$ ) in Cd ( $0.079 \pm 0.088$  vs  $0.037 \pm 0.010$ ). Aerobic-anaerobic sportsmen have significantly higher serum concentrations than the control group ( $p < 0.001$ ), of Be ( $0.073 \pm 0.021$  vs  $0.036 \pm 0.011$ ) and Pb ( $2.388 \pm 1.257$  vs  $0.119 \pm 0.238$ ). Sportsmen aerobic-anaerobic have significantly lower serum concentration ( $p < 0.001$ ) of Cd than the sportsmen aerobic and sportsmen anaerobic ( $0.039 \pm 0.037$  vs  $0.079 \pm 0.039$  vs  $0.079 \pm 0.039$ ). All concentrations are in the normal range in terms of reference levels found. Discussion. All sportsmen show serum concentration toxic trace elements greater than the control group of active men. These results suggest an increase in the uptake of toxic elements through exposure routes since athletes consume more water and move great volumes of air during training (Speich et al., 2001). References Kabata-Pendias A, Mukherjee AB (2007). *Trace elements from soil to human*. Springer. Sarmiento-González A, Marchante-Gayón J, Tejerina-Lobo J, Pazjiménez J, Sanz-Medel A (2005). ICP-MS multielemental determination of metals potentially released from dental implants and articular prostheses in human biological fluids. *Anal Bioanal Chem*; 382:1001-9. Speich, M, Pineau A, Françoise Ballereau F (2001). Minerals, trace elements and related biological variables in athletes and during physical activity. *Clinica Chimica Acta* 312(1-2): 1-11.

**PHYSIOLOGICAL PROFILES IN DIFFERENT LEVELS OF WINDSURFERS**

Lo, K.K.1, Raymond So, C.H.1, Wong, S.H.2, Appel, R.1

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Introduction Since the sanction of sail pumping in all Olympic windsurfing competitions in 1993, windsurfing has become a physically demanding sport. However, no researchers raised a more fundamental question as to what physical and physiological attributes of elite windsurfers set them apart from sub-elite players. Our study below mainly focused on the physiological attributes of the windsurfers at different levels with a view to bridging the information gap between the athletes and the academics, and facilitate talent identification as well as targeted training. Methodology A total of 82 male windsurfers has participated in the study and was divided into four groups namely the Elite Senior (ES), Elite Junior (EJ), Sub-Elite Junior (SEJ), Novice Junior (NJ) according to their competitive levels. All subjects were required to participate in the assessment of anthropometry and physical fitness on two separate sessions with one week apart. In the first

session, anthropometric evaluations on height, body mass, arm span and leg length were conducted. This is followed by sit & reach, vertical jump, handgrip strength and 1-minute sit-ups assessments. The second test session consisted of torso pull, 1-minute push-ups, hanging and 20-m multi-stage shuttle run tests. Results Significant higher values were found from flexibility, handgrip strength, torso pull, sit-ups, modified pull-ups and hanging tests of SEJ players than NJ players, whilst handgrip strength, push-ups and 20m shuttle run tests were higher for SJ players than SEJ players, with no difference were observed in other physiological variables. Hanging test was higher in ES player than all other levels players. Discussion Consistent with Castagna's study, the estimated VO<sub>2</sub>max values from the 20-m multi-stage shuttle-run test on ES and EJ players were significantly higher than SEJ and NJ players that sailing can be considered physical task associated with a high-level aerobic demand. Specific endurance ability is beneficial for improving competition performance as windsurfers possess in greater forearm endurance ability, which is the only indicator among the test items that shows significantly higher values in ES players of reflecting the importance of endurance ability in elite level. To conclude, the present study shows that there is a progressive improvement in the physiological capacities of windsurfers as the playing level increases. It extends the scope of study on the elite windsurfers by providing normative data and performance standard for elite, sub-elite and novice junior players. References Vogiatzis I, De Vito G, Rodio A, Madaffari A, & Marchetti M. (2002). *EJ AP*, 86(5), 450-454. Castagna O, Pardo C, Brisswalter J. (2007). *EJAP*, 100 (2), 247-252 Campillo P, Leszczynski B, Marthe C, & Hesp J. (2007). *JSSM*, 6(1), 135-141.

## MOTHER'S SACRIFICES AND CONCERNS ASSOCIATED WITH HIGH LEVEL SPORT

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**Introduction** The demands of competitive sport, but also of training, are unique circumstances that divert the normal course of family life. Numerous family resources are absorbed as a result of the sport, assuming a strong impact on the family (Bloom, 1985; Coakley, 2006; Cote, 1999; Gould, Lauer, Rolo, Jannes and Pennisi, 2008; Holt and Dunn, 2004). Aim Therefore, the objective of this research was to determine what it means, in particular for the mother, helping her child in the sport and in the reach of that high level. Method To that end, 20 high-level athletes and 17 of their mothers were interviewed. We used a qualitative methodology, inductive, based on technical and typical procedures of Grounded Theory (Corbin and Satruss, 2008). Results The results show two categories. On one side, one called pain, fear and concern of the Mother, and on the other side, Sacrifices, withdrawals and efforts of the mother. The first category refers to feelings of grief or uneasiness because of the child's sport. This category consists of four dimensions: 1. concern for their child in himself, for his happiness, 2. concern for injuries or health as a result of the high demands of top-level sport, 3. concern for the future and how the child, after a lifetime devoted to the sport, may be affected; 4. concern about studies and how the huge time spent on sport can reduce the time devoted to the studies. The second category, related to the sacrifices, withdrawals and efforts, refers to various negative situations related to the child's sport. This category consists, in turn, of eight dimensions: 1. Leisure, the mother reduces and in many cases withdraws her leisure activities. 2. Economy, for the families and for mothers in particular, sport is a significant economic cost that may result in important efforts or simple withdrawals. 3. Time, the mother gives up his own time for the child's sport. 4. Son, the mother refuses her own son for the sport; 5. Labor, the mother even refuses his own professional growth for the son's sport, 6. Energy, the mother makes a physical effort to help her child on the road to the high level; 7. Psychological welfare, for the mother, the child's sport is a source of uneasiness, fears, which affect her daily welfare; 8. Schedules, family life is completely changed and altered by the sport. **Conclusion** In general it can be concluded that the mother helps her son in his pursuit of excellence and that such support is a big negative emotional investment, yield in different ways

## COMPARISON OF AEROBIC AND ANAEROBIC CAPACITY IN PROFESSIONAL AND AMATEUR VOLLEYBALL PLAYERS

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**Introduction** Volleyball is a game performed worldwide by professionals and amateurs on different surfaces (hall, beach). Time of match varies from several dozen minutes to over 1 h. Thus, aerobic capacity in the players is as important as anaerobic power. Other authors confirm this statement, though most of them concern vertical jump power (explosive power) one of crucial abilities of volleyball players, determining their game effectiveness (Kollias et al., 2004). Methods Amateur volleyball players, AVP, (n=26, age 20.9•0.1.25 yr, body height 188.3•5.14 cm, mass 80.2•5.14 kg) and professionals, PVP, (n=14, 26.5•4.49 yr; 199.5•5.06 cm; 93.5•7.49 kg respectively) participated in the study. Maximal oxygen uptake (VO<sub>2</sub>max) and anaerobic threshold (AT) were measured by continuous graded test until exhaustion using gas analyzer and cycloergometer (Oxycon Pro, Erich JAEGER GmbH, Hoechberg, Germany) (Beaver et al., 1986). Total anaerobic work and peak power were measured by 30-s Wingate test on cycloergometer (Monark Ergonomic 894 E, Monark, Sweden) (Bar-Or, 1981). Results Statistical significant differences between AVP and PVP were stated twice for VO<sub>2</sub>max /AT% (79.32•5.66% and 74.3•7.13%) and for HRmax (188•9.22 bpm and 182.9•5.44 bpm). VO<sub>2</sub>max per mass unit were similar in both groups (45.8•5.50 ml/kg/min and 43.2•5.0 ml/kg/min respectively). No significant differences were stated for anaerobic capacity indices: Pmax 10.6•0.50 W/kg and 10.7•0.67 W/kg, and total work 251.0•13.4 J/kg and 252.7•15.1 J/kg respectively. Discussion No statistical significant differences of crucial aerobic and anaerobic capacity indices were stated between amateur and professional volleyball players. Therefore, we can conclude that technical and tactic skills of the players play crucial role in game effectiveness. Similarly, Willmore and Costill (1994) or Jastrzębski (2004) state that physical capacity is an important but not most important factor of high performance in team games players including volleyball. References Bar-Or O. (1981) Le test anaerobic de Wingate, caracteristiques et applications. In: In: 21e Congres Mondial de Medicine du Sport, Brasilia, Symbioses XIII;3:157-172. Beaver, W.L., Wassermann, K., Whipp, B.J. (1986). *J. Appl.Physiol.* 60: 2020-2027. Jastrzębski Z. (2004) Zakres obciążeń treningowych a ich wpływ na rozwój sportowy zawodników. Wydaw. Uczelniane AWFIS, Gdańsk. Kollias I., Panoutsakopoulos V., Papaïakovou G. (2004). *Journal of Strength and Conditioning Research*, 18 (3) 546-550. Willmore J.H. and Costill D.L., (1994) *Physiology of sport and exercise. Human Kinetics, Champaign.*

## PHYSIOLOGICAL AND BIOMECHANICAL DIFFERENCES BETWEEN SMALL-SIDED SOCCER GAMES ON 21X21M PITCHES <3X3> VERSUS 30X30M PITCHES <6X6 PLAYERS>

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**Physiological and biomechanical differences between small-sided soccer games on 21x21m pitches (3x3) versus 30x30m pitches (6x6 players).** Introduction Small-sided ballgames adapt to the specificity of the game of soccer and will improve endurance (1). Lengthening

and shortening the playing area, changing rules, one-touch and two-touch play, controlled passing and trainer motivation have a bearing on the number of ball touches and the intensity of the exercise (2). The objective of this study was to analyze the effects playing on a small-sided 21 x 21 m pitch with 3x3 players versus playing on a 30x30m pitch with 6x6 players has on the variables of the distance run, changes in running speed, accelerations in  $m \cdot s^{-2}$  and impacts, and also on maximal and mean heart rate (HR). Methods Twelve professional Spanish Soccer League players took part in this study. The physiological profiles and biomechanical loads were recorded by means of an SPI Elite GPS and Team AMS software, the resulting tri-axis acceleration also having been recorded at a data storage rate of 100 times/second. The HR was also recorded during the small-sided games (SSG), in addition to the technical playing actions having been filmed with a Sony camera and analyzed using the SportsCode software. Results Significant differences were found to exist between the small-sided 21x21m soccer field (3x3) and the 30x30m (6x6) series for the following variables: distance (m) and average distance (ad)  $p=0.008$ , respectively. For the high-intensity distance Area (m)  $p=0.001$ , Sprint distance Area  $p=0.050$ , Sprints  $p=0.048$ . For accelerations  $p=0.006$ , top acceleration  $p=0.016$  and for Impacts  $p=0.035$ . As also for the Average HR  $p=0.000$ , the maximal HR  $p=0.025$ , the HR for zone Mins\_167  $p=0.004$ , the sum of HR  $p=0.05$  and the New HR Ex\_  $p=0.003$ . Discussion These results lead us to the conclusion that by increasing the number of players from 3x3 to 6x6 players per game played on small-sided fields, the biomechanical and physiological strains are greater on small-sided fields, in consonance with the studies published by Dellal, Drust and Lago-Penas (3). Bibliography 1. Little, T and Williams, AG. Suitability of soccer training drills for endurance training. *J Strength Cond Res* 20: 316–319, 2006. 2. Rampinini, E, Impellizzeri, FM, Castagna, C, Abt, G, Chamari, K, Sassi, A, and Marcora, SM. Factors influencing physiological responses to small-sided soccer games. *J Sports Sci* 25: 659–666, 2007. 3. A Dellal, B Drust, and C Lago-Penas 2012 Variation of Activity Demands in Small-Sided Soccer Games. *Int J Sports Med*. 2012 Feb 8.

### EFFECTS OF CONCENTRIC AND ECCENTRIC EXERCISE IN HEMOSTASIS

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Introduction Different types of contraction during resistance exercise, could cause distinct changes in hemostasis and inflammation. Exercise stimulates clotting by increasing factor VIII (FVIII) and von Willebrand factor (vWF). The fibrinolytic activity is primarily regulated by tissue plasminogen activator (t-PA) and plasminogen activator inhibitor type 1 (PAI-1) and increased fibrinolytic activity as a consequence of exercise is attributed to the increased release of t-PA from the vascular endothelium and decreased PAI-1 activity. Eccentric exercise is metabolically less demanding but causes more damage to muscle fiber and a greater response of c-reactive protein (CRP). The increased CRP deregulates the balance between coagulation and fibrinolysis due to increased PAI-1 which increases the risk for thrombosis (Singh et al, 2005). Methods This study included eleven sedentary young subjects with a mean age of  $25.4 \pm 2.8$  years, height  $176.2 \pm 4.4$  cm, body mass  $77.1 \pm 8.7$  kg, fat mass of  $32.3 \pm 5.2$  kg and  $VO_{2max}$  of  $41.4 \pm 6.5$  ml / kg / min. Subjects attended three visits to the laboratory: The first visit consisted of pre and post protocol blood sampling, a maximal voluntary contraction (MVC) on an isokinetic damage protocol. In the second and third visit, subjects performed only the MVC and blood sampling. After seven days of rest, subjects repeated all the previous tests changing the type of contraction. The protocols were randomly assigned to prevent an order effect. Results The eccentric protocol resulted in higher strength deficits 24h ( $62.4 \pm 30.6$  5.3  $\pm$  29.9 Nm) and 48h ( $64.3 \pm 33.6$ , 2.5  $\pm$  31.1 Nm) post exercise. There was also an increased CRP ( $0.140 \pm 0.04$ ,  $0.06 \pm 0.04$  mg / L) and increased PAI-1 (13, 5  $\pm$  7.5, 7.3  $\pm$  6.7 ug / L) 48h post exercise when compared to the concentric protocol. In addition, a positive correlation was found between CRP and PAI-1 48h after eccentric protocol  $r = 0.69$ ,  $p < 0.05$ . Discussion There is evidence that an increase in CRP can disrupt the balance between coagulation and fibrinolysis (Ribeiro et al, 2007). In the present study found a higher concentration of PAI-1 in eccentric exactly at the point where the CRP level was increased compared to concentric, agreeing with the findings in the literature showing that CRP stimulates the release of PAI-1 (Fay, 2010). Moreover, a positive correlation was found between PAI-1 and CRP ( $r = 0.69$ ) showing that the higher the concentration of CRP also higher PAI-1. The literature show that CRP is a predictor for cardiovascular disease, because it interferes directly on the balance between coagulation and fibrinolysis (Devaraj et al, 2003). References Singh U, Devaraj S, Jialal I. (2005). *Arterioscler Thromb Vasc Biol*. 25(10). 2216-21. Ribeiro, J. (2007). *Int J Sports Med*. 28(3). 193-6. Fay P. (2010). *World J Cardiol*. 2(11). 365-9. Devaraj S, Xu Y, Jialal I. (2003). *Circulation*. 107(3). 398-404.

### CORRELATIONS BETWEEN EXPLOSIVE POWER AND RUNNING SPEED OF WOMAN HANDBALL PLAYERS OF POLISH NATIONAL TEAM

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Introduction Handball is a team game involving various activities performed in changeable conditions. Field size and game specificity result in the fact that running speed and explosive power play crucial role in this game (Jastrzebski and Ciepliński, 2001; Cardiale, 2002). The aim of the study was to determine correlations between running speed and explosive power in female handball professionals. Methods Polish female handball representatives volunteered for the study ( $n=19$ ,  $26.58 \pm 3.72$  yr, body height  $176.95 \pm 6.66$ cm, mass  $70.42 \pm 8.13$ kg). The participants were subjected to 15-min warm-up including explosive exercises followed by 10-min of recovery. Then explosive power was measured by force plate, Kistler brand. The subjects performed a single vertical jump with arms swing (Hfmax) and a series of maximal vertical jumps with arms swing within 10s period (Hfmean). Moreover, mean value of power of the jumps Pmean [W/kg] and mean time of contact with the plate Tcont [ms] were calculated. After 10 min of recovery, running speed of 5, 20 and 30m was measured by Swiss photocells Tag Heuer HL 2-31 model. There were 3-5 min of rest between the trials depending on the covered distance. Results The results showed significant ( $p < 0.05$ ) correlations (r) between indices. Positive relations were observed between Hfmax and Pmax (0.76), Hfmean (0.87), Pmean (0.83) and negative between Hfmax and 5m run (-0.67), 20m (-0.58), 30m (-0.55). Significant associations were stated between Pmax and Hfmean (0.77) or Pmean (0.87) and negative between Pmax and 5m run (-0.59), 20m (-0.54), 30m (-0.53). Moreover, strong correlations were revealed between Hfmean and Pmean (0.77), and negative for 5m (-0.54) and 20m run (-0.47). Negative relations were also observed between Pmean and run on 5m (-0.50), 20m (-0.53), 30m (-0.46), as well as Tcont and k (-0.59). Discussion The results revealed strong correlations between explosive power and running speed in handball players. The higher explosive power achieved, the shorter running time of 5, 20 or 30m run. Moreover, longer contact with the plate (tcont) involves less take off power generation. Similar studies (Jastrzebski and Ciepliński, 2001; Cardiale 2002) reported crucial role of jumping explosive power generated during ball shots as well as running speed on 30m (e.g., during counter-attack) for game effectiveness. References Cardiale M. (2002). Handball performance: physiological considerations and practical approach for training metabolic aspects. The

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### DOES LOWERING EVENING RECTAL TEMPERATURE TO MORNING LEVELS OFFSET THE DIURNAL VARIATION IN MUSCLE FORCE PRODUCTION?

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Muscle force production and power output in active males, regardless of the site of measurement (hand, leg or back), are higher in the evening than the morning. This diurnal variation is attributed to motivational, peripheral and central factors and higher core and, possibly muscle temperatures in the evening. This study investigated whether decreasing evening rectal temperature to morning resting values, by immersion in a water tank, leads to muscle force production and power output becoming equal to morning values in motivated subjects. Ten healthy active males (mean±SD: age, 22.5±1.3 yrs; body mass, 80.1±7.8 kg; height, 1.72±0.05 m) completed the study, which was approved by the Ethics Committee of the University. The subjects were familiarized with the techniques and protocol and then completed three sessions (separated by at least 48 h): control morning (07:30 h) and evening (17:30 h) sessions (with an active 5-min warm-up on a cycle ergometer at 150 W) and then a further session at 17:30 h but preceded by an immersion in a cold water (~16.5°C) to lower rectal temperature (T<sub>rec</sub>) to morning values. During each trial, 3 measures of handgrip strength, isokinetic leg strength measurements (of knee flexion and extension at 1.05 rad.s<sup>-1</sup> and 4.19 rad.s<sup>-1</sup> through a 90° ROM) and 3 measures of maximal voluntary contraction (MVC) on an isometric ergometer (utilizing the twitch-interpolation technique) were performed. T<sub>rec</sub>, rating of perceived exertion (RPE) and thermal comfort (TC) were measured. Measurements were made after the subjects had reclined for 30-min at the start of the protocol and prior to the measures for handgrip, isokinetic and isometric ergometry. Muscle temperature (T<sub>m</sub>) was taken after the warm-up or water immersion and immediately before the isokinetic and MVC measurements. Data were analysed using ANOVA with repeated measures. T<sub>rec</sub> values were higher at rest in the evening (0.37°C; p<0.05) than the morning, and values were no different to that of the morning immediately after the passive pre-cooling, but progressively decreases over time thereafter; the subjects' ratings of thermal comfort reflecting this. T<sub>m</sub> also displayed significant diurnal variation, with higher values in the evening (0.39°C, p<0.05). Right grip strength, isometric peak power, isokinetic knee flexion and extension for peak torque and peak power at 1.05 rad.s<sup>-1</sup>, and knee extension for peak torque at 4.19 rad.s<sup>-1</sup>; all showed higher values in the evening (a range of 3-14%). All other measures of strength or power showed a statistical trend to be higher in the evening than in the morning (0.10>p>0.05). Pre-cooling in the evening reduced force or power variables, and subjects reported maximal values for effort for each strength measure. In summary, effects of time of day were seen in some measures of muscle performance, in agreement with past research. However, in this population of motivated subjects, there was evidence that decreasing evening T<sub>rec</sub> to morning values by cold water immersion decreased muscle strength to values similar to that found in the morning.

### THE EFFECT OF HIGH AMBIENT TEMPERATURE ON THE RESPONSES TO A CONTROLLED FOOTBALL SIMULATION

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**Introduction** The performance characteristics of match-play in football, such as the number of sprints and distance covered are thought to be reduced when ambient temperature is high (Ozgunen et al. 2010). However, assessment of the extent of additional fatigue due to temperature is difficult owing to the voluntary nature of football activity. The present study demonstrates the responses to a controlled football match-play simulation (Stone et al. 2011) performed in contrasting mean ambient temperatures of 19 and 27 degrees ('normal' and 'hot', respectively). **Methods** Semi-professional, male University football players (n=13) were tested. The procedure was divided into identical six 16-min blocks of activity, comprising sprinting and controlled-speed walking, jogging and running with a 15-min break to replicate half-time. The total distance covered in each trial was 11.2km. Single-sprint performance over 15m was assessed through each 16-min block. Midway through each 16-min block, one bout of repeated sprint (RS) exercise (6 x 15m starting every 18 seconds) was also used. All sprints were made from a standing start. Heart rate (HR) and blood lactate were monitored through the whole procedure. Data were analysed using 2 way (time \* temperature) repeated measures ANOVA and Bonferroni post hoc. Significance was accepted at P<0.05. Data are reported as mean ± SD. **Results** Players consumed more fluid in 'hot' ('hot'; 2.3 ± 0.6 vs. 'normal'; 1.6 ± 0.6 l; P<0.05) with no significant difference in the change of body mass. Within the football simulation, mean RS speed was reduced in 'hot' by around 3% in the fourth ('hot'; 5.49 ± 0.24 vs. 'normal' 5.65 ± 0.17 m/s; P<0.05) and sixth block ('hot'; 5.47 ± 0.28 vs. 'normal' 5.64 ± 0.18 m/s; P<0.05). Similarly, mean single-sprint performance was lower by 2-3% in blocks 4, 5 and 6. Mean HR across the six blocks was significantly higher throughout 'hot' ('hot'; 170 ± 9 vs. 'normal'; 165 ± 10 bpm; P<0.05), however, blood lactate concentration was not different between the conditions ('hot' 5.3 ± 1.8 vs. 'normal'; 4.8 ± 2.1 mM; P>0.05). **Discussion** The 'hot' trial led to more fatigue and greater HR than the 'normal' condition. Sprint performance over 15-m was slower by around 3% in 'hot' vs. 'normal' conditions and, in keeping with the match-play data from Ozgunen et al. (2010), the decline in performance was only significant in the second half of the simulation. By controlling distance covered and using standard exercise intensities for all but the sprints, these data show the extent to which ambient temperature is likely to influence responses to football match play. Stone, K. et al. (2011). *Int. J. Sports Physiol. & Perform.* 6: 427 - 431. Ozgunen, K.T. et al. (2010). *Scand. J. Med. Sci. Sports* 20. (Suppl 3): 140-147.

### EFFECTS OF SOCCER ON THE PLATELETS MEMBRANE FATTY ACIDS

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**Introduction** Furthermore, a relationship exist between free fatty acids and health. They are presently considered as an attractive target to regulate the human diseases as obesity, diabetes, cancer, and cardiovascular complications (Wakil, 2009). So, high concentrations of saturated fatty acids may have potentially harmful health effects, while unsaturated fatty acids may play a protective role (Woodside and Kromhout, 2005). Therefore, the aims of this study were to compare basal levels of fatty acids platelet in trained and untrained subjects; and to compare n6/n3, desaturation and lipidic peroxidation index in trained and untrained subjects and performance status relationship. **Method** The sample of this study was made for 44 subjects, were divided into 2 groups: Trained subjects (T), consisted in 22 players from youth level, following a regular training schedule 10 hours/week. Untrained subjects (UT) consisted in 22 subjects who did not follow

a systematic training plan with an activity not exceeding 3 hours/week. Each subject was performed anthropometric evaluation, following the indications of the Spanish Group Cineanthropometry (Esparza, 1993), and an assessment of platelet fatty acids, these being determined by the technique of Lepage and Roy (1986). Results Significant differences were found in the acid C24:0, C16:1, C20:3n6, C18:3n3 and the peroxidation index C20:4n6/C16:0, obtaining higher values in untrained subjects, therefore of the acid C18:2n6, n6/n3 index and delta5-n6 index were higher in trained subjects. Moreover, correlations were observed in these parameters with the degree of training. Discussion Currently, in the literature we have not found similar researches to ours in this biological matrix in humans, on the other hand, there are other studies that have determined lipid profiles in plasma and erythrocytes in different sports (Arsic et al., 2012; Tepsic et al., 2011). References Arsic, A., Vucic, V., Tepsic, J., Mazic, S., Djelic, M., & Glibeti, M. (2012). Altered plasma and erythrocyte phospholipid fatty acid profile in elite female water polo and football players. *Appl Physiol Nutr Metab*, 37 (1):40-47. Esparza, F. (1993). *Manual de Cineantropometría*. Pamplona: (GREC) FEMEDE. Tepsic, J. Vucic, V., Arsic, A., Mazic, S., Djelic, M. & Glibetic, M. (2011). Unfavourable plasma and erythrocyte phospholipid fatty acid profile in elite amateur boxers. *Eur J Sport Sci*, 1746-91. Wakil, S. J., & Abu-Elheiga, L. A. (2009). Fatty acid metabolism: Target for metabolic syndrome. *J Lipid Res*, 50: 138-43. Woodside, J. V., & Kromhout, D. (2005). Fatty acids and CHD. *Proc Nutr Soc*, 64: 554-64.

## COMPARISON BETWEEN EXPLOSIVE POWER OF HALL AND BEACH VOLLEYBALL PLAYERS

Jaskulska, E.1, Jastrzębski, Z.1, Radzimiński, Ł.1, Kortas, J.1, Jastrzębska, M.1, Bichowska, M.1, Konieczna, A.1

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Introduction Previous studies regarding hall and beach volleyball focus on vertical jumping ability of the players (Newton et al., 1999; Kollias, 2004), which is related to attack and block effectiveness. The type of surface, on which the players perform, determines the type of training developing their power of legs. Methods The study participants were recruited from hall volleyball players Gr1 (n=13, 20.5±0.56 yr, 190.9±5.51cm, 79.2±4.67kg) and beach volleyball players Gr2 (n=21, 23.4±3.64 yr, 193.1±5.2cm, 85.5±4.23kg respectively). Explosive power was measured by force platform, Kistler brand. First, the participants were submitted to 15-min warm-up including explosive exercises followed by 10-min recovery. Then they performed a single vertical jump with arms swing (Hfmax) and a series of maximal vertical jumps with arms swing within 10 s period (Hfmean). Moreover, mean value of power of the jumps (Pmean [W/kg]) and mean time of contact with the platform (Tcont [ms]) were calculated. Results The study revealed significant differences between hall (Gr1) and beach (Gr2) volleyball players regarding Hfmax and Hfmean. The results in Gr1 were as follow: Hfmax 56.9±4.02cm, Hfmean 53.3±3.85cm, Pmean 40.3±4.25 W/kg, Tcont 371.9±57.6 ms, and in Gr2: 50.6±5.46cm; 41.7±4.65cm, 43.5±2.14 W/kg, 223.6±32.5 ms respectively. Discussion Results of the study (Hfmax and Hfmean) revealed greater explosive power in beach volleyball players than in hall volleyball players. Their longer time of contact with the platform (Tcont) corresponds with the sport specificity that involves training of explosive power (jumps) on the sand. Our results are in line with the research of other authors (Homborg and Papageorgiou, 1994; Riggs and Sheppard, 2009), which stated that beach volleyball players perform jumps with greater explosive power, and the jumps make up 27% of all jumps executed during the match. References Kollias I., Panoutsakopoulos V., Papaiaikovou G. (2004). Comparing jumping ability among athletes of various sports: Vertical drop jumping from 60 centimeters. *Journal of Strength and Conditioning Research*, 18 (3), 546-550. Newton R.U., Kraemer W.J., Hakkinen K. (1999). Effects of ballistic training on preseason preparation of elite volleyball players. *Medicine and Science in Sport and Exercise*, 31 p. 323-330. Homborg S., Papageorgiou A. (1994). *Handbook For Beach Volleyball*. Aachen: Meyer & Meyer Verlag; Riggs M.P., Sheppard J.M. (2009). The relative importance of strength and power qualities to vertical jump height of elite beach volleyball players during the counter-movement and squat jump. *Journal of Human Sport and Exercise*. Vol. 4, No 3., 221-236.

14:00 - 15:00

## Mini-Orals

### PP-PM52 Physiotherapy [PT] 1

#### INJURIES ARISING FROM KART COMPETITIVE RACING IN CHILDREN: AN EPIDEMIOLOGICAL STUDY

Delmuns Carvajal, S.1, Javierre, C.2, Roig, M.3, Mans, C.4, Giné-Garriga, M.1

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Introduction. Kart competitive racing (KR) is a sport modality where children compete from very early ages. Traditionally, KR has been the stepping stone for the formation of current F1 Spanish pilots. There are no epidemiological data regarding the incidence and characteristics of injuries derived from KR practice.(1) Objective. To explore the incidence and characteristics of injuries derived from KR practice among children aged 7 to 15 years in the Catalan Championship during 2005 to 2009. Design. Longitudinal epidemiological study with retrospective data. Methods. Data from medical records of races taking place between seasons 2005 to 2009 were extracted. Data retrieved included number of pilots, participations, kilometres covered as well as number and characteristics (severity and location) of injuries. Injuries were categorized according to the Orchard Sports Injury Classification System guide (OSICS). A descriptive stratified analysis taking into account seasons, races and age categories was performed. Results. Data from 334 pilots that participated 2485 times and covered a cumulative total of 445591 kilometres were retrieved. Only 38 children presented an injury during the five years of study. Overall the risk of suffering an injury per participation was low, with risk ratios (RR) ranging from 0.001 to 0.02 depending on the season. Hand and wrist (42.1%) followed by thorax and elbow (13.1%) were the most commonly injured areas. Most injuries were mild, only involving bruises and superficial lacerations and allowing for the prompt incorporation of pilots to competitions. Four serious injuries (fractures) were reported. Significant differences (p=0.026) in the number of injuries per year were found, being 2007 (RR=3.06; IC 95%=1.45, 6.43) the year with the highest incident rate. There were differences in the number of injuries depending on where the race took place (p=0.015) with some races showing higher injury incidence. Differences in injury occurrence among age categories were not statistically different although pilots in older categories showed a greater injury incidence. Conclusion. KR is a sport with a low incidence of injuries. However, our data suggest that injuries occur in specific parts of the body and in some specific races. It is important to improve safety

measures for these bodily areas and analyse why specific races show a higher incidence risk. References. (1) Eker HH, Van Lieshout EM, Den Hartog D, Schipper IB. (2010). *Open Orthop J*, 17(4), 107-110.

### ASSESSMENT OF THE EFFECT OF QUADRICEPS STRETCHING

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Introduction In Patellofemoral pain syndrome (PFPS) many authors found a weakness in eccentric muscle strength, within the quadriceps muscle and in terminal knee extension. It could represent a runway for treatment of PFPS. The evidence that muscular eccentric work is more effective in treating PFPS than others muscular work or others treatment protocol was limited. So what can be expected with stretching Quadriceps on the PFPS? Our objective is to compare the knee pain and the quadriceps strength before and after Quadriceps Stretching. Methods For each patients the two knees were selected to make comparison between healthy and not healthy knee. EVA method was used to assess the pain at each speed of the isokinetic test (60°sec /180° sec/30°sec) and that before and after Quadriceps stretching .In the same time each patients do the isokinetic test always in the same chronology: Training the test with the healthy knee at the three mode : 60°sec concentric /180°sec concentric /30°sec eccentric. Then, assessment of the injured knee at the three same speeds followed by Quadriceps stretching (3x 20 sec) and a last isokinetic evaluation made three minutes after stretching. Results With 27 patients evaluated we found a pain decrease after stretching: 55%. (P<0,02) .We found also an increase of the quadriceps strength after stretching at each speed : + 15,8% ( p<0,02) . (r significatif correlation R=0,44445) Discussion On looking at the results there are important modifications of the knee pain and the quadriceps muscular strength before and after stretching. We should certainly include the quadriceps stretching as efficiency therapeutic and it must be added in the treatment protocol of PFPS. References Clark DI, Downing N. *Ann Rheum Dis*, (2000) 59:700-4. DvirZ, Halperin N. *Isokinetics and Exercise Science* (1991) 1:31-5

### TRUNK MUSCLE ACTIVITY AND SPINAL MOVEMENT WHILE STANDING UP IN INDIVIDUALS WITH A HISTORY OF LOW BACK PAIN

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Introduction Previous research has demonstrated that activity of the lumbar multifidus (MF) muscle is decreased during rapid arm movements in individuals with low back pain history (LBPH). Decreased activity of this muscle leads to altered spinal movement, which may contribute to the recurrence of LBP. Furthermore, standing up is associated with the occurrence of LBP (Xu, 1997). The aim of this study was to analyze activity of the trunk muscles and spinal movement during standing up in individuals with LBPH. Methods Eight healthy males (control (CTR) group; age, 22.4 ± 1.2 years) and 8 males with LBPH (LBPH group; age, 21.5 ± 1.5 years) participated in the study. The LBPH group included subjects who had experienced LBP over at least 3 months, with a severity rating of >30 mm on a visual analog scale, and had no pain at the time of intervention. The study's exclusion criteria were as follows: slipped intervertebral disc, spondylolisthesis, spondylolysis, and/or any neurological symptoms concomitant with LBP. Subjects were asked to rise from a seated position in 2 s and spinal movement was recorded using a 6-degree-of-freedom electromagnetic tracking system. Activity of the thoracic and lumbar erector spinae, MF, rectus abdominis, obliquus externus abdominis, and gluteus maximus muscles was recorded using a surface electromyography system. Angular changes in the sagittal axis of the upper and lower thoracic and lumbar spine, and the spine, i.e. the sum of these three segments, were computed for the entire standing up movement (from sitting to maximum extension of the spine), flexion phase (from sitting to maximum flexion of the spine), and extension phase (from maximum flexion to maximum extension of the spine). Peak muscle activity in the flexion and extension phases was computed. The Mann-Whitney U-test was employed to assess differences in variables between the CTR and LBPH groups. Results MF muscle activity in the extension phase was significantly lower in the LBPH group [34.1 ± 7.3% of maximum voluntary contraction (MVC)] than in the CTR group (43.2 ± 8.3% MVC). Angular change in extension of the spine during the entire standing up movement was significantly greater in the LBPH group (35.2 ± 10.4°) than in the CTR group (22.3 ± 10.3°). Furthermore, angular change in flexion of the lower thoracic spine in the flexion phase was significantly lower in the LBPH group (0.1 ± 3.0°) than in the CTR group (3.9 ± 2.5°). Discussion Peak activity in the MF muscle was decreased and spinal movement increased while standing up in individuals with LBPH. This excessive spinal movement may contribute to the recurrence of LBP. Reference Xu Y, et al. (1997). *Occup Environ Med*, 54(10), 741-745.

### THE EFFECT OF MYOFASCIAL RELEASE INTERVENTION ON THE SHOULDER INTERNAL/EXTERNAL ROTATION RANGE OF MOTION AND MUSCLE STRENGTH FOR COLLEGIATE SOFTBALL PLAYERS

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Softball or baseball players had often observed the posterior shoulder tightness at throwing arm. However, lack of evidence related myofascial release technique applied over posterior shoulder tissue. Therefore, the aim of this study was to investigate the effects of myofascial release intervention on the shoulder internal external rotation range of motion and muscles strength for collegiate softball players while applied over dominate throwing shoulder of athletes. Fourteen collegiate softball players participated in this study. Myofascial release technique (MFR) applied over Latissimus dorsi, Deltoid, and Pectoralis majors of dominate throwing shoulder. The range of motion and muscles strength of dominant shoulder internal/external rotation (IR/ER), and horizontal adduction (HA) were measured by goniometer and handheld muscle tester before and after MFR intervention and with non-dominant shoulder of players as control group. After MFR intervention, the ROM of internal rotation, external rotation, and horizontal adduction were improved 34.3±8.5%, 12.5±8.8%, and 37.6±24.1% in the dominant arm, respectively. However, the muscles strength of dominant shoulder had no significantly changed between before and after intervention. The results showed that the MFR were able to improve the shoulder IR/ER and HA range of motion without loss muscle strength while the MFR applied for softball players. However, previous studies did not investigate the influence on strength of muscles that the soft tissue technique applied on. Our study had investigated both ROM and muscle strength while technique applied. Base on aforementioned evidences, this study concluded that acute application of MFR successfully improved IR/ER and HA of ROM of shoulder and without loss of strength collegiate softball players. Future study may examine the difference of MFR and stretch on posterior shoulder tightness in athletes.

## REFERENCE DATA FOR THE ASSESSMENT OF LUMBAR EXTENSION BY MEANS OF VIDEO RASTERSTEREOGRAPHY

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Introduction: Three-dimensional x-ray investigations revealed relevance of spinal mobility for low back pain (LBP) (4). By means of dynamic MRI, Kulig et al. (2) could demonstrate that decreased as well as increased lumbar mobility might indicate LBP, and diagnosis results might lead to specific consequences, especially in conservative therapy settings. Therefore, it appeared to be reasonable to look for a diagnosis system that is non-invasive on the one hand, and less expensive than MRI on the other hand. Recent research could establish a functional test protocol using dynamic video rasterstereography for the assessment of lumbar extension mobility (5). The present study was aiming at presenting lumbar extension reference data of pain free persons for a latter clinical use with LBP patients. Methods: 50 pain free volunteers (28 females: age  $27\pm 7$  y, BMI  $22\pm 2$  kg/m<sup>2</sup> and 22 males: age  $31\pm 8$  y BMI  $24\pm 2$  kg/m<sup>2</sup>) went through a standardized test protocol: static spine shape analysis (Formetric®: resolution 10 Pts./cm<sup>2</sup>, reconstruction error <0.2 mm) (1), followed by a functional dynamic test of lumbar hyperextension in terms of an increasing lumbar lordosis angle ( $rtt=0.93$ ) (5). Results: Lumbar hyperextension ranged between 7° and 53° within the total sample, while females ( $25\pm 11^\circ$ ) and males ( $18\pm 8^\circ$ ) differed significantly ( $p=.014$ ). Females showed an angle of 12° at the 5% quantile, and 42° at the 95% quantile level, whereas males had 8° and 34° at these levels, respectively. Conclusions: Our results were according to the literature (3) and might serve as a reference pool to judge future data assessed for LBP patients. So far, out-liers of a two standard deviation interval were assumed as LBP indicators (2). Here, it is proposed to use the 5% and 95% quantile as boarder lines for restricted or extended lumbar extension mobility. References: 1. Drerup B, Hierholzer E. 1994. Back shape measurement using video rasterstereography and three-dimensional reconstruction of spinal shape. *Clinical Biomech* 9:28-36 2. Kulig K, Powers CM, Landell RF et al. 2007. Segmental lumbar mobility in individuals with low back pain: in vivo assessment during manual and self-imposed motion using dynamic MRI. *BMC Musculoskeletal Disorders* 8:8 3. Mannion AF, Knecht K, Balaban G et al. 2004. A new skin-surface device for measuring the curvature and global and segmental ranges of motion of the spine: reliability of measurements and comparison with data reviewed from the literature. *Eur Spine J* 13:122-36 4. Pearcy M, Portek I, Shepherd J. 1985. The effect of low back pain on lumbar spinal movents measured by the three-dimensional x-ray analysis. *Spine* 10:150-3 5. Schröder J, Matthes K. 2012. Objektivierung der lumbalen Wirbelsäulenbeweglichkeit – Test-Reliabilität und Referenznormwerte. *Z Physiotherapeuten* 64(10):10-22

## KINESIO TAPE – IMMEDIATE EFFECTS ON SPINAL ALIGNMENT: AN RCT PILOT APPROACH

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Introduction: Recent reviews of RCTs did not reveal evidence of efficacy of Kinesio Tape and its assumed positive effects on blood flow, lymphatic drainage, pain decrease, or increases in proprioception, muscle activation, force, and performance (1, 3). Solely, benefits for the range of motion could be proved as evident (4). This current approach was seeking for immediate effects of elastic Kinesio taping on the spinal alignment in pain free persons in the sense of a memory tape. Methods: 12 pain free volunteers (6 female, Age:  $28.7\pm 7.8$ , BMI:  $21.1\pm 2.1$  and 6 male, Age:  $32.8\pm 11.9$ , BMI:  $23.9\pm 1.8$ ) were randomly blinded assigned to a verum or a placebo group: verum taping with approx. 135% tape tension, and placebo taping with no tension. Spinal alignment of all participants was examined at a baseline level without tape and afterwards under tape conditions (double tested and averaged) within 30 minutes at the same day. Spinal alignment (trunk inclination, pelvis inclination, thoracic and lumbar angle) was assessed using video rasterstereography (Formetric®), which was proved to be a valid and high resolution instrument (10 Pts./cm<sup>2</sup>, error < 0.2 mm) for non-invasive back shape reconstruction (2). Data were analyzed using non-parametric procedures (SPSS 12.0). Results: There were no significant differences between both groups at the baseline level ( $P>.05$ ). Taping did not lead to significant changes of spinal alignment, neither in the verum nor the placebo group ( $P>.05$ ). Although adaptations were more extended in the verum group, samples did not differ significantly in their differences from baseline to tape condition ( $P>.05$ ), except for the lumbar angle, when only the value, not the direction of adaptation, was taken into account ( $P=.029$ ). Conclusions: No evidence could be shown for the assumption that Kinesio taping should be leading to a spinal erection. But with respect to single case analyses, there seemed to be two different patterns of Kinesio tape induced spinal erection, depending on a de- or increasing trunk inclination. Further reseach is necessary. References: 1. Bassett KT, Lingman SA, Ellis RF. 2010. The use and treatment efficacy of kinaesthetic taping for musculoskeletal conditions: a systematic review. *NZJP* 38(2):56-62 2. Drerup B, Hierholzer E. 1994. Back shape measurement using video rasterstereography and three-dimensional reconstruction of spinal shape. *Clin Biomech* 9:28-36 3. Williams S, Whatman C, Hume P, Sheerin K. 2012. Kinesio taping in treatment and prevention of sports injuries: A meta-analysis of the evidence for its effectiveness. *Sports Medicine* 42(2):153-64 4. Yoshida A, Kahanov L. 2007. The effect of kinesio taping on lower trunk range of motions. *Research Sports Medicine* 15:103-12

## VALIDITY AND RELIABILITY OF AN INSTRUMENT MANUFACTURED FROM A HAND-HELD DYNAMOMETER FOR MEASURING THE STRENGTH OF TRUNK MUSCLES

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Introduction The measurement of maximum isometric strength is necessary in many areas of health and sport. Trunk muscles have some particular characteristics that make them hard to evaluate with simple, inexpensive instruments a like hand-held dynamometer. The aim of this study was to evaluate the validity and reliability of an instrument manufactured with a hand-held dynamometer and a metallic structure (HHD+S) for measuring the maximum isometric voluntary strength of the trunk muscles. Methods The maximum isometric voluntary strength of the trunk muscles (extension, flexion and lateral flexion) was measured in 20 healthy individuals (mean age 27.6 years, SD 10.1) using the manufactured instrument HHD+S and the gold standard Back-Check (BC). Participants performed three trials in each instrument in a random order. Three different methods to compute a single value of maximum muscle force were used: (1) average of the three attempts, (2) average of the best two, or (3) average of the two closest. Relative reliability (coefficient of variation, CV, and intra-class correlation, ICC), absolute reliability (standard error of measurement, SEM), minimum detectable change (MDC), and validity (Pearson correlation) were computed. Results The results showed that the two instruments had high and similar intra-subject reliability. Both instruments had CV <8% (95%CI=4.1-9.7%); ICC >0.96 (95%CI=0.91-0.99%); SEM <0.80; MDC between 0.85 to 2.22 Kg or 1.64 to 3.70%. The validity of the HHD+S was demonstrated by the high Pearson correlation between the two instruments ( $r = 0.78$ ) despite the averaging method used: the three attempts, the best two, or the two closest. Discussion Given the close correlation between the two devices

and the good reliability between trials, we believe that the use of an HHD jointly with the manufactured metallic structure (HHD+S) gives an evaluation of the maximum isometric voluntary strength of the trunk muscles that is very similar in quality, accuracy and reliability to the BC. The metallic structure made the hand-held dynamometer suitable to assess back muscles' strength. Good validity using just two measurement trials may imply a major advantage in populations with poor physical condition, history of lesion (i.e. people with back pain) or unaccustomed to big efforts. Although the HHD+S has no support software for data analysis and interpretation, which the BC instrument does, it provides other advantages like low cost, easy assembly and light weight.

### EFFECT OF ROTATOR CUFF TRAINING OF SUPRASPINATUS ON MUSCLE THICKNESS

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**Introduction** Rotator cuff training of the supraspinatus muscle is important to prevent shoulder injuries (Tsutsui et al., 1992). However, the effect of rotator cuff training on supraspinatus is still unknown, because there is no appropriate method for evaluating this muscle in clinical practice. Hodges et al. (2003) reported that muscle thickness (MT) in the case of other muscles, such as transversus abdominis, is related to muscle activity. Therefore, MT may be a useful indicator of the effects of training on muscles. The purpose of this study was to examine the effect of rotator cuff training of supraspinatus on MT. **Methods** Sixteen healthy male subjects (age: 21.7±1.9 years; height: 169.8±4.2 cm; weight: 62.2±4.2 kg) participated in the study. At a frequency of 5 days a week for 6 weeks, the subjects performed training by abducting the arm from 0 to 30 degrees in the scapular plane with humeral external rotation, using a yellow Thera-Band (#DAB-1, D&M, Japan). Supraspinatus MT was measured by ultrasonography (SSD-4000, Aloka, Japan). MT was determined as the distance between the superficial fascia and the deep fascia of supraspinatus at positions 10% and 50% of the distance from the medial edge of the scapular spine (scapular spine length was 100%). At the time of measurement, the seated subjects performed abduction at 30 degrees in the scapular plane with humeral external rotation. MT was measured during three tasks: 1) with the arm supported by a sling (0 kg); 2) with the wrist loaded by using a yellow (2 kg) Thera-Band; and 3) in maximum voluntary contraction (MVC). MTs before and after the end of training were compared by using the Wilcoxon signed rank test. **Results** At a position 10% of the distance from the medial edge of the scapular spine, MT under 0 kg (before: 0.31±0.20 cm; after: 0.46±0.19 cm,  $P < 0.01$ ) and 2 kg (before: 0.64±0.22 cm; after: 0.84±0.23 cm,  $P < 0.01$ ) loads was increased after the end of training. At a position of 50% from the medial edge, MT at 0 kg (before: 1.79±0.26 cm; after: 2.10±0.17 cm,  $P < 0.01$ ) was increased after the end of training. **Discussion and Conclusion** MT was increased after training for 6 weeks. The results of a preliminary experiment (data not shown) revealed that the MT of supraspinatus was related to muscle activity, as measured by electromyography. Our results suggested that rotator cuff training of supraspinatus increased the MT and activity of this muscle. **References** Hodges PW, et al. (2003). *Muscle Nerve*, 27(6), 682-692. Tsutsui H, et al. (1992). *The Shoulder Joint*, 16(1), 140-145.

### INTER-HEMISPHERIC TREATMENT OF VISUAL CUES: EFFECTS ON POSTURAL CONTROL FOR HEMIPARETIC PATIENTS

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**Introduction** Postural strategies are depending on a fine sensorimotor control. When the inter-hemispheric relation is disturbed, this control is not so efficient anymore. In this framework, we have considered the hemiparesis model through an auto-stabilization paradigm, with the aim to improve knowledge about a probably right hemispheric specificity for postural control (Bonan et al., 2004). As visual information is known to play a major role in postural control, our main purpose was to examine the potential influence of visual cues treatment on posture depending of the injured cerebral hemisphere. **Methods** 12 healthy subjects and hemiparetic patients with either a right (RH lesion, 12 subjects) or a left (LH lesion, 10 subjects) cerebral hemisphere lesion were asked to maintain their position as stable as possible while sitting on an instable seesaw in either sagittal or frontal plan. Four visual conditions were tested: vision (Vis), free right visual field (RVF), free left visual field (LVF) and darkness (NVis). Standard posturographic parameters and mean position ranges (Y & X range) were computed. Statistical analysis was performed using ANOVA with repeated measures. **Results** Surface and length covered by the center of pressure (CoP) were always higher for hemiparetic patients than healthy subjects. In the frontal instable condition, CoP surfaces were for the sole RH lesion group significantly lower in the Vis than in the NVis condition. In the sagittally unstable condition, CoP surfaces were for all groups 3 to 5 times lower than in the frontal unstable condition. LVF and RVF testing conditions had an effect on hemiparetic patients, with similar CoP surfaces between the Vis condition and the condition with visual field opposite to the hemiparetic side. LVF and RVF testing influenced on the X range for "RCH lesion" group and on the Y range for "LCH lesion" group. **Discussion** Auto-stabilizations in the frontal plan confirm a visual reliance for RH lesion patients. LH lesion patients seem to adopt a non-visual strategy. It leads us to consider a sensory hemispheric more than a postural hemispheric specificity, with some plan-dependent strategies (Van Nes et al., 2008). Auto-stabilizations in the sagittal plan show a specific hemispheric selectivity of visual cues for the two hemiparetic groups, known as spatial neglect strategy. This selectivity seems to organize more accurately the postural control. A hemispheric control of postural directions appears with a medio-lateral sensitivity for RCH lesion patients and antero-posterior for LCH lesion patients. These hemispheric specificities bring major elements for adaptability and efficiency of rehabilitation programs for hemiparetic patients. **References** Bonan, I., Colle, F.M., Guichard, J.P., Vicaut, E., Eisenfisz, M., Tran Ba Huy, P., Yelnik, A.P. (2004) *Arch Phys Med Rehabil*, 85(2):268-273. Van Nes, J., Nienhuis, B., Latour, H., Geurts, A.C. (2008) *Gait Posture*, 28(3):507-12.

### THE ROLE OF HIP ABDUCTOR AND EXTERNAL ROTATOR MUSCLE STRENGTH IN THE DEVELOPMENT OF EXERTIONAL MEDIAL TIBIAL PAIN: A PROSPECTIVE STUDY.

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**ABSTRACT Objective:** To prospectively identify proximal risk factors contributing to the development of exertional medial tibial pain (EMTP). **Methods:** Data were prospectively collected on healthy female students in physical education, who were freshmen in 2010-2011 and 2011-2012. Ninety-five female students aged 18.15±0.84, were tested at the beginning of their first academic year. Testing included isokinetic hip strength measurements of abductors, adductors, internal rotators and external rotators. The follow-up of the subjects was assessed using a weekly online questionnaire and a three-monthly retrospective control questionnaire. EMTP was diagnosed by an experienced M.D. (Doctor of Medicine). Cox regression analysis was used to identify the potential risk factors for the development of

EMTP. Results: Twenty-one subjects were diagnosed with EMTP during follow-up. The results of this study identified that decreased hip abductor concentric strength is a predictive parameter for the development of EMTP in females. More specific, total work ( $P=0.010$ ) and average power ( $P=0.045$ ) for concentric abduction strength were found to be significant predictors for this lower leg overuse injury. Conclusions: Hip abductor weakness is a significant predictor for EMTP in females. Preventive screening methods for EMTP should therefore include this proximal contributing factor.

### THE EFFECT OF DEEP TRANSVERSE FRICTION MASSAGE ON THE ACHILLES TENDON BLOOD FLOW IN HEALTHY VOLUNTEERS

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Introduction: There is a hypothesis in literature that the mechanical action of deep transverse friction massage (DTF) produces vasodilation and increases blood flow. But as yet, no experimental study has confirmed this effect in healthy subjects. The purpose of the present study was to investigate whether one session of DTF can influence the Achilles tendon blood flow. Methods: A randomized pre- posttest trial was set up. Sixty-two healthy participants volunteered. Each person underwent the following four steps of the procedure: 1. Measuring the tendon blood flow (PRE), 2. fifteen minutes of DTF on the Achilles tendon, 3. Measuring of the tendon blood flow (POST), 4. follow-up measurement after 20 minutes of rest (POST20). One leg of each person was randomly assigned to deep transverse friction session, the other leg was used as a control leg. Friction was applied continuously for a total of 15 minutes. The microcirculation was determined at 2 and 8 tissue depths at the distal and the proximal midportion of the Achilles tendon. For each level, the capillary blood flow, the tissue oxygen saturation, and the postcapillary venous filling pressure was registered. Results: The blood flow and the tendon oxygen saturation increase after DTF, while the postcapillary venous filling pressure decreases. After 20 minutes of rest, all parameters normalized towards their baseline - values. Discussion: These findings confirm that the Achilles tendon blood flow increases after one session of DTF in healthy volunteers. To what extent the described microcirculatory effects of sole deep transverse massage are evident in patients with Achilles tendinopathy should be investigated in future research.

### SUPRASPINATUS TENDON AND SUBACROMIAL SPACE PARAMETERS MEASURED ON ULTRASONOGRAPHIC IMAGING IN SUBACROMIAL IMPINGEMENT SYNDROME

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Introduction The purpose of this study was to characterize the supraspinatus tendon thickness, subacromial space, and the relationship between tendon thickness and subacromial space in patients with subacromial impingement syndrome to understand the mechanisms of subacromial impingement syndrome. Methods Single-blind cross-sectional design was used. Subjects diagnosed with subacromial impingement syndrome ( $n=20$ ), and asymptomatic controls ( $n=20$ ) matched for age, gender, and hand dominance were recruited. Ultrasound images were collected using a 4-12MHz linear transducer in B-mode of the supraspinatus tendon in the transverse (short-axis) and the anterior aspect of the subacromial space outlet. Using image calipers, measurements of tendon thickness were made at 3 points along the tendon and averaged for a single thickness measure. The subacromial space outlet was measured via the acromiohumeral distance (AHD) defined by the inferior acromion and superior humeral head. The occupation ratio was calculated as the tendon thickness as a percentage of AHD. Results The subacromial impingement syndrome group had a significantly thicker tendon [mean difference= $0.6\text{mm}$ ;  $t=1.924$ ,  $p=0.048$ ], and a greater tendon occupation ratio [mean difference= $7.5\%$ ;  $t=2.57$ ,  $p=0.014$ ] as compared to the matched controls. There were no AHD group differences. Discussion An intrinsic mechanism is supported with a thicker supraspinatus tendon (Joensen et al., 2009; Leong et al., 2012) and a potential extrinsic mechanism with the tendon occupying a greater percentage of the AHD. Tendon extrinsic compression may occur if the unoccupied AHD is reduced during arm elevation when the tendon is directly under the acromion (Giphart et al., 2012); future studies that image the tendon during arm elevation are needed to confirm direct tendon compression. References Giphart JE, van der Meijden OA, Millett PJ. (2012) J Shoulder Elbow Surg, 21(11),1593-600. Joensen J, Coupe C, Bjordal JM. (2009) Physiotherapy, 95(2),83-93. Leong HT, Tsui S, Ying M, Leung VY, Fu SN. (2012) J Sci Med Sport, 15(4):284-91.

14:00 - 15:00

## Mini-Orals

### PP-PM61 Sports Medicine [SM] 5

#### ENERGY COST DURING REPEATED SPRINT ABILITY IN PROFESSIONAL FUTSAL PLAYERS

Olla, S.1, Crisafulli, A.1, Cominu, M.2, Ghiani, G.1, Marcelli, M.1, Pinna, M.1, Milia, R.1, Tocco, F.1, Concu, A.1, Angius, L.1

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Introduction Futsal like other team sports is classified among activities where both aerobic and anaerobic energy sources are recruited. An important skill of team sport has been termed repeated-sprint ability (RSA). Despite large amount of studies investigated the RSA response, a lack of knowledge is present when players underwent a RSA test using the ball. The aim of the study was to investigate how the use of the ball affects RSA test performance. Methods Six male professional futsal players were recruited, goalkeepers were not included. They underwent two RSA field tests randomly assigned on different days. The test consisted on 8 shuttle maximal sprints with passive recovery of 10s. The first part of the track consisted of seven changes of direction (20.1 m) while in the second part the subject ran straight towards the starting line (15.5 m). RSA test was repeated with (RSABall) and without ball (RSAnoball). Ventilatory response during both tests was continuously monitored breath-by-breath by means of portable gas analyser. Results Values were averaged for the entire test duration. No statistical differences in  $\text{VO}_2$ ,  $\text{V}_e$ ,  $\text{VCO}_2$ , RER and HR between two tests were observed. Averaged time of RSABall was higher compared to RSAnoball ( $14.49 \pm 0.29$  s vs.  $10.53 \pm 0.22$  s). Speed was significantly reduced when players ran with the ball ( $8.87 \pm$

0.18 km vs. 12.19 ± 0.25 km). Energy cost of running in RSAnoball was lower respect to RSAball (0.56 ± 0.17 cal vs. 1.00 ± 0.04 cal). portable gas analyser. Discussion Our data show a significance increase of energy expenditure when players used the ball, probably caused by a different pattern of muscle activation or change in running technique that lead to a less efficient technique. A second reason could be addressed to the impossibility of the gas analyser to detect the high anaerobic component during RSAnoball. References Buglione A, di Prampero PE. (2013). *Eur J Appl Physiol*. Jan 9 Crisafulli A., Melis F., Tocco F., Laconi P., Lai C., Concu A. (2002). *J of Sports Med and Phys Fit*; 42, 409-417. Rampinini E., Sassi A., Morelli A., Mazzoni S., Franchini M., Coutts, A.J. (2009). *Appl Phys Nutr and Met*; 34, 1048-1054. Spencer M., Bishop D., Dawson B., Goodman C. (2005). *Sports Med*; 35, 1025-1044.

### **BRAIN ACTIVATION AND INHIBITION DURING CYCLING INCREMENTAL EXERCISE: A FMRI STUDY**

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Introduction Perceived exertion indicates the conscious tolerance to a physical exercise (1), however, little is known about the activation and inhibition patterns of cerebral areas involved in this regulation. Objective Verify the brain areas involved during cycling in different intensities of perceived exertion. Methods Eight healthy adult males (79.7 ± 10.5 kg; 177 ± 9.1 cm; 27.4 ± 4.8 yrs) participated in this study. The participants were positioned carefully to a adapted cycling ergometer attached to a Magnetic Resonance Scanner (MRI) and performed an incremental test consisted in blocks of 30 seconds cycling and 30 seconds rest. At the end of each cycling block the perceived exertion was reported with hands based on 6-20 Borg Scale displayed on the MRI internal screen. The initial load was 50 W which was increased in 25 W at the end of every four blocks of exercise. Workload was increased until the volunteers reached the perception '17 - Very hard' on the Borg scale Results During the perceived exertion related to 'light intensity' (6 to 9 on Borg scale), the brain activation indicated the medial frontal gyrus, inferior frontal gyrus, pre-central gyrus, superior temporal gyrus and ipsilateral cerebellum. For the inhibition were identified fusiform gyrus, frontal superior gyrus, medial frontal gyrus, parahippocampal gyrus and precuneus. For the efforts perceived as 'high intensity' (Borg scale 13-15), activation also indicated the pre-central gyrus, the medial frontal gyrus and paracentral lobule. For the inhibition were identified the upper and lower temporal gyrus, frontal superior and medial gyrus as well as the fusiform gyrus and precuneus. Conclusion The present study elucidated brain areas involved in regulating the exercise at low and high intensity indicating activation of regions associated to motor control and inhibition of several areas as known to exert cognitive functions. References (1)Borg GAV. Borg's perceived exertion and pain scales. Champaign, IL: Human Kinetics, 1998.

### **EFFECT OF CONTINUOUS TRAINING ON DISTRIBUTION OF BONE AND MUSCLE IN COLLEGIATE WATER POLO PLAYERS**

Iizuka, S.1, Torii, S.2

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Introduction There are many previous studies demonstrating the effect of different types of sport activity on the distribution of bone and muscle in athletes. The knowledge about the body composition of the elite athletes helps to build and maintain the body of young athletes. However, there is no report about the water polo players in Japan. So in this meeting last year, we reported the distribution of muscle and bone of water polo players comparing with those in handball player and competitive swimmer. As further study of last year report, we had 2-years follow-up study of Japanese water polo players. Methods 10 collegiate male water polo players participated in this study and their body composition was assessed using dual X-ray absorptiometry (DXA), when they are sophomore and senior degree. We examined the changes of their bone mineral content (BMC), bone mineral density (BMD) and lean mass (LM), and also, the relative value of the upper limb to the lower limb (Up/Low). Results BMC and LM significantly increased in bilateral upper limb. In the trunk, only lean mass significantly increased. BMD significantly increased only in the dominant arm. However, BMC and LM in lower limbs did not change. Also, Up/Low of BMC and LM significantly increased. Discussion It is considered that the increase of BMC and LM in dominant and non-dominant arm was resulted from their swimming movement, throwing movement, as well as strength training on land. From these results, the training of the upper limbs would be important for improvement in the skill of water polo players. However, further researches are needed about the effect of lower limbs training on water polo skills. Conclusion Continuous water polo training develops LM and BMC of the upper limbs.

### **THE EFFECTS OF TENDONS TEMPERATURE ON THE RATE OF TORQUE DEVELOPMENT**

Kang, H.W., Huang, C.H.

National Taiwan sport university

Jumper's knee is one of the common injuries especially for athletes anticipated in sports such as basketball, volleyball or handball. The tendon's capacity to transmit the forces generated by the muscles plays an important role in sports performance. Furthermore, the examination of the tendon stiffness could provide us some information on the tendon's capacity. Temperature is one of many factors could affect the tendon stiffness. Studies in the past have demonstrated that tendon can be more compliant as the temperature increased. However, the degree of compliance associated with the sports performance has not been closely observed. The purpose of the study was to exam the effects of tendons temperature on the rate of torque development. Subjects : Eight competitive male athletes with patella tendinitis participated in the study. Research Design : Cross-over design. Methods: Each subject received the short-wave diathermy and/or ice for twenty minutes in different days. The isokinetic machine – BIODEX III was utilized to collect the rate of torque development before and after the applications of heat/cold interventions, respectively. Statistical analysis : Descriptive statistics and Pair T-test were used for data analysis. The level of significance is set at .05. Result: Under cooling condition, the average RTD within 200ms was greater than under heat condition(p< 0.05). However, the maximum RTD of 10ms within 200ms was not significantly different in cooling, heat or regular condition.

### **COMBINATION OF ULTRASOUND AND EXERCISE ON NEUROPATHIC PAIN IN RATS**

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Introduction Neuropathic pain is a common neurological disorder which affects 7% of general population (Bouhassira et al., 2008). Clinical interventions for neuropathic pain included medication and transcutaneous electrical nerve stimulation (Somers and Clemente, 2009).

However, the effect of ultrasound treatment on neuropathic pain remains unclear. Also, previous report suggested that treadmill exercise alleviated neuropathic symptoms (Chen, 2012). Therefore, we investigated the effect of ultrasound treatment and the outcome of combining treadmill exercise and ultrasound treatment in chronic constriction injury (CCI) induced neuropathic rats in this study. Methods We provided a constricted injury by loose ligation on rat's sciatic nerve (Bennett and Xie, 1988). Forty Sprague-Dawley rats were randomly assigned to five groups: Naïve, sham operation, CCI with ultrasound treatment (CCI+USD), CCI with treadmill exercise treatment (CCI+TME), and CCI with combine treatment (CCI+TME+USD). Ultrasound treatment of 1 w/cm<sup>2</sup> with 100% duty cycle started immediately after surgery and gently applied on the skin surface above sciatic nerve for 5 minutes per day, 5 days a week for 4 weeks (Somers and Clemente, 2009; Yang et al., 2008). Exercise treatment started at post-operative day 7 with intensity of 14-16 m/min with 8% incline grade, 5 days a week for 3 weeks (Stagg et al., 2011). Thermal hyperalgesia and mechanical allodynia were used to determine the level of neuropathic pain by using Plantar Test and Von Frey Hair Aesthesiometer, respectively. Results In thermal hyperalgesia, we found that i) the withdrawal latency of CCI rats was shorter than sham ones; ii) all three treatments groups significantly increased the latency of withdrawal responses; iii) the withdrawal latency of CCI+TME+USD group was significantly higher than CCI+USD group or CCI+TME group; iv) No significant difference between CCI+USD and CCI+TME group; v) after 4-weeks intervention, withdrawal latencies were indistinguishable between sham and CCI+TME+USD group. Discussion In conclusion, ultrasound treatment reduced neuropathic pain and combination of ultrasound and treadmill exercise could even provide a better outcome. References Bouhassira D, Lantéri-Minet M, Attal N, Laurent B, Touboul C. (2008). *Pain*, 136(3), 380-7 Somers DL, Clemente FR. (2009). *J Pain*, 10(2), 221-9 Chen YW, Li YT, Chen YC, Li ZY, Hung CH (2012). *Anesth Analg*, 114(6), 1330-7 Bennett GJ, Xie YK. (1988) *Pain*, 33(1), 87-107. Yang JH, Kim TY, Lee JH, Yoon SW, Yang KH, Shin SC. (2008). *Arch Pharm Res*, 31(4), 511-7 Stagg NJ, Mata HP, Ibrahim MM, Henriksen EJ, Porreca F, Vanderah TW, Philip Malan T Jr. (2011). *Anesthesiology*, 114(4), 940-8

### QUADRICEPS ISOMETRIC STRENGTH AS PREDICTOR OF DECREASED Z-SCORE BMD IN ADOLESCENTS WITH DOWN SYNDROME

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**Introduction** Adolescents with Down syndrome (DS) have shown low levels of bone mineral density (BMD). In addition, maximal isometric strength (MIS) seems a good predictor of BMD in some populations. As BMD is related with age, Z-score might be a more suitable method to evaluate risk of low BMD in growing populations. **Aim** To observe possible relations between MIS and Z-score from BMD in adolescents with DS, and to investigate whether MIS tests might predict risk of low BMD in this population. **Methods** Whole body, hip and lumbar spine BMD of 31 adolescents (15.8±2.9 yr) with DS was evaluated with dual energy X-ray absorptiometry (DXA), and Z-scores were calculated based on age- and sex-matched reference values. Participants were classified as at risk of having low BMD (Z-score ≤ -2SD) or not (Z-score > -2SD). MIS was evaluated for leg extensors (quadriceps) and forearm and hand (handgrip) muscular groups. Age-controlled partial correlations between Z-scores and MIS were conducted. Three different stepwise linear regressions including age, height, weight, and MIS for quadriceps and handgrip as independent variables were performed with the three different Z-scores as dependent variables. This provided 3 prediction equations for estimate Z-score. Estimated Z-scores were calculated and participants were reclassified as at risk of having low BMD or not with these estimations. The risk of having low BMD was compared between the actual DXA values and those calculated with the prediction equations. **Results** Correlations were found for both handgrip and quadriceps MIS and BMD Z-score at lumbar spine (r=0.4 and 0.5 respectively, both p<0.05), and also between quadriceps MIS and BMD Z-score at hip and whole body (both r=0.5 and p<0.05). Linear regressions showed quadriceps MIS as the stronger predictor for BMD Z-score overall. The prediction equations had an accuracy of prediction for the risk of having low BMD of 68, 61 and 84% for whole body, hip and lumbar spine respectively. **Discussion** Quadriceps MIS is an important predictor of Z-score BMD in adolescents with DS and it might, by itself, or in combination with age, height or weight provide an accurate estimation of the risk of having low BMD. This is an important issue that quadriceps MIS could act as a first screening which would inform regarding the importance of performing a DXA scans in certain adolescents with DS. **References** Gonzalez-Aguero A, Vicente-Rodriguez G, Moreno LA, Casajus JA.(2011). *Osteopor Int*, 22(7), 2151-7. Huuskonen J, Vaisanen SB, Kroger H, Jurvelin C, Bouchard C, Alhava E, Rauramaa R. (2000). *Osteopor Int*, 11(8), 702-8.

### DOES MUSIC INTERVENTION FACILITATE CARDIOPULMONARY FUNCTION DURING HEAVY CYCLING EXERCISE AND RECOVERY PHASE

Hu, C.Y., Ko, H.T., Lin, H.T.

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**Introduction** The music stimulation has been extensively applied in the process of exercise or during sports competition (Karageorghis et al., 2011). Listening music during exercise could increase the degree of the awakening and enhance the performance of the exercise. However, the mechanism of music intervention affected physiological change is still not clear. Therefore, the aim of this study is to explore the impact of the music intervention in the cardiopulmonary system function during cycling. **Methods** Three female university students without cardiopulmonary system syndrome were participated in this study. The exercise intensity was based on each subject's power output at maximum VO<sub>2</sub>, and it was determined by the Astrand's program (Astrand 1965). During testing, the pulmonary gas exchange system (K4b2, cosmed, Italy) and heart rate detector were worn on the subject to record the cardiopulmonary parameters during cycling. The subjects were asked to keep at rest for five minutes to record the data as the baseline, and then doing cycling at resistance of 40% of maximum power for warm-up for 10 minutes and 60% of maximum power for exercise for 20 minutes. The pedaling rate was set at 50 rpm. The data recording was still continued for 15 minutes after exercise for detect the effect of music in recovery. Cycling with music and without music were tested. The music is at tempo 134 bits/min. **Results** Under music intervention, in the warm-up (low intensity exercise) phase, oxygen uptake was increased, and during exercise and recovery phase, heart rate was increased, all of them reached the statistically significant differences. The respiration frequency and oxygen uptake had increasing trend but did not reach statistically significant difference. In the recovery phase, after ten minutes rest, the rise in oxygen uptake reached statistical significant difference under music intervention. **Discussion** The results of this study found that music intervention can enhance subject to have better oxygen uptake and efficiency use of oxygen that could access to the status of the exercise faster in the warm-up stage. In the main exercise, music intervention could increase heart rate and can make the body to adapt the faster oxygen consumption during the exercise. The music intervention during the recovery, the heart rate of subjects decreased faster but still keeps higher oxygen uptake, that could use oxygen more

efficiently and recovery faster. These mechanisms can cause the metabolic rate rose. This physiological change under music intervention could help body to adopt exercise quickly and help body to remove metabolic waste quickly during exercise and recovery fast. References Karageorghis CI, Terry PC, Lane AM, Bishop DT, Priest DL. (2012). *J Sports Sci*, 30, 953-956. Astrand, P. O. (1976). *Prog Cardiovasc Dis*, 19, 51-67.

### ADAPTATION OF THE AUTONOMIC NERVOUS SYSTEM FROM RECOVERY TO COMPETITION PERIOD IN ELITE TRACK AND FIELD ATHLETES.

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**Introduction** Successful endurance training must balance overload and recovery to prevent overreaching (OR). Analysis of markers of the autonomic nervous system measured by heart rate variability (HRV) has the potential to guide training by monitoring the increase in vagal tone, generally associated with repetitive training loads (Kiviniemi et al., 2007). However, a conversion from vagal to sympathetic predominance has been observed in successfully performing elite rowers (power endurance athletes) immediately before competition (Iellamo et al., 2002). To confirm this result in endurance athletes, we investigated HRV in elite track and field athletes during recovery period (RP) and competition period (CP). **Methods** Seventeen male athletes competing at national level were examined ( $20 \pm 3$  years, body mass index  $21.2 \pm 1.3$  kg/m<sup>2</sup>, running speed  $17.5 \pm 1.9$  km/h at the anaerobic threshold and  $20.2 \pm 1.6$  km/h at maximum). The power spectrum of HRV was measured in supine position and after an orthostatic load during RP and CP. Four minutes segments were analyzed with an autoregressive spectrum. Three spectral components were distinguished: Total power (TP) in ms<sup>2</sup>, and low frequency (LF) and high frequency (HF) power in normalized units (n.u.). The sympatho-vagal balance was calculated as LF/HF power ratio after the orthostatic load test. HRV parameters of RP were compared with CP by Mann-Whitney U tests. Results Fourteen athletes had sufficient data quality in both tests and were included in the final analysis. No athlete exhibited symptoms of OR during the CP. Comparing orthostatic load test in the RP and CP, athletes showed an increase of the LF/HF power ratio (median (IQR) 5.6 (6.8) vs. 10.2 (8.5);  $p=0.009$ ), and of LF power (84.8 (13.8) vs. 91.0 (7.9);  $p=0.016$ ), and a decrease of HF power (15.3 (13.8) vs. 8.9 (7.9);  $p=0.016$ ). No changes were observed for TP. **Discussion** The results of our study show a shift of sympatho-vagal balance towards higher sympathetic tone before competitions in male elite track and field athletes. In the absence of symptoms of OR, this pattern of adrenergic activation may reflect readiness for competition. Kiviniemi, A.M., Hautala, A.J., Kinnunen, H., Tulppo, M.P. (2007). *Eur J Appl Physiol*, 101:743-751. Iellamo, F., Legramante, J. M., Pigozzi, F., Spataro, A., Norbiato, G., Lucini, D., Pagani, M. (2002). *Circulation*, 105:2719-2724.

### THE DIFFERENCES OF MUSCLES CO-CONTRACTION AROUND THE SHOULDER AT VARIOUS POSITION AND VELOCITIES

Ko, H.S., Hu, C.Y., Lin, H.T.

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**Introduction** Muscle co-contraction not only can reach the motion accuracy, but also can maintain the joint stability. Maximum joint strength is various with joint position and moving velocity due to the muscle length-force and loading-velocity relationship. For that reason, muscles around the joint should have different co-contraction condition to keep joint stability in different motion situation. The shoulder joint relies on muscles most around the joint to maintain the joint stability. The purpose of this study is to investigate the effect of joint position and moving velocity in muscles co-contraction in shoulder rotation. **Methods** Four healthy subjects, aged 20-23, without any upper limb injuries were recruited in the study. Before testing, the subjects were asked to warm up the shoulder and measured the muscle maximum voluntary contraction (MVC). Eight muscles including anterior deltoid, posterior deltoid, pectoralis major, supraspinatus, infraspinatus, teres major and teres minor were tested by the surface electromyography system (Trigno•, Delsys Inc, USA). In the isokinetic shoulder internal and external rotation test, the joint velocity was set by the dynamometer system (System 3, Biodex Medical Systems, USA) in 60°/sec, 120°/sec and 210°/sec at shoulder abduction 45°, 70° and 90°. **Results** During internal rotation, the teres minor, teres major, pectoralis major and anterior deltoid were more activated than in external rotation. However, the supraspinatus, infraspinatus and posterior deltoid were more activated in external rotation. Analyzed the effect of joint position in muscle activation, the teres minor, teres major, supraspinatus and infraspinatus had largest activation at shoulder abduction 70°, but the pectoralis major, posterior deltoid and anterior deltoid were more activated at shoulder abduction 90°. About the effect of moving velocity in muscle activation, the teres minor, supraspinatus and posterior deltoid have more activation at 210°/sec, and most of muscles had less activation at 60°/sec, except teres major and anterior deltoid. **Discussion** From this study, we had found that the joint angle and moving velocity did affect muscles activation during internal and external rotation. However, subjects in this study didn't show the consistent change in the different moving velocities at various joint positions. That may result from that we choose the maximum muscle contraction value for analysis during the test, however, the peak value for different muscles were not occurred at the same time. Only four subjects was also the limitation. More subjects tested will be required to define the muscle co-contraction change with motion velocity change at different joint position. These results will be helpful for athletes training for injury prevention and rehabilitation program design. References Walmsley RP, Szybbo C. (1987). *J Orthop Sports Phys Ther*, 9, 217-222. Soderberg GJ, Blaschak MJ. (1987). *J Orthop Sports Phys Ther*, 8, 518-524. Dark A, Ginn KA, Halaki M. (2007). *Phys Ther*, 87(8), 1039-46.

### THE EFFECT OF HIGH-INTENSITY INTERVAL EXERCISE AND RESISTANCE EXERCISE ON BLOOD PRESSURE IN OBESE ADULTS

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1: MPI (Macao, China). 2: UMAC (Macao, China). 3: LNU (Dalian, China). 4: HKBU (Hong Kong, China). **Introduction** Current recommendations for blood pressure (BP) control involve performing prolonged endurance and resistance exercise. However, the general population fails to follow such regimes due to lack of time. Therefore, it is very important to develop time-efficient exercise intervention strategies. A growing body of evidence demonstrates that minimal volume of high-intensity interval training and resistance training can serve as effective alternatives to traditional time-consuming training, inducing similar or even superior physiological adaptations (Babraj et al., 2009). However, limited information is available regarding the impact of minimal volume exercise on BP. The study aimed to analyze BP responses in obese adults following minimal volume high-intensity interval exercise (HIE) and resistance exercise (RES). **Methods** Fifteen obese adults (age:  $21.7 \pm 2.4$  years; BMI:  $34.1 \pm 5.9$ ) underwent: (1) HIE: all-out cycling exercise 30 sec  $\times$  4, interspersed with 4 min of rest; (2) RES: a circuit of nine resistance exercise involved the large muscle groups with ten repetitions, interval with 1 min of rest; and (3) CON: a

control session of no exercise. Systolic (SBP), diastolic (DBP) and mean arterial (MAP) were measured by ambulatory blood pressure monitoring (ABPM) over a 15 hrs period following exercises and CON, including daytime and nighttime. Results SBP increased ( $P < 0.05$ ) immediately after both HIE (Pre vs. Post:  $135 \pm 11$  vs.  $158 \pm 21$  mmHg) and RES (Pre vs. Post:  $136 \pm 11$  vs.  $148 \pm 20$  mmHg), but returned to pre-exercise level since then. Only RES elicited post-exercise DBP (CON vs. RES:  $72 \pm 11$  vs.  $68 \pm 12$  mmHg) and MAP (CON vs. RES:  $94 \pm 11$  vs.  $91 \pm 12$  mmHg) reduction that lasted near 2 h after exercise ( $P < 0.05$ ). Compared with CON, no significant change in the BP was found during sleep post-exercise ( $P > 0.05$ ) after HIE or RES. Discussion The results of the present study demonstrate that, compared with no exercise and HIE, minimal volume RES (total exercise period of 14 min) was effective in promoting hypotension effects in DBP and MAP in normotensive adults, as measured by ABPM. It is known that responses to physical training are the result of cumulative acute effects over time (Thompson et al., 2001). Further, longer exercise-induced hypotensive effects may be observed in subjects with higher baseline levels compared with normotensive individuals (Cardoso et al., 2010). Therefore, the current findings led the authors to speculate that minimal volume resistance exercise involved the large muscle groups may represent a practical and time-efficient exercise strategy to BP control in individuals with baseline-elevated BP. \*The study was supported by a research grant from Macao Polytechnic Institute (RP/ESE FD-02/2012). References Babraj JA, Vollaard NB, Keast C (2009). *BMC Endocr Disord*, 28;9:3. Cardoso CG Jr, Gomides RS, Queiroz AC (2010). *Clinics*, 65(3), 317-325. Thompson PD, Crouse SF, Goodpaster B (2001). *Med Sci Sports Exerc*, 33(6 Suppl), S438-S445.

## AN INNOVATIVE TREATMENT CONCEPT FOR TRIATHLETES SUFFERING FROM ACHILLODYNIA

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INTRODUCTION: According to former published data up to 90% of active triathletes suffer at least one injury during their career.(1) Because of this high injury prevalence, our study group accomplished a survey, interrogating nearly 1200 long distance triathletes, concerning their injuries and training habits. The aim of our study was to detect risk factors for injuries to establish prevention and treatment concepts. We found a particularly high occurrence of Achillodynia (AD) (34%), and due to these findings we developed a treatment concept, especially for triathletes suffering from AD. METHODS: Our e-questionnaire - available in 5 languages - was sent to all members of the Austrian triathlon association and to participants of several Ironman events in Europe. 1158 athletes met our inclusion criteria and returned the questionnaire between July 2011 and February 2012. Chi square tests were applied to identify differences in risk factors between athletes with and without AD. RESULTS: We recommend a treatment concept based on a modified version of the EdUReP model, a tendinopathy treatment model emphasizing Education, Unloading of the Achilles Tendon and controlled reloading. (2) Week 1 -4: During the first 4 weeks a consistent unloading phase is scheduled. Within this period a rigorous running rest and key aspect on alternative training (e.g. strength training upper body, swimming, aquajogging,...) is intended. We also recommend an all day long heel pad supply for both legs. Additionally, anti-inflammatory and pain-relieving measures, implying the use of anti-inflammatory drugs, deep friction massage, physiotherapy, ice, therapeutic ultrasound and ESWT should be applied. If the athlete is free of pain after 4 weeks of unloading, a gradually reloading phase should be started for the next 8 weeks. Week 5-6: Intermittent relieve of heel pas during daily life, gain of alternative training, retain of running rest. Week 7-8: Start with Nordic walking training and moderate cycling sessions using heel pads. Eccentric training of the calf muscles should be entered to training. Week 9-10: Start with moderate running sessions on flat terrain using heel pads, gain of cycling training and eccentric calf muscle training. Week 11-12: Gain of running training with intermittent relieve of heel pads. After 12 weeks the athlete should return to the full training coverage. DISCUSSION: Due to our statistical analysis we found a long median time span of athletes suffering from AD until they return to training (mean 31 days) and high percentage of chronication. Because of these findings best possible treatment concepts should be applied. REFERENCES: (1)Egermann M, Brocai D, Lill CA, et al. Analysis of injuries in long- distance triathletes. *Int J Sports Med* 2003;24:21-6. (2)Davenport, T. E.; Kulig, K.; Matharu, Y.; and Blanco, C. E.: The EdUReP model for nonsurgical management of tendinopathy. *Phys Ther*, 85(10): 1093-103, 2005

## DRINKING AD LIBITUM OF ELITE MALE RUNNERS DURING HALF MARATHON COMPETITION

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Introduction Drinking ad libitum appears to optimize performance and safety during exercise in many situations. The presence of thirst, not of water loss, may be the biological signal that impairs exercise performance in those who drink less than their thirst dictates during exercise.(1) Method Twenty three runners were assessed during the official Serbian Championship on International Belgrade Marathon event. In order to estimate hydration status we collected urine samples of each athlete before and after the race, we measured body mass of all athletes before and after the race, as well as weather conditions in Belgrade on that day. Athletes were advised to drink ad libitum. Fluid intake estimated from fluid recall questionnaire after the race. Hydration status was evaluated by urine specific gravity (Usg), urine color (Ucol), sweat rate (SR), and fluid intake (FI). Results Runners age was  $26 \pm 5$  years. After the race body mass loss was  $2,2 \pm 1,3$  kg, percentage of dehydration  $3,6 \pm 1,5\%$ , total fluid intake  $322 \pm 302$  ml and sweat rate  $1,74 \pm 0,7$  L/h. Mean Usg before the race  $1017 \pm 8$  and after the race  $1013 \pm 8$  were obtained. Ambient temperature was  $23^\circ\text{C}$  and humidity 96%. 78% of the participants in this study used the water for rehydration, 13% of them used sports drink and 9% did not take any fluid during race. Statistically significant differences where found between body mass before and after the race ( $p < 0,05$ ) also we found significant negative correlations between fluid intake and body mass loss as well as positive correlations between body mass loss and result time of race. Discussion Drinking of fluids "ad libitum" of 23 runners was adequate for them to complete their race, while maintaining their hydration status. Drinking habits in our study does not corresponding with the ACSM guidelines for fluid intake for marathoners which suggested that fluid intake should be from 0.4 to 0.8 L/h.(2). Endurance athletics events always as a result have huge loss of fluid which does not necessary leads to dehydration. Most of the lost fluids in prolonged exercise come from the process of glycogen oxidation which means that there is no loss from extracellular fluid compartment.(3) References 1. Noakes D. Is drinking to thirst optimum; *Ann Nutr Metab* 2010. 2. American College of Sport Medicine. Position Stand: exercise and fluid replacement. *Med Sci Sport Exerc*. 2007;39(2):377-90. 3. P B Laursen et al.; Core temperature and hydration status during an Ironman triathlon; *Br J Sport Med* 2006.

## INJURIES IN GERMAN ELITE MEN'S SOCCER – VIDEO ANALYSIS OF INJURY SITUATIONS

Klein, C., Luig, P., Henke, T.

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**Introduction:** With about 6.8 million members the German soccer federation is one of the biggest sport federations of the world. In Germany, soccer is the most popular sport, but particularly on professional level a sport with a very high injury incidence (approx. 18.4 inj. / 1000h). During the seasons 2010/11 and 11/12 more than 3,500 injuries within the 1st and 2nd league led to about 50,500 days of disability and medical costs of almost 8 million. The purpose of this study was to identify typical injury situations in professional men's soccer and the illustration of resulting prevention measures. **Methods:** The observation period focused on the season 2010/11 and 11/12 of the two highest leagues in German men's soccer. To describe the sample of all professional soccer players who played at least once in a competitive match, soccer specific journals were consulted. Injury data including information about nature and severity of the injuries were provided by the German accident insurance of the athletes (VBG). The footage was available via the media library of the German Soccer League. With the aid of a validated checklist approx. 200 injuries of the given period were analysed. **Results:** Throughout the observation period 78 % of all athletes got injured at least once. In average each player sustained 2.5 injuries per season. About two-thirds of the injuries in German professional soccer concerned the lower limbs. Most of them were injuries of the thighs (19.5 %), the knees (16.0 %) and the ankles (12.4 %). Knee injuries showed the highest severity leading to nearly 7,500 days of disability and 1.6 million medical costs. In case of thigh injuries prevalently chronic injuries were monitored as a result of overuse effects during the season. Concerning knee injuries pivoting or coordination deficits in non-contact situations are common. Most of the ankle injuries are a result from direct contact with an opposing player. **Discussion:** At least on professional level soccer is a high risk sport. Most scientific preventive measures focus on physical preparation and training approaches. To increase applicability and acceptance of these approaches a sport specific implementation is recommended. Particularly to prevent injuries resulting from irregular contact situations approaches should focus on referee education and technique advises helping the athletes to withstand risk situations uninjured. Furthermore injury prevention modules should be included into education curricula of all trainer licenses.

## A META-ANALYSIS ON SPORTS INJURY PREVENTION IN CHILDREN AND ADOLESCENTS

Rößler, R., Donath, L., Schweizer, T., Faude, O.

*Institute of Exercise and Health Sciences*

**Introduction** Physical inactivity during childhood and adolescence has considerable detrimental health effects and thus the promotion of sports and physical activity during early years is widely recommended to support a healthy lifestyle (Mountjoy et al., 2011). Otherwise, being engaged in sports always bears the risk of sustaining an injury. Injuries, in turn, can lead to a reduction in current and future involvement in physical activity and, therefore, may negatively affect future health as well as quality of life (Emery, 2003). The aim of the present meta-analysis was to analyse the effectiveness of injury prevention programmes in organised sports in children and adolescents. **Methods** A computer based literature search was conducted in six databases (CINAHL, Cochrane, EMBASE, ISI Web of Science, PubMed, SPORTDiscus) using the search terms: sport\* injur\*, athletic injur\*, sport\* accident\* AND prevent\*, prophylaxis, avoidance AND child\*, adolescen\*, youth. Moreover, citation tracking and hand searching were carried out until February 2013. A total of 1556 articles were found. 22 studies met the inclusion criteria (analysing the effects of a prevention strategy on injury occurrence in children and/or adolescents during organised sport compared to a control group). Statistical analysis was conducted using a Mantel-Haenszel random effects model. Risk ratios (RR with 95% CI) were calculated by dividing the injury rate of the intervention group by the injury rate of the control group. **Results** The overall RR was 0.58 [0.44; 0.76] (P<0.001). 16 studies evaluated "active programmes" (e.g. neuromuscular training) and found a mean significant effect (RR=0.60 [0.49; 0.72], P<0.001). Of those, 9 studies aimed at reducing "global injuries" (RR=0.66 [0.53; 0.83], P<0.001) and 7 studies focused on "specific injuries" (e.g. knee, head) (RR=0.48 [0.32; 0.71], P<0.001). 6 studies evaluated "passive prevention" (e.g. safety equipment) and demonstrated a non-significant effect (RR=0.64 [0.29; 1.42], P=0.27). 2 of those studies focused on "global injuries" (RR=0.60 [0.38; 0.95], P=0.03) and 4 studies on "specific injuries" (RR=0.62 [0.19; 1.99], P=0.42). **Discussion** The present analysis clearly demonstrates the potential of preventive measures in youth sports. Depending on the mode of intervention and the specific aim, a reduction in injury rate of 40% seems possible. Active prevention focusing on specific injuries revealed the most promising effects. This is in line with Emery (2003) who emphasized the impact of modifiable risk factors like poor strength or endurance. **References** Emery, C. A. (2003). *Clin J Sport Med*, 13, 256-268. Mountjoy, M., Andersen, L. B., Armstrong, N., Biddle, S., Boreham, C., Bedenbeck, H. P., ... van Mechelen, W. (2011). *Br J Sports Med*, 45, 839-848.

**14:00 - 15:00**

### Mini-Orals

## PP-PM14 Health and Fitness [HF] 8

### EXERCISE HYDRATION KNOWLEDGE OF SINGAPOREAN SCHOOL-GOING YOUTH ATHLETES

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**Introduction** Youth athletes in Singapore are at a higher risk of heat-associated disorders due to the exposure to outdoor co-curricular activities and sports training in hot and humid weather conditions all year round. To enhance sports safety and health, it is important to understand the baseline exercise hydration knowledge in this population before guidelines can be formalised and implemented. The study examined the exercise hydration knowledge of Singapore school-going youth athletes. **Methods** 586 youth athletes (13.91±2.53y, male=322, female=264) from primary schools, secondary schools and a junior college participated in the study. All participants completed a hydration knowledge questionnaire based upon the ACSM and NATA guidelines on fluid replacement for athletes (Casa et al. 2000; Sawka et al. 2007). The questionnaire consisted of pre-exercise, during-exercise and post-exercise hydration knowledge sections. Adequate hydration knowledge was accepted as a score of 80% and above (Ransone and Dunn-Bennett 1999). **Results** 82.3% of the participants were involved in team sports. The average knowledge scores of primary, secondary and junior college athletes were

41.08±11.84%, 43.10±14.07% and 53.27±13.86% respectively. Of the 586 participants, only one athlete from junior college could attain the passing score. Overall, the post exercise knowledge scores were lower compared to pre-and during exercise hydration knowledge (pre=47.2±22.0%, during=48.7±16.9%, post=36.3±18.3%). 46.9% responded that their teachers and coaches were their main source of hydration knowledge. Reliance on parent and coaches for hydration knowledge reduced with the age of the athletes (Coaches and teachers: Pri=52.8%, Sec=45.2%, JC=39.7%; Parents: Pri=52.4%, Sec=27.9%, JC=19.9%; Self-taught: Pri=21.6%, Sec=41.6%, JC=52.2%). Discussion The lack of hydration and fluid replacement knowledge in Singaporean youth athletes is a cause of concern and increases the risk of dehydration and heat-associated disorders. These athletes must be empowered with adequate hydration knowledge and practices, for enhanced sports safety and safeguarding health. Coaches, PE teachers and parents should play a major role in educating and facilitating learning among youth athletes. In addition, resources on hydration tips and strategies should be made freely available. The findings of this study can contribute to the development of formalised hydration guidelines for Singapore and the Southeast Asian region. References Casa DJ, Armstrong LE, et al. (2000). Journal of athletic training 35(2): 212-224. Ransone J & Dunn-Bennett LR (1999). Journal of athletic training 34(3): 267-271. Sawka MN, Burke LM, et al. (2007). Medicine and science in sports and exercise 39(2): 377-390.

### **POST-RESISTANCE EXERCISE HYPOTENSION IS NOT MEDIATED BY THE CENTRAL NERVOUS SYSTEM NOR INFLUENCED BY TRAINING METHOD**

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INTRODUCTION: Hypertension affects approximately 40% of the population over 40 years old; therefore it is extremely important to search strategies for prevention and treatment of this disease. Although the cardiovascular behavior is partially unknown, resistance exercise (RE) has been recommend for this population, especially, executed in circuit (C) and multiple sets (MS) training methods. PURPOSE: The aim of this investigation was to check the post RE hypotension (PREH) and heart rate variability (HVR) after different training methods (C and MS) in normotensive middle-aged men. METHODS: Volunteers (n= 15; 46,5 ± 4,9 years; BMI 27,9 ± 2,6 Kg/m<sup>2</sup>; MBP 96,4 ± 4,0 mmHg; HR 66,5 ± 4,7 bpm) performed two experimental RE sessions (C and MS) composed by 12 exercises (3 sets; 14-17 reps; 60 % of 1-RM) with the same total work. Blood pressure (BP) and HRV were monitored before (20 min) and after (90 min) the exercises sessions. Autonomic regulation was evaluated by normalized low-LFR-Rnu) and high-frequency (HFR-Rnu) components of the R-R variability. RESULTS: Data showed significant changes in HRV (P > 0,05). LFR-Rnu increased, while HFR-Rnu decreased in both exercise sessions. MBP results are presented on the table below: RESULTS: The MBP remained significantly reduced throughout the monitoring period after the end of the exercise in relation to rest values for both RE training methods (C = - 6,1 ± 1,3 mmHg and MS = - 6,3 ± 1,5 mmHg; p 0,05). There was no significant difference in the MBP when the methods were compared. Data showed significant changes in HRV (p < 0,05). LFR-Rnu increased, while HFR-Rnu decreased in both exercise sessions. DISCUSSION: Despite some evidences that the RE variables could influence the cardiovascular behavior after its end (Polito et al., 2003; Jones et al.,2007; Rodriguez et al., 2008), both training methods caused PREH similarly. Furthermore, PREH is accompanied by an increase in sympathetic modulation to the heart observed by the HFR-Rnu increase. This behavior has been previously described for the MS (Rezk et al., 2006) but not for the C method. Additionally we can speculate that the PREH is not determined by the central nervous system. REFERENCES: Jones H, Atkinson G, George K, Edwards B. Eur J Appl Physiol (2007) 102:33-40. Polito M, Simão R, Senna G, Farinatti P.. Braz J Sports Med. 2003; 9: 74-7. Rezk CC, Marrache RCB, Tinucci T, Mion Jr D. Forjaz CLM. Eur J Appl Physiol (2006) 98:105-112. Rodriguez D, Polito MD, Bacurau RFP, Prestes J, Pontes Jr. Fl. Int J Exerc Sci 1(4) : 153-162, 2008.

### **THE PRESENCE OF PETS EFFECTS THE MENTAL AND PHYSICAL HEALTH OF JAPANESE OWNERS**

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Introduction The number of pets has been increasing in Japan, but the culture of pet ownership is different from other countries. Several reports associating the physical, psychological and social effects of human pet bonding exist in Japan. The objective of this study was to investigate the relationship between the presence of pets and the mental and physical health of their Japanese owners. Methods Persons selected at random voluntarily participated in this study. A questionnaire related to presence/absence of pet, animal breed, pet care, life change raising the pet and health-related QOL items was administered. Health-related QOL items assessed with the SF-36, the relationship between 4 scales (physical functioning:PF, general health perceptions:GH, vitality:VT, general mental health :MH) and pet ownership were analyzed. Results and Discussion The data sample consisted of 284 male and 714 female respondents. Score results of the 4 scales did not significantly differ between the pet owner group (POG) and non-pet owner group (NPOG). But GH scores in POG playing with pets were significantly higher than POG not-playing with pet and NPOG. MH scores in POG feeding to pets, grooming of pets, cleaning pet's cages were significantly higher than NPOG. It is suggested that regardless of the kind of pet, and contact pets have a good influence on the health of the owner. VT and MH scores in POG increased the opportunity for going at with pet breeding and POG increased the amount of physical activity with pet breeding were significantly higher than NPOG. 90% of POG was the dog owner. Moreover, the group with the increased amount of physical activity walking with dogs showed a tendency to increased VT scores. We could show the presence of dog play as a major role in promoting physical activity of the owner. The walking of a dog would bring benefits to the health of the owner by noticing that the walking of dogs helps to promote one's own health.

### **THE RELATIONSHIP BETWEEN PLASMA KLOTHO CONCENTRATION AND AEROBIC EXERCISE CAPACITY IN POST-MENOPAUSAL WOMEN**

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INTRODUCTION: The Klotho gene is a suppressor of the expression of aging-associated phenotypes (Kuro-o et al., 1997) and its plasma concentration decreases with aging (Yamazaki et al., 2010). It is also widely published that habitual aerobic exercise is an effective therapy for preventing aging-related diseases. However, little is known about the relationship between plasma Klotho concentration and aerobic exercise capacity. Therefore, the aim of this study was to determine whether plasma Klotho concentration is associated with aerobic exercise capacity. METHODS: Sixty-nine healthy, post-menopausal women aged from 50 to 76 years, participated in this study.

We measured physiological and hemodynamic characteristics, as well as oxygen consumption (VO<sub>2</sub>) at ventilatory threshold (VT), an index of aerobic exercise capacity. Plasma Klotho concentration was measured by enzyme-linked immunosorbent assay. The correlation between plasma Klotho concentration and VO<sub>2</sub> at VT was calculated by partial Pearson correlation analysis. Stepwise regression analysis was used to extract the significant parameters associated with plasma Klotho concentration. RESULTS: There was positive correlation between plasma Klotho concentration and the VO<sub>2</sub> at VT, adjusting for age and BMI ( $\beta = 0.329$ ,  $P < 0.01$ ). Furthermore, stepwise regression analysis showed that plasma Klotho concentration was significantly associated with VO<sub>2</sub> at VT. DISCUSSION: The present study found that plasma Klotho concentration was associated with aerobic exercise capacity in postmenopausal women. These results suggest that habitual aerobic exercise might increase plasma Klotho concentration. Therefore, the increase in plasma Klotho concentration may contribute to habitual aerobic exercise-induced anti-aging effect. REFERENCES: Kuro-o M, et al. Mutation of the mouse klotho gene leads to a syndrome resembling ageing. *Nature* 390: 45-51, 1997. Yamazaki Y, et al. Establishment of sandwich ELISA for soluble alpha-Klotho measurement: Age-dependent change of soluble alpha-Klotho levels in healthy subjects. *Biochem Biophys Res Commun.* 398: 513-518, 2010.

## DETERMINANTS OF PHYSICAL FUNCTION CHANGES AFTER A FALL-PREVENTION PROGRAM IN OLDER JAPANESE WOMEN

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**Introduction** Benefits to physical function (PF) induced by exercise training vary between adults. The purpose of this study was to investigate determinants of PF changes in older adults during a period of exercise training. **Methods** The subjects of this study were 68 community-dwelling older women (mean age:  $70.5 \pm 4.1$  years) in Kasama City, rural Japan. All subjects participated in a fall-prevention exercise called Square Stepping Exercise (SSE) (Shigematsu et al., 2008) conducted once a week for 11 weeks. To ascertain the PF benefits induced by the exercise program, we measured 9 physical performance tests: grip strength, one leg stand, sit and reach, functional reach, 5-time sit-to-stand, timed-up-and-go, 5-m habitual walk, manipulating pegs and choice-stepping reaction time. Additionally, we calculated a comprehensive score of the 9 physical performance tests using a principal component analysis. Change in comprehensive PF score between baseline and post test was used as a dependent variable, while baseline values of physical activity, the Lubben social network scale, the geriatric depression scale, the five cognitive function test and the comprehensive PF score were treated as independent variables. **Results** Stepwise multiple regression analysis revealed that the change in the comprehensive PF score correlated significantly with baseline values of comprehensive PF score ( $\beta = -0.448$ ) and the five cognitive function test ( $\beta = 0.257$ ). **Discussion** These results suggest that older women with a low level of PF at baseline are more likely to improve their PF with a period of exercise training. However, the improvement in PF would be less in older women with a low level of cognitive function than in older women with a high level of cognitive function. We recommend that researchers and physiotherapists consider this difference in PF improvement during exercise training programs when working with older women having a lower level of cognitive function. **References** Shigematsu R, Okura T, Nakagaichi M, Tanaka K, Sakai T, Kitazumi S, Rantanen T. Square-Stepping Exercise and Fall Risk Factors in Older Adults: A Single-Blind, Randomized Controlled Trial. *J Gerontol A Biol Sci Med Sci* (2008) 63 (1): 76-82.

## EFFECT OF EXERCISE HABIT ON DEPRESSION AND SENSE OF COHERENCE IN UNIVERSITY STUDENTS: FOCUS ON SEX DIFFERENCE

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**Introduction** Mental health disorder such as depression is one of serious problems in university students worldwide (Kunugimoto and Yamasaki.2008; B  r   et al. 2011). However, students with mental disorder who received treatment are rather few (Eisenberg. 2012). Thus, constructing students' mental health care system on campus is necessary. Regular exercise habit has a preventive effect against physical and emotional health problems; however, few studies have shown the association of exercise with mental health among university students categorized by sex. The aim of this study was to examine the association among depression, sense of coherence and regular exercise habit by sex. **Methods** The study was carried out in freshmen ( $n=2631$ ) in May to June 2010 at one of government funding university in the southeast part of Japan. The study participants answered to the following questionnaires; Center for Epidemiologic Studies Depression scale (CES-D), Sense Of Coherence by 13 items scale (SOC), students health questionnaires on regular exercise habit ("very few", "sometimes" and "almost every day") and quality and nature of college life. Height, weight, age and sex of the students were collected from students' annual health checkup held on April, 2010. Data was analyzed using SAS statistical package. Logistic regression analysis was conducted by sex using depression and SOC as dependent variables and regular exercise habit as an independent variable to assess the interrelationship among depression, SOC and regular exercise. Odds ratio and its 95%CI were calculated with adjustment of quality and nature of college life factors. **Results** In males, the adjusted odds ratio for depression in the group having moderate exercise habit (G2) was 0.74 (95%CI, 0.56 - 0.98) , and that in the group having exercise habit almost everyday (G3) was 0.54 (0.35 - 0.83), compared to the group who had least exercise habit (G1). The adjusted odds ratio for high SOC score in G2 was 1.36 (1.05 - 1.76) , and that in G2 was 2.27 (1.56 - 3.29), compared to G1. In females, those ratios were not significant. The adjusted odds ratio for depression in G2 was 0.69 (0.46 - 1.03), and that in G3 was 0.39 (0.11 - 1.35), compared to G1. The adjusted odds ratio for high SOC in G2 was 2.0 (1.41 - 2.86), and G3 was 1.09 (0.48 - 2.48), compared to G1. **Discussion** In male, regular exercise habit was independently associated with both depression and SOC. Conversely in female, regular exercise was not significantly associated with depression, and solely G2 was associated with SOC after adjusting by quality and nature of college life factors. The findings of the current study indicated that exercise has favorable preventive effect against depression and for SOC, whereas other factors than regular exercise have rather greater impact on depression and SOC for women. **References** Kunugimoto N, Yamasaki K.(2008). *Shinrigaku Kenkyu*, 16( 2), 141-148. B  r   E, Ad  ny R, K  sa K.(2011). *BMC Public Health*,11,871. Eisenberg D, Hunt J, Speer N. (2012). *Harv Rev Psychiatry*, 20(4),222-232.

## LOW FREE TESTOSTERONE LEVELS ARE ASSOCIATED WITH LOSS OF APPENDICULAR MUSCLE MASS IN JAPANESE COMMUNITY-DWELLING WOMEN

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**Introduction:** The relationship between endogenous testosterone (T) and age-related muscle loss among Japanese women is poorly understood. The objective was to demonstrate longitudinal relationships between baseline T levels and muscle mass changes in 477 community-living, middle-aged and elderly Japanese women. **Methods:** The subjects were 477 women who had participated in both the baseline and follow-up examinations (mean duration, 8.3 years). The subjects were not classified as having sarcopenia at the time of the baseline examination. Appendicular skeletal muscle mass (ASMM) was measured by dual-energy X-ray absorptiometry at baseline and follow-up examinations. The cut-off point for sarcopenia was defined as a skeletal muscle index (calculated by ASMM divided by height squared) of 5.46 kg/m<sup>2</sup> (Baumgartner et al., *Am J Epidemiol*, 1998; Sanada et al., *Eur J Appl Physiol*, 2010). Total T (TT) and free T (FT) were measured by radioimmunoassay at the baseline examination. The TT and FT were categorized approximately into tertiles. Multiple logistic regression models were fit to determine the association between TT or FT and sarcopenia while controlling for baseline age, body mass index, leisure-time physical activity, nutritional intakes (total energy, total protein, vitamin D), serum levels of C-reactive protein, medical histories (heart disease, osteoporosis, rheumatoid arthritis), menstruation, and smoking habit. The study protocol was approved by the Ethics Committee of the National Center for Geriatrics and Gerontology, and written, informed consent was obtained from all participants. **Results:** There were no significant relationships between sarcopenia and TT. The odds ratio of sarcopenia for the Low-FT group (<0.7 pg/mL) compared to the High-FT group (≥1.2 pg/mL) was 4.101 (95% confidence interval, 1.334-12.609). A significant negative trend ( $p$  for trend=0.0106) in the odds ratios of sarcopenia was found with increasing serum FT level. **Discussion:** The results indicate that endogenous FT levels are significant predictors of muscle loss over an 8-year period. Improvement of endogenous FT levels by appropriate therapies, such as androgen replacement therapy or lifestyle interventions, may reduce the risk of muscle loss during aging. **References:** Baumgartner RN, Koehler KM, Gallagher D et al., 1998 Epidemiology of sarcopenia among the elderly in New Mexico. *Am J Epidemiol* 147: 755-763. Sanada K, Miyachi M, Tanimoto M et al., 2010 A cross-sectional study of sarcopenia in Japanese men and women: reference values and association with cardiovascular risk factors. *Eur J Appl Physiol* 110: 57-65.

## PHYSICAL ACTIVITY AND FITNESS IN AFRICAN HIV POSITIVE WOMEN

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**INTRODUCTION** Physical activity (PA) has an important role on cardiovascular health. By turn, cardiorespiratory fitness (CRF) is and consensual indicator of cardiovascular health. High levels of CRF, expressed by VO<sub>2</sub>max, predicted lower risk of cardiorespiratory mobility and mortality. In this context PA and CRF in HIV positive population is an important issue since these population tend to drastic reduce PA physical levels as well as CRF. The aim of this study was to determine the levels of PA and CRF in a sample of HIV positive African women population from Mozambique which were submitted to antiretroviral therapy (ART) **METHODS:** 54 HIV positive Mozambican women (age=38,6±8,4 years) that were clinical controlled by ART participated on the study. Physical activity was assessed by accelerometer wearing, during 7 days, an accelerometer Actigraph model GT3X. Cardiorespiratory fitness were assessed by VO<sub>2</sub>max using a modified treadmill Balke protocol and a Cosmed K4 gas analyser. CRF classification criterion was made according to ACSM classification for healthy women's for the respective age. **RESULTS** Time spent in moderate to vigorous activity was higher than one hour per day in 66% of the subjects while 97.7% spent more than half hour on that activity level. Average percentile of VO<sub>2</sub>max relative to ACSM norms were 65±24. According to classification criteria 81,8% were classified as Healthy (10.9% Reasonable=; 29,1 % Good; 36.4% Exlent; 5.5% Superior). Only 18,2% did not attained the criterion value. **DISCUSSION** CRF levels were higher than expected for HIV positive women's. Associated with their healthy condition, levels of activity and consequently levels of fitness use to be reduced. Due to the socioeconomic conditions of this sample, levels of activity seems to be high related to survival activities like walking, carrying and non-mechanical households. Their lower levels of fat may also contribute for the high aerobic power. Further similar studies in African population are needed to explore our finding in different settings.

## RELATIONSHIPS AMONG SLEEP DURATION, BODY MASS INDEX AND ARTERIAL STIFFNESS IN 4TH TO 8TH GRADES JAPANESE CHILDREN

Morita, N., Oda, S.1, Kambayashi, I., Okuda, T., Nakajima, T.2, Ishizawa, N., Nakamichi, R., Fukuoka, R., Kamiie, S., Takahashi, M., Mizoguchi, H., Asakura, J., Narayama, S., Shide, N., Shinkaiya, H.

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**Introduction:** The childhood obesity and high blood pressure are expected to increase cardiovascular disease risk in adulthood. Recently, some studies demonstrated that short sleep duration associated with obesity and high blood pressure even in children (Javaheri et al., 2008; Lytle et al., 2011). However, little is known about whether short sleep duration increases arterial stiffness in children. In this study, we investigated relationships between daily sleep duration and arterial stiffness indices in Japanese 4th to 8th grades children. **Methods:** This is a cross-sectional study of 113 elementary and junior high school children (63 boys and 50 girls). As noninvasive arterial stiffness indices, the children's cardio-ankle vascular index (CAVI; Vasera VS-1000, Fukuda Denshi Co., Tokyo; Shirai K et al., 2011) were measured in rest condition. During the measurement, brachial systolic blood pressure and heart rate were also obtained. When systolic blood pressure or heart rate were over 130 mmHg or 100 bpm, respectively, those children's data were excluded. Children answered questionnaires regarding their sleep habits (bedtime and wake-time on usual weekday) and then we obtained their sleep duration by difference between the bedtime and the wake-time. Body weight and height were measured, and then body mass index (BMI) z-score was calculated by using BMI reference data of Japanese children. Relationships among measures were analyzed by Pearson correlation and multiple regression analyses. **Results:** CAVI values were 4.8±0.9 in boys and 4.7±0.9 (arbitrary unit) in girls. CAVI values were correlated negatively with sleep duration (boys,  $r = -0.34$ ,  $p < 0.01$ ; girls,  $r = -0.24$ ,  $p = 0.10$ ). Significant linear correlations were shown between BMI z-score and CAVI values in both genders (boys,  $r = -0.56$ ; girls,  $r = -0.35$ , both  $p < 0.01$ ). In multiple regression analysis, when CAVI was used as the dependent variable and age, gender, BMI z-score and sleep duration as the independent variables, only CAVI and BMI z-score remained significant (R-square = 0.328,  $p < 0.001$ ). **Conclusion:** These results raise a possibility that short sleep duration in childhood

could lead to acceleration of arterial stiffening. References: Javaheri S, et al., (2008) *Circulation*, 118: 1034-1040. Lytle LA, et al., (2011) *Obesity*, 19: 324-331. Shirai K et al., (2011) *J Atheroscler Thromb*, 18: 924-938.

### SEASONAL DIFFERENCES IN THE LIFE-STYLE AND MENTAL HEALTH IN MIDDLE AND OLD AGE SPORTS CLUB MEMBERS LIVING IN A NORTHERN AREA

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**Introduction:** Seasonal affective disorder (SAD) which can manifest as depression from autumn to winter, is often associated with the shortening of sunlight hours in higher latitude areas (Magnusson et al., 2003). In addition, it has been reported that people living in northern areas have a decreased amount of daily activity in winter (Marchant et al., 2007). It has also been reported that sleep quality is improved by an increase of daily activity (King et al., 1997). However, there were few studies that examined the relationships between the amount of daily activity, sleeping habits, and mental health. The purpose of this study is to examine the seasonal differences of sleep habits and mental health in middle and old age sports club members living in a northern area. **Methods:** Subjects in this study were 226 people over the age of 40 with a mean age of  $61.0 \pm 7.4$ . All participants were members of comprehensive community sports club in a northern area of Japan. They participate in a fitness classes. To compare the seasonal differences, a questionnaire was given in spring and then again in autumn 2011. The questionnaire was composed of personal profiles about their life-style, including sleep and eating habits and psychological measurements. Sleep habits were assessed by the Japanese version of the Pittsburgh Sleep Quality Index (PSQI-J). Eating habits were assessed by a food intake frequency questionnaire (FFQ). The psychological measurement used a 30-item General Health Questionnaire (GHQ30). **Results:** Mean values of total points for PSQI-J were  $5.4 \pm 2.8$  in spring and  $5.1 \pm 3.0$  in autumn, while the total points for GHQ30 were  $3.6 \pm 3.8$  in spring and  $3.0 \pm 3.5$  in autumn. In comparing spring and autumn, there was no significant difference between the total score of PSQI-J and GHQ30. The ratio of high score to PSQI-J was 41.0% in spring and 35.1% in autumn. Two items of FFQ in autumn, exercise and health and eating behavior, were significantly higher than in the spring. **Discussion:** There were not seasonal differences in the sleep habits and mental health in middle and old age sports club members living in the northern area. There were however, seasonal differences in food intake behavior. These results suggest that people who have an active lifestyle are not affected by seasonal changes in regards to their sleep quality and mental health. Even though this study's population with active lifestyle was not affected by seasonal changes, it became clear that sleep problems still occur in over 30% of the population. **Acknowledgments:** This study was performed in part by a grant from MEXT-Supported Program for the Strategic Research Foundation at Private Universities, 2011-2013. **References:** King et al (1997) : Moderate-intensity Exercise and Self-rated Quality of Sleep in Older Adults, *JAMA*. 277(1), 32-37 Magnusson et al (2003) : Seasonal Affective Disorder: An Overview, *Chronobiol Int*, 20(2), 189-207 Marchant et al (2007): Seasonal Variation in Leisuretime Physical Activity Among Canadians, *Canadian J Public Health*, 98(3), 203-208

### ASSOCIATION BETWEEN PHYSICAL ACTIVITY INTENSITIES AND SLEEP HABITS IN JAPANESE WORKERS

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**ASSOCIATION BETWEEN PHYSICAL ACTIVITY INTENSITIES AND SLEEP HABITS IN JAPANESE WORKERS** 1) Graduate School of Human Environment Studies, Kyushu University, Japan 2) Institute of Health Science, Kyushu University, Japan **Introduction** Sleep is one of the most important factors in maintaining optimal health. Previous research showed that physical activity has impact on quality of sleep<sup>1)</sup>. However, few studies indicate the relationship between objective physical activity measures and sleep habits. The aim of this study is to evaluate the concordance between an accelerometer-derived physical activity and subjective sleep habits in Japanese workers. **Methods** Data was collected from a total 395 men and women, aged above 20 years who participated in the CRC Health Survey in the northwest of Japan. Physical activity during waking hours was measured by a single tri-axial accelerometer device (HJA-350IT; Omron Healthcare, Inc., Kyoto, Japan) placed on the waist for an average of 7 consecutive days. Physical activity rate indicators included the volume (METs hour/day) and time spent (minute). Sleep habits (sleep time, wake time and sleep latency) was evaluated by Pittsburgh Sleep Quality Index (PSQI) Descriptive statistics were carried out for all variables. A chi-square test was used to analyze a relationship among categorical variables. To calculate crude associations of sleep habits with physical activity intensities, a simple linear regression was run for each of the two physical activity intensities; light physical activity (LPA) and moderate-to-vigorous physical activity (MVPA). **Results** The study has shown insomnia prevalence rates of 28.8% with sleep time average of  $24.30 \pm 2.0$  (hour), wake time average of  $7.12 \pm 2.12$  (hour) and sleep latency average of  $16.30 \pm 14.30$  (minute). The association between the volume of LPA and sleep time was 4.15 ( $P < 0.05$ ), which shows that the volume of LPA and sleep time were statistically significant and positively associated. The volume of and time spent in LPA also was positively associated with wake time variable ( $P < 0.05$  in both), whereas MVPA was only inversely associated with sleep time ( $P < 0.05$ ). **Discussion** The primary finding of this study is that, the volume of and time spent in LPA showed positive association with sleep and wake time, which shows that sleep-wake cycle was affected by LPA. The significant association between the volume of MVPA and sleep time shows that MVPA might improve the sleep-wake cycle. Since the studies on objective measurements of physical activity intensities and sleep habits conducted in workers were relatively few, further studies are needed to confirm these results. **References** 1) Shelley S. Tworoger, et al. Effects of a Yearlong Moderate-Intensity Exercise and a Stretching Intervention on Sleep Quality in Postmenopausal Women. *SLEEP*, Vol. 26, No. 7, 2003

### MODELING SPORTS PARTICIPATION IN PORTUGUESE YOUNGSTERS USING A VARIANCE COMPONENTS APPROACH. A SIBLING STUDY

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**Introduction** It is well established that a vast majority of youngsters do not meet international guidelines for moderate-to-vigorous physical activity. Furthermore, it has been shown (Vilhena et al., 2012) that family is a potent correlate of physical activity and sports participation (SP) habits. Not many studies addressed the issue of sibling clustering in SP (Gomes et al., 2012), and if their age, birth order (BO), sex and body mass index (BMI) condition this healthy habit. This study addresses these issues. **Methods** We sampled 10 to 18 years old Portuguese siblings: 270 male, and 279 female pairs, as well as 499 opposite-sex pairs (totaling 2096 subjects). SP was assessed with the Baecke et al. (1982) questionnaire, using information from sports practiced, corresponding estimated energy expenditure, its duration,

and frequency. Furthermore, BMI and BO were also assessed. Siblings' correlations (rsibs) and modeling age, sex, BMI, and BO effects in SP were done in S.A.G.E. software, for variance components among family members. Results Sport participation prevalence in males is 68.3% (95%CI= 66.1-70.3), and in females is 42.3% (95%CI=40.1-44.6). Team sports are most prevalent than individual sports. No sex-specific correlations were found among siblings (Chi-Square=3.27,  $p=0.19$ ; rsibs=0.27±0.02,  $p<0.001$ ). Sibling dyads explained 30% of SP total variance. On average, boys are more sportive than girls (sex effect=0.39±0.036,  $p<0.001$ ); SP increases with increasing age (age=0.030±0.006,  $p<0.001$ ); first born siblings do more sports than second born siblings (BO=0.062±0.02,  $p=0.021$ ). No significant effects were found for BMI, or BO by sex interactions. Discussion On average, 55.2% of Portuguese youngsters practice sport, and boys are consistently more sportive than girls, which is consistent with international data, and public information from the Portuguese Institute of Sport (IDP, 2011). As expected older subjects do more sport, and birth order does significantly distinguish within dyads sports practice (Gomes et al., 2012). Siblings' variance component (30%) may be explained by genetic and shared family environment (Vilhena et al., 2012). The most important finding is that BMI does not condition sports practice – a true message that sport is for all. References Baecke JA, Burema J, Frijters JE (1982). *Am J Clin Nutr* 36: 936-942. Vilhena DM, Katzmarzyk PT, Seabra AF, Maia JA (2012). *Behav Genet* 42: 559-578. Gomes TNQF, Santos FK, Chaves RN, Garganta R, Seabra A, et al. *Rev Port Ciên Desp* (2012). (in press). IDP (2011). Instituto de Desporto de Portugal. This work was supported by the FCT –Fundação para a Ciência e a Tecnologia for granting this research (PTDC/DES/67569/2006, FCOMP-01-0124-FEDEB-09608 and SFRH/BD/65290/2009).

## 14:00 - 15:00

### Mini-Orals

#### PP-PM20 Health and Fitness [HF] 14

##### **INTEGRABILITY OF A COMPUTER-BASED EXERCISE PROGRAM IN PEDIATRIC ONCOLOGY AND EFFECTS ON QUALITY OF LIFE AND FATIGUE SYNDROME -TRIAL IN PROGRESS-**

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**Introduction** The benefits of physical activity in cancer therapy in adults are well documented. In addition to an increase of physical performance there can be positive effects on quality of life and reduction in fatigue syndrome. In pediatric oncology this approach has not been sufficiently explored. The aim of this study is to research the integrability of a child-friendly computer-based exercise program in the pediatric oncology as well as the effects of the intervention on quality of life and fatigue syndrome. Results could underline the need for exercise therapy as a useful supportive therapy in pediatric oncology. **Methods** Thirty subjects with malignant neoplasm (ICD10 C00-C97) between 6-18 years will be included. The intervention involves a computerized exercise program over three months, twice a week. Intensity and duration of exercise program depends on individual day's form and consists of a fitness program and an active adventure game. Health-related quality of life (KINDL) and fatigue syndrome (PEDsQL multidimensional Fatigue-scale) will be assessed by questionnaire. During the intervention heart rate will be measured. Before and after every fourth intervention a brief emotional questionnaire (mood meter) will be answered. Integrability of the intervention will be determined by drop-out. **Discussion** Well-controlled studies about physical activity in pediatric oncology do not exist. Small uncontrolled interventions already shows that movement in any form and intensity in the acute phase in paediatric oncology can have positive effects on functional mobility, quality of life and self-confidence (San Juan et al. 2007). Studies about other chronic diseases could demonstrate that the use of a computer-aided fitness program was able to reduce fatigue (Yuen et al. 2011) and improve sensorimotor skills (Wuang et al. 2011). More studies exploring this approach in pediatric oncology and supporting natural need for movement will be needed. **Perspective** The findings of the this study suggest guidelines and recommendations about possibilities and contraindications of exercise therapies in pediatric oncology. References San Juan AF, et al. (2007). Early-phase adaption to intrahospital training in strength and functional mobility of children with leukemia. *J strength cond res.* 21(1): 173-77 Wuang YP, et al. (2011). Effectiveness of virtual reality using Wii gaming technology in children with Down syndrome. *Res dev disabil.* 32(1): 312-21 Yuen H, et al. (2011). Using Wii Fit to reduce fatigue among African American women with systemic lupus erythematous: A pilot study. *Lupus.* 20(12): 1293-99

##### **THE EXPECT STUDY - EXERCISE DURING PREGNANCY EVALUATIVE CONTROLLED TRIAL**

Davies, R.E., D'Silva, L., Emery, S., Lewis, M.J.

*Swansea University*

Exercise is believed to be beneficial during pregnancy and is therefore recommended for healthy women with normal pregnancies (Artal & O'Toole, 2003). Antenatal exercise might also be important in the management of pregnancy-induced disease (Sorensen et al., 2003). However, no official exercise guidelines have been published in the UK, leading to conflicting advice and much confusion for pregnant women. This study aimed to examine the influence of regular exercise during pregnancy on cardiovascular, haemodynamic and autonomic nervous system (CHANS) parameters during and following pregnancy. Participants were randomly assigned to either one of two weekly exercise groups (water (w) or land (l) based class) or to a control group (n, no organised exercise) using a 2x2x2 design. Non-invasive monitoring of CHANS variables (Heart Rate (HR), Stroke Volume (SV), Left Ventricular Ejection Time (LVET), SDRR, RMSSDRR, LFn) were performed at 15.0±0.2 weeks (T1, n=47, l=12, w=5), 25.4±0.2 weeks (T2, n=43, l=5, w=2), 34.7±0.3 weeks (T3, n=36, l=0, w=1) and 13.5±0.5 weeks post partum (T4, n=22, l=0, w=0). 62 non-pregnant females (no organised exercise) were also assessed using the same protocol. Participants performed postural manoeuvres (supine, standing), stepping exercise, seated recovery (all 6 minute blocks), mental arithmetic and controlled and spontaneous breathing (all 3 minute blocks). Mixed between-within repeated measures ANOVA assessed the influence of main factors 'Protocol Stage', 'Trimester (T1-T4)' and 'Exercise Group' on each CHANS variable. Post-hoc analysis with Bonferroni correction identified the locations of significant differences. One way ANOVA assessed the stage-specific influence of trimester and exercise group on CHANS variables. Qualitative changes in HR, SV and LVET were observed with advancing gestation during the T1-T3 period. RMSSDRR was diminished between T1 and T3 compared with non-pregnant women during the standing and exercise transitions ( $p<0.0005$ ). A reduced LFn response to standing was observed throughout pregnancy ( $p<0.0005$ ). The SDRR response to standing was enhanced during T2 and T3 ( $p=0.041$ ,  $p=0.028$ ). Exercise influenced the trend in LVET and HR throughout the protocol ( $p=0.047$ ,

$p=0.050$ ). There was also a tendency towards an Exercise Group x Trimester interaction for HR ( $p=0.072$ ). HRV variables and SV were not affected by exercise. The results of this pilot study are limited by the fact that recruitment is still at an early stage, and so the number of participants in each of the exercise groups is low. However these initial findings suggest that HR and LVET might be influenced by antenatal exercise. Sorensen, T. K. et al (2003) Hypertension, 41:1273-80 Artal, R. & O'Toole, M. (2003) British Journal of Sports Medicine, 37:6 – 12

### ACTIVATING EVERYDAY LIFE OF GENERATION X – A RCT STUDY

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**Introduction** Physical inactivity accounts for more than 3 million deaths annually (WHO 2011). Physical activity (PA) is a major contributor for both physical and mental wellbeing, and is needed to maintain public health. PA is not only about sports and exercise, but also being active at work, home, in commuting and during leisure time. Evidence-based interventions to promote PA are therefore of great importance. Many of us want to be physically more active, but have found it challenging. Activity monitors provide a means to set targets for daily activity and to follow the intensity, frequency, and duration of PA. Monitoring daily activity has been shown to motivate for PA. We studied the PA changes induced by Polar Active (Polar Electro Oy, Kempele, Finland) activity monitor during a 10-week randomized controlled trial. **Methods** Inclusion criteria for the study were: age 35 – 55, BMI < 30.1 and no sports engagement. The subjects also reported daily PA challenging and wanted to increase everyday PA. In total 60 females and 54 males were randomized into an intervention (30 females, 28 males) and control group (30 females, 26 males). During a 1 week run-in period all subjects used a blinded PA monitor for baseline PA recording. During the following eight week period the intervention group used PA monitor with display and diary functions while the control group continued with the blinded PA monitor. All subjects downloaded their PA data biweekly via an internet interface. The effect of intervention was evaluated by comparing baseline PA to week 8 PA estimated in METs. **Results** Both groups increased their weekday daily mean PA (> 2 MET); intervention group by  $62 \pm 114$  min ( $p < 0.001$ ) and control group by  $47 \pm 104$  min ( $p < 0.001$ ). The mean increase was 40 min higher in females in the intervention group ( $73 \pm 119$  min) than in the control group ( $34 \pm 103$  min;  $p = 0.003$ ). There was no difference between groups in males. Also the weekday mean of more vigorous PA (> 3.5 MET) increased in both groups but there was no difference between the groups. No change was seen in more vigorous PA (> 3.5 MET) during weekend even though PA > 2 MET increased similarly in both groups during weekends. **Discussion** Pretty light intervention, a wrist-worn activity monitor and a biweekly email reminder together with activity data downloads increased the > 2 MET PA with an hour per weekday in the intervention group. Such increase, if durable, has a positive impact on health. The results also confirm that female daily PA may differ from the one of males and that PA monitoring tool may have a stronger effect on females.

### RELATIONSHIP OF CARDIORESPIRATORY FITNESS WITH HEALTH-RELATED QUALITY OF LIFE IN MOROCCAN ADULT WOMEN

Aparicio, V.A., Carbonell-Baeza, A., Senhaji, M., Ruíz-Cabello, P., Camiletti-Moirón, D., Fernández, M., Andrade, A., Delgado-Fernández, M., Aranda, P.

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**Introduction** Due to religion and socioeconomic factors, Moroccan women's health is understudied, especially regarding fitness. The purpose of this study was to analyze the association of cardiorespiratory fitness with health-related quality of life in Moroccan adult women. **Methods** The study comprised 151 women from the North of Morocco (Tetouan and close villages) with an age ranged 45-65 years ( $52.5 \pm 3.8$  years). The 6-min walking test was used to assess cardiorespiratory fitness. Quality of life was assessed by means of the Arabic version of the Short-Form-36 Health Survey (SF36). **Results** The 6-min walking test showed a weak relationship with physical function ( $=0.002$ ), physical role ( $=0.005$ ) and bodily pain ( $=0.003$ ) subscales from the SF-36 ( $p$  ranged 0.241-0.263), and a low relationship with vitality ( $=0.023$ ) and emotional role ( $=0.044$ ) ( $p$  ranged 0.173-0.194). General health, social function and mental health subscales did not show significant correlations. **Discussion** We have found associations between cardiorespiratory fitness and most of the subscales from the quality of life questionnaire employed (SF36). In agreement with our results, Karelis et al. (2008) examined the psychosocial correlates of cardiorespiratory fitness ( $VO_{2peak}$ ) in 137 overweight and obese sedentary post-menopausal women and observed almost the same correlations than us for all the SF36 subscales. The association of cardiorespiratory fitness with mental health is gaining importance in the last years. Therefore, Ortega et al. (2010) observed as individuals with both a low level of negative emotion and a high level of cardiorespiratory fitness had a 63% lower risk of premature death than those with higher levels of negative emotion and a low level of cardiorespiratory fitness. **References** Karelis, A.D., Fontaine, J., Messier, V., Messier, L., Blanchard, C., Rabasa-Lhoret, R., Strychar, I., 2008. Psychosocial correlates of cardiorespiratory fitness and muscle strength in overweight and obese post-menopausal women: a MONET study. *J Sports Sci* 26:935-40. Ortega, F.B., Lee, D.C., Sui, X., Kubzansky, L.D., Ruiz, J.R., Baruth, M., Castillo, M.J., Blair, S.N., 2010. Psychological well-being, cardiorespiratory fitness, and long-term survival. *Am J Prev Med* 39:440-8.

### SELF-ADMINISTRATED VESTIBULAR REHABILITATION TREATMENT FOR DIZZY PATIENTS

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**Introduction** The aim of this study was to evaluate the effectiveness of the physiotherapy manipulation treatment for dizzy patients that could also be home-based. The so-called vestibular gymnastics protocol involving various head, neck and whole body exercises was conducted throughout the period of 5 weeks 5 times a week. Indication areas for this type of physiotherapy are all types of vertigo and dizziness no matter if it is central or peripheral. The designed exercises were aimed to provoke the vestibular apparatus response. Apart from the first educational session, all of the patients received the information leaflet describing and depicting the exercise protocol in details. **Methods** For the purpose of the study the data of 130 patients (age 23-67;  $49.6 \pm 12.2$ ; 72 male and 58 female) with vestibular vertigo symptoms treated during the 2007 and 2008 were analyzed. Two 1-20 point symptoms scales FreqSymp and IntSymp (frequency and intensity of the disturbances) were designed for this purpose and were used in order to obtain subjective evaluation. The peripheral impairments were diagnosed by Fitzgerald-Hallpike caloric test while the central impairments as well as the differentiation between both were diagnosed by electronystagmography. **Results** Altogether 86.03% of the patients gained some benefits from the treatment. The group of the patients in which the improvement was not observed consisted mostly of the older patients, all with central impairments

(N=17). On the contrary, only 21% of the controls were evaluated as improved. There was a small but significant correlation observed between the age and the results while no correlation was seen between the gender and the improvements. Unfortunately there was also a high correlation between the intensity and the frequency of the symptoms meaning that the patients who had the most severe symptoms had them also the most often. Conclusions We have demonstrated that the very simple modified vestibular rehabilitation program, which could easily be home-based, might decrease the frequency and the intensity of symptoms in dizzy patient. It seems that in this type of rehabilitation the improvements may be achieved no matter if symptoms were acute or chronic or if the etiology was central or peripheral. References 1. Bittar RS et al. Critical analysis of vestibular rehabilitation outcome according to dizziness etiology, Braz J Otorhinolaryngol. 73(2007),760-4. 2. Chang CP, Hain TC. A theory for treating dizziness due to optical flow (visual vertigo), Cyberpsychol Behav. 11(2008), 495-8. 3. Giray M, et al. Short-term effects of vestibular rehabilitation in patients with chronic unilateral vestibular dysfunction: a randomized controlled study, Arch Phys Med Rehabil. 90(2009), 1325-31. 4. Teggi R et al. Rehabilitation after acute vestibular disorders, J Laryngol Otol.123(2009),397-402.

## COMPARISON OF STATIC BALANCE WITH VISUAL CONTROL IN ELDERLY PERSONS

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Introduction Balance is fundamental functional capacity in elderly to carry out their daily living activities (DLA). Over the time the elderly tend to lose this functional capacity, increasing the risk of injury from falls. Therefore, the goal of this research is to compare the visual static balance control in elderly people. Methods The sample consisted of 202 older adults with a mean age of 68 years and standard deviation of  $\pm 8$ . For the analysis of visually controlled static balance the volunteers performed the static balance battery by Grene Williams (1990). Results Statistics demonstrated the predictive effect of the percentage of seniors who completed the test between variables: Man / Woman (Men = 43.75% - 16.96% = Women), active / non-active (Assets = 23 28% - No Assets = 21.42%), AFRID / non-AFRID (AFRID = 26.47 - 20.48 = Not AFRID). And we noted a higher rate of occurrence of seniors who completed the test in the range 60-69 years (58.62%). Another fact that was observed: only 23.26% of the total sample reached the 30 seconds of the test. Conclusion We found that men had a higher percentage of visually controlled static balance than women, active subjects also had a small advantage over non-active subjects, and the group that trained supervised by the University trainers had an advantage over the group that trained without supervision. The age range with the highest occurrence of visually controlled static balance was the 60-69 years, ahead of the 70-79 and 80-89 years. We concluded that the static balance training should be taken into consideration in gyms and clubs, because physical activity to prevent falls should be included in elderly training programs to help them carry out their DLA. References BOTELHO, M. F. C. & RIBEIRO, T. V. Estudo do Equilíbrio Estático e Dinâmico em Indivíduos Idosos. Actas das Jornadas Científicas. Faculdade de Ciências do Desporto e Educação Física - Universidade do Porto, 2009. MATSUDO, S. M. M. Avaliação do Idoso: física e funcional. São Caetano do Sul: Midiograf, 2000. SPIRDURO, W. W. Physical dimensions of aging. Champaign IL: Human Kinetics, 1995.

## SUBSTRATE OXIDATION FOLLOWING CONCENTRIC AND ECCENTRIC ENDURANCE EXERCISE IN OLDER ADULTS

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Introduction A lower ability to oxidise fat is associated with ageing and several disease states (Jeukendrup & Wallis, 2005; Sial et al., 1996). However, participation in endurance based exercise has been shown to decrease carbohydrate utilization and increase lipid oxidation when tested at the same absolute exercise intensity (Carter et al., 2001). We examined substrate oxidation in elderly adults, at a constant self-selected walking speed, following a program of regular level and downhill treadmill walking (i.e. concentric or eccentric endurance exercise) at self-selected walking speeds. Methods 18 healthy elderly adults (67 $\pm$ 5 yrs, 170 $\pm$ 9 cm, 77 $\pm$ 14 kg) volunteered. Participants completed 12-weeks of level [LW: 0% gradient (n=8)] or downhill [DW: -10% gradient (n=10)] treadmill walking (30-mins, 3x week) at a self-selected walking speed (SSWS, re-adjusted every 4-wk). Gas exchange measurements were obtained using the Douglas bag method during the last 3-minutes of a 15-minute level treadmill walk (Baseline SSWS: 1.24  $\pm$  0.13 m/s-1) before and after the exercise intervention. Substrate oxidation (carbohydrate, CHO; Fat, F) was calculated using the equations presented by Peronnet & Massicotte (1991). A two way repeated measures ANOVA with post-hoc pre-planned t-tests were used for data analysis (P<0.05). Results Baseline absolute VO<sub>2</sub> (LTW: 0.94  $\pm$  0.29 L/min-1; DTW: 0.98  $\pm$  0.22 L/min-1) and VCO<sub>2</sub> (LTW: 0.85  $\pm$  0.24 L/min-1; DTW: 0.86  $\pm$  0.19 L/min-1) were similar for both exercise groups walking on a level gradient at SSWS (P>0.05). Following 12-weeks of treadmill walking, VO<sub>2</sub> and VCO<sub>2</sub> decreased by 9% and 8 % respectively at SSWS, for both LTW (VO<sub>2</sub>: 0.85  $\pm$  0.22 L/min-1; VCO<sub>2</sub>: 0.77  $\pm$  0.22 L/min-1) and DTW (VO<sub>2</sub>: 0.84  $\pm$  0.16 L/min-1; VCO<sub>2</sub>: 0.81  $\pm$  0.16 L/min-1; P<0.05). Substrate oxidation during the level treadmill walk was similar between exercise groups at baseline (P>0.05) and did not change following 12-weeks of LTW (CHO: 0.88  $\pm$  0.34 g/min-1; F: 0.14  $\pm$  0.14 g/min-1) or DTW (CHO: 0.96  $\pm$  0.35 g/min-1; F: 0.10  $\pm$  0.09 g/min-1; P>0.05). Discussion Regular level and downhill treadmill walking at a self-selected walking speed resulted in lower oxygen consumption and carbon dioxide production for the same intensity (1.24  $\pm$  0.13 m/s-1). However, there was no increase in fat oxidation or decrease in carbohydrate oxidation as demonstrated following exercise training in older adults (Sial et al., 1998). This could be due to the lower intensity of the training programme (% age-predicted maximum heart rate = range 56-74). Additionally, the exercise period during which substrate oxidation was measured (15-minutes) was lower than previous studies (60 – 90 minutes) (Carter et al., 2001; Sial et al., 1998). References Carter S, Rennie C, Tarnopolsky M. (2001). Am J Physiol Endocrinol Metab, 280, E898-E907. Jeukendrup A, Wallis G. (2005). Int J Sports Med, 26, S28-S37. Peronnet F, Massicotte D. (1991). Can J sport Sci, 16, 23-29. Sial S, Coggan A, Hickner R, Klein S. (1998). Am J Physiol Endocrinol Metab, 274, E785-E790.

## CROSS-COUNTRY SKIING IN KIDNEY TRANSPLANT RECIPIENTS

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Introduction Cross-country skiing is an endurance sporting activity that stimulates aerobic performance capabilities. In chronic diseases aerobic metabolism is impaired particularly in patients waiting for solid organ transplantation. After successful transplantation, patients can recover their physical fitness utilizing endurance sporting activities, however limited information has been published about sporting activities in organ Transplant Recipients (TR). The aim of this preliminary study is to evaluate "in the field" the metabolic response and the performance capacities of a group of kidney TR during a cross-country skiing competition. Methods Eight kidney TR (one of which with combined kidney-pancreas transplant) aged 45 $\pm$ 13yrs, participated in a cross-country skiing race (3 km long, flat) at an altitude of 1,520

m above sea level (air temperature: 3°C). They undergone transplant 179±98 months before, all were under immunosuppressive therapy, with creatinine 1.2±0.3 mg/dL. The energy expenditure (EE) was measured by a multi-sensor device recording physiological body signals (skin temperature, heat flux, galvanic skin resistance, the pattern of movement; Armband, Body Media, Pittsburg, PA) worn on the lateral head of the right triceps brachii. The Heart Rate (HR) was measured by heart rate monitors (Polar, Finland). Between the 3rd and the 5th minute after the finish each skier was took a sample of capillary blood from the earlobe which was immediately analyzed with Arkray portable Lactate Analyzer for blood lactate concentration [La]. Results All the transplanted skiers complete the race without problems. The mean time taken for completing the cross-country skiing race was 9:27±3:14 (mm:ss). During the race the mean HR was 80±9% of the theoretical maximum HR (220-years) and the mean [La] measured at the end of the competition was 7.1±1.2 mmol/L. The mean EE during the race was 458±219 kcal/h. Conclusions Kidney TR may participate in a cross-country skiing race choosing the technique (skating or classical) according to their capabilities and are able to stress the cardiovascular system up to intensities around the anaerobic threshold. Obviously there are a wide range of performances but the metabolic involvement can be considered normal and roughly comparable to that of amateur cross-country skiers. These patients represent the upper limit of performance currently available for kidney transplant patients and in any way can not be considered representative of the entire TR population. However, data collected on patients who practice sports activities can help us to understand their potential performance and thus to promote physical activity and sport for all the transplant patients.

### EFFECTS OF HIGH AND MODERATE INTENSITY AEROBIC EXERCISE ON EXCESS POST-EXERCISE OXYGEN CONSUMPTION IN MEN WITH METABOLIC SYNDROME

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**Introduction** Physical activity is central in the prevention and treatment of metabolic syndrome, as effective weight reduction and increased physical activity levels reduce risk factors associated with metabolic syndrome (Katzmarzyk et al., 2005). It may also induce larger energy expenditure during post-exercise recovery. The primary aim of this study was to compare the excess post-exercise oxygen consumption (EPOC) between three sessions of aerobic exercises with different intensity and duration. **Methods** Seven men (age: 39-70 yrs) with metabolic syndrome participated in this crossover study. Three aerobic exercise sessions were performed as: four aerobic intervals (4-AIT) at 85-95% of HRmax, one aerobic intervals (1-AIT) at 85-95% of HRmax, and 47 minutes of continuous moderate exercise (CME) at 70% of HRmax in separate days, with at least 48 hours between each test day. Resting metabolic rate (RMR) was measured pre-exercise before each exercise session and used as baseline value. EPOC was measured until baseline metabolic rate was re-established. Results 4-AIT showed a significant longer period of EPOC than both 1-AIT (mean diff.: 35 min,  $P < 0.001$ ) and CME (mean diff.: 25 min,  $P = 0.04$ ). 4-AIT had a significantly higher accumulated O<sub>2</sub>-uptake during the EPOC period as compared to the 1-AIT (mean diff.: 1.5 l O<sub>2</sub>,  $P = 0.05$ ). **Discussion** The results of this study suggest that 4-AIT induces a larger EPOC compared with and, hence it seems appropriate to recommend high intensity interval exercise with regards to prevention and treatment of metabolic syndrome. Higher exercise intensity training has been shown to be more effective in decreasing risk and preventing metabolic syndrome compared to lower intensity training. A previous study demonstrated that high intensity exercise training was superior to moderate-intensity training in reversing risk factors of metabolic syndrome (Tjønnå et al. 2005). An increased EPOC in addition to reversing risk factors of metabolic syndrome makes high intensity intervals beneficial in preventing the metabolic syndrome. In addition to the exercise intensity, this study also highlights the importance of the duration of the training stimuli, i.e. 4-AIT significantly increased EPOC as compared to 1-AIT. Notwithstanding the higher EPOC for 4-AIT, the major contribution of both treatments to weight loss is via the energy expended during the actual exercise, and the exercise should likely be undertaken regularly for EPOC to have an increasing effect on weight reduction. **References** Katzmarzyk PT, Church TS, Janssen I, Ross R, Blair SN. (2005). *Diabetes Care*, 28, 391-397. Tjønnå, A.E, Lee, S. J., Rognum, O., Stølen, T.O, Bye, A., Haram, P.M., Loennechen, J. P., et al. Aerobic interval training versus continuous moderate exercise as a treatment for the metabolic syndrome: a pilot study. *Circulation*. 2008;118(4):346-54.

### THE EFFECT OF AN 8-WEEK GREEN EXERCISE PROGRAMME ON MARKERS OF MENTAL AND VASCULAR HEALTH

Thompson, J.E.S., Webb, R., Llewellyn, D., Hewlett, P., McDonnell, B.J.

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**Introduction** Green exercise is defined as any exercise that takes place in a relatively natural environment. Therefore, it is considered cheap and available to almost the whole population. Current literature illustrates the effects of acute bouts of green exercise on mental health (Pretty et al., 2005). However, no literature to date has demonstrated the effect of a long-term, green exercise programme upon markers of mental and vascular health. The current study aims to investigate the effects of community-based walking groups, as a mode of green exercise, upon markers of mental health (mood state) and vascular health (blood pressure and wave reflection). **Methods** Thirty six healthy, sedentary individuals (43±14 yrs), not taking any cardiovascular-acting or psychiatric medication, joining an aerobic, moderate-intensity, green exercise programme, were recruited. Physical activity (measured in MET-minutes, using IPAQ), constructs of mood (measured using POMS), supine blood pressure and augmentation Index (AIx), a measure of wave reflection (SphygmoCor, Atcor Medical) were obtained at baseline and following eight weeks of participation in a green exercise programme. Participants were split into those who adhered to the proposed green exercise programme (AD) (n=17) and those who did not (NAD) (n=19). Results Participants in the AD group significantly increased their physical activity over the eight week period, compared to those participants in the NAD group ( $p < 0.001$ ). Constructs of the POMS questionnaire; 'anger-hostility', 'depression', 'tension-anxiety' and 'total mood disturbance' were all significantly reduced ( $p=0.046$ ,  $p=0.007$ ,  $p=0.001$  and  $p=0.023$ , respectively) in the AD group following the eight weeks when compared to the NAD group. Mean arterial pressure and AIx were significantly reduced in the AD group when compared to the NAD group ( $p=0.044$  and  $p=0.045$ , respectively), over the eight weeks. **Discussion** These data illustrates for the first time that an eight week, green exercise programme has been shown to improve markers of mental and vascular health in sedentary, healthy individuals. These data demonstrate that unstructured, moderate-intensity exercise that is free and accessible to all, elicits many of the benefits that are associated with structured exercise programmes. The impact of green exercise programmes upon systemic markers of health needs to be investigated further. These preliminary data suggest that a moderate-intensity, green exercise programme may be a method by which low physical activity levels and poor health in areas of low socio-economic status could be addressed. **References** Pretty J, Peacock J, Sellens M, Griffin M (2005). *Int J of Environ Health Res*, 15(5), 319-337.

## PSYCHOSOCIAL WORK RISKS, EXERCISE AND MENTAL HEALTH: DOES EXERCISE SERVE AS A BUFFER AGAINST CONSEQUENCES OF PSYCHOSOCIAL WORK RISKS?

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Psychosocial work risks, exercise and mental health: does exercise serve as a buffer against consequences of psychosocial work risks? Introduction Work factors may cause or contribute to adverse mental health and mental health complaints affect participation in both the work and non-work areas. In this study, we aimed to identify the role of exercise in the relationship between psychosocial work characteristics and indicators of mental health. Specifically, hypotheses were: 1) Psychosocial work risks will be associated with higher level of mental health complaints; 2) Regular exercise will be associated with lower level of mental health complaints; 3) Exercise will attenuate the relationship between psychosocial work risks and mental health complaints. Methods In this longitudinal study, we used two waves (T1: 2008 and T2: 2009) of the Netherlands Working Conditions-Cohort Study (N=708, Koppes et al., 2010), a survey on the quality of work, health and well-being of Dutch employees. Three work characteristics (autonomy, task demands and emotional demands) and two indicators of mental health (emotional exhaustion and depression) were measured. Exercise was assessed as number of days a week complying to 30 minutes of moderate-intensity exercise. Results Regression analyses revealed that autonomy T1 was negatively related to emotional exhaustion T2 ( $\beta = -.057$ ,  $p < .05$ ) and depressive complaints T2 ( $\beta = -.088$ ,  $p < .05$ ), but we found no relation between task and emotional demands and the two indicators of mental health. Furthermore, we found that exercise T1 negatively related to levels of emotional exhaustion T2 ( $\beta = -.069$ ,  $p < .05$ ), but not to depression. Finally, moderated regression analysis showed that exercise T1 attenuated the relationship between autonomy T1 and emotional exhaustion T2. Simple slope analyses revealed that the relationship between autonomy and emotional exhaustion was stronger for individuals with a lower level of exercise ( $\beta = -.088$ ,  $p < .05$ ) than for individuals with a higher level of exercise ( $\beta = -.022$ ,  $p > .05$ ). Discussion Results partly supported our hypotheses. We found evidence for the relation between autonomy and the two indicators of mental health. In addition, we found that exercise was related to less emotional exhaustion and that exercise attenuated the effect of autonomy on emotional exhaustion. The finding that exercise was not related depressive complaints was surprising, because many studies indicate that exercise benefits depression in particular. It might be that decrease in depression requires different modes of exercise (i.e. intensity, type and frequency). However, this current study indicates that at least moderate-intensity exercise is a buffer for work-related emotional exhaustion. Acknowledgement We are grateful to TNO for permitting us to utilize the data of their Netherlands Working Conditions-Cohort Study. References Koppes, L. L. J., De Vroome, E., M. M. & Van den Bossche, S. N. J. (2010). The Netherlands Working Conditions Cohort Study. Hoofddorp (The Netherlands): TNO.

## THE EFFECTS OF PHYSICAL FITNESS ON CHILDREN WITH PREVIOUS NEOPLASIA

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Introduction: There is a lack of data investigating the effects of physical activity (PA) on adolescent and young adults survivors of childhood leukemia, moreover some authors suggest that children with diagnosis of leukemia (LK) are showing decreased level of fitness and a moderate risk for developing neuromuscular and musculoskeletal complications. We aim to verify if, in children involved in an individualized physical exercise program, the above-mentioned low fitness level may be prevented or at least reduced. Subjects and methods: We assessed the level of physical fitness on children with diagnosis of leukemia during the post-chemotherapy period. We evaluated the fitness in 9 children ( $8.3 \pm 2.7$  yrs), off-therapy by  $\geq 6$  months (group GOT) at the end of a physical activity program (13 weeks length). Few validated fitness tests (Ruiz et al., 2011) were adopted and then administered three times in 2 weeks: standing broad jump, 4 x 10 m shuttle test, sit-up test and handgrip strength test. The tests were also administered to a sedentary control group (CG) of 32 children ( $8.12 \pm 1.56$  yrs) with no diagnosis of neoplasia. The scores from the performances were used for statistical purposes. Results: Standing broad jump results showed  $112.55 \pm 32.80$  cm in GOT and  $124.18 \pm 22.19$  cm in CG, without remarkable differences ( $p = 0.11$ ). An interesting finding comes from 4 x 10 m shuttle run test with GOT that revealed  $16.27 \pm 0.83$  seconds, while CG performed the same test in  $14.02 \pm 0.25$  seconds ( $p = 0.001$ ). No differences were found when comparing sit-up performances (0.25) and handgrip performances (0.08 left arm and 0.15 right arm). Conclusions: After 13 weeks of properly PA program, the level of GOT's physical fitness appears to be in line with control group results. These preliminary findings are confirming the eligibility of GOT to start a specific exercise program in order to reduce cardiovascular and muscular complications and improve their quality of life. The only concern is about the agility test (4 x 10 SRT) that showed very high significant differences ( $\Delta = 2s$ ). The sample is not adequate to make conclusions. More data coming from a bigger sample size of GOT are necessary to confirm this pilot. References Gohar, S.F., Comito, M., Price, J., and Marchese, V. (2011). Feasibility and parent satisfaction of a physical therapy intervention program for children with acute lymphoblastic leukemia in the first 6 months of medical treatment. *Pediatr Blood Cancer* 56, 799-804. Ruiz, J.R., Espana Romero, V., Castro Pinero, J., Artero, E.G., Ortega, F.B., Cuenca Garcia, M., Jimenez Paven, D., Chillón, P., Girela Rejon, M.J., Mora, J., et al. (2011). [ALPHA-fitness test battery: health-related field-based fitness tests assessment in children and adolescents]. *Nutr Hosp* 26, 1210-1214.

## PERCEIVED INFLUENCE OF HORMONE CONTROL AND MENSTRUAL SYMPTOMS ON PHYSICAL ACTIVITY PARTICIPATION IN ACTIVE FEMALES

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Introduction Hormone control (HC) habits of competitive athletes and physically active females are not known, nor is it clear whether these females believe whether HC use influences their capacity to exercise. Given that hormone control through oral contraceptive (OC) use has been shown to reduce exercise capacity in both highly trained (Lebrun et al., 2003) and recreationally active (Casazza et al., 2002; Notelovitz, 1987) females, the present study investigated whether perceived changes in exercise ability with HC use influences involvement in physical activity (PA). Methods 97 active females (age  $25 \pm 4$  years; BMI  $22 \pm 2.4$  kg/m<sup>2</sup>; physical activity levels  $360 \pm 290$  min/week) completed a 32-page questionnaire booklet, designed to assess previous and current use of HC, hormone-specific barriers to PA, as well as PA status. Results Prevalence of OC use was 64%, with 4% reporting use of other HC. Of the 32% not using any form of HC, 65% had previously taken an OC. 0% of HC users reported 'often' or 'very often' avoidance of PA due to pill side-effects and/or menstrual symptoms, yet 25% of non-HC users reported avoiding PA 'often' or 'very often' in the previous year due to menstrual symptoms. Only

13% of HC users reported avoiding PA 'often' or 'very often' in the previous year because of menstrual bleeding, yet 47% of non-HC users reported the same behaviour. Additionally, respondents perceived that OC use 'never' or 'rarely' affected their ability to train (85%) compared to non-HC users (34%), and 'never' or 'rarely' reduce their involvement in PA (90%), compared to non-HC users (40%). Discussion The reported prevalence of HC use in active females is similar to use reported from previous Australian population surveys (Greig et al., 2010). Preliminary results suggest that HC users are less-likely to avoid PA due to menstrual symptoms or menstrual bleeding than non-HC users, and are less likely to feel that they cannot train or exercise to their full potential or reduce their involvement in PA due to menstrual symptoms. This suggests that HC use potentially reduces the impact of female hormone-related barriers to PA involvement. References Casazza, GA, Suh, SH, Miller, BF, Navazio, FM, Brooks, GA. (2002). JAP, 93, 1698-1702 Grieg, AJ, Palmer, MA, Chepulis, LM. (2010). Sexual and Rep Health, 1, 99-103 Lebrun, CM, Petit, MA, McKenzie, DC, Taunton, JE, Prior, JC. (2003). Br J Spors Med, 37, 315-320 Notelovitz, M. (1997). Am J Obst Gyn, 156, 591-598

## PHYSICAL ACTIVITY, HEALTH-RELATED QUALITY OF LIFE AND SALIVARY BIOMARKERS OF ADOLESCENTS IN DISASTER AREA

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Introduction In ECSS2012, we reported that the physical activity level of adolescents living in disaster areas is decreased by tsunami and earthquake hit regardless of the damage situation (Suzuki, et al. 2012). The decrease of the physical activity in the adolescents of growth period may have an influence to psychosomatic health. The purpose of this study is to examine the time-dependent change of salivary biomarkers (saliva flow (ml/min), cortisol concentration ( $\mu\text{g}/\text{dL}$ )) and association with physical activity and health-related quality of life (QoL) in adolescents living in a town affected by the earthquake and tsunami 2011. Methods The participants were 178 adolescents aged 11-13 (91 boys, and 87 girls) in the town of Onagawa (where housing damage affected 60% of participants). The survey was performed in September 2011 (the disaster after 6 months) and March 2012 (after 1 year). Survey items included time spent on physical activity (PAwk (min/week)), QoL (the 23-item Pediatric Quality of Life Inventory Version 4.0 Generic Core Scales). In addition, whole saliva samples were collected, and saliva flow rate (SF: ml/min) and salivary cortisol concentration (COR:  $\mu\text{g}/\text{dL}$ ) were determined. Results The SF was significantly increased after one year in comparison with the disaster after six months ( $P<0.05$ ), but COR, PAwk and QoL did not have the significant change. In the boys, the COR was significantly decreased after one year, but SF and COR have the no significant change in the girls. When PAwk of Sep. 2011 were divided into two groups based on the median and compared each groups, SF was significantly increased in the PAwk-high group after one year, but there were not significantly changed for SF and COR in the PAwk-low group. In addition, when QoL of Sep. 2011 were divided into two groups based on the median and compared each groups, SF was significantly increased in the QoL-low group after one year, but there were not significant changed in SF and COR in the QoL-high group. Conclusion These results show that they are different in the subsequent change of the basal saliva flow levels by the state of physical activity and health-related quality of life of adolescents living in disaster area. References Suzuki K, Okazaki K, Sasaki K, Takahashi S, Sakamoto Y. (2012) Physical activity and health-related quality of life of adolescents in disaster areas. 17th European College of Sport Science Congress (Bruges, Belgium)

14:00 - 15:00

## Mini-Orals

### PP-PM11 Health and Fitness [HF] 5

#### PHYSICALLY ACTIVE = HEALTHY? - ACTIVITY TYPES AND HEALTH STATUS AMONG GERMAN CHILDREN

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Introduction In today's society, even children have to deal with various demands of everyday life and developmental aspects to maintain individual wellbeing. In this context, physical activity as well as psychosocial determinants have to be considered as health-enhancing resources (Brandl-Bredenbeck & Brettschneider, 2010). However, there is a lack of studies regarding the causal relationship of the children's level of physical activity and their health status (Ottevaere et al., 2011). Therefore, the purpose of the present study was to investigate whether specific types of activity levels can be differentiated among German children and whether these activity types are characterized by distinctive health-enhancing resources. Methods The present cross sectional study included 385 children (f: 192, m: 193) with an average of 11.86 years of age and their parents. With the help of a children fitness test (KATS-K) and a questionnaire, we collected data giving evidence about anthropometric (BMI-SDS), physical, and psychosocial aspects (KINDL, FSKI, social support) as well as data concerning the level of physical activity and inactivity (HBSC-index). The different clusters regarding specific activity types have been calculated with a hierarchical cluster analysis and an additional z-transformation. Results For each gender (boys and girls), the results indicate four specific activity types (2 examples each: inactive media freaks: boys = 11.7%, girls = 22.7%; athletic actives: boys = 33.9%, girls = 29.1%), which significantly differ in various physical and psychosocial resources (e.g. HBSC-index – boys:  $F=10.44$ ,  $p<0.001$ , girls:  $F=5.97$ ,  $p=0.001$ ; self-concept – boys:  $F=50.24$ ,  $p<0.001$ , girls:  $F=33.74$ ,  $p<0.001$ ; family support – boys:  $F=5.46$ ,  $p=0.001$ , girls:  $F=10.99$ ,  $p<0.001$ ). Additionally, we found differences concerning the activity types and their health status (boys:  $F=6.40$ ,  $p<0.001$ ; girls:  $F=6.62$ ,  $p<0.001$ ). Discussion One of the main goals of health-enhancing physical activity programs is the promotion of individual resources to improve quality of life levels. By identifying different activity types and related psychosocial determinants, there is the possibility to improve the necessary individualization of these programs. Consequently, these individualized interventions reach more people who are threatened by risk factors (concerning their health status) and improve the program's sustainability. References Brandl-Bredenbeck, H P, Brettschneider, W-D (2010). Kinder heute: Bewegungsmuffel, Fastfoodjunkies, Medienfreaks? Eine Lebensstilanalyse. Aachen: Meyer & Meyer. Ottevaere et al. (2011). Clustering patterns of physical activity, sedentary and dietary behavior among European adolescents: The HELENA study. BMC Public Health, 11:328.

## JOINT ASSOCIATIONS OF PHYSICAL ACTIVITY AND SEDENTARY BEHAVIORS WITH OBESITY INDICES AND DIETARY HABITS AMONG SAUDI ADOLESCENTS

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1: King Saud University, 2: King Saud University, 3: Education Ministry, Eastern Province, 4: King Abdulaziz University

**Introduction** Physical inactivity and sedentary behaviors appear to be independent entities (Ekelund et al, 2006) and differently associate with adverse health outcomes (Tremblay et al. 2010). Physical activity is related more to healthy food choices, whereas sedentary behaviors are linked more to unhealthy dietary choices (Plataat et al. 2006). Thus, the aim of this study was to investigate the joint associations of physical activity and sedentary behaviors with obesity indices and dietary habits among Saudi adolescents aged 14-19 years. **Methods** Data were from the Arab Teens Lifestyle Study (ATLS), a school based, cross-sectional lifestyle study involving Arab adolescents (Al-Hazzaa et al., 2011). The present analysis included 2822 secondary-school students (51.2% females) aged 14-19 years, randomly selected from three major cities in Saudi Arabia, using a multistage stratified cluster sampling technique. Participants were classified into four categories based on cut off scores of 60 minutes daily physical activity and 3 hours of screen time/day (high activity-low screen time, high activity-high screen time, low activity-low screen time and low activity- high screen time. Results One-way ANOVA tests indicated that there were no significant differences in age ( $p = 0.103$ ), body mass index ( $p = 0.472$ ) or waist to height ratio ( $p = 0.116$ ) between the four categories. However, body weight ( $p = 0.002$ ), and consumption (day/week) of breakfast ( $p = 0.012$ ), vegetables ( $p = 0.000$ ), fruit ( $p = 0.000$ ), milk ( $p = 0.000$ ), sugar-sweetened beverages ( $p = 0.000$ ), fast food ( $p = 0.000$ ), French fries/potato chips ( $p = 0.000$ ), and sweets ( $p = 0.000$ ) were all significantly different among the four categories. **Discussion** Adolescents with high activity and low screen time tend to consume breakfast more frequently than their low activity and high screen time peers. Intakes of vegetables, fruit and milk were higher among high activity group whether they have high screen time or not. Less healthy foods like fast food, potato chips, sweets and sugar-sweetened beverages tend to associate with those adolescents with high screen time. It can be concluded that adolescents with high activity and low sedentary behaviors tend to have healthy dietary habits, whereas low activity and high sedentary behaviors increases adolescent's risk of having unhealthy dietary habits. **References** Al-Hazzaa HM, Musaiger AO; ATLS group. (2011). *Diabetes Metab Syndr Obes*, 4, 417-426. Ekelund U, Brage S, Froberg K, et al. (2006). *PLoS Med*, 3, e488. Plataat C, Perrin AE, Oujaa M, et al. (2006). *Br J Nutr*, 96, 501-507. Tremblay MS, Colley RC, Saunders TJ, et al. (2010). *Appl Physiol Nutr Metab*, 35, 725-740.

## ADOLESCENTS' PERCEIVED LIFESTYLE PATTERNS IN SELECTED SECONDARY SCHOOLS IN THE WESTERN CAPE, SOUTH AFRICA

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**Introduction** Holistic enhancement during adolescence not only refers to physical growth and development, it also entails the emancipation process. Cognitive development entails the accumulation of knowledge, self-knowledge and reasoning, whereas emotional growth refers to a realistic identity formation, which can be divided in the self-concept and self-esteem. The primary aim of the study was to determine adolescent lifestyle patterns, while the secondary aim was to determine personal and social reasons for participating in sport. **Methods** Quantitative data was captured by a questionnaire, obtained from the International Committee of Sport Pedagogy (ICSP). The questionnaire covered the following: biographical information; preferences and dislikes; and patterns of participation in sport and leisure activities. The secondary schools ( $N=30$ ) and the learners ( $N=60$ ) were randomly selected from Grade 9 and 11. Twenty-two schools ( $N=22$ ) responded providing a sample of 880 participants. The data were processed with Statsoft Statistica version 10. Descriptive statistics were used. The comparison of ordinal scales between groups was done with the non-parametric Mann-Whitney test. The level of significance was set at 5% ( $p \leq 0.05$ ). **Results** There were significant differences according to race regarding reasons for sport participation. The most important reasons were: it is good for my health ( $p=0.03$ ); to be fit ( $p=0.04$ ); and to relax ( $p=0.05$ ). Both genders, although not significant, placed the highest premium on their health. Significant differences were found between the genders on the following reasons for sport participation: to be fit ( $p=0.02$ ); I want my body to be in good condition ( $p=0.05$ ); it makes my body look good ( $p=0.02$ ); I have the opportunity to prove myself ( $p=0.01$ ); to relax ( $p=0.01$ ); and I like competition ( $p=0.01$ ). Significant differences for feeling successful in sport participation according to race were: when I notice that a new skill I have learned works ( $p=0.01$ ); when I practice really hard ( $p=0.05$ ); and when I am the only one that can play the sport ( $p=0.02$ ). Regarding gender, significant differences were found for the following: when I practise really hard ( $p=0.01$ ); when I learn new sports ( $p=0.01$ ); when I can do something better than my friends ( $p=0.02$ ); and when I am the only one that can play the sport ( $p=0.03$ ). **Discussion** The race and gender groupings indicated that the most significant personal reason for sport participation was health. However, boys also wanted to look good, competitive and relax. The key reasons for being successful in sport by the race and gender were of a personal nature. Something that was noticeable regarding success in sport was that although adolescents, especially boys, were very competitive in nature it was not to the disadvantage of their peers. Both race and gender groupings did not feel being successful in sport when others are not as good as I am and when other makes mistakes and not me indicating that they held a high social esteem for their peers.

## ENERGY EXPENDITURE AT CONSTANT SPEED IN DIFFERENT SLOPES IN CHILDREN WITH OVERWEIGHT AND OBESITY

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**Introduction** The amount of energy expended during physical activity plays a significant role in the prevention of overweight and obesity and in the process of weight loss (Peyrot, 2009). The main objectives of the present study are to evaluate the progression of energy expenditure (EE) with the increase of slope in a treadmill test at constant speed and the interrelation with the degree of adiposity, in overweight and obese children. **Methods** In the study participated 11 boys and 9 girls who were divided into two groups depending on their degree of obesity, by the International Obesity Task Force Criteria: Overweight group ( $n = 10$ ; age =  $9.7 \pm 1.34$ ) and obese group ( $n = 10$ ; age =  $10.40 \pm 1.43$ ). Both groups performed a submaximal exercise test on a treadmill. Speed was kept constant at  $1.53 \text{ m}\cdot\text{s}^{-1}$  and the slope increased every 3 minutes following the sequence 0-4-8%. During the test  $\text{VO}_2$  and RER were measured by means of breath-by-breath gas exchange. The EE was calculated according the equation of Robergs (1997):  $\text{EE} (\text{kcal}\cdot\text{min}^{-1}) = \text{VO}_2 (\text{L}\cdot\text{min}^{-1}) \times (\text{RER} \times 1.232 + 3.815)$ . **Results** EE in each group increased significantly with slope. The EE in the three slopes was significantly ( $p < 0.001$ ) superior in obese children in relation to overweight ones. This differences at 0% slope were  $3.32 \pm 0.80$  vs.  $5.33 \pm 0.77 \text{ Kcal}\cdot\text{min}^{-1}$ ; at 4% slope were  $4.28 \pm 0.76$  vs.  $6.54 \pm 0.88 \text{ Kcal}\cdot\text{min}^{-1}$ ; and at 8% were  $5.16 \pm 0.86$  vs.  $7.89 \pm 0.95 \text{ Kcal}\cdot\text{min}^{-1}$ . Differences at each slope disappeared when EE was adjusted by weight. But, were still present when EE was adjusted by Fat Free Mass. Correlation index between weight and EE

indicates that weight can explain a 68% of the variance of EE. Discussion These results indicate that increases of slope, as speed (Lazzer et al., 2003), raise EE. Moreover, children with greater body mass were penalized by the excess of fat mass. In the present study weight mass is the most influential parameter on EE. References Cole TJ, Bellizzi MC, Flegal KM, Dietz WH (2000). *BMJ* 320:1–6. Lazzer S, Boirie Y, Bitar A, Montaurier C, Vernet J, Meyer M, Vermorel M. *Am J Clin Nutr* 78: 471–479, 2003. Peyrot N, Thivel D, Isacco L, Morin JB, Duche P, Belli A. *J Appl Physiol*. 2009;106: 1763–1770. Robergs, R. A., and S. O. Roberts. St. Louis: Mosby-Year Book, 1997, pp. 840.

### **USING GPS TO TRACK THE COMMUTE HOME FROM SCHOOL: ESTABLISHING THE CONTRIBUTION TO FREE-LIVING PHYSICAL ACTIVITY.**

Collins, P., Al-Nakeeb, Y., Lyons, M.

1. Newman University, Birmingham., 2. Qatar University., 3. University of Limerick

**Introduction** Active school commuting is widely regarded as a key opportunity for youth to participate in physical activity (PA). Whilst young people's school commuting patterns have been widely researched, inconsistencies and inaccuracies in the measurement of commute type and commute journey are a major limitation in many previous studies (Lubans et al., 2011). Using global positioning system (GPS) technology, the current study aims to accurately track the commute journey home from school and its contribution to total free-living moderate-to-vigorous PA (MVPA) in youth. **Methods** 75 adolescents (38 males, 37 females) wore an integrated GPS and heart-rate device during after-school hours for four consecutive weekdays. Descriptive statistics and analyses of variance were utilised to explore differences in the commute patterns of youth according to mode of transport, gender and socio-economic status (SES). **Results** The commute journey home of walkers and cyclists on average contributed 35% of their total free-living PA. Active commuters were significantly more active (11.72 minutes MVPA) than passive commuters (3.5 minutes MVPA) during their commute home from school ( $p=0.001$ ). However, there was no significant difference in the overall free-living PA levels of passive and active commuters ( $p>0.05$ ). 92.7% of youth living within 1.5 miles of the school actively commuted, compared to just 16.7% of youth who lived further away. SES differences in commuting patterns were also evident, with a higher proportion of low SES youth (74%) actively commuting compared to high SES youth (57%). **Discussion** The findings highlighted the significant proportion of total free-living PA that was attributed to active commuting home from school. Furthermore, the utilisation of GPS monitors allowed for the accurate tracking of young people's commute journey, and provided a detailed account of important commute information such as travel mode, speed, distance, directness, and deviations. The study provides a valuable insight into the complex methods utilised and intriguing comparisons between youth from different demographic backgrounds. The findings highlight commute distance as a major determinant for commute mode in youth, although the high proportion of youth who lived within 1.5 miles of the school and actively commuted was encouraging. Future research and intervention studies may wish to focus on the promotion of cycling as a means of encouraging youth who live further than 1.5 miles away from the school to actively commute. **Reference** Lubans DR, Boreham CA, Kelly P, Foster CE. *Int J Behav Nutr Phys Act*. 2011; 8:5.

### **EFFECT OF PHYSICAL TRAINING ON HEART RATE VARIABILITY IN HEALTHY CHILDREN: SYSTEMATIC REVIEW WITH META-ANALYSIS**

Silva, C.C., Pereira, L.M., Cardoso, J.R., Moore, J.P., Nakamura, F.Y.

Universidade Estadual de Londrina

**Introduction** Studies have demonstrated that reduction of heart rate variability (HRV) is associated with increased risk of cardiac events and premature death. Therefore, analysis of HRV in childhood and adolescence may provide early indication of future cardiovascular disease risk. Furthermore, whilst it is reported that the cardioprotective effects of exercise in adults includes a beneficial effect on HRV, the effect of exercise in children remains unclear. Thus, the aim of this study was to undertake a systematic review of available literature to determine whether physical training positively impacts upon HRV in prepubertal healthy children. **Methods** Systematic computerized searches were performed in 9 databases from 1950 to 2012. The key words used were: heart rate variability, autonomic nervous system, exercise training, physical activity, continuous exercise, intermittent exercise, children, prepubescent and adolescents healthy. This systematic review followed the recommendations of the PRISMA Statement. According to the recommendations proposed by the Cochrane Collaboration, only randomized controlled trials were included. **Results** Searches identified 6164 articles from which 2 studies (Mandigout et al., 2002; Gamelin et al. 2009) satisfied the inclusion criteria of this systematic review. **Meta-analysis** compared the experimental group to control group for parameters of HRV: R-R intervals, SDNN, RMSSD, pNN50, LF (log), HF (log), LF/HF and Total Power (log). The total number of children in the intervention group was 29, while 28 were in the control group. The meta-analysis did not demonstrate significant differences between groups for any of indexes of HRV. **Discussion** Exercise training did not affect indices of HRV. Although there is a high risk of bias in each of the studies admitted to the analysis, we conclude that currently there is insufficient evidence to suggest that physical training in healthy children has an effect on HRV. **References** Gamelin FX, Baquet G, Berthoin S, Thevenet D, Nourry C, Nottin S, et al. Effect of high intensity intermittent training on heart rate variability in prepubescent children. *Eur J Appl Physiol*. 2009;105(5):731-8. Mandigout S, Melin A, Fauchier L, N'Guyen LD, Courteix D, Ober P. Physical training increases heart rate variability in healthy prepubertal children. *Eur J Clin Invest*. 2002;32(7):479-87.

### **AN INVESTIGATION OF THE DIFFERENCES BETWEEN PLAYING SPORTS, WATCHING TELEVISION AND USING COMPUTER IN ADOLESCENTS**

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**Aim:** The aim of this study is to investigate the effects of factors of playing sports, watching television and using computer on the balanced height and weight development of 11-17 years old boys and girls. **Material and Method:** This study was conducted on a total of 13761 students, 6927 girls and 6834 boys, studying at secondary schools and high schools in different cities of Turkey during the 2009-2011 Academic Year. The students' weights were measured with 0.1 kg precision scale and their heights were measured with 0.1 cm precision metal bar. The measurements were taken before noon during a week. The students' habits of playing sports, watching TV and using computer were determined through a questionnaire. One way analysis of variance and Tukey HSD were used for statistical processes. **Findings:** For boys, average height was found to be 162,42 cm and average weight was found to be 53,92 kg while the average height was 159,72 cm and average weight was 50,78 kg for the girls. HWI values were found to be 20,22 kg/m<sup>2</sup> for boys and 19,78 kg/m<sup>2</sup> for girls. The difference between height, weight and HWI values by sex was statistically significant ( $p<0.001$ ). The average age for the students who played sports was 14,31 years and 14,88 years for the students who didn't. The average height of the students who didn't play

sports was 160,42 cm while the average height of the students who played sports was 162,03 cm. for weight, the students who didn't play sports were lighter than those who did (51,63 kg versus 53,42 kg). The difference between age, height, weight and HWI values between the students who played and didn't play sports was statistically significant ( $p < 0.001$ ). The students who watched TV for an hour or less had more weight and higher HWI values than those who watched TV for 2-3 and 4-5 hours ( $p < 0.001$ ). The students who didn't use computer and the ones who did for 1-2 hours had less weight and HWI values than those who used computer for 3-5 hours and more than 5 hours ( $p < 0.001$ ). Result: The results of this study show that for the students to have balanced weight and height development, they should have a more controlled TV and computer use and their habits of playing sports should be increased.

### **LONGITUDINAL CHANGES IN PHYSICAL FITNESS FROM ADOLESCENCE TO MIDDLE AGE. THE SWEDISH PHYSICAL ACTIVITY AND FITNESS COHORT STUDY SPAF**

Westerståhl, M., Aasa, U.

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**Aim** To study the longitudinal changes in aerobic power, muscular endurance and strength, flexibility and balance in men and women from 16 and/or 34 to 52 years of age. Further, factors in younger age that could predict the changes was studied. **Background** Longitudinal studies on the changes in physical capacity during the life span with a long follow-up period are very rare. The focus of the SPAF study is multidisciplinary and involves physical and psychological variables that are related to a wide range of health outcomes. The unique feature of the SPAF study is that physical activity, physical capacity, CVD risk factors, health habits and health are measured over 36 years. Here the results from the longitudinal changes in, and indicators for, physical capacity are presented. **Subjects and Methods** The same men and women were followed for 36 years in three waves of data collection (1974, 1992 and 2010). The test battery was partly the same as baseline and partly supplemented at the two follow-ups. **Baseline:** A group of 425 randomly selected Swedish boys and girls from strategically selected cities in Sweden at 16 years of age. **Follow-up I:** 65% of the original sample participated in tests and measurements at 34 years of age. **Follow-up II:** 50% of the original sample participated in tests and measurements at 52 years of age. Physical capacity was objectively measured with field tests of muscular endurance, maximal strength, aerobic capacity, balance and flexibility. The Regional Ethical Review Board in Umeå approved the study. **Statistics** The longitudinal changes were analyzed using linear mixed model with covariates. A full model with all significant covariates was created for each measure of physical capacity. **Results** There was an increase or no change from 34 to 52 years of age in balance, lower body flexibility, thoracic back extension or muscular endurance of the abdomen. There was a decrease from 34 to 52 years of age in flexion and rotation of the neck, in muscular endurance of the back and in aerobic capacity. There was an increase from 16 to 52 years of age in muscular endurance of the arms. Maximal static lifting strength increased in men but decreased in women from 16 to 52 years of age. The longitudinal changes in physical capacity were often predicted by background characteristics at baseline. **Discussion** Decreasing flexibility of the neck and strength of the back could be a predictor or a symptom of back pain and will be further explored in this study. Background characteristics already in adolescence seem to predict capacity in middle age which is important knowledge for the understanding of life time physical capacity.

### **VERIFICATION OF DELAYED MENARCHE EVALUATION IN FEMALE ATHLETES BY WAVELET INTERPOLATION METHOD**

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**Introduction** To improve the accuracy of the evaluation of delayed menarche proposed by Fujii and Demura (2005), data on general Korean females were obtained and the validity of the polynomial from the first to the fourth order was examined with regard to the regression evaluation of the age at menarche for age at MPV of height. A delayed menarche evaluation chart was constructed by deriving a regression evaluation of the most appropriate order. This regression evaluation was applied to various sports to judge delayed menarche in athletes. Specifically, by investigating delayed menarche and menstrual status in individuals in this study, the relation between delayed menarche and menstrual status in female athletes was examined for the first time. **Methods :** The subjects were 124 second year female students at a physical education high school in the suburbs of Busan, South Korea. A questionnaire survey of these girls was conducted, from which their date of birth, age at menarche, and athletic activities in elementary, junior high, and high school were obtained. In addition, health check records were examined retrospectively, and longitudinal growth data for height were obtained from the 1st year of elementary school (7 years old) until the second year of high school (17 years old). Next, the same survey as above was also done for second year students at a general high school in the same area, as a control group. Three hundred forty-five non-athletes for whom all data were available were selected. **Results** The third order polynomial was found to be most suitable for the regression polynomial. When it was applied to individual female Korean athletes with respect to the regression evaluation, positive scores were obtained for many athletes and an overall delay in menarche was seen. Delayed menarche was not seen, however, in archery athletes. A strong delay in menarche was thus found in Korean athletes. **Discussion** This study was the first to attempt this kind of analysis. Menstrual status was judged by the intensity of menstrual pain in this study. A judgment of delayed menarche may be a warning for continuing training in female athletes. The delayed menarche evaluation in Korean female athletes in this study further advances the delayed menarche evaluation established by Fujii (2008) in Japanese girls, and leads to a relation with menstrual status following delayed menarche. The present findings will be useful for resolving problems related to menstrual abnormalities in female athletes. **References** Fujii K, and Demura S (2005) An Approach to Verifying Delayed Menarche in Japanese Female Athletes —Analysis by wavelet interpolation method—, *The Journal of Sports Medicine and Physical Fitness*, 45, 580-593. Fujii K (2008) Construction of Delayed Menarche Evaluation System in Japanese Female Athletes, *J. Educ. Health Sci*, 53, 273-285.

### **MENSTRUAL ATTITUDE OF COLLEGIATE ATHLETE**

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*ankara universitesi*

**Introduction:** Cultural environment and religion play an important role at attitude toward menstruation. Most of the former female athletes believe that menstruation affects their performance negatively and recently many girl and women refuse to join physical activities during menstruation. Most women who are professional or non-professional athletes probably form their attitudes toward "menstruation and sport" in their elementary school gym classes. Current studies indicated that perceptions and severity of psychological and physical symptoms during menstruation mostly affected by negative or positive attitudes toward menstruation (Marván.2005). The aim of this study was to evaluate the attitudes of collegiate athletes (CA) toward menstruation and compare them with their sedentary college students (CS)

counterparts. Methods : Female CA (n=181) and female CS (n=148) and total 329 volunteers participated in this study. Menstrual Attitude Questionnaire (MAQ) was used as a data collection device in this study. The original MAQ developed by Brook-Gunn and Ruble is the gold standard measurement of menstruation (Brooks-Gunn, 1980). Results: The mean age of the sample (n= 329) was found  $20.5 \pm 1.9$ . The mean menarche age of CA was  $13.70 \pm 1.07$  and CS was  $13.50 \pm 1.12$  and there is no significant differences between menarche age of groups since  $p=0.09 \geq 0.05$ . The total of 74.5 % participants stated that they have a regular menstrual cycle and there is no significant differences between menstrual cycle order of athletes and sedentaries since  $p=0.65 \geq 0.05$ . By looking at the average overall score of CA and CS (X(CA)=3,13 and X(CS) =3,17), it can be said that both groups have positive attitudes toward menstruation. When we look at the lower scales, menstruation as a "bothersome event" has highest score and "anticipation and prediction of onset of menstruation" sub-scale has lowest score for both groups. In the perception of menstruation as a debilitating event and as a natural event there is significant differences between athlete and sedentary group. Discussion: The results of this study reported that 49.7% of college athletes do not believe in that menstruation is negatively effect their sport performance, on the other hand this negative perception is still more common between non-athletes. Despite this high frequency, menstruation is still perceived by athletes as something that they have to put up with. While attitudes toward menstruation is positive for athletes and non-athletes, non-athletes perceived menstruation more debilitating. References Marván M, Cortés-Iniestra S, Gonzáles R. Beliefs about and attitudes toward menstruation among young and middle-aged Mexicans. *Sex Roles* 2005;53:273- Brooks-Gunn J, Ruble D, (1980), The Menstrual Attitude Questionnaire, *Psychosomatic Medicine*, 42(45):503-512

## PHYSICAL ACTIVITY AND CARDIOVASCULAR FITNESS IN PERIPUBERTAL BOYS WITH DIFFERENT WEIGHT STATUS

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Introduction Low physical activity (PA), poor cardiovascular fitness (CVF), increasing overweight and obesity in children are the major health problems nowadays (Blair 2009). There are limited data on the relationship between objectively measured PA and directly measured peak oxygen uptake ( $VO_{2peak}$ ) from a stepwise incremental exercise test using a cycle ergometer. The aim of the present study was to examine the relationship between PA and CVF in peripubertal boys and to determine if differences in weight status affect this association. Methods In total 265 boys were analysed (age  $12.04 \pm 0.77$  y). On the basis of body mass index (BMI), the children were grouped as normal-weight ( $<19.8-22.6$ ), overweight ( $\geq 19.8-22.6$  and  $<24-27.6$ ) and obese ( $\geq 24-27.6$ ), according to the age-adjusted cut-offs (Cole et al. 2000). CVF was determined on cycle ergometer for  $VO_{2peak}$  and  $VO_{2peak}$  per kilogram of body mass ( $VO_{2peak}/kg$ ) and maximal power output ( $W_{max}$ ) and  $W_{max}/kg$ . PA was assessed by accelerometer for seven consecutive days. Time spent in moderate PA and vigorous PA were calculated based on cut-offs of 2000 and 4000 counts per minute, respectively. Time spent in moderate-to-vigorous PA (MVPA) was calculated as the sum of moderate PA and vigorous PA. Results Normal weight group had a significantly higher vigorous PA and MVPA levels compared to overweight group ( $p < 0.05$ ) and had significantly higher moderate PA, vigorous PA, MVPA and total PA compared to obese group ( $p < 0.05$ ). No differences were found in PA levels between the overweight and obese. Obese group had significantly lower values of  $VO_{2peak}$ ,  $VO_{2peak}/kg$  and  $W_{max}/kg$  compared to normal weights and significantly lower values  $VO_{2peak}/kg$  and  $W_{max}/kg$  compared to overweight ( $p < 0.05$ ). Measured PA levels (except vigorous PA in obese boys) were significant predictors of  $W_{max}/kg$  in normal weight and obese boys. Vigorous PA, MVPA, total PA in normal weight and vigorous PA in obese were significant predictors of  $W_{max}$ . Variation in  $VO_{2peak}/kg$  was significantly explained by moderate PA, vigorous PA, MVPA and total PA in normal weight only. Discussion In normal weight boys, total amount of activity and intensity are important in prediction of CVF and also for relative workload ( $W/kg$ ), respectively in obese subjects in general. It was interesting to note that in the overweight group, PA was not associated with any of the fitness parameters, that could be explained to higher-energy intake, which affects body composition and therefore also CVF. Therefore, if studying interactions between PA and CVF, the weight status, especially between normal and overweight boys should be taken into account. References Blair SN. (2009). *Br J Sports Med*, 43, 1-2. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. (2000). *BMJ*, 320, 1-6.

14:00 - 15:00

## Mini-Orals

### PP-PM04 Adapted Physical Activity [AP] 4

#### EXCESSIVE BODY WEIGHT INFLUENCE ON PROPRIOCEPTION IN POSTURAL CONTROL IN YOUNG SUBJECTS

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Introduction Excessive body weight is repeatedly reported to increase postural instability and to lead to fall-induced injury (Hue et al., 2007). In most studies balance stability has been evaluated in a constrained feet position, with and without vision. The present research questioned, first, the influence of a pre-set feet position on the postural instability reported for obese subjects and, secondly, the relative influence of the proprioceptive information on their postural control. Methods This study included a total of 136 children and adolescents: 68 obese (Ob) and 68 non-obese (NOB) subjects. To investigate the feet position influence, each group of subjects was divided into two subgroups examined in either 'standardized' (St) or 'natural' (Nat) feet position. Each subject was tested in 3 conditions: with vision (Vis), without vision (NVis), without vision and Achilles tendon vibration (Vib). The postural test lasted 51.2 sec in a standing position on two combined force-plates (acquisition frequency of 40 Hz). In the Vib condition, each Achilles tendon was equipped with a neuromuscular vibrator (VB115, Techno-Concept ©). The 80 Hz vibration stimulus started 5 to 15 sec after the beginning of the postural test and lasted for 20 sec. Appropriate MANOVA and Student-t tests were used, with statistical significance set at  $p < 0.05$ . Results Independently of feet position (St or Nat), all parameters indicate a decreased stability in the Ob subjects when compared to NOB ones, except for the length of medio-lateral displacements. All the subjects were more stable in the Nat feet position. For the Ob subjects only, the antero-posterior length of displacements was not reduced when switching from the St to the Nat feet position. The Romberg coefficient (NVis/Vis surface) was  $> 1$ , and did not differ between Ob and NOB subjects. The Ob subjects were more sensitive to the vibration stimulus than the NOB subjects (antero-posterior difference). Among Ob subjects, the sensitivity to vibration was enhanced in the St feet position. Discussion This

demonstrates that evaluation of Ob subjects should be performed in a more natural testing position, although inter-feet position should be controlled. The absence of inter-group difference in the Romberg coefficient (NVis/Vis surface) contrasts with the results obtained with the vibratory stimulus. This suggests that Ob subjects would rely more on proprioceptive than on visual cues as compared to NOb subjects. Considering the potential effect of body mass on proprioception, their combined changes along treatment should be considered as favoring potentially to the occurrence of injuries. References Hue O, Simoneau M, Marcotte J, Berrigan F, Doré J, Marceau S, Teasdale N (2007) *Gait & Posture* 26: 32-38.

### **USE OF COMPUTER OPTICAL TOPOGRAPHY IN POSTURAL DISORDERS AND SPINAL DEFORMITIES DIAGNOSIS AND CORRECTION IN CHILDREN AND ADOLESCENTS**

Kovalenko, T., Shklyarenko, A., Ulyanov, D.

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Continuity Postural disorders fall under an important group of diverse in nature and manifestations pathological spinal deformities of the musculoskeletal apparatus in children, so the issues of its early diagnosis, treatment and effectiveness control refer to this research actual continuity [1, 2]. In recent years, new estimation methods and techniques based on three-dimensional evaluation of postural disorders have appeared. Based on numerous children and adolescents examinations, an effective system of identifying posture and spinal deformities followed by recreational activities has been worked out in the children's orthopedic sanatorium. Methods We used computer optical topography method that was developed at the Novosibirsk Institute of Traumatology and Orthopedics. The topography is harmless, accurate and provides images of the dorsal surface of the body in three dimensions: lateral analysis characterizes the deviation in the frontal plane and the parameters of scoliotic arcs; sagittal analysis describes the severity of physiological sagittal curves; and horizontal analysis shows the relative rotation of shoulder girdle pelvic. Topographic screening results were analyzed for postural disorders and spinal deformities in three dimensions: frontal, sagittal and horizontal. After image processing and results interpretation we distribute all examined patients in three groups: I - healthy, II - children with functional disorders of posture, III - patients with structural scoliosis and kyphosis. Results We recommended the healthy children to be active, control body posture and have monitoring survey in one year. For the second group of children in addition to the above recommendations we prescribe corrigent gymnastics exercises, laying on the rollers at an increased thoracic kyphosis and flattening of the lumbar lordosis, back muscles massage in absence of contraindications, as well as computer optical topography re-examination in three or six months (depending on the disorder gravity). In case of revealed signs of structural pathology, pelvic tilt, twist expressed in the horizontal plane (III group), the patient is sent to an orthopedist for further examination and clinical survey. Once the diagnosis is confirmed, the child is assigned with combined treatment with mandatory computer topography control. Discussion The experience in examination of more than 1,300 patients allows us to assume the screening ensures timely diagnosis of existing abnormalities and give correct recommendations to form a group of children in need of an orthopedic consultation and a group of patients who can start immediately corrigent gymnastics exercises (in absence of somatic contraindications) and further control by computer topography. References 1. Loveyko, I.D. Therapeutic physical training in spinal diseases in children - 2nd ed. - L: Medicine, 1988. - 141 p. 2. Shklyarenko, A.P. Overall assessment of the health of 8 – 16 year old girls according to the gravity of scoliosis / *Pediatrics*. - 2002. - № 6. - p. 45 - 50. [ser authors here](#)

### **PHYSICAL EXERCISE FOR THE PREVENTION OF DEMENTIA : A RANDOMIZED, PARALLEL-GROUP, OBSERVER-BLINDED CLINICAL TRIALS**

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Molise University (Campobasso, Italy) Introduction Several observational studies have shown that physical activity reduces the risk of cognitive decline in subjects at risk of dementia; however, evidences from well-conducted randomized controlled trials are scanty (Lautenschlager et al, 2012). The aim of the study is determine whether physical exercise reduce the rate of cognitive decline in the older adults at risk of dementia. Methods A Randomized controlled trial of 24 months of monitored physical activity was conducted in Campobasso, Italy. Two hundred thirty-five subjects aged 50 years and over were screened for eligibility, 18 were not eligible for health problems, 28 refused to participate and 10 could not be recontacted. Subjects who reported memory problems but did not meet criteria for dementia were also included. A total of 180 subjects were recruited and 111 of these have completed 24 months of the study. Subjects were randomly assigned to a control group (n = 90), which has not received the treatment, or to an intervention group (n = 90) which has been subjected to a physical exercise program for 24 months. Outcome measures were Mini-Mental State Examination (MMSE), Frontal Assessment Battery (FAB), Rey's word list immediate and delayed recall tests, Attentional Matrices, Raven's Progressive Matrices, Stroop test, Prose memory immediate and delayed test, Copying of Drawings with and without landmarks, Trial Making Test (TMT) version A and B. Results: At baseline, the two groups were homogeneous in terms of age, education and scores on tests of cognitive performance. At 24-month assessment, Repeated Measures Analysis of Variance (RM-ANOVA) showed significant differences between the two groups in both Rey's word list immediate and delayed recall tests (p<0.05) and in the Prose memory immediate test (p<0.05). No significant difference was found in the other tests. Conclusion Preliminary results show that, in elderly patients with memory disorder, a controlled physical exercise program, lasting 24 months, leads to significant improvements in memory performances. References Lautenschlager NT, Cox K, Cyarto EV. (2012). *Biochim Biophys Acta*, 1822, 474-81.

### **EFFECTS ON V-WAVE WITH SKIN AND MUSCLE COOLING DURING %MVC**

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Introduction We have demonstrated that with skin cooling the amplitude of H-reflex is unchanged and the amplitude of V-wave increases more than under normal skin temperature conditions in the latter half of the %MVC. However, there is no clear effect of muscle cooling. The purpose of this study was to investigate the effects of muscle cooling on spinal and neural drive by analyzing V-wave. Methods Six healthy adults volunteered for this study. The force of the isometric contraction and twitch of the triceps surae muscle were measured with a force transducer attached to a footplate apparatus. Electric signals were picked up by surface electrodes (10mm) on the belly of the soleus (SOL). This experiment was performed under three conditions that consisted of skin cooling (skin temp. 26 deg.; SC), muscle cooling (muscle temp. about 2 deg. less than normal: MC) and control (skin temp. about 33 deg.; NSC). A cooling pad, attached to the skin (SC: 3 minutes, MC: 5min), was used in the cooling conditions. Two 3 second maximal voluntary isometric contractions (MVC) were per-

formed at the control temperature. The force at every 10%MVC was calculated using the MVC under control temperature. H-reflexes, M-wave and V-wave were evoked in the soleus muscle by electrical stimulation of the posterior tibial nerve via a cathode ball electrode (5mm in diameter) pressed into the popliteal fossa. H-reflex and Mmax were obtained under the three conditions at rest. During sub-maximal contractions (10, 20, 30, 40, 50, 60, 70, 80 and 90% of one MVC) and MVC performance, a supra-maximal stimulus was delivered at supra-maximal intensity, which allowed us to record the superimposed M-wave (Msup) and V-wave of the SOL. Results and Discussion There was no significant difference in Hmax, Mmax and H/M ratio under each condition. M-wave amplitude recorded during maximal voluntary plantar flexor contractions (Msup) was significantly greater than that recorded at rest (Mmax) in each condition. However, there was no significant difference between SC, MC and NSC. The amplitude of V-wave increased gradually with increased %MVC under the three conditions. The polynomial relationship indicated with skin cooling was higher than that of MC and NSC over 80%MVC ( $p < 0.05$ ). However, there was no significant difference between MC and NSC. These results suggest that the increase in V-wave response with skin cooling is related to elevated motorneuron excitability due to the influence of cutaneous inputs, especially cold receptors.

### LONGITUDINAL CHANGES OF DEPRESSIVE SYMPTOMS IN PATIENTS WITH MULTIPLE SCLEROSIS AFTER EXERCISE IN DEPENDENCY TO THE SEVERITY OF FATIGUE

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**Introduction** Fatigue is a frequent and often disabling symptom in patients with multiple sclerosis (MS) and severity of fatigue is further increased by co-existing depressive symptoms (Bradshaw und Rose 2008). Here, we investigated the impact of endurance training on depressive symptoms in relation to the extent of fatigue. **Methods** Untrained patients with relapsing-remitting MS were included (n=44, mean age 38.7 +/-8.5 yrs) with a mean EDSS of 1.9 +/-0.6. At the beginning of the examination all participants were rated according to the 'fatigue severity scale' (FSS) and the German version of the 'Center for epidemiological studies depression scale' questionnaire (ADS) (Krupp et al., 1989; Hautzinger et al., 2012). The patients were then assigned to either a non-fatigue group (nFG: n=20; FSS<4.0) or a fatigue group (FG: n=24; FSS≥4.0). Subsequently, all subjects completed a treadmill exercise test and afterwards a home-based exercise training for twelve months. Details of the treadmill test and the exercise program have already been published (Wonneberger et al., 2012). **Results** The mixed-model ANOVA with repeated measurements showed neither a significant group by time effect nor a time effect ( $p > .05$ ). However, the group effect was significant over the entire observation period and constantly higher for the FG ( $F(1;42)=7.13$ ;  $p \leq .01$ ;  $\text{part.}\eta\text{-square}=0.15$ ). **Discussion** We assume that the low mean ADS score for both groups at baseline (nFG: 10.1; FG: 16.0) mainly accounts for the fact that no treatment effects were detectable. When comparing the ADS-Score for the FG to a German general population (11.7) the difference is statistically significant ( $p < .05$ ), but still below the cut-off value for depressive disorders ( $>22.0$ ) (Hautzinger et al., 2012). It is also possible that the lack of constant supervision could also lead to no changes (Romberg et al., 2005). However, the results of our study further confirm the interdependence of fatigue and depressive symptoms. We propose to select patients with higher ADS scores at baseline for further studies to detect possible treatment effects of exercise interventions on depressive symptoms in MS patients. **Bradshaw J; Rose A (2008):** Cognition, Depression and Fatigue in Multiple Sclerosis. In: *Advances In Clinical Neuroscience & Rehabilitation* 8 (4), S. 15–17. **Hautzinger M; Bailer M; Hofmeister D; Keller F (2012):** Allgemeine Depressionsskala. Göttingen: Hogrefe-Verlag GmbH und Co. KG. **Krupp LB; LaRocca NG; Muir-Nash J; Steinberg AD (1989):** The fatigue severity scale-Application to patients with multiple sclerosis and systemic lupus erythematosus. In: *Arch. Neurol* 46 (10), S. 1121–1123. **Romberg A; Virtanen A; Ruutinen J (2005):** Long-term exercise improves functional impairment but not quality of life in multiple sclerosis. In: *J. Neurol.* 252 (7), S. 839–845. **Wonneberger M; Drogge D; Schmidt S; Froböse I (2012):** Veränderung von Gangparametern weiblicher Multiple Sklerose Patienten nach einem Ausdauertraining. In: *Deutsche Zeitschrift für Sportmedizin* 63 (5), S. 143–147.

### INTENSIVE PHYSICAL RETRAINING PROGRAM FOR PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Calcagno, G.1, Aquino, G.1, Vardaro, A.2, Iuliano, E.1, Di Gioia, C.2, Verlingieri, G.1, Di Cagno, A.1, De Simone, G.2

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**Introduction** COPD is clinically characterized by a functional respiratory deficit and reduced capacity for exercise. These symptoms determine physical deconditioning as well as a decreased in cognitive function and health related quality of life (J.W. Dodd, 2010). Exercise training is fundamental for the management of COPD patients, inducing improvement in physical performance and quality of life (Wadella K., 2004). Different training types have been evaluated, but the most effective training for COPD patients has not yet been defined. The aim of this study was to examine the effects of a high intensity retraining on exercise tolerance, cognitive decline and quality of life. **Methods** Seven COPD male patients (aged 60.8±12.8), hospitalized in a rehabilitation centre, were recruited. Retraining program provided one session per day of 60 minutes, for 5 day per week, for 3 weeks. It consisted of endurance, strength and respiratory exercises at high intensity (70-90 % of baseline capacity). Before and after the experimental retraining protocol, the patients were evaluated for anthropometric parameters, laboratory test, blood gases, respiratory tests, dyspnea scales, physical exercise tests, mental deterioration battery (MDB) and S. George Questionnaire to assess the quality of life. **Results** The results showed a significant reduction of total cholesterol and glucose values. The physical exercise tests, some tests of MBD and level of quality life were also significantly improved. All patients showed a significant reduction of dyspnea scales, increased maximal inspiratory pressure (Pimax), and improvement of oxygen flow rate (PaO2). No significant changes were found for other respiratory tests. **Discussion** The preliminary results of the study confirm the beneficial effects of the high intensity retraining on physical performance, dyspnea and quality of life, limiting the progression of the disease. Moreover, due to increased cerebral oxygenation produced by high intensity exercises, this protocol may prevent some aspects of cognitive decline, characteristic in severe COPD patients (William W. et al., 2010) These preliminary results seems an optimal strategy for patients with COPD and may contribute to optimizing training and to provide guidance for the design of retraining exercise programs (Subin et al., 2010). **References** Wadella K, Sundelina G, Henriksson-Lars K, Rune L.(2004). *Respiratory Medicine*, 98, 428–38 **Dodd JW, Getov SV, Jones PW.** (2010). *Eur Respir J*, 35, 913–22 **William W, Hung JP, Wisnivesky, Albert LS, Joseph SR.**(2009). *Am J Respir Crit Care Med*, 180, 134–7 **Subin, Vaishali R, Prem V, Shaoo.** (2010). *Lung India*, 27(1), 4–7.

### PHYSICAL ACTIVITY LEVELS IN ADULTS WITH INTELLECTUAL DISABILITIES

Guerra, M.1, Javierre, C.2, Oviedo, G.R.1, Barnet, S.1, Carbó, M.1, Fernhall, B.3

1-FPCEE-Blanquerna (University Ramon Llull), 2-University of Barcelona (Spain), 3-University of Illinois at Chicago (IL)

**Introduction** Individuals with intellectual disabilities (ID) have low physical activity (PA) levels and total energy expenditure (TEE). Purpose To evaluate the total physical activity (TPA), the quantity of moderate to vigorous PA (MVPA), daily steps (DS) and TEE of an active and a sedentary group of adults with ID during the intervention period. **Methods** Two groups of adults with moderate to severe ID, with and without Down Syndrome, participated in this study. The intervention group (IG) (17 women, 22 men, age=40±11 years) followed an aerobic and strength training program during 14 weeks, 1 hour 3 times per week and the control group (CG) (13 women; 15 men; age=45±12 years) did not train. TPA, MVPA, DS and TEE were obtained through triaxial accelerometry during 7 consecutive days of the intervention period. Body Mass Index (BMI), TPA, MVPA, DS and TEE differences between groups were analyzed using the student t-test ( $p < 0.05$ ). **Results** The BMI was  $27.6 \pm 5.4$  and  $28.4 \pm 6.6$  in the IG and the CG respectively. TPA and MVPA in the IG were  $297.2 \pm 143.4$  counts/min and  $155.5 \pm 132.7$  min respectively and in the CG  $223.2 \pm 109.6$  counts/min and  $87.7 \pm 81.4$  min respectively. TEE in the IG was  $2205.6 \pm 1245.4$  kcal and  $1605.5 \pm 779.2$  kcal in the CG. The IG exhibited a significant higher number of daily steps ( $7086.7 \pm 3038.6$  steps) than the CG ( $5164.45 \pm 2307.3$  steps) ( $p = 0.033$ ). No significant difference was founded between groups in BMI. The IG presents significant higher values in TPA ( $p = 0.036$ ), MVPA ( $p = 0.029$ ) and TEE ( $p = 0.039$ ) than the CG. **Discussion** Even though the TPA and MVPA of the IG was higher than the CG, neither group achieved the recommendations of 10000 DS, while the IG achieved the 150 minutes/week of MVPA recommended by the WHO, 2010. More research is needed. **References** Fernhall, B., Pitetti, K. H., Rimmer, J. H., McCubbin, J. A., Rintala, P., Millar, A. L., Burkett, L. N. (1996). Cardiorespiratory capacity of individuals with mental retardation including down syndrome. *Medicine and Science in Sports and Exercise*, 28(3), 366-371. Organización Mundial de la Salud. (2010). *Recomendaciones mundiales sobre actividad física para la salud*. Ginebra: WHO. Temple, V. A., & Walkley, J. W. (2003). Physical activity of adults with intellectual disability. *J Intellect Dev Dis*, 28(4), 342-353. doi: 10.1080/13668250310001616380 Tudor-Locke, C., & Bassett, D. R., Jr. (2004). How many steps/day are enough? preliminary pedometer indices for public health. *Sports Medicine (Auckland, N.Z.)*, 34(1), 1-8. (Supported by the MEC, ref. DEP2012-35335)

### IMPACT OF A PHYSICAL ACTIVITY PROGRAM TO IMPROVE BALANCE AND MOBILITY PERFORMANCE IN ADULTS WITH INTELLECTUAL DISABILITY

Cabedo, J., Giné-Garriga, M., Fortuño, J., Oviedo, G., Carbó, M., Barnet, S., Martín-Borràs, C., Guerra, M.

University Ramon Llull

**Introduction:** Balance and mobility limitations are common in persons with intellectual disability (ID). Differences in balance and mobility between persons with ID and controls have mainly been demonstrated by instrumented assessments (e.g. posturography and gait analysis), which require sophisticated and expensive equipment such as force plates or a 3D motion analysis system. Most physicians and allied healthcare professionals working with persons with ID do not have such equipment at their disposal, so they must rely on clinical tests to determine whether mobility is affected. There is insufficient evidence to demonstrate that there is improvement in physical performance outcomes such as balance and mobility in adults with ID (Andriolo et al., 2010). This descriptive study investigated the impact of a physical activity (PA) program in improving balance and mobility performance in older adults with ID. **Methods:** A descriptive design was developed. Thirty seven (15 women, 22 men) adults,  $39.7 \pm 11.4$  years old with mild to moderate ID, from an Occupational Day Center placed in Girona, followed an aerobic, strength and balance training program during 14 weeks, 1 hour 3 times per week. All subjects were measured while doing a Timed Up and Go Test, a Flamingo balance test and a Gesell bar test. Balance and mobility descriptive data were compared between the groups using paired-sample t-tests. **Results:** Between the first test (T1) and the second test (T2) there were only significant differences ( $p < 0.05$ ) for dynamic balance (Gesell bar: T1= $14.92 \pm 11.23$ s vs T2= $6.84 \pm 4.51$ s). However, no significant differences ( $p < 0.05$ ) were found for static balance and mobility (Flamingo: T1= $10.64 \pm 11.61$ s vs T2= $12.47 \pm 10.05$ s and Timed Up and Go: T1= $15.27 \pm 3.78$ s vs T2= $14.38 \pm 3.54$ s) **Discussion:** Results showed significant differences in dynamic balance. A different pattern of results emerged for static balance and mobility where no statistically significant differences were found. It is possible to speculate that the balance-based exercises included in our training program could be responsible for the statistically better dynamic balance. More research is needed to understand why so few differences exist in static balance and mobility performance in adults with intellectual disability. **References:** Andriolo RB, El Dib RP, Ramos L, Atallah AN, da Silva EM. (2010). *Cochrane Database Syst Rev*, 12(5):CD005176. Suported by MEC, ref: DEP2012-35335

14:00 - 15:00

## Mini-Orals

### PP-PM26 Neuromuscular Physiology [PH] 4

#### INFERIOR MUSCULARITY OF THE RECTUS FEMORIS TO VASTI IN CYCLISTS BUT NOT IN LACROSSE PLAYERS

Ema, R., Wakahara, T., Kanehisa, H., Kawakami, Y.

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**Introduction** We have reported inferior muscularity of the rectus femoris (RF) to vasti (vastus lateralis (VL), vastus medialis (VM), and vastus intermedius (VI)) in oarsmen (Ema et al., 2012). This was assumed to be due to muscle-specific adaptation to the rowing motions, which include cyclic leg extensions (combination of knee and hip extensions). However, it is unknown whether the inferior muscularity of RF, observed in oarsmen, can be generalized to other athletes who mainly perform cyclic leg extensions in their competitive and training activities. We examined this subject by comparing the muscularity of four constituents of the quadriceps femoris among cyclists, lacrosse players and non-athletes. **Methods** T1-weighted magnetic resonance (MR) images of the thigh were obtained from seven male cyclists, 13 male lacrosse players and 21 non-athlete men. From the MR images, muscle volume of each muscle of the quadriceps femoris was determined. The muscle volume relative to body mass and to that of the total quadriceps femoris were calculated for each muscle.

Results The muscle volume relative to body mass of the total quadriceps femoris, VL, VM, and VI was significantly larger in the cyclists than in the lacrosse players and non-athletes, whereas that of RF was significantly smaller in the cyclists and non-athletes than in the lacrosse players. The relative value of RF to the total quadriceps femoris in volume was significantly lower in the cyclists than in the lacrosse players and non-athletes. Discussion The present study demonstrated inferior muscularity of RF to the vasti in the cyclists. This result was consistent with our finding in oarsmen (Ema et al., 2012). This may be attributable to the difference in muscle activation between RF and the vasti during cycling motions (Chin et al., 2011). The current results indicate, regardless of sport events, that inferior muscularity of RF to the vasti is common to the athletes who mainly perform cyclic leg extensions. On the other hand, larger size of RF in the lacrosse players may be partly due to repeated sprint activities during field sports (Spencer et al., 2005), which include hip flexions during the swing phase. The present findings suggest that chronic participation in sport activities that require cyclic leg extensions results in inferior muscular hypertrophy of RF compared to the vasti. References Chin LM, Kowalchuk JM, Barstow TJ, Kondo N, Amano T, Shiojiri T, Koga S. (2011). *J Appl Physiol*, 111, 1259-1265. Ema R, Wakahara T, Kanehisa H, Kawakami Y. (2012). 25th Scientific Congress for Sports and Exercise Training (abstract in Japanese). Spencer M, Bishop D, Dawson B, Goodman C. (2005). *Sports Med*, 35, 1025-1044.

## NEUROMUSCULAR FATIGUE OF THE QUADRICEPS FOLLOWING CONCENTRIC ISOLOAD VS ISOKINETIC FATIGUE PROTOCOL

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Introduction Isolead (against a constant load, IL) and isokinetic (at constant angular velocity, IK) movements are commonly used in rehabilitation and training programs. IL and IK contractions exhibit specific mechanical constraints that influence EMG activity of the quadriceps muscle (Guilhem et al., 2011; Remaud et al., 2009). In the same time, fatigue has been shown to be task dependent and to depend on mechanical features and motor unit activation (Babault et al., 2006). Our study aimed to compare neuromuscular fatigue of the knee extensors induced by concentric IL and IK standardized fatigue protocols. Methods 12 subjects participated in IL and IK test sessions. Each session comprised a fatigue protocol performed in the tested contraction mode and neuromuscular tests carried out before, immediately after and 5-min after the fatiguing exercise. In order to compare the effects of contraction mode on neuromuscular response, IL and IK fatigue protocols were standardized by equalizing total amount of work and mean angular velocity. During the tests, peak torque (Pt), rate force development (RFD) and voluntary activation (VA) were assessed through isometric maximal voluntary contraction. Contractile properties were estimated from the mechanical response to supramaximal paired stimuli, i.e. the maximal rate of force development, the peak torque and the maximal rate of torque development. The statistical differences between contraction mode and/or tests were computed using a two-way ANOVA with repeated measures. Results Our results indicated similar Pt decrease consecutive to both IL and IK exercises (respectively -20 and -17%;  $p < 0.005$ ). In the same way, VA did not demonstrate differences between the two sessions. On the contrary, RFD decrease (-29%;  $p < 0.005$ ) and contractile properties impairment (-25% on average for corresponding parameters;  $p < 0.005$ ) were specifically induced by IL fatigue protocol. Discussion Our study highlighted that neuromuscular fatigue was different when protocol was made of IL or IK contractions. Contractile properties impairment probably originated in modifications of excitation-contraction coupling processes, while RFD decrease could be linked with both neural and muscular changes. EMG analysis of maximal voluntary and electrically evoked contraction is in progress and will be presented at the ECSS conference. References Babault N, Desbrosses K, Fabre MS, Michaut A, Pousson M. (2006) *J Appl Physiol*, 100, 780-785. Guilhem G, Cornu C, Guével A. (2011). *Eur J Appl Physiol*, 111(11), 2723-2733. Remaud A, Cornu C, Guével A. (2009). *J Electromyogr Kinesiol*, 19(3), 449-458.

## HOW MANY HEALTHY INDIVIDUALS RESPOND TO WIDE-PULSE, HIGH-FREQUENCY NEUROMUSCULAR STIMULATION BY GENERATING "EXTRA FORCE"?

Wegrzyk, J.1, Fouré, A.1, Vilmen, C.1, Maffioletti, N.A.3, Place, N.2, Mattei, J.P.1, Bendahan, D.1, Gondin, J.1

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Introduction In contrast to conventional (CONV) NMES, the use of "wide-pulse, high-frequency" (WP-HF) NMES has been reported to generate up to five times higher forces than expected from the direct activation of motor axons alone [1]. This "extra force" (EF) phenomenon has been mostly ascribed to central mechanisms and observed in 80-85% of healthy individuals (i.e., responders) [2, 3]. The latter calculation, however, was based on small samples (5-15 subjects) using a single criterion analysis. In the present study, we aimed at determining the number of responders to the EF phenomenon on the basis of a large sample size and an original methodological approach. Methods Electrically evoked isometric force of the plantar flexor muscles was recorded in 42 healthy subjects (20 men, 22 women; age:  $28 \pm 6$  years). CONV (25Hz, 0.05ms) and WP-HF (100Hz, 1ms) NMES consisted of  $5 \times 20$  s constant-frequency stimulation trains at 5% of the maximal voluntary contraction (MVC) force. A three step calculation process was applied to classify responders, i.e., S1) inclusion of subjects for whom the force difference between 0-2 s and 18-20 s of WP-HF was significantly greater than zero, S2) exclusion of subjects showing no significant difference in force output between the two protocols, S3) inclusion of subjects for whom peak force occurred before 18-20 s. Results After S1, 25 subjects were classified as potential responders from whom two were excluded after S2, and to whom three were added after S3. Overall, 26 subjects i.e. 62% were classified as responders. For this group, the mean force increased significantly from  $4.4 \pm 1.5$  to  $14.1 \pm 3.4$  % MVC for WP-HF whereas it remained constant for the non-responders ( $4.7 \pm 1.0$  to  $4.4 \pm 1.3$  % MVC). No significant effect of age, sex, height, weight, caffeine intake and stimulation intensity (mA) on EF was found. Discussion Although the extent of EF (i.e. threefold force increment) was comparable to former studies, the relative amount of responders i.e. 62% was considerably lower than the 80-85% value [2,3] previously reported. The use of multiple selection criteria allowed us to discard false-responders and to include false non-responders who would have been wrongly classified on the basis of a single criterion. Overall, this methodological approach provides a framework for unraveling the physiological mechanisms involved in EF generation. References 1 Collins DF. et al. (2002). *J Physiol* 538(1), 289-301. 2 Lagerquist O. et al. (2009). *J Appl Physiol* 107(1), 161-167. 3 Dean JC et al. (2007). *J Appl Physiol* 103, 170-176.

## ENGINEERING INNERVATED SKELETAL MUSCLE IN VITRO

Martin, N.R.W., Passey, S.L., Mudera, V., Baar, K., Greensmith, L., Lewis, M.P.

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Introduction: In vitro skeletal muscle cultures have provided a novel method for investigations into mechanisms governing skeletal muscle maturation and adaptation to exercise in an isolated environment. However, typically such in vitro cultures have limited utility for such

investigations due to the fact that they are not cultured in a biologically relevant niche, and they lack innervation which inhibits physiologically correct stimulation. We aimed to create 3-dimensional skeletal muscle with an extracellular matrix and subsequently co-culture these skeletal muscle models with primary motoneurons to determine if a neuromuscular junction (NMJ) can be created in vitro. Methods: Primary rat muscle derived cells (MDCs) were isolated from P1 neonates by enzymatic digestion, and seeded on to fibrin based hydrogels as previously reported (Huang et al. 2005). After 4 days in culture, primary rat motoneurons were isolated from the ventral horn of spinal cords from 14 day old embryos and were seeded on to the muscle derived cells and maintained for a further 7-10 days. At the end of the culture period constructs were fixed and immunostained for markers of muscle, motoneurons and NMJs. Results: Over 14 days in culture, the hydrogels self-assembled into 3-dimensional constructs with a maximum width of <500µm. Immunohistochemistry of cross-sections of these muscles displayed that muscle fibres expressing the cytoskeletal protein desmin were present throughout the core of the constructs. Furthermore, longitudinal immunostaining displayed the structural biomimicry as evidenced by densely packed fascicular bundles of myotubes. When co-cultures were immunostained for MAP-2, there was clear evidence for motoneuron survival and extension of neurites/axons from neuronal cell bodies. Furthermore, co-localisation of pre- and post-synaptic proteins gives evidence to suggest that NMJs can be formed in this system. Conclusions: We have succeeded in creating a system for the co-culture of skeletal muscle with motoneurons and have evidence of NMJs. Stimulation through these motor nerves will allow for both phenotypic and molecular skeletal muscle regulation of exercise adaptation to be explored in a model which closely recapitulates native skeletal muscle. References: Huang, Y., Dennis, R.G., Larkin, L., Baar, K. (2005) Rapid Formation of Functional Muscle in Vitro using Fibrin Gels. *J. Appl. Physiol.* 98: 706-713.

### **DYNAMOGRAM IN ANTIOQUIA'S TEAM FINSWIMMING ATHLETES, COLOMBIA: COMPARATIVE CHARACTERISTICS**

Marino, F.E.1, Romero, L.J.P.2, Valbuena, L.H.1, Orozco, A.3, Escobar, N.3

*INDEPORTES ANTIOQUIA - UNIVERSIDAD PONTIFICIA BOLIVARIANA UPB*

Introduction Training done by athletes produces metabolic and physiological adaptations which are related to execution of sports movements and increasing of strength, agility, flexibility, power, speed, intra or intermuscular recruitment and metabolic pathways of energy production. The determination of force-velocity musculoskeletal system characteristics is one of the most widely method used to analyze and evaluate these variables. This uses technological devices and computers applied by means of dynamometry and electromyography. Dynamometer is used to measure developed force in a maximum isometric contraction and to determine fast characteristics of muscle contraction strength, by force curve graphic or dynamogram. The aim of this study was measure dynamometric variables in Antioquia Team Finswimming athletes, Colombia. The measurements were performed at Exercise Physiology Laboratory of Indeportes Antioquia. Two measurements were taken of each athlete and calculated with software designed to calculate and graph the dynamogram. Latency, first peak force, first peak time, maximum force, maximum force time, relaxation latency, relaxation time, relaxation force, maximum gradient strength and relaxation coefficient were measured. Results The results show differences between genders in the evaluated parameters. The intra and intergroup differences could be due to different forms of training or muscle imbalances that have not been corrected. Tables are presented with the results and statistical analysis. Discussion Assessing neuromuscular variables in athletes helps to build a more suitable training system. Obtained values for latency in both genders related to those reported in the literature (250 to 320 ms). The relationship between extensor and flexor strength is near to 2:1 but is not related to body weight or sport modality according data obtained in our laboratory. It provides a comparison between genders to see their statistical significance. References 1. Alonso Hernández, J; Iznaga Dapresa, A. Algunos métodos para la valoración de la adaptación funcional del sistema neuromuscular al proceso de entrenamiento. *IMD, documentos*, 1993, La Habana, Cuba 3. Marino F, Valbuena LH, Cardona OM, Contreras LE, Quiceno JC, Pérez J, et al. Pruebas Fisiológicas para la evaluación de la condición física en el laboratorio: Unidad de Medicina Deportiva de Indeportes Antioquia (parte II). *Revista Antioqueña de Medicina Deportiva y Ciencias Aplicadas a la Actividad Física y el Deporte*, VOL.4, No.1. (2001) 4. Ramírez J.P., Escobar N, Valbuena L.H, Marino F.E, Estudio de variables neuromusculares mediante un sistema prototipo de biomecánica muscular a partir de dinamometría isométrica en deportistas de natación con aletas del departamento de Antioquia

### **PERFORMANCE AND POWER OUTPUT IN VERTICAL JUMPS PERFORMED WITH POSITIVE AND NEGATIVE LOADING**

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Department of Kinesiology and Applied Physiology, University of Delaware, Newark, USA, 2Faculty of Sport and Physical Education, University of Belgrade, Serbia, 3Faculty of Kinesiology, University of Zagreb, Croatia Introduction The aim of the study was to explore the effects of positive and negative load on the differences in performance and power output of the maximum vertical jumps (VJ) performed with and without the stretch-shortening cycle (SSC). In line with the Maximum Dynamic Output Hypothesis (Markovic, Jaric, 2009), we predicted that the maximum advantage of the SSC would be revealed under no-load (i.e., body mass only) conditions. Methods Thirteen physically active participants (age: 21.2 ± 1.3 yr, body mass: 79.5 ± 10.8 kg, height: 1.84 ± 0.06 m; mean ± SD) performed maximum squat jump (i.e., VJ without SSC) and various counter movement jumps (i.e., VJ with SSC) when loaded by a pulley system exerting a vertical force upon the body within the range between -40% and +40% of body weight (BW). Results The differences in performance between VJ executed with and without SSC revealed maxima strikingly close to no-load conditions (0%-2%BW), while the same differences in the power output were observed under relatively low positive loads (14%-25%BW). Discussion The obtained results support the Maximum Dynamic Output Hypothesis and suggest that all neuro-mechanical processes that enhance SSC associated performance could be optimized for one's own body weight. Future studies should extend this line of research both to different ballistic movements and different loading methods. Acknowledgments This work was supported in part by a National Institutes of Health grant R21AR06065, grants from the Serbian Research Council (#175037), and Croatian Ministry of Science, Education and Sport (034-0342607-2623). References Jaric, S., Markovic, G. (2009) Leg muscles design: the maximum dynamic output hypothesis, *Med Sci Sports Exercise*, 41:780-7.

## SHORT-TERM DISUSE AND SUBSEQUENT RECOVERY INDUCE AGE-SPECIFIC ALTERATIONS IN NEUROMUSCULAR ACTIVATION

Hvid, L.G., Suetta, C., Ørtenblad, N., Kjaer, M., Aagaard, P.

*University of Southern Denmark*

**Introduction** An optimal efferent neural drive (neuromuscular activation) is a governing factor for the ability to develop maximal muscle strength. However, it remains unknown how short-term disuse (< 7 days) and subsequent recovery affects neuromuscular activation in young compared to old individuals. The purpose of the study was to investigate this. **Methods** Eleven young (~24 yrs) and 11 old (~67 yrs) recreationally active healthy men underwent 4 days of unilateral lower limb disuse (locked knee brace, ambulation using crutches) followed by 7 days of recovery (free ambulation including one session of resistance training). Assessment of knee extensor maximal voluntary isometric contraction (MVC) and neuromuscular activation (NA) using superimposed twitch interpolation were carried out in a custom-built dynamometer (Suetta et al. 2009) before and after disuse as well as after recovery. **Results** Prior to disuse, old demonstrated lower MVC than young (159±11 vs. 208±12Nm, respectively) as well as reduced NA (89.2±2.2 vs. 94.0±0.8%, respectively). Following disuse, MVC decreased in old (135±12Nm, -16%) and young (188±12Nm, -10%), while NA decreased in old only (81.8±3.9%, -8%) and remained unaffected in young (92.9±1.1%). Following recovery, MVC and NA increased both in old (147±12Nm, +11%; 87.2±2.6%, +8%) and in young (205±13Nm, +10%; 95.6±0.7%, +3%). Notably, compared to pre disuse levels, MVC remained suppressed in old whereas NA increased in young following 7 days of recovery. **Correlations** were observed between relative changes in MVC and NA induced by disuse (old:  $r=0.83$ ) and recovery (young:  $r=0.65$ , old:  $r=0.66$ ). **Discussion** While short-term disuse and subsequent recovery caused similar changes in MVC in young and old, respectively, these changes were accomplished through different mechanisms. Hence, old demonstrated more marked alterations in NA compared to young, in accordance with longer lasting (7-14 days) disuse studies (Deschenes et al. 2008, Suetta et al. 2009). **In conclusion**, short-term disuse and subsequent recovery induce age-specific alterations in lower limb neuromuscular function. Deschenes MR, Holdren AN, McCoy RW. Adaptations to short-term muscle unloading in young and aged men. *Med Sci Sports Exerc* 40(5), 856–863, 2008. Suetta C, Hvid LG, Justesen L, Christensen U, Neergaard K, Simonsen L, Ortenblad N, Magnusson SP, Kjaer M, Aagaard P. Effects of aging on human skeletal muscle after immobilization and retraining. *J Appl Physiol* 107(4), 1172–1180, 2009.

## TWITCH POTENTIATION INDUCED BY NEUROMUSCULAR ELECTRICAL STIMULATION IS NOT AFFECTED BY STIMULATION PARAMETERS.

Silva, S.R.D.1,2, Maffiuletti, N.A.3, Gondin, J.4, Neyroud, D.2, Place, N.2

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**1**School of Physical Education and Sport of Ribeirão Preto, USP, Brazil **2**ISMMS, University of Geneva, Switzerland **3**NRL, Schulthess Clinic, Zurich, Switzerland **4**CRMBM, Aix-Marseille University, Marseille, France. **Introduction** Neuromuscular electrical stimulation (NMES) recruits motor units in a nonselective, spatially fixed and temporally synchronous pattern (1). It has recently been suggested that the use of wide-pulse (1 ms) high-frequency (> 80 Hz) NMES can additionally recruit motor units through a "central" mechanism (2), which would be similar or close to the orderly recruitment observed in voluntary contractions. The increase in twitch force after a conditioning contraction (twitch potentiation) is affected by the activation history of the muscle but has also been shown to be greater for fast-twitch muscle fibers (3). Thus, the aim of the present study was to compare the extent of twitch potentiation after three different conditioning contractions: conventional NMES (CONV); wide-pulse high-frequency NMES (WPHF) and voluntary (VOL). A lower potentiation for WPHF in comparison to CONV would indicate that proportionally more slow-twitch motor units are recruited during WPHF. **Methods** Thirteen healthy subjects (nine men and four women) aged  $30 \pm 7$  yrs sat in a custom-built chair with the dominant foot placed on a pedal equipped with a strain gauge. Knee angle was 140° (180° = full extension) and ankle angle was 90°. Peak twitch (Pt) was evoked by supramaximal stimulation of the tibial nerve before and immediately after the three following conditioning contractions (duration 10 s): WPHF (1-ms pulse width/100-Hz frequency), CONV (50- $\mu$ s pulse width/25-Hz frequency) and VOL. Each condition was separated by 5-10 min. NMES was delivered by two large electrodes positioned over the triceps surae muscle belly, and stimulation intensity was set to produce an initial force of 10% MVC for the WPHF modality. Force-time integral was then matched for the two other 10-s contractions. **Results** The force time integral was comparable ( $p>0.05$ ) for WPHF ( $958 \pm 614$  N.s), CONV ( $958 \pm 559$  N.s) and VOL ( $968 \pm 544$  N.s). Peak twitch force was similarly potentiated after WPHF (from  $112 \pm 26$  N to  $116 \pm 29$  N,  $p<0.05$ ) and CONV (from  $105 \pm 25$  N to  $109 \pm 27$  N,  $p<0.05$ ), whereas no potentiation was observed for VOL (from  $103 \pm 26$  N to  $103 \pm 26$  N,  $p>0.05$ ). **Conclusion** The main finding of the present study is that low-intensity WPHF and CONV NMES of the triceps surae potentiated the twitch response to a similar extent. These results do not lend support to the theory that WPHF NMES can result in different motor unit recruitment compared to CONV NMES. **References** (1) Bickel CS et al. *Eur J Appl Physiol* 111, 2399-2407, 2011 (2) Collins DF et al. *J Physiol* 538, 289-301, 2002 (3) Moore RL & Stull JT. *Am J Physiol* 247, 462-471, 1984

## FREQUENCY DEPENDENCE OF JOINT VISCOELASTICITY BY SINUSOIDAL ANALYSIS

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**Introduction** In addition to muscle activation, joint viscoelasticity is important element for motor control. Although joint viscoelasticity is variable related displacement and velocity, recent study has not considered frequency dependence of joint viscoelasticity. To investigate the frequency dependence of joint viscoelasticity, sinusoidal analysis (Kawai M 1978) was applied in which the complex stiffness was calculated by relationship between displacement and force when the sinusoidal displacement was given. The purpose of the present study was to examine the frequency dependence of joint viscoelasticity by sinusoidal analysis. **Methods** Eight subjects were participated in this study. The vibratory stimulation on the index finger of left hand in which the amplitude was 1 deg and the frequency was 14 levels (0.25 Hz ~ 66 Hz) was given in direction of adduction-abduction. The force transducer was attached to the left index finger and the adduction-abduction torque was calculated. Using the high resolution (10  $\mu$ m) laser displacement sensor, adduction-abduction angular displacement was measured. Surface EMG was recorded from first dorsal interosseous in order to monitor the muscle activities. Then, to investigate the frequency dependence of joint viscoelasticity, sinusoidal analysis was applied and the procedure was as bellow. 1) Five cycles in which there were no reflex activities was selected as the analysis period at each trial. 2) The time series of angle and torque were fitted to the sinusoidal wave by the least-squares method. 3) From the amplitude ratio of torque and angle ( $T_0/\theta_0$ ) and the phase shift ( $\delta$ ) of torque and angle, the complex stiffness ( $G^* = T_0/\theta_0 \cdot e^{i\delta}$ ) was calculated and plotted in complex plane. This index has the property that real part shows the elastic component and the imaginary part shows the viscos component. 4) Elastic coefficient (K) and

viscos coefficient (B) were the quantified using the Results The complex stiffness existed in not only first quadrant but also second quadrant, because the obtained torque data contained the torque proportional to angular acceleration. Combining the model and the complex stiffness in order to extract the information of joint viscoelasticity, it was found that elastic coefficient (K) largely increased and the viscos coefficient (B) largely decreased, as the frequency became high. Discussions Main result that elastic coefficient increased and viscos coefficient decreased as the frequency became high corresponded to the resent study (Kawai M 1978) in which muscle preparation of rabbit psoas had been used. In conclusion, frequency dependence of joint viscoelasticity is verified. Reference Kawai M (1978). edited by Haruo Sugi and Gerald H.Pollack: 149-169

## STRUCTURE OF PROXIMAL AND DISTAL COMPARTMENTS IN RAT MEDIAL GASTROCNEMIUS MUSCLE

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**Introduction** Muscle compartments are subvolumes of the skeletal muscle which are innervated by primary extramuscular nerve branches and are documented in several muscles of mammals. These regions are innervated by unique sets of motoneurons, contain characteristic proportions of muscle fiber types and thus have various contractile and histochemical profiles. Rat medial gastrocnemius is composed of two subvolumes: the proximal compartment containing predominantly fast twitch oxidative fibers and the distal compartment with mainly fast twitch glycolytic fibers. The aim of this study was to determine the histological structure of muscle fibers (number and diameter) in the two medial gastrocnemius compartments on various levels along the muscle. **Methods** Adult female Wistar rats of the same age were studied. To diversify muscle compartments, glycogen depletion technique based on a stimulation protocol of one of the two primary nerve branches to medial gastrocnemius was applied. The area of compartments, number and diameters of muscle fibers in the two distinct subvolumes on five muscle levels (about 10, 25, 50, 75 and 90% of the muscle length) were determined from serial cross sections. For analysis the Nikon DS-Fi1c Camera and NIS-Elements Basic Research software were used. **Results** It was shown that the two smallest, opposite serial sections: close to the knee (about 10% of muscle length) and close to the Achilles tendon (about 90% of muscle length) are occupied by only one compartment: proximal and distal, respectively. The largest section (at about 50% of muscle length, 27.8 – 29.5 mm<sup>2</sup>), the proximal compartment constituted 27 – 33% of the muscle area. Maximal number of muscle fibers in the proximal compartment was 5,008 – 6,698, while in the distal one 4,773 – 6,241. The mean muscle fibers diameter in the proximal and the distal subvolumes ranged: 36.9 – 48.9  $\mu$ m and 46.5 – 63.5  $\mu$ m, respectively. Moreover, the diameter muscle fibers revealed a tendency visible within each of the two compartments to increase along the muscle. **Conclusion** It is concluded that size and number of muscle fibers in proximal and distal compartments of the medial gastrocnemius are different. In comparison to the distal compartment, the proximal one has smaller cross-section area but contains slightly higher number of muscle fibers which are smaller in diameter.

## EFFECTS OF REDUCED PLANTAR SENSATION ON MAXIMUM FOOT GRIP STRENGTH

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**Effects of reduced plantar sensation on maximum foot grip strength [Introduction]** A better understanding of the functional role of the foot is the major key to understand regulatory mechanisms of human bipedal locomotion and postural control. It has been suggested that the foot muscle strength is an important role in motor task of the human movements (Goldmann et al. 2012). Also, it has been reported that greater sensory loss of the foot is related to loss of postural control (Wang and Lin 2008). This impairment of postural stability might be related to the decrease in muscle force production of foot after desensitization of foot if foot muscle strength is also required to maintain a whole body balance. However, no studies were investigated to the effects of reduced plantar sensation on the force generating capacity of foot muscle. **[Purpose]** The aim of the present study was to investigate the effects of reduced plantar sensation on maximum foot grip strength. **[Methods]** Twenty young healthy individuals (age 21.2 $\pm$ 3.4years, body height 1.67 $\pm$ 0.1m, body mass 56.9 $\pm$ 10.6kg, mean $\pm$ S.D) were participated and their maximum foot grip force (FGF), postural control, skin temperature (ST) and the cutaneous light-pressure thresholds (CPT) were measured with the foot grip dynamometer, Kistler force plate, thermography and Semmes-Weinstein monofilament, respectively, before and after the intervention (normal and reduced plantar sensation). For maximum isometric force measurement of foot grip, subjects optimally grabbed the grip-handle bar of the dynamometer by toe and fingers of foot in a sitting and standing position and exerted maximum force, and then, the highest value among the 3 trials was used for a further analysis. Postural control was assessed during double and single leg quiet standing in open eyes condition, using force plate to quantify center of pressure (COP) dynamics. Intraclass correlation coefficient (ICC) were used as estimates of reliability and precision. The right foot was placed into cold water (0°C) for 20 minutes, while the left foot was stayed outside of water as a control. The room temperature was maintained at 20°C. **[Results and Discussion]** After cold water immersion, FGF, ST and CPT significantly decreased, while the control foot did not changed. ICC values before and after intervention for the control foot was 0.95. The results of this study suggest that a desensitization of foot induces an impairment of foot muscle functions. Also, cold water immersion might cause to decrease muscle temperature itself and such lowered muscle temperature could imparted the force generating capacity of muscle. **[Reference]** Goldmann JP et al., The potential of toe flexor muscles to enhance performance, *J Sports Sci.* 2012; in press Wang TY and Lin SI, Sensitivity of plantar cutaneous sensation and postural stability, *Gait Posture* 2008; 23(4):493-499.

## PRESYNAPTIC CONTROL IN THE REGULATION OF THE VOLUNTARY MOVEMENT IN PERSONS OF DIFFERENT AGE

Chelnokov, A.

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The purpose of our research was in studying the role of presynaptic inhibition (PI) of Ia afferents in regulation of a voluntary muscle contraction in persons of different ages. **Methods** 9-12 year-old boys (n=15), 14-15 (n=15) and 17-18 year-old teenagers (n=15), and 22-27 year-old men took part in the research. PI of Ia afferents were evaluated according to the degree suppression m. soleus H-reflex amplitude of a testing person in conditioning stimulation of n. peroneus profundus (Mizuno et al., 1971). The lower the m. soleus H-reflex amplitude of a testing suppression is in relation to H-reflex amplitude of a control, the stronger is the PI. The interval between the conditioning and testing stimuli in 9-12 year-old boys was 40 ms, in 14-15 year-old teenagers was 70 ms, in 17-18 year-old teenagers and 22-27 year-old men 100 ms in rest and during isometric contraction on 1st, 15th and 30th seconds. The subjects performed an isometric muscle contraction (plantar flexion) with a 25% of maximal voluntary contraction effort in a sitting position in the dynamographic system Biodex (Biodex Medical System, USA). **Results** It is shown that without dependence from age at all groups in the conditions of static effort expres-

sion of PI decreased in comparison with the background data received in rest. The higher expression of PI at performance of isometric contraction throughout 30 seconds of effort is characteristic for 14-15 year-old teenagers, and the least for children of 9-12 years. Unlike previous age groups of 9-12 year-old boys and 14-15 year-old teenagers, at of 17-18 year-old teenager's expression of PI at performance of any movement is characterized by weakening and comes nearer to level of 22-27 year-old men. We consider the activity of PI to be not only under the influence of afferent, but also corticospinal and the cortical ones depending on the degree of spinal and cortical structures of maturation at different ontogenesis period of the human. References 1. Mizuno Y, Tanaka R, Yanagisawa N (1971). *J Neurophysiol*, 34, 1010-1017.

### LONG-TERM SPORTS ACTIVITIES MAY INDUCE PLASTICITY IN SPINAL MOTOR CONTROL SYSTEMS

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**Introduction** More active skeletal muscle contractions significantly change work of central and peripheral sections of the nervous system. Therefore, research of the spinal cord plastic changes, connected with specific sport training, is of great importance. Methods and subjects 18 non-athletes, 13 basketball-players and 13 ski-racers (aged 18-22) were involved into the investigation. We used the technique of registration of posterior root-muscle reflexes (PRM-reflexes) (Minassian K., Persy I., Rattay F. et al., 2007) which were evoked by percutaneous surface electric spinal cord stimulation at the cervical levels (C2-C7). These responses are equivalents of the H-reflex. There were investigated PRM-reflex thresholds and maximal amplitudes of bilateral biceps brachii, triceps brachii, brachioradialis, extensor digitorum muscles. Results The lowest thresholds and the highest amplitudes of the PRM-reflexes of the studied muscles were revealed at C4-C7 level stimulation in both groups of the athletes, while the same data in the non-athletes were received in a narrower area - at C6-C7 level. At all levels of the stimulation PRM-reflex thresholds and maximal amplitudes in the basketball-players and the ski-racers were significantly different from those in the non-athletes. Practically at all levels alpha-motorneuron reflex excitability of biceps brachii and brachioradialis muscles was much higher in the ski-racers than in the basketball-players. It indicates more pronounced motorneuron plasticity of spinal cord cervical enlargement in ski-racers in comparison with basketball-players. Conclusion The studied long-term sport activities led to plastic changes of spinal cord structures affecting motor control. Further the type sport activity defines the nature and extent of the plasticity. References Minassian K., Persy I., Rattay F., Dimitrijevic M.R., Hofer C., Kern H. Posterior root-muscle reflexes elicited by transcutaneous stimulation of the human lumbosacral cord// *Muscle Nerve*. 2007 Mar;35 (3):327-36.

### EFFECTS OF ELECTRICAL NOISE TO A TIBIAL NERVE ON SOLUES H-REFLEX

Taki, C., Kimura, T., Shiozawa, N.

*Ritsumeikan University*

**Introduction** A recent study (Kouzaki et al. 2012) showed that a minute electrical noise to an afferent nerve reduced force fluctuation during a force matching task, accompanied with the decreased variability of motor units inter-spike intervals. This may be accounted for by the stochastic resonance in the spinal neurons. The aim of this study was to verify the effect of subthreshold electrical noise of afferent nerve on the static and dynamic properties of the alpha motor neuron excitability. Methods The subjects were 12 healthy young men. They sat on a chair and were given subthreshold electrical noise stimulation (5-1000 Hz) (Kimura et al. in press) on a tibial nerve (80% of M-wave threshold) in the right leg. At the same time, a series of single twitch stimulation were injected to the tibial nerve, in order to induce H-waves at the frequency of 1 Hz. In each subject, trials with (ES) and without (CON) noise for 20 min were performed in random order. The H-wave was recorded in the soleus muscle. The time series data of the peak-to-peak amplitudes of 1200 H-waves was obtained for each trial. The variability of the fluctuation was quantified by coefficient of variance (CV). The detrended fluctuation analysis (DFA), based on the long-range correlation (Peng et al. 1995), was also performed to assess its dynamic property. Results The averages of H-wave amplitudes were not different between CON (average (SD), 5.14 (2.99) mV) and ES trials (5.50 (3.15) mV) ( $P > 0.05$ ). On the other hand, CV of the amplitudes in ES (14.0 (7.4) %) was significantly smaller than that in CON (16.7 (8.3) %) ( $P < 0.05$ ). In the DFA, the self-similarity parameter  $\alpha$  was significantly decreased by the injected noise (0.85 (0.06) and 0.98 (0.10) in ES and CON, respectively) ( $P < 0.05$ ). Discussion These results indicate that the static and dynamic properties of alpha motor neuron excitability are changed by a minute electrical noise to an afferent nerve. In terms of the static property, the fluctuation seemed to be attenuated by the noise. However, the DFA indicated that the fluctuation in ES trial became closer to the white noise ( $\alpha = 0.5$ ), not to the  $1/f$  fluctuation ( $\alpha = 1$ ). Further study is required to assess the physiological implication of the changes in dynamic property. References Kouzaki M et al. *Neurosci Lett*, 513:146-150, 2012. Kimura T and Kouzaki M. *Gait Posture*, in press. Peng CK et al. *Chaos*, 5:82-87, 1995.

**14:00 - 15:00**

## Mini-Orals

### PP-PM71 Training and Testing [TT] 6

#### SLACKLINE TRAINING TO PROMOTE BALANCE, GAIT AND STRENGTH PERFORMANCE IN HEALTHY SENIORS

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**Introduction** Aging-induced deteriorations of neuromuscular performance account for higher fall risks in seniors. Balance and strength training, in turn, improve neuromuscular performance and reduce fall rates up to 50% (Gillespie et al. 2009). Slackline training (balancing over nylon ropes) may be regarded as an appealing and challenging approach to train balance and was recently employed in young adults (Granacher et al. 2010) and children (Donath et al. 2013). As comparable studies are lacking in seniors, the present study examined effects of slackline training on standing balance, spatio-temporal gait characteristics and strength performance in seniors. Methods 24 seniors were stratified (strata: age, gender, physical activity (PA)) to an intervention [INT, n=12, 6 women, 6 men, age: 62±6y, PA: 8.7±3.5h/week] or control [CON, n=11, x women, y men, CON: age: 61±6y, PA: 8.5±3.5h/week] group. Slackline training was performed

within 6 weeks (3 times/week, 1 hour/session). INT comprised e.g. double and single limb standing, swinging; walking, turning; backwards walking. Training attendance was 97% (1 drop out in CON due to illness). Before and after the intervention, balance, gait and strength was assessed by (a) tandem and single limb stance (30s) on the slackline and a force plate (sway path of the center of pressure), (b) normal overground walking to obtain spatio-temporal gait characteristics during single, dual (+cognitive interference) and multi (+cognitive and motor interference) task conditions and (c) lower extremity strength (plantar flexion, dorsal extension, maximal force and force development). Results Large group (INT vs. CON) x time (pre vs. post) interactions were found for tandem ( $p=0.049$ ,  $\eta^2=0.17$ , INT, pre,  $1.4\pm 0.7$  s vs. post,  $4.5\pm 4.1$  s,  $p<0.001$ ; CON, pre  $1.5\pm 0.6$  s vs. post,  $2.3\pm 0.9$  s) and left-leg ( $p=0.04$ ,  $\eta^2=0.16$ , INT, pre,  $4.6\pm 3.6$  s vs. post,  $26.5\pm 29.1$  s,  $p<0.01$ ; CON, pre  $3.0\pm 1.4$  s vs. post,  $3.0\pm 1.8$  s) slackline standing. Right-leg slackline standing (INT, pre,  $3.8\pm 2.4$  s vs. post,  $12.9\pm 21.8$  s; CON, pre  $4.5\pm 3.5$  s vs. post,  $3.3\pm 4.2$  s) was slightly affected ( $p=0.12$ ,  $\eta^2=0.11$ ). Static upright stance on the force-plate, spatio-temporal gait characteristic and explosive and maximal strength were not relevantly affected (0.06

## RELIABILITY AND VALIDITY OF THE CHAIR SIT-AND-REACH TEST IN JAPANESE ELDERLY ADULTS

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1: Tenri University (Nara, Japan), 2: Poole Gakuin University (Osaka, Japan)

**Introduction** The sit-and-reach test is the most commonly used approach for measurement of lower back and hamstring muscle flexibility. The test is important because tightness in these muscles is responsible for musculoskeletal injuries and lower back problems (Stutchfield and Coleman, 2006), especially in older adults. The newly designed chair sit-and-reach (CSR) test has been used to measure hamstring flexibility in elderly individuals (Jones et al., 1998). However, the reliability and validity of this test in Japanese elderly adults has not yet been evaluated. We aimed to investigate the test-retest reliability and criterion-related validity of the CSR test in healthy Japanese elderly adults. **Subjects and Methods** A total of 1426 elderly subjects (419 men and 1007 women) aged 60–93 years participated in this study. The results of the CSR test were compared with those obtained using the passive straight leg raise (PSLR) test. The CSR values were also compared to standing trunk flexion (STF) and sit-and-reach (SR) measurements. **Results** The intraclass correlation coefficient (ICC) for the CSR test values was very high (ICC = 0.88–0.96). Significant differences in Pearson correlation coefficients ( $P < 0.05$ ) were observed between CSR values and the values obtained in PSLR ( $r = 0.66$  for men;  $r = 0.28$  for women), STF ( $r = 0.84$  for men;  $r = 0.85$  for women), and SR ( $r = 0.71$  for men;  $r = 0.74$  for women) assessments of hamstring flexibility. Two-way analysis of variance showed a significant interaction between age and gender. No age-related changes were observed in the CSR values in men. However, among female participants, a significant difference was observed between subjects aged 60–69 years and <70 years ( $P < 0.05$ ). Moreover, significant gender-related differences in CSR values were observed across all age groups. **Discussion** The high reliability values for the CSR test in Japanese elderly adults in this study were consistent with the results reported by Jones et al. (1998) in their assessment of the CSR test. The criterion-related validity coefficients (0.28 to 0.85) found in our study were accepted to be consistent with the results of previous studies. These findings suggest that the CSR test is a reliable approach and provides an acceptable measure of hamstring flexibility in Japanese elderly adults. **References** Jones C.J., et al. (1998). The reliability and validity of a chair sit-and-reach test as a measure of hamstring flexibility in older adults. *Res. Q. Exerc. Sport*, 69, 338-43. Stutchfield B.M. and Coleman S. (2006). The relationships between hamstring flexibility, lumbar flexion, and low back pain in rowers. *Eur. J. Sport Sci.*, 6: 255-60.

## REPEATED SPRINT ABILITY IN YOUNG SOCCER PLAYERS AT DIFFERENT GAME STAGES

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**Introduction** In previous studies, repeated sprint ability (RSA) was usually measured when participants were fresh following an appropriate warm-up (Bishop et al., 2001; Meckel et al., 2009). However, in soccer players are required to perform repeated sequences of sprints under fatigue conditions throughout the 90 min game. Therefore, the aim of this study was to determine young ( $16.9\pm 0.5$  yr) soccer players' RSA at different game stages, and to examine the relationships between the player's aerobic fitness ( $VO_2$  max) and the difference in RSA indices between the different stages. **Methods** Twenty players performed three repeated sprint test (RST) (12X20 m) after warm-up prior to the game, at half-time and after a full soccer game, each on a different day, at random order. The players performed also an aerobic power test (twenty-meter shuttle run test). **Results** Ideal (fastest) sprint time (IS) and total (accumulative) sprint time (TS) were significantly slower at the end of the game compared to after the warm-up prior to the game ( $p<0.01$  for each). The difference between IS and TS after the warm-up prior to the game and at half-time, and between IS and TS at half-time and the end of the game, did not reach statistical significance. There was no significant difference in the performance decrement (PD) during the RST after warm-up prior to the game, at half-time, and at the end of the game. Significant negative correlation was found between predicted  $VO_2$  and the difference between TS prior to the game and at the end of the game ( $r=-0.52$ ), but not between predicted  $VO_2$  and the difference between IS and PD prior to the game and end of the game. There were no significant correlations between predicted  $VO_2$  and the difference in any of the RST performance indices between prior to the game and half-time, or between half-time and the end of the game. **Discussion** The findings indicate that RSA of young soccer players is reduced as the game progress (Mohr et al., 2005). However, while fatigue can be recovered and RSA maintained during half-time, a significant long-lasting fatigue and RSA reduction is noticed at the end of a soccer game. The results also indicate that the involvement of aerobic energy sources in intermittent-type activity increases as the amount of work and fatigue level is increased. Therefore, the contribution of the aerobic system to soccer game intensity maintenance seems to be crucial mainly during the final stages of the game. **References** Bishop D, Spencer M, Duffield R, Lawrence S. (2001). *J Sci Med Sports*, 4, 19-29. Meckel Y, Machnai O, Eliakim A. (2009). *J Strength Cond Res*, 23, 163-169. Mohr M, Krstrup P, Bangsbo J. (2005). *J Sports Science*, 23, 593-599.

## NON CONVENTIONAL METHODS FOR ASSESSING STANDING BALANCE: RELIABILITY EVALUATION OF THE NINTENDO WII BALANCE BOARD

Carraro, A.I, Cardaioli, M.2, Pavan, A.I, Ferri, I.I, Gobbi, E.I, Pavan, P.2

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**Introduction** Standing balance assessment represents a problem in field-based health-related fitness test battery and the research of low cost, portable and widely available measure tools is an important issue (Clark et al., 2010; Clark et al., 2011). Therefore, the aim of this study was contributing to analyse the validity and reliability of Wii Nintendo Balance Board (WBB) compared with a laboratory-grade force platform (FP) in evaluating subjects balance. The method adopted for comparing WBB and FP was intentionally simple in order to provide

a user friendly calibration, in line with the low cost approach to the problem. Method Four unmodified WBB were placed upon the FP and correctly aligned in order to avoid relative rotation of the respective intrinsic coordinate systems. Data from WBB with standard sampling frequency of 30 Hz were treated by an open source software and compared with the set of data obtained by the FP. WBB were tested in determining the centre of pressure (COP) in different static and dynamic tests. The static test consisted in the evaluation of COP over time for a mass of 64 kg placed on WBB, while dynamic tests involved thirty individuals (17 female, 13 male, age 23.8 ± 2.7 years). Dynamic tests consisted in double limb standing of 30 s with open and close eyes. Each subject performed 4 trials (2 with opened eyes, 2 with closed eyes). Results In static tests the variation of the COP over time for the WBB with respect to the effective COP position estimated with the FP was limited and similar for all the tools. In dynamic tests it was found a constant offset between COP position on the medio-lateral or anterior-posterior axis that can be related to the effect of horizontal forces on the effective position (Bobbert & Schamhardt, 1990). It was shown that this offset can be easily compensated for each WBB and, after compensation, values of sway path and sway area measures obtained by WBB and FP were comparable. Discussion Frequency sampling of unmodified WBB (30 Hz) is lower than usual frequency sampling of laboratory-grade force platforms (100 Hz) but this does not appear as a limit in evaluating the position of COP over time. Therefore, COP related measures such as sway path and sway area can be estimated in reliable way also by using a low cost set up based on WBB. This can represent a valid and easy-to-use tool for assessing standing balance control. References Clark R, Bryant A, Pua Y, McCroy P, Bennell K, Hunt M (2010). *Gait Posture*, 31, 307-310. Clark R, McGough R, Paterson K (2011). *Gait Posture*, 34, 288-291. Bobbert MF, Schamhardt HC (1990). *JBiomech*, 23, 705-710.

### RELIABILITY OF ANAEROBIC LACTATE THRESHOLD CONCEPTS IN RUNNING.

Prettin, S., Schnabel, A., Pottgiesser, T., Roecker, K., Ahlgrim, C.

*University Hospital of Freiburg, Hochschule Furtwangen University*

Introduction: Testing aerobic performance using blood lactate kinetics is a routine procedure in sports medicine and sports science. Several threshold models have been proposed and are routinely applied. Quantification of the test-retest-reliability of the respective concepts is necessary to differentiate between analytical and/or biological variation of the respective test results and real improvements or deteriorations e.g. after training interventions. In the present study we present a reliability analysis of commonly applied lactate threshold concepts in a healthy study group. Methods: 59 healthy subjects (40m, 19f, age: 41.7±12.6 yrs) performed three graded exercise tests on a treadmill (start 6km/h, increased by 2km/h every 3 min) until volitional exhaustion within 7 days. The initial test was performed to adjust to the test procedure; data for the analysis was obtained from the second and third exercise test. Lactate samples were taken from the hyperaemised earlobe during the last 20 sec of each step and 2, 3, 5 and 10 minutes after the test. Velocities and heart rates at conventional 4mmol (AT-4mmol) [Mader et al., 1976] and individual anaerobic thresholds as proposed by Stegman (IAT-ST) [Stegmann et al., 1981] and by lactate net-increase (IAT-DI) [Aunola et al., 1988] were determined. Typical errors (TE) of the velocities and the heart rates at the respective thresholds were calculated [Hopkins et al., 2001]. Results: For all subjects, mean velocity at AT-4mmol was 13.3 (± 2.0) km/h (TE: 2.4% (95%-CI: 2.0-3.0%)). Mean heart rate at AT-4mmol was 171.6 (± 11.3) bpm (TE: 1.9% (1.6-2.3%)). Mean velocity at IAT-ST was 12.3 (± 1.9) km/h (TE: 5.4% (4.1-7.5%)). Mean heart rate at IAT-ST was 161.2 (± 13.3) bpm (TE: 3.9% (3.1-5.4%)). For IAT-DI mean velocity was 12.4 (± 1.8) km/h (TE 2.6% (2.3-3.2%)) and mean heart rate was 164.8 (± 1.4) bpm (TE 2.4% (2.1-3.0%)). Discussion: Typical error for IAT-DI and AT-4mmol are of similar magnitude whereas TE for IAT-ST showed values almost twice the width and hence less reliability. This could lead to the conclusion, that AT-4mmol and IAT-DI are more sensitive to detect real changes than IAT-ST. Given that significant changes can be concluded when the difference between two values exceeds 2.77\*TE (95% CI), which means a difference of 0.89 km/h on average for velocity at IAT-DI, this illustrates that reliability of the respective measures have to be taken into account before 'real' improvements can be assumed.

### LACTATE CONCENTRATION IN GRECO-ROMAN WRESTLERS BEFORE AND AFTER FINAL MATCHES

Drid, P., Galovic, Z., Jovancevic, A., Trivic, T., Drapsin, M., Vujkov, S.

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Introduction As a result of recent rules changes in a match duration modern wrestling takes more the anaerobic energy system, elevates heart rates to maximal level (Kraemer et al., 2001) and accumulates moderate to high lactate concentrations (10-20 mmol•L<sup>-1</sup>) following competition. Up to date, level of lactate in athletes during intense training or competition has been used for assessing level of acidosis and muscle fatigue (Karninčić et al., 2009). The aim of this study was to investigate differences in blood lactate levels between wrestlers that have ended final matches in different rounds. Methods Study was conducted on three groups of wrestlers divided based on match duration. First group included wrestlers who ended their match after first round, second group included wrestlers who ended their match after two rounds and third group was made of wrestlers who ended their match after three rounds. All measurements were taken after final bouts during team championship of Serbia. Blood samples for lactate control were collected at two intervals: before the first round (after warm-up) and third minute after the end of a bout. T-test and one-way ANOVA were used for analyzing differences between groups and measuring time intervals. LSD test was used for post-hoc comparison. Results Results obtained in this study showed statistically significant differences between groups, divided on the basis of match duration. Third group of wrestlers (15.55±4.05 mmol•L<sup>-1</sup>) had statistically significant higher lactate level than first (8.06±2.35 mmol•L<sup>-1</sup>) and second group (11.10±2.27 mmol•L<sup>-1</sup>). Discussion Unlike findings of Kraemer et al. (2001) that showed resting lactate level concentrations before warmup between 1.7 mmol•L<sup>-1</sup> to 2.3 mmol•L<sup>-1</sup> this study showed higher lactate level values of first measurement (2.61-2.68 mmol•L<sup>-1</sup>). However, results of this study are in line with research of Karninčić et al. (2009) that reported lactate level of 2.61-2.63 mmol•L<sup>-1</sup> after warm-up as well. On the other hand, lactate concentration presented in this study is a bit lower than same values reported by Kraemer et al. (2001), where lactate concentration at the end of the wrestling match ranged from 17.1 to 20.0 mmol•L<sup>-1</sup>. References 1. Karninčić, H., Tocilj, Z., Uljević, O., Erceg, M. (2010). Lactate profile during Greco-Roman wrestling match. *Journal of Sports Science and Medicine*, 8(CSSI 3), 17-19. 2. Kraemer, W.J., Fry, A.C., Rubin, M.R., Triplett-McBride, T., Gordon, S.E., Koziris, L.P., Lynch, J.M., Volek, J.S., Meuffels, D.E., Newton, R.U., Fleck, S.J. (2001) Physiological and performance responses to tournament wrestling. *Medicine and Science in Sports and Exercise*, 33, 1367-1378.

## YOUNG SWIMMERS SHOULDER STRENGTH PROFILE: INTERNAL AND EXTERNAL ROTATION ISOKINETIC EVALUATION. A CONTRIBUTION TO NORMATIVE DATA

Batalha, N.1,2, Raimundo, A.1,2, Tomas-Carus, P.1,2, Marmeleira, J.1,2, Silva, A.J.2,3

1:UE (Évora, Portugal), 2:CIDESD (Portugal), 3:UTAD (Vila Real, Portugal)

**Introduction** The high incidence of overuse shoulder injuries in competitive swimmers is often attributed to both the high repetitive stresses inherent in the sport, as well as muscular imbalances in the humeral rotators (O'Donnell et al., 2005). The purpose of this study was to measure concentric glenohumeral joint internal and external rotation strength, to develop a bilateral descriptive profile in young competitive swimmers, contributing to the creation of normative data. **Methods** This was a cross-sectional study in which 60 male swimmers (age:  $14.55 \pm 0.5$  years old; body mass:  $61.16 \pm 7.08$  kg) were assessed. The peak torque of the external rotator (ER), internal rotators (IR) and the ER/IR ratio were evaluated with concentric actions. A seated position was used ( $90^\circ$  abduction and elbow flexion) at  $60^\circ$ .s<sup>-1</sup> and  $180^\circ$ .s<sup>-1</sup> angular speeds using an isokinetic dynamometer (Biodex System 3). Both dominant (DS) and non-dominant shoulder (NDS) were assessed. Descriptive statistics was performed for all variables using means and standard deviations. Calculations were performed using the SPSS software, version 19.0. **Results** The peak torque of IR ranged from  $34.81 \pm 9.33$ Nm to  $31.15 \pm 9.33$ Nm; the ER values were from  $26.39 \pm 5.66$ Nm to  $22.07 \pm 3.87$ Nm. Swimmers showed unilateral ratios of  $77.89 \pm 15.23\%$  in the DS and  $73.39 \pm 17.26\%$  in the NDS for assessments at  $60^\circ$ .s<sup>-1</sup>. At  $180^\circ$ .s<sup>-1</sup>, ratios were  $74.77 \pm 13.99\%$  for DS and  $70.11 \pm 14.57\%$  for NDS. **Discussion** Our results confirm that the IR ability to produce power is invariably superior to that of their antagonists. Regarding the shoulder rotators muscle balance, despite the fact that no normative data were available for young swimmers, some authors who evaluated older overhead athletes found values of ER/IR ratios between 66-75% (Ellenbecker & Roetert, 2003; Cingel et al., 2007). In our study, swimmers ER/IR ratios ranged from  $70.11 \pm 14.57\%$  to  $77.89 \pm 15.23\%$ , values that are close to, but slightly higher, than the normative values previously described. Since the unilateral ratios distinguish the quality of muscle balance (Ellenbecker & Roetert, 2003), these data can serve as a normative reference to shoulder rotators balance in young swimmers. **References** 1. Cingel R, Kleinrensink G, Mulderc P, Bied R, Kuiperse H. (2007). *Isok Exerc Sci*, 15(4), 287-93. 2. Ellenbecker TS, Roetert EP. (2003). *J Sci Med Sport*, 6(1), 63-70. 3. O'Donnell CJ, Bowen J, Fossati J. (2005). *Phys Sportsmed*, 33(9), 27-35.

## STRATEGY BUILDING IN SOCCER

Cordes, O., Lames, M.

*University of Augsburg*

**Introduction/ Problem** One of the central tasks of sports teams' coaches is the generation of a suitable game strategy for the next competition. So far, the conception, the methodology and the effectiveness of this process have hardly been processed and documented by sport scientists. The aim of this work is to accompany and support the coaches at their usual strategy building and analysis and hence to generate a model of strategy building. **Methods** Before the season and over a period of one season (34 match days), the coaches of a team of the second division of the German Bundesliga were interviewed before and after every league game (by means of semi-structured interviews) so that their strategy building techniques could be reconstructed. Out of these interviews, an observation system was designed, which helps to analyze the tactics shown in the game in a systematic (Lames, 1994) and qualitative (Dreckmann et al, 2009) way. **Results** The first result was a model of strategy building which was generated according to concepts of applied economics. It shows the various sources of information and provides an overview of the steps of an idealized strategy building and analysis, including newly designed feedback loop. The empirical results of the study prove on the one hand the effectiveness of the developed game strategies, on the other hand, they show a strong bias of the coaches when it comes to the perception of the match performance, which is strongly influenced by the outcome of the match. Thus, the method and the results of the study (Cordes et al., 2012) offer the coaching staff the chance to optimize their work and their expertise. **Discussion** Methodologically, the combination of quantitative and qualitative methods has proven to be profitable when it comes to analyzing the development and the adherence to game strategies (Cordes, 2011). The study indicates that the strategic preparation could be more effective if carried out on the basis of conceptual rules and controlled by scientific methods (Cordes, unpub.).

## MAXIMAL EFFORT INTERVAL AND CONSTANT-RATE RUNNING USE SIMILAR AMOUNTS OF OXYGEN

O'Brien, B.J., Pratt, D.

*University of Ballarat*

**Introduction** The question of whether interval or constant-rate training has the greater potential to improve 5 km run performance remains unresolved. Interval running facilitates more oxygen consumption (VO<sub>2</sub>) than a constant-rate run when matched for average speed, and the physiological adaptations of interval training have been shown to be superior. However the constant rate efforts of these experiments have been sub-maximal and do not reflect athlete training practice. To address the question of which training strategy has the greater potential to enhance endurance performance, this study compared the VO<sub>2</sub> of a maximal effort interval run to a maximal effort constant-rate run at lactate threshold matched for time. **Methods** The VO<sub>2</sub> of 10 recreational runners (VO<sub>2</sub> max :  $4158 \pm 390$  mL.kg<sup>-1</sup>.min<sup>-1</sup>) were compared between three different 20 minute treadmill runs. The runners performed a maximal effort constant-rate run approximating lactate threshold (CRLT), a maximal effort interval run (INT) consisting of 2 min @ VO<sub>2</sub> speed with 2 minutes at 50% of VO<sub>2</sub> max repeated 5 times, and a run at the average speed sustained during the interval run (CR sub-max). Initial interval running speeds were determined from the treadmill speed corresponding to VO<sub>2</sub> max determined by an incremental test, and the lactate threshold speed from a 5 km time trial. To ensure a maximal effort, after successful completion of a 20 minute run – on another day participants would repeat the run 0.2 km.h<sup>-1</sup> faster. If the participant could sustain this speed and reported they could sustain a faster speed, treadmill velocity was raised a further 0.2 km.h<sup>-1</sup> in the next run to approximate a maximal effort. **Results** The average VO<sub>2</sub> for INT was  $3451$  mL.kg<sup>-1</sup>.min<sup>-1</sup> (3269-3633) - 83% VO<sub>2</sub> max; CRLT was  $3464$  mL.kg<sup>-1</sup>.min<sup>-1</sup> (3285-3643) - 84% VO<sub>2</sub> max and CR sub-max was  $3464$  mL.kg<sup>-1</sup>.min<sup>-1</sup> (3285-3643) - 76% VO<sub>2</sub> max. There was no significant difference in VO<sub>2</sub> between INT and CRLT, but the VO<sub>2</sub> was significantly greater in both treatments compared to CR sub-max ( $p < 0.05$ ). The distance covered was 4070 m (3831-4309), 4070 m (3831-4309), 4431 m (4202-3731) in INT, CR sub-max and CRLT respectively. Distance covered was significantly greater in CLRT ( $p < 0.05$ ) compared to INT and CL sub-max. Data are presented as mean and 95% confidence intervals. **Discussion** The novel finding of the present study is a 20 minute maximal effort constant rate run uses similar amounts of oxygen as a 20 minute maximal effort interval run, despite the greater distance covered in the maximal effort constant-rate run. An investigation comparing the impact of several training sessions

of maximal effort interval and constant-rate training would address which, or if any strategy is superior to improve a 5 km time trial.  
Introduction

### **GRIP STRENGTH-ENDURANCE IN AMBITIOUS AND RECREATIONAL CLIMBERS: DOES THE STRENGTH DECREMENT INDEX SERVE AS AN APPROPRIATE MEASURE?**

Donath, L.1, Faude, O.1, Zahner, L.1, Schöffl, V.2,3

*University of Basel*

Do not insert Introduction Hand-grip measures are serving as a simple low-cost method to assess fore-arm strength in the general population and in climbers as well. Since intermittent isometric handgrip exercises about 340 N lead to occluded fore-arm blood flow and average handgrip forces of >300 N for each hand were observed on a vertical wall (Quaine et al. 1999), it appeared interesting to examine the time course of maximal isometric grip strength in climbers, depending on testing position, laterality and climbing level. Therewith, we intended to provide a feasible maximal strength-endurance parameter. Methods Seventeen recreational (RC: climbing level (CL): 6.8±0.5 UIAA metric scale, 25±7 y; 70±9 kg; 21.5±2.0 kg/m<sup>2</sup>) and eleven ambitious (AC: climbing level: 8.7±0.6; 30±8 y; 72±8 kg; 21.8±1.9 kg/m<sup>2</sup>) climbers participated in the present study. All participants completed maximal isometric handgrip strength tests in four positions: Left and right hand beside the trunk as well as left and right hand above the shoulder. Each testing consisted of twelve repetitive work-relief cycles, applying a work-relief ratio of 5 and 1 second(s) (Donath et al. 2011) where isometric strength, heart rate and perceived exertion were recorded. Results A side x position x time x group interaction was found for the time series data of isometric grip strength ( $p = 0.009$ ,  $\eta^2=0.71$ ). Post hoc testing revealed significant differences between the left and right side for the ambitious (left: 55±8 kg vs. right: 62±9,  $p=0.01$ ) and recreation group (left: 47±8 vs. right: 51±9,  $p=0.04$ ). The upper grip position did not differ for the ambitious (left: 55±10 vs. right: 62±10) and the recreation group (left: 49±9 vs. right: 52±10). A group difference for heart rates was merely found for the bottom right position (AC, pre: 91±19 to post: 106±24; RC, pre: 91±21 to post: 124±32). Perceived exertion did not differ between both groups. Correlation analysis between asymmetry (left vs. right) and climbing level showed an inverse relationship for the lower position in ambitious climbers ( $r = -0.70$ ). Discussion The slope of grip strength decline did not relevantly differ between ambitious and recreational climbers. Thus, the time course of grip strength endurance seems to mainly depend on the amount of maximal isometric strength values. From a diagnostically point of view, it appears sufficient to evaluate maximal grip strength level in recreational and ambitious climbers. References Quaine et al. (1999). Gait Posture, 10:233-239. Donath et al. (2011). Scand J Med Sci Sports (in press) authors here

**14:00 - 15:00**

## **Mini-Orals**

### **PP-PM77 Training and Testing [TT] 12**

#### **STUDY OF STRESS MARKERS AND HEART RATE VARIABILITY IN BASKETBALL PLAYERS SUBJECTED TO THE IVE LOADS PERIODIZATION SYSTEM**

Souza, H., Mazon, J.E.

*University of Sao Paulo*

Introduction: To improve performance in sports, athletes are subjected to intense training loads. Accordingly, to enable athletes to achieve a maximal performance at a desired time, it is necessary to strictly control their training loads through structuring and planning in periods or stages, also known as periodization (Bompa, 1984). Furthermore, thorough knowledge of the organic adaptive processes triggered in athletes by training is important (Moreira, 2010). Therefore, we investigated the effects of the application of selective loads periodization (SLP) on physical stress markers and heart rate variability (HRV) in basketball players (N=16) before and after a competition period. Methods: The experimental protocol consisted of evaluating the autonomic modulation of HRV by a spectral analysis of the time series composed of R-R intervals (RRI) obtained in the supine position and during a tilt test. The evaluation of stress markers consisted of measuring plasma catecholamines, cortisol and free testosterone. Results: The results showed no significant changes in HRV, plasma concentrations of catecholamines and free testosterone when pre-competition and post-competition values were compared. However, reduced levels of plasma cortisol were observed. Discussion: Our results suggest that the organisation of training by SLP during the competition period produced beneficial adaptations in basketball players. This conclusion is supported by the absence of change in the autonomic modulation of HRV, plasma concentrations of catecholamines, free testosterone and the testosterone/cortisol ratio. In addition, the observed reduction of cortisol levels indicates an attenuated response of musculoskeletal catabolic processes between training sessions. References: Bompa T. Theory and methodology of training: the key to athletic performance. Boca Raton (FL): Kendall/Hunt, 1984. Moreira A. La periodización del entrenamiento y las cuestiones emergentes: el caso de los deportes de equipo [Training periodization and emerging questions: the case of team sports]. Rev Andal Med Deporte 2010;3(4):170-78.

#### **CYCLING ENDURANCE PERFORMANCE IS DESCRIBED BY THE POWER-LAW NOT CRITICAL POWER**

Passfield, L., Coakley, S.L., Jobson, S.A.

*University of Kent*

Introduction The critical power (CP) model of Monod & Scherrer (1965) proposes an exercise intensity - time relationship that describes maximum work capacity. The determination of CP is typically restricted to intensities that result in exhaustion in >2-min and <15-min, as the model's validity has been questioned when determined from data outside of this range. An alternative explanation however, may be that CP is not the most appropriate model for describing the exercise intensity - time relationship, and that this becomes apparent when a wider range of intensities are examined. A simple alternative to CP is to describe performance with the ubiquitous power-law (i.e. as a fatigue curve). To test this hypothesis, we compared CP and the power-law model over a wider range of intensities than typically used to determine CP. Methods Our participants were fifteen active males (mean ± SD; age 28 ± 9yr, body mass 82.9 ± 9kg, maximum aerobic

power  $283 \pm 28W$ ,  $VO_{2max}$   $49.5 \pm 7$  ml/kg/min). Participants completed an initial maximal incremental test and two familiarisation trials to exhaustion. Then in a random order they completed nine cycle ergometer trials to exhaustion, each separated by at least 48-h. Five of these trials were within the typical range of intensities for CP determination (80%, 90%, 100%, and 110% maximum aerobic power output). Four trials were outside the typical range for CP determination (60%, 70%, 150%, 200% maximum aerobic power output). Data from the five trials within the typical range were used to generate two models (CP and power-law). The two models were then used to predict the actual performance in the four trials performed outside of the typical range for CP determination. A two way (model, power output) repeated measures ANOVA and estimated marginal means were used to compare the actual power output for the trials with those predicted by CP and power-law models. Significance was accepted at  $P < 0.05$ . Results There was no difference between models in their fit to data within the typical range of intensities used to determine CP (80%, 90%, 100% and 110%,  $P > 0.05$ ). Outside this typical range the power-law predicted actual performance better than CP at all intensities. Parameter estimates were similar for actual performance and the power-law model in trials at 60%, 70% and 150%. In contrast, the CP model was only similar to the actual performance in the 70% trial. Neither model predicted actual performance in the 200% trial. Conclusion This study demonstrates that the power-law, not critical power, predicts cycling endurance performance from 60% to 150% of maximum aerobic power output. Reference Monod H, Scherrer J, (1965) *Ergonomics* 8, 329-338.

## ANTHROPOMETRIC DETERMINANTS AND PHYSICAL CONDITION IN RHYTHMIC GYMNASTS

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1: University of Vigo (Vigo, Spain), 2: Institute for Sport, Physical Education and Health Sciences University of Edinburgh (Edinburgh, UK)

**Introduction** Anthropometric characteristics and physical condition are believed to be important predictors of the level of performance in elite rhythmic gymnasts (e.g., Avila-Carvalho et al., 2012). We aim to investigate to identify and determine the relationship between both. **Methods** We measured the anthropometric characteristics and physical condition of 12 competitive (national-level), female rhythmic gymnasts (aged 12.17 (+1.59) years). On average, the gymnasts had 6.04 (+3.60) years of training experience and trained 11.42 (+3.26) hours per week. We used standardised laboratory-based tests: Anthropometric and body composition determinants (height, body mass, body composition, Beighton 9-point joint laxity), flexibility (sit and reach, trunk hyperextension and passive and active high hip extension), static strength (Kendal, Wedge and Plank) and agility (hexagon test). Results The height of the gymnasts was 150.10 (+9.79) cm, the BMI was 16.95 (+1.59) kg/m<sup>2</sup> and body fat percentage was 13.75 % (+2.18). The mean level of joint laxity was 5.33 (+2.15), with 66.67% of the gymnasts scoring over 4 points on the Beighton scale. Sit and reach flexibility was 30.49 cm (+4.38) with both legs, 32.62 cm (+3.52) the left leg and 32.60 cm (+4.44) right leg. Maximal trunk extension was 162.70 degrees (+10.74) from the horizontal. The maximal hip extension ROM was 30.58 degrees (+6.71) for the left leg and 25.50 (+5.37) for the right leg, the difference between the passive and active ROM was 30.33 degrees, left leg (+14.84), and 25.75 degrees right leg (+12.57). The gymnasts maintained the required position for 27.62 seconds (+12.96) in the Plank test, 25.05 seconds (+12.12) in the Wedge test. In the Kendal test, the loss of control of the neutral pelvis occurred at 38.67 (+5.77) degrees from the vertical axis. Agility was measured as 12.28 (+1.65) seconds in the hexagon test clockwise and 12.50 (+2.19) seconds anticlockwise. **Discussion** In conclusion, the results are in accordance with the findings reported in previous studies (Avila-Carvalho et al., 2012; Douda et al., 2008; Rutkausakaita and Skarbalius, 2009). Further data analysis will provide correlations between, a) strength and flexibility indicators and anthropometric measures and b) balance and coordination. **References** Avila-Carvalho LA, Klentrou P, da Luz Palomero M, Lebre E. (2012). Body composition profile of elite group rhythmic gymnasts. *Science of Gymnastics Journal*, 4 (1), 21-32. Douda H, Toubekis AG, Avloniti AA, Tomakidis SP. (2008). Physiological and anthropometric determinants of Rhythmic Gymnastics performance. *International Journal of Sport Physiology and Performance*, Mar 3 (1), 41-54. Rutkausakaita R, Skarbalius A. (2009). Training and sport performance of the 11-12 year old athletes in rhythmic gymnastics. *Sportas*, 1 (72), 107-115.

## THE DEVELOPMENT OF ANTHROPOMETRIC AND PHYSIOLOGICAL CHARACTERISTICS IN RETAINED AND RELEASED ELITE YOUTH FOOTBALL PLAYERS AGED 8-19 YEARS

Saward, C.1, Sunderland, C.1, Goto, H.2, Morris, J.G.2, Nevill, M.E.2

1: Nottingham Trent University (Notts, UK), 2: Loughborough University (Leics, UK)

**Introduction** A major aim of the professional football Academy is to guide young players towards becoming senior professionals. Anthropometric and physiological characteristics may influence this process. Indeed, characteristics including height, mass, aerobic capacity, power, speed, and agility have differentiated between senior players of varying playing standards (Stølen et al., 2005). The aim of this study was to examine the development of anthropometric and physiological characteristics of retained and released elite youth footballers aged 8-19 years. **Methods** A fitness testing battery was used to assess the anthropometric and physiological characteristics of 350 elite youth footballers aged 8-19 years, belonging to a professional Academy. Players were repeatedly assessed, up to 22 times, across six football seasons from 2007-2013. The assessments conducted included three vertical jump tests (rocket jump; countermovement jump; countermovement jump with arm swing), a 30 m sprint test (splits at 5, 15m), a slalom agility test and the Yo-yo Intermittent Recovery Test 1. Height and mass were also assessed. At the end of the study players were categorised as retained or released by the Academy. Multilevel analysis was used to model the development of each anthropometric and physiological variable for released and retained players. Relevant parameters were systematically added to a null model and were accepted on the basis of significant improvements in model fit as indicated by the likelihood ratio test statistic ( $p < 0.05$ ). Results All anthropometric and physiological characteristics improved with age. Development of slalom agility was best described with a quadratic age term and all other variables with cubic age terms. There was random variance in the intercepts and slopes for all models. Compared to released players, retained players were significantly quicker on the 5, 15 and 30 m sprints and slalom agility tests. **Discussion** Anthropometric and physiological characteristics develop in a non-linear manner and there is variance in the timing, tempo, and magnitude of changes. This variability highlights the need for flexibility from coaches when considering anthropometric and physiological factors in the talent identification process (Philippaerts et al., 2006). Retained players had superior acceleration, speed and agility suggesting that assessing these physiological characteristics throughout adolescence can provide useful information in predicting progression through an Academy. **References** Philippaerts R, Vaeyens R, Janssens M, Van Renterghem B, et al (2006). *J Sports Sci*, 24, 221-230. Stølen T, Chamari K, Castagna C, Wisloff U (2005). *Sports Med*, 5, 501-36.

## STUDY OF CONTROLLING IMPACTS IN CHILDREN AND ADOLESCENTS ON HEMODIALYSIS

Thys, S., Potreck, H., Schaar, B.

*German Sport University Cologne*

**Introduction:** The incidence of end stage renal disease (ESRD) is in childhood and adolescence significantly lower than in adults. For hemodialysis adults there are validated activity guidelines according to American College of Sports Medicine with respect to intensity, frequency, duration and type of physical load. For children and adolescents with equal diseases, there are less specific informations. Especially in training sessions, that take place during dialysis, there are very limited findings. Aim of this pilot study is to review controlling impacts of a subjective measured aerobic endurance training in children and adolescents during hemodialysis. **Methods:** The study involved 5 children with ESRD. The trial is a single-group experiment with pre-/ posttest design. The intervention consisted of a 12-week subjective controlled training with two to three sessions per week. The training took place during dialysis on a spinning bike. The following parameters were recorded: heart rate (in beats/min.), blood pressure (in mmHg), subjective perceived exertion by Borg, duration (in min.). Also the pedaling frequency is set in a range between 60-70 revolutions/min.. Based on a cardiopulmonary exercise testing before dialysis (spirometry, protocol of Godfrey), the examination of exercise capacity was reviewed. **Results:** Subjective controlled aerobic endurance training is feasible and well tolerated. The consideration of the heart rates during the course of training phases indicates that two subject has trained during the main phase in the range of its individual ventilatory threshold (VT1). The other subjects were  $11,6 \pm 8,82$  beats/min. below the ventilatory. The analysis of the blood pressure shows a drop down of  $21,4 \pm 17,87$  mmHg in systolic blood pressure in the process of training in all subjects. The diastolic blood pressure declines by two subjects continuously with increasing duration ( $13 \pm 5,66$  mmHg). **Discussion:** In the present study, due to the low examination of exercise capacity in dialysis children, a subjectively controlled training was performed. Regarding to the individual assessment of the subjects can be seen, that various competitive levels are shown. Three volunteers trained below their ventilatory threshold. One possible reason for not reaching the ventilatory threshold could be the blood pressure development. Especially the systolic value falls in the course of training in all subjects. **References:** Berlin, J.A.&Colditz, G. A.(1990). *Am.J.Epidemiol.*, 132(4),612-628. Bonzel, K., Wildi, B., Weiss, M.&Schärer, K.(1991). *Pediatric Nephrology*(5), 22-28. Borg G.(1998). Champaign: Human Kinetics. Eijssermans, R.M., Creemers, D.G., Helders, P.J.&Schröder, C.H.(2004). *Pediatric Nephrology*, 19(11), 1262-1266. Goldstein, S.L. & Montgomery, L.R. (2009). *Pediatric Nephrology*, 24(4), 833-839. Pattaragarn, A., Warady, B.A.&Sabath, R.J. (2004). *Peritoneal Dialysis International*, 24, 274-280. Schaar, B., Feldkötter, M., Nonn, J.M.&Hoppe, B.(2011). *Nephrology Dialysis Transplantation*,(0), 1-9.

## THE PROFICIENCY OF SERVE AND RECEPTION OF ADOLESCENT MALE VOLLEYBALLERS' IN ESTONIAN CHAMPIONSHIPS IN 2005 AND 2008.

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*Tallinn University*

**Introduction** The study analyses volleyballers' performance at Estonian championships for U16 (boys up to 16 year-olds) in two tournaments – Tartu 2005 and Rakvere 2008. The participants were members of eight best teams of Estonia at the moment. **Methods** To record the games an original computer program Game was used, which was first introduced in the *International Journal of Volleyball Researches* (Stamm et.al 2000). For simultaneous recording of the performance of two opposing teams, two computers equipped with the program Game were used. Parallel recordings were made by volleyball experts. Twenty – eight indicators of proficiency in the game were registered, but in this study we focus only on the elements of serve and reception. All together 56 games were analyzed. **Results** From our data we can conclude that the quality of serve was improved. In 2005 there were 278 serves which earned a point at once (aces) (SD = 4,26) and 309 serves (SD = 4,18) in 2008. These data were statistically significant. When we look at the mistakes during the serve we can see that there were also less mistakes in 2008 Championship tournament. In 2005 – 308 mistakes and in 2008 – 246 mistakes where the opposite team got a point. The same thing appears when we look at the average of the proficiency index. It has been statistically significantly increased from 0,38 (SD = 0,10) to 0,45 (SD = 0,07). Now when we look at the reception values then we can see that the amount of mistakes during the reception is statistically significantly increased, in 2005 – 272 (SD = 3,65) and in 2008 – 292 (SD = 4,24). Also every player in each game has made reception mistakes in average 0,65 (SD = 0,58) in 2005 championship and in 2008 - 0,75 (SD = 0,62). But when we look at the index of proficiency we can see that it is still increased a little - 0,52 in 2005 and 0,54 in 2008, although the last date were not statistically significant. **Discussion** The quality of serve is playing more important role in the game from year to year. It is not any more simply the element to begin the ball rally in volleyball, but it has become a real attacking element. In concordance are increased the amount of mistakes during the reception, but the proficiency index of reception is still better in 2008 than in 2005. We can explain the phenomena so that the amount of mistakes was higher during the reception in 2008 than in 2005, but those balls which the players could catch, they played them more correctly and directly in 2008 than in 2005. **References** Stamm R.,Stamm M., Oja A. (2000). *Int. J Volleyball Res*, 2 (1), 18 – 22.

## COMPARISON OF ANTHROPOMETRIC PROFILES BETWEEN DIFFERENT SENIOR MALE VOLLEYBALL COMPETITION LEVELS: NATIONAL TEAM, FIRST AND SECOND PORTUGUESE DIVISIONS.

Carvalho, A.1,2,3, Mourão, P.1, Resende, R.1,2,3, Abade, E.3, Carvalho, C.1,2,3

*1:ISMAI (Maia, Portugal), 2: CIDAF (Maia, Portugal), 3: CIDESD (Portugal)*

**Introduction** Identifying and describing the players' anthropometric profiles may contribute to better understand the differences among different level athletes. In fact, the morphological characteristics are considered essential to achieve top level performances in volleyball (Malousaris et al., 2008). The aim of this study was to compare the anthropometric profile of elite male volleyball players of the national team, first and second portuguese divisions. **Methods** 73 players participated in the study and were divided into 3 groups: GA (n=17, national team), GB (n=28, first division) and GC (n=28, second division). The data collected included the weight, height, arm span, 7 skinfolds (triceps, biceps, subscapular, suprailiac, abdominal, thigh and calf), 4 body perimeters (relaxed brachial, contracted brachial, thigh and calf) and 2 body diameters (humerus and femur). **Results** Differences were found between groups with players from the GA presenting the highest weight ( $87.95 \pm 5.30$ kg,  $p < 0.05$ ) height ( $194.08 \pm 5.24$ cm,  $p < 0.05$ ), arm span ( $199.59 \pm 6.80$ cm) and lean mass values ( $77.88 \pm 5.17$ kg,  $p < 0.05$ ). The fat mass percentage of the GA players was the lowest ( $11.56 \pm 2.03$  %). **Discussion** The anthropometric profile of volleyball players may vary according to competitive levels. The results of the present study show that are differences in morphological profiles between playing levels. The highest values of weight, height, arm span and lean mass presented by the GA players show that this variables are important in top level competitions. Thus, coaches should consider these profiles in talent selection

programms to identify players with potential to achieve elite performances. References Malousaris, G. G., Bergeles, N. K., Barzouka, K. G., Bayios, I. A., Nassis, G. P., & Koskolou, M. D. (2008). Somatotype, size and body composition of competitive female volleyball players. *Journal of Science and Medicine in Sport*, 11(3), 337-344. doi: DOI.10.1016/j.jsams.2006.11.008

### VALIDITY OF LACTATE TURN POINTS OF TRAINED AND UNTRAINED SUBJECTS WHILE TREADMILL RUNNING

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**Introduction:** According to the lactate shuttle theory (Brooks, 2002), two turn points (LTPs) and three distinct phases of lactate metabolism may be detected during incremental exercise tests (Hofmann & Tschakert, 2011) and from several constant load exercise bouts on cycle ergometer. The aim of this study was to validate LTPs detected during incremental running tests on a treadmill by means of constant load running (CE) slightly below and above the pre-determined LTPs in a heterogenous group of subjects. **Method:** 16 healthy male and female subjects (age: 38.9±17.6 yrs; BMI: 23.6±5.5 kg; VO<sub>2</sub>max: 46.3±9.1 ml/kg/min) performed a maximal incremental exercise (IE) test on a treadmill (start: 1.5 m/s (female), 2.0 m/s (male); increments: 0.2 m/s every minute). The first (LTP1) and the second (LTP2) lactate turn point were determined by means of linear regression break point analysis. CE tests (30 min) were performed at 5% Pmax below and above LTP1 and LTP2 in all subjects. Heart rate (HR) and gas exchange variables were determined continuously and blood lactate concentration (La) was determined at rest, at the end of every workload step (IE) and every 5 min after reaching target running speed (CE). **Results:** Power output in IE was 3.6±0.6 m/s at Pmax, 2.9±0.6 m/s LTP2 (77.8±3.5% of Pmax) and 2.4±0.4 m/s of LTP1 (60.7±5.4% of Pmax). Blood lactate concentration (La) was 8.21±1.61 mmol/l (Pmax), 3.33±0.83 mmol/l (LTP2) and 1.93±0.58 mmol/l (LTP1), respectively. Mean running speed of CE was 2.14±0.37 m/s (LTP1-), 2.49±0.40 m/s (LTP1+), 2.73±0.45 m/s (LTP2-) and 3.02±0.52 m/s (LTP2+) which were 55.8±4.6 %Pmax (LTP1-), 63.4±6.0 %Pmax (LTP1+), 73.9±3.0 %Pmax (LTP2-) and 81.0±3.2 %Pmax (LTP2+) and resulted in La of 1.24±0.71 mmol.l<sup>-1</sup>(LTP1-), 2.26±0.86 mmol.l<sup>-1</sup> (LTP1+), 4.86±1.90 mmol.l<sup>-1</sup> (LTP2-), and 7.29±2.19 mmol.l<sup>-1</sup> (LTP2+), respectively. Subjects completed all 30 min of CE up to LTP2- and stopped after 11.6±5.6 min at LTP2+. 13 of 16 subjects presented a lactate steady state at LTP2-. At LTP1- baseline La was given. **Conclusion:** In support of the lactate shuttle theory, two distinct turn points and three phases of lactate metabolism were detected and validated during both IE and CE in treadmill running. LTPs distinguished the lactate curve into different metabolic domains, were significantly related to the CE lactate response and define and discriminate the main metabolic trainings zones "low", "moderate" and "vigorous" for constant load exercise training in running. **References:** Brooks G.A. (2002) *Biochem Soc Trans* 30(2), 258-64 Hofmann P., Tschakert G. (2011) *Cardiol Res Pract*, 10 pages

### FATIGUE DURING INTERCHANGE-SPECIFIC SIMULATED RUGBY LEAGUE MATCH PLAY

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**Introduction:** Declines in work rate associated with neuromuscular fatigue have previously been observed during competitive rugby league match play (Duffield et al., 2011; Waldron et al., 2012). The nature of this change in distance covered and high-intensity running is dependent on the nature of the playing bout performed. Whole-match (~ 80 min) players demonstrate a subtle and steady decline in work rate, whereas interchanged players (approximately 21 min) exhibit a rapid decline in the first exercise bout, followed by a lower-intensity u-shaped profile in their second bout (Waldron et al., 2012). The aim of this study was to determine the extent of changes in player work rate, physiological and perceptual markers of fatigue and muscle function during a simulated interchange-specific rugby league movement protocol (RLMSP-i). **Methods:** Twenty-two elite level academy players from two different clubs in the English Super League (age = 19.8 ± 0.6 years; body mass = 89 ± 6.7 kg; stature = 179.9 ± 3 cm) completed the RLMSP-i involving 2 x 23 min bouts of exercise interspersed with 20 min passive recovery. During the protocol participants wore a 5 Hz GPS device to determine distance covered (m/min), high-intensity distance covered (> 14 km/h; m/min), average speed (m/s), peak speed (m/s), sprint speed (m/s) and heart rate (b/min). Blood lactate, glucose, vertical jump height and isometric handgrip force were also measured throughout the protocol in a subset of the sample (n = 8; age = 18.9 ± 1.4 years; body mass = 92.2 ± 8.9; stature = 182.8 ± 4.2 cm). **Results:** Distance covered (m/min) declined from quartile 1 to 4 in bout 1 (106 ± 2.9 to 104.3 ± 104.3) and bout 2 (104.1 ± 3.5 to 102.7 ± 3.6). High intensity running was lower in bout 2 (23 ± 3.2 m/min) than bout 1 (25.3 ± 3 m/min), and declined across quartiles of play (26.1 ± 2.7 to 22.2 ± 3.4 m/min), as did peak sprint speed (22.6 ± 1.4 to 20.6 ± 1.6 km/h). Heart rate, countermovement jump height, blood lactate and glucose concentration did not change over the course of the protocol. **Discussion:** The RLMSP-i elicits changes in distance covered in high-intensity running which are similar to, albeit less marked than, those reported during competitive rugby league match play. Thus, the RLMSP-i offers a potentially useful method to assess fatigue in interchanged rugby league players. The causes of this decline are unclear, as muscle function and physiological markers of fatigue remained unchanged throughout the protocol. **References:** Duffield R, Murphy A, Snape A, Minett GM, Skein M. (2011). *J Sci Med Sport*, 15(3), 238-43. Waldron M, Highton J, Twist C. (2012). *Int J Sports Physiol Perform*, Epub ahead of print.

### BASKETBALL: LONG LIVE TIME DURATION REQUIRE HIGHER LOADS ON HEART RATE, BUT THEY ARE LESS FREQUENTLY

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**Introduction:** Basketball is an intermittent modality, consisting of actions in moments of live time (LT) in different intensities and durations (d), separated by moments of stoppage time (ST), of different d. Some authors analyzed several aspects related to the actions and demands imposed but not analyzed the d of LT and ST moments and their physiological responses. The aims of this study were to analyze the d and frequency (f) of LT and ST, as well as the %HR in their moments. **Methods:** Ten Brazilians elite basketball players (27.6±5.54years; 91.61±11.51kg; 1.93±0.08m) were observed in one basketball game of the National Basketball Championship. LT refers the time during which the game clock was running and the ball was in play. ST refers the time during which the game clock was stopped. The f and d of LT and ST moments were obtained by video analysis. The maximum HR was obtained by the Maximal Multistage 20m Shuttle Run Test. The HR values during the test and the match were obtained by a HR monitor. At the same instant was activated a digital timer, to later synchronize the data of the monitors with the LT and ST. The data were kept in computational bank and produced information in descriptive way. **Results:** The f of the moments were: LT ≤10s = 14, >10s ≤20s = 10, >20s ≤30s = 4, >30s ≤40s = 8, >40s ≤50s = 6, >50s ≤60s = 3, >60s ≤70s = 5, >70s ≤80s = 6 and from that 1 or 2; ST ≤10s = 12, >10s ≤20s = 17, >20s ≤30s = 6, >30s ≤40s = 4, >40s ≤50s = 7, >50s ≤60s = 4 and from that 1 or 2. The %HR were: LT ≤30s e 110s between 80-84.9%HR, 40-60s and 80s between 85-

89.9%HR, 70s, 90s, 100s, 140s and 210s between 90-94.9%HR; ST  $\leq$ 40s between 85-89.9%HR, 50-80s and 120s between 80-84.9%HR, 100s between 75-79.9%HR and 90s, 110s and 180s  $<$ 75%HR. The ST  $\geq$ 90s were due to time-outs, combined with more free throw. Discussion The higher f ( $\geq$ 10) of LT and ST occurred in up to 20s, but can still be considered for LT to 80s and 60s up to ST. The longer d of LT, the higher %HR and most times above 30s showed average between 85-94.9%HR. McInnes et al (1995) found an average of 89.2%HRpeak for LT in the whole game. The longer d of ST, the lower %HR and over 40s are needed for reductions below 85%HR. As found by McInnes et al (1995), the greatest reductions were HR during time-outs (70-75% and 60%HRpeak). This information is very important for the organization of the training in relation to the choice of d of exercise game without interruption and pause duration for recovery, with respective f. References Abdelkrim NB, El Fazaa S, El Ati J (2007). *Br J Sports Med*, 41(2): 69-75. McInnes SE, Carlson JS, Jones CJ, McKenna MJ (1995). *J Sports Sci*, 13, 387-397. Leger LA, Mercie, D, Gadoury C et al. (1988). *J Sports Sci*, 6: 93-101.

## SPRINT PERFORMANCE OF FEMALE SOCCER PLAYERS OF THE GERMAN FIRST AND THIRD LEAGUES

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Introduction Evaluation of sprint performance is a common test in soccer. While there are many data in reference to male players, information about female players is still limited [1]. So, the aim of this study was to compare linear sprint performance of female players of the first (elite) and third (sub-elite) leagues in Germany. Methods Twenty-four elite (Women-Bundesliga, n = 12, 22.3  $\pm$  4.8 years, 61.7  $\pm$  8.1 kg, 168.1  $\pm$  0.1 cm) and sub-elite (Women-Regional-Liga West n = 12, 17.7  $\pm$  2.6 years, 60.0  $\pm$  5.3 kg, 163.2  $\pm$  0.1 cm) outfield female players performed a 20 m linear sprint test including 5 m and 10 m split-times. Sprint times were measured with double light barriers (TDS 2002, Austria). Players accomplished three trials interspersed with a 3 min rest and the mean of the two fastest were used for analysis. Differences between groups were determined through Student t-Test for independent samples. Statistical significance was set at p  $\leq$  0.05. Results Elite female players of the German first league are older (p = 0.007) and run at least 7% faster (p < 0.001) over all sprint distances (20 m: 3.46  $\pm$  0.09; 10 m: 2.02  $\pm$  0.06; 5 m: 1.20  $\pm$  0.04 s) than sub-elite players of the German third league (20 m: 3.71  $\pm$  0.11; 10 m: 2.18  $\pm$  0.07; 5 m: 1.31  $\pm$  0.05 s). Discussion Linear sprint performance has been reported as able to differentiate female soccer players of different levels in Australian and Sweden [2,3] as well as sprint speed to distinguish between drafted and non-drafted high-level players in an American professional selection process [4]. Similar results could be found in the present study with female players of the German first and third leagues. However, the influence of age in the sprint performance must be further investigated. Even better results have been already observed for players of the Germany Women's National Squad (1.05 s over 5 m) [5]. Linear sprint test over 5 m, 10 m and 20 m seems to be a good parameter to differentiate competitive level in women's soccer. References [1] Vescovi JD, Rupf R, Brown TD, Marques MC. (2011). Physical performance characteristics of high-level female soccer players 12-21 years of age. *Scand J Med Sci Sports*, 21(5), 670-8. [2] Mohr M, Krustup P, Andersson H, Kirkendal D, Bangsbo J. (2008). Match activities of elite women soccer players at different performance levels. *J Strength Cond Res*, 22(2), 341-9. [3] Gabbett TJ. (2010). The development of a test of repeated-sprint ability for elite women's soccer players. *J Strength Cond Res*, 24(5), 1191-4. [4] Vescovi JD. (2012). Sprint speed characteristics of high-level American female soccer players: Female Athletes in Motion (FAiM) Study. *J Sci Med Sport*, 15(5), 474-8. [5] Schneider U. (2010). The feminine factor. *Medicine Matters*. Nyon, Switzerland: UEFA's Football Development Division, 18, 12-15.

## COMPARISON OF ANTHROPOMETRIC PROFILES BETWEEN DIFFERENT SENIOR MALE BASKETBALL COMPETITION LEVELS: FIRST, SECOND AND THIRD PORTUGUESE DIVISIONS

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Introduction Elite basketball requires for optimal morphological characteristics and a high level of physical, technical and tactical capacities. Previous investigations have been focused on the ideal anthropometric profiles of elite players, however there is a lack of data concerning to the European players (Ostojic, Mazic, & Dikic, 2006). This study aimed to compare the body composition and somatotype characteristics of elite basketball senior players participating in the Portuguese first, second and third division. Methods 89 male senior players participated were divided into 3 groups: GA (n=29, first division), GB (n=31, second division) and GC (n=29, third division). The data collected included the weight, height, arm span, 7 skinfolds (triceps, biceps, subscapular, suprailiac, abdominal, thigh and calf), 4 body perimeters (relaxed brachial, contracted brachial, thigh and calf) and 2 body diameters (humerus and femur). Results Differences were found between groups with players from the first division presenting the highest weight (97.64  $\pm$  12.55kg, p < 0.05) height (195.59  $\pm$  7.93m, p < 0.05), arm span (198.83  $\pm$  10.64cm) and lean mass values (79.37  $\pm$  8.67kg, p < 0.05). The fat mass percentage of the first division group was the lowest (18.44  $\pm$  3.46%). Discussion The anthropometric profile of basketball players may be heterogeneous and vary according to competitive levels. The results of the present study show that are differences in physical profiles between playing levels. Apparently, elite players present the highest values in weight, height, arm span and lean mass. These variables may be considered as important for success in top-level basketball. Our results are in accordance with this idea, since the first division players' physical profiles presented the highest values in such variables. The unique demands of each division require for specific training and recruiting processes. Coaches should be aware of these differences to design accurate training programs and maximize the players' fitness level. References Ostojic, S. M., Mazic, S., & Dikic, N. (2006). Profiling in basketball: Physical and physiological characteristics of elite players. *Journal of Strength and Conditioning Research*, 20(4), 740-744. doi: Doi 10.1519/00124278-200611000-00003

14:00 - 15:00

## Mini-Orals

## PP-PM83 Training and Testing [TT] 18

**NO DIFFERENCES BETWEEN 24H, 3H AND 30MIN RECOVERY IN THE ESTIMATIONS OF CRITICAL POWER AND W' IN CYCLING**

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Introduction Measurements of Critical Power (CP) and W', total work that can be performed above CP, requires a set number of time-to-exhaustion (TTE) trials. Recovery periods of 24h between trials are common, making this protocol impractical. The aim of this study was to compare estimates of CP and W' derived from protocols using 24h, 3h and 30min recovery times. Methods Six male cyclists (mean  $\pm$  SD: age  $33 \pm 9.4$  yr, body mass  $73.45 \pm 6.28$  kg, Maximal Aerobic Power (MAP)  $350 \pm 40$  W,  $VO_{2max}$   $49.97 \pm 3.51$  ml  $\cdot$  kg  $\cdot$  min $^{-1}$ ) completed three testing methods for the estimation of CP and W'. Method 1 required tests separated by a recovery of 24h (CP24, W'24), method 2 by 3h (CP3, W'3) and method 3 by 30 min (CP30, W'30). Cyclists were blinded to all performance feedback. The 3h and 30min testing method were performed in the order from lower to higher TTE intensities, whilst the 24h testing was performed in a randomised order. Lactate was sampled at rest before each trial and immediately after exhaustion. CP and W' were estimated using the work-time model ( $IP = W' + (CP \cdot t)$ ). Results Repeated measure ANOVA identified no significant differences between CP and W' estimates derived through the three protocols (CP: F (1.8, 9.2) = 1.40, p = 0.29; W': F (1.5, 7.5) = 3.67, p = 0.09). Mean Standard Error (SE) values for CP24 were  $3 \pm 2.96$  W, for CP3 they were  $4 \pm 1$  W and for CP30 they were  $1 \pm 0.93$  W. Table 1: Mean Difference (W), 95% Confidence Intervals and Limits of Agreement between CP estimates. CP24 vs. CP3 CP24 vs. CP30 CP3 vs. CP30 Mean Diff. (W)  $4.79 \pm 6.87$   $0.78 \pm 8.21$   $-4.01 \pm 6.34$  95% CI -3.53 - 32.53 8.88 - 34.29 -10.58 - 21.04 LoA (W) -10.21 to 18.54 - 16.87 to 17.54 -16.44 to 8.8 Table 2: Mean Difference (W), 95% Confidence Intervals and Limits of Agreement between estimates of W'. W'24 vs. W'3 W'24 vs. W'30 W'3 vs. W'30 Mean Diff. (kJ)  $-0.80 \pm 3.94$   $3.45 \pm 5.00$   $4.25 \pm 2.97$  95% CI -4.9 - 14.49 -1.83 - 22.86 1.13 - 15.59 LoA (kJ) -8.5 to 6.96 -6.4 - 13.28 -1.55 to 9.98 Discussion Results suggest that recovery periods as low as 30min between trials provides a valid estimate of CP and W' in cycling. Despite our subjects starting trials following 3h and 30min recovery with elevated lactate, no impact on performance was observed. Results support those of Jenkins and Quigley (1992), and Housh et al. (1990) who utilised 3 h recovery periods, and Nebelsick-Gullett et al. (1988) who used a 30 min protocol. References Housh D, Housh T, Bauge S. (1990). Res Q Exerc Sport. 61(4), 406-409. Jenkins D. (1992). Endurance training enhances critical power. Med Sci Sports Exerc 24(11):1283-1289 Nebelsick-Gullett LJ, Housh TJ, Johnson GO, Bauge SM. (1988). Ergonomics. 31(10), 1413-1419.

**EFFECTS OF COORDINATION EXERCISES ON MOTION CAPACITY OF PRESCHOOL CHILDREN—QUANTITATIVE AND QUALITATIVE CHANGES IN THROWING AND CATCHING ABILITY—**

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Introduction The purpose of this study was to investigate the effects of a coordination exercise program focused on basic ball handling techniques on quantitative and qualitative changes of throwing and catching abilities among preschool children. Methods The subjects were 30 preschool children (14 boys, 16 girls), each five years of age. A four week control period and a four week exercise period were separately established. According to the instruction guidelines, the exercise program was conducted for 40 min for a total of eight sessions over a four week period. The subjects performed motion capacity tests (standing broad jump and side jump) and ball handling tests (control, catching and tennis ball handling) during each exercise session. Their throwing and catching motions were video recorded and then evaluated using five typical developmental stages of motion patterns (Nakamura et al., 2011). Results The mean scores showed a statistically significant increase in the side jump, catching, tennis ball handling and score evaluation for throwing and catching motions in the exercise period compared to the control period. There were no gender related differences in scores. Discussion Recently, Nakamura et al. (2011) reported that the developmental stage of the fundamental motions of preschool children in 2007 was significantly lower than preschool children in 1985. In our research, the evaluation scores for throwing and catching motions in the exercise period were consistent with the 1985 scores; however, the control period scores were approximate to the 2007 scores. Our results suggest that the coordination exercise program focused on basic ball handling technique enhances the ball handling capacity and agility among five-year-old preschool boys and girls, who require adequate exercise instruction to improve their throwing and catching abilities. References Nakamura K, Takenaga R, Kawaji M, Kawazoe K, Shinohara T, Yamamoto T, Yamagata Z, Miyamaru M (2011) Development of fundamental motor pattern using the observational evaluation method in young children. Studies of growth and development, 51, 1-18

**PHYSIOLOGICAL PREPARATIONS OF A SEMI-ELITE VETERAN KAYAK PADDLER – A CASE STUDY.**

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Introduction This case-study outlines the training approach of a sub-elite veteran athlete in preparation for an individual (K1) 125 mile kayak marathon over 4 days of racing that included 77 portages. The athlete's personal aim was to complete the race in <20 h. Typical novice and world class race times are <24 h and <18 h respectively. Methods The subject was a female ex-Olympic cross-country skier (51 yrs; 1.70 m;  $64.8 \pm 1.7$  kg; sum of 8  $54.3 \pm 4.3$  mm) with a consistent 33 yrs aerobic training history. The subject's training history was a high volume, low intensity (HVLI) approach before the programme. A linear training periodisation was used focusing on 1-2 performance variables per training phase. Training phases were 1) 8 wks pre-season: high intensity interval training (HIIT), 2) 12 wks aerobic endurance: HVLI, 3) 6 wks portaging (P), 4) 6 wks on-water race pacing (OWP), 5) 1 wk taper (TP). Training duration (h.week $^{-1}$ ) was HIIT  $10.8 \pm 2.1$ ; HVLI  $13.3 \pm 1.6$ ; P  $10.2 \pm 0.6$ ; OWP  $11.2 \pm 0.8$ ; and TP 2.8. Weekly training intensity < lactate threshold (LT), LT to anaerobic threshold (AT) and >AT was HIIT 65%, 17%, 18%; HVLI 70%, 25%, 5%; P 56%, 34%, 10%; OWP 60%, 31%, 9%; and TP 35%, 47%, 18%, respectively. Training responses in HIIT and HVLI were assessed using laboratory ramp tests to max using a cycle ergometer to determine  $VO_2$  (CV: 4.0%) and

LT. Time per repetition for a standardised on-water session (4 x 10 min) was monitored in P. Results VO<sub>2</sub>MAX increased from 43.7 to 49.3 mL.kg<sup>-1</sup>.min (+12.8%) after HIIT and to 52.6 mL.kg<sup>-1</sup>.min (+6.7%) after HVLI. LT increased by 25 W (+20%) after HVLI. Time per repetition of monitored on-water session decreased by 12 s (-2%) after P. Calculations of smallest worthwhile change showed this decrease to be meaningful. Total race time was 20:43:30 (hh:mm:ss), setting a new >50 female course record and winning the senior single ladies, >50 female and veteran female classes. Average river flow rate was +34.3 m<sup>3</sup>.s<sup>-1</sup>, 11.6% slower than when the former >50 female course record was set. Discussion Improvements in VO<sub>2</sub>MAX after HIIT and HVLI training supports previous research suggesting both training methods improve aerobic capacity (Laursen, 2010). The results also demonstrate a veteran athlete's ability to adapt to endurance training, contradicting the view that veteran athletes only attenuate the age-related decline in performance with training (Maharam et al., 1999). Improvements in VO<sub>2</sub>MAX and LT were reflected in on-water improvements. This case study highlights the trainability of a sub-elite veteran athlete using a linear training periodisation. References Laursen PB. (2010). *Scand J Med Sci Sports*, 20(s2), 1-10. Maharam LG, Bauman PA, Kalman D, Sknolnik H, Perle SM. (1999). *Sports Med*, 28, 273-285.

### SPEED TESTING DURING SPECIFIC ATTACKS IN FENCING

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Introduction Fencing bouts are characterized by various attacks with the aim of hitting the opponent with the weapon. The speed during fencing attacks is considered to be important for competition success, but there is a lack of data on speed testing in fencing because no suitable methods have been established. The aim of the study was therefore to develop a method for speed testing in fencing and to determine speed at specific fencing attacks. Methods 8 male epee fencers of the German Olympic Team (27.5 ± 4.7 yrs, 90.8 ± 10.7 kg, 189.6 ± 4.9 cm) took part in the study. The measurements were focused on speed of the weapon hand during the fencing attacks touch (TOU), lunge (LUN), step forward lunge (SFL) and fleche (FLE). An optical motion capture system (2000 Hz, Lukotronic, Austria) with 16 active infrared markers was used to determine speed. A fencing dummy with target areas was developed and integrated into the system for detecting reaction time (RTIME) of fencers. The study participants performed 5 trials for every fencing attack. During attacks, distance of the tip of the epee to target (DIST), mean speed (MEANSPD), maximum speed (MAXSPD), speed in the moment of hit (HITSPD) and time to reach maximum speed (TMAXSPD) were measured. Parameters of attacks were compared by one-way analysis of variance (ANOVA). Results MEANSPD at SFL (3.21 ± 0.49 m/s) was higher compared to FLE (2.62 ± 0.60 m/s, p < .01), LUN (2.13 ± 0.30 m/s, p < .01) and TOU (1.76 ± 0.57 m/s, p < .01). MAXSPD at SFL (4.05 ± 0.92 m/s) was higher than during LUN (3.44 ± 0.62 m/s, p < .01) and TOU (2.60 ± 0.55 m/s, p < .01), but no significant differences between SFL and FLE (3.85 ± 0.66 m/s) were found. HITSPD at SFL (2.75 ± 0.75 m/s) was higher than during LUN (2.34 ± 0.46 m/s, p < .05) and TOU (1.69 ± 0.66 m/s, p < .01). Differences in HITSPD between SFL and FLE (2.54 ± 0.57 m/s) and LUN and FLE were not significant. DIST at SFL (1.55 ± 0.16 m) was greater than at LUN (0.99 ± 0.11 m), FLE (1.00 ± 0.21 m) and TOU (0.25 ± 0.09 m). TMAXSPD for FLE (0.36 ± 0.11 s) was better than for LUN (0.44 ± 0.12 s, p < .01) and SFL (0.96 ± 0.11 s, p < .01). No significant differences were found for RTIME at TOU (0.20 ± 0.03 s), LUN (0.19 ± 0.04 s), SFL (0.20 ± 0.05 s) and FLE (0.20 ± 0.05 s). Discussion The developed method and the described speed parameters are suitable to analyze reaction time and movement speed during fencing attacks. We report here data derived from a newly developed, complex motion analysis method and found significant differences between speed parameters of different fencing attacks. The motion analysis method will be further evaluated and developed to provide a tool for performance testing in fencing.

### ELITE FEMALE SOCCER PLAYER'S BODY COMPOSITION AND POSTURAL STABILITY

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Introduction The sport training should lead to symmetric development of the body. However player's lower limbs are unequally loaded during soccer trainings and matches. It may cause asymmetric development of the muscular apparatus or difference in balance of lower limbs. Therefore, the aim of this study was to evaluate bilateral symmetry in fluid distribution of lower limbs and postural stability in elite female soccer players. Methods Twenty elite female soccer players of Czech representation (n = 20; aged 23.3 ± 4.3 years; height 167.2 ± 6.4 cm; weight 60.9 ± 5.3kg) participated in the study. Body composition was measured by multifrequency bioelectrical impedance analyzer InBody 3.0 with segmental distribution of body fluids in lower limbs. Postural stability was measured by pressure measurement system FootScan (RScan, Belgium) by one lower limb stand test (Flamingo). The test lasted for 60 s. Evaluation was based on movement of Centre of pressure (COP) and evaluated parameters were front-back deviation (Y), right-left (X) deviation and Total Travel Way (TTW). Results The average values of movements of COP in right-left direction in stance on right and left lower limb Xavg = 18.6 ± 6.6 mm, resp. Yavg = 17.8 ± 3.3 mm. The average values of front-back direction in stance on right and left lower limb Yavg = 32.5 ± 14.2, resp. Xavg = 30.2 ± 7.7 mm. The average values of Total Travel Way parameter in stance on right and left lower limb TTWavg = 831.9 ± 319.8 mm, resp. TTWavg = 888.9 ± 451.3 mm. The average value of fluid distribution symmetry between right and left lower limb 0.0655 ± 0.0049 liter. Analysis of correlation between morphological dysbalances and differences in stability didn't demonstrate significant correlation r = 0.01; p > 0.05. Conversely, the relation appears to be orthogonal. Mean value of fluid distribution in the right, resp. left lower extremity was 5.98 ± 0.61 l, resp. 6.03 ± 0.62 l (p < 0.01). This difference was significant. Difference during comparison of means stability in test called flamingo – right lower extremity (889.0 ± 463 mm) and left extremity (831.9 ± 328 mm) wasn't significant (p > 0.01). Discussion Based on measured values was research sample homogenous in both postural stability and fluid distribution between lower limbs. Significant correlation between morphological dysbalances and differences in stability wasn't found. However difference in fluid distribution between lower limbs was significant. One of the main requirements for soccer players is ability to perform specific movement activities in appropriate manner by both lower limbs. References Gstättnr, M, Neher, A, Scholtz, A, Millonig, M, Lambert, S, Raschner, Ch (2009). *Motor Control*, 13, 218-231. Paterno, MV, Myer, GD, Ford, KR, Hewett, TE (2004). *J Orthop Sports Phys Ther*, 34 (6), 305-316.

### FORCE AND TESTOSTERONE RESPONSES AND RECOVERY TO A SINGLE SESSION OF COMBINED ENDURANCE AND STRENGTH LOADINGS BEFORE AND AFTER TRAINING: "ORDER EFFECT"

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INTRODUCTION Endurance (E) loading performed immediately before strength (S) loading may compromise the gains in maximal S (e.g. Cadore et al. 2012) when compared to the opposite training order (E+S vs. S+E). While this is attributed to neuromuscular fatigue pro-

duced by the E loading, differences in recovery between E+S and S+E have not been studied. This study investigated acute responses and recovery in maximal S and serum testosterone (T) to a combined loading of E+S vs. S+E before and after combined training as well as 1RM strength development. METHODS 29 untrained men (30±5 years, 179±6 cm, 77±9 kg) were matched to an E+S (n=12) or S+E (n=17) group and conducted E and S training combined in a single session (2-3x [1E+1S or 1S+1E]/wk) for 24 wks. Before (0) and after the training (24) subjects performed a 1RM test in leg press and one standardized E+S or S+E loading. This loading consisted of explosive, hypertrophic and maximal leg press exercises (S) conducted either before or after an E loading of 30min cycling. Maximal isometric leg press (MVC) and serum T were measured before (PRE) and after the loading (POST) and after 24h and 48h. RESULTS At 0 MVC decreased in both loadings at POST (E+S, 24%, p<0.001; S+E, 22%, p<0.001), while no responses in T were observed. At 24h and 48h of recovery T decreased in E+S (24h, 23%, p<0.01; 48h, 21%, p<0.001) but not in S+E (between group difference p<0.05), while MVC returned to PRE values in both groups. At 24 MVC decreased at POST (E+S, 25%, p<0.001; S+E, 27%, p<0.001) but no significant responses in T were observed. At 24h and 48h MVC returned to PRE values in E+S and S+E, while T was only slightly lowered in E+S and not significantly different from S+E. Both groups increased 1RM at 24 (E+S, 13%, p<0.001; S+E, 17%, p<0.001). DISCUSSION This study did not show differences in acute loading responses in MVC and T between the E+S and S+E loadings either before or after the training. Although the recovery in MVC was mainly completed after 24h both before and after the training, at 0 T was reduced in E+S at 24h and 48h of recovery showing an order effect (E+S vs. S+E). After 24 weeks of training, however, this decrease of T in E+S became smaller and the difference between E+S and S+E was reduced. Whether this reduced between group difference may be associated with 1RM strength gains during higher frequency and/or longer periods of training needs further investigation together with thorough examination of training-induced neuromuscular adaptations. REFERENCES Cadore EL et al. *Exp Gerontol* 2012 , 47 :164-169.

### CENTRALLY ACTING PERFORMANCE MODIFIERS IN OPEN-ENDED VERSUS CLOSED-ENDED EXERCISE TESTS

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*Fontys Sporthogeschool*

Introduction Exercise performance is regulated by a series of complex mechanisms to insure that humans always exercise with reserve and terminate the exercise bout before there is a catastrophic failure of homeostasis<sup>1</sup>. Testing methodologies have traditionally included open-ended submaximal cycle performance tests at a fixed percentage (constant work rate test) maximal power output (W<sub>max</sub>). The reproducibility of these Time to Exhaustion (TTE) protocols show poor reproducibility compared with closed-ended test protocols such as the time trial (TT)<sup>2</sup>. The poor reproducibility of TTE protocols has been attributed to the fact that TTE protocols do not have a clearly defined ending point and psychological factors (i.e. motivation, monotony, and boredom), that might influence performance are more pronounced in these tests than in closed-ended test in which the ending point of the test is known<sup>2</sup>. Therefore, the purpose of the study was to evaluate the contribution of centrally acting performance modifiers to exercise performance in open-ended and closed-ended test protocols Methods Subjects performed an incremental exercise test to determine their maximal workload (W<sub>max</sub>). In the first exercise test subjects had to perform a TT on an electromagnetically braked ergometer (Lode Excalibur Sport) in linear mode (RPM dependent) at approximately 70%W<sub>max</sub> for 30 min. During this test subjects only received feedback about the progress of their performance in kJ and received no time cue. In the second test, subjects were asked to cycle to exhaustion during a constant work rate (CWR) test at the mean workload of the TT test. In the CWR test (initially without time cue), the cycle ergometer was set in the hyperbolic mode (RPM independent). If exercise endurance time of the CWR test was shorter than in the TT test, subjects received a time cue and got informed about their TT time to completion performance. Heart rate was monitored during both tests. Results Preliminary results. One male subject performed all tests. The time trial time to completion was 31 minutes and 33 second at a mean workload of 287 W (66% W<sub>max</sub>). In the CWR test the subject cycled to exhaustion in 17 minutes at 287W. Subject was not able to extend the performance after showing the TT time to completion. Heart rate showed the same pattern although TRIMP score was lower in the second test (71 vs 116). Discussion One subject is not enough to draw firm conclusions, but it's very interesting that the second test was about 14 minutes shorter (with the same physiological response in heart rate). Centrally acting performance modifiers do influence exercise performance, especially in open-ended exercise test protocols. 1. Noakes, T. The Central Governor Model in 2012: eight new papers deepen our understanding of the regulation of human exercise performance. *British journal of sports medicine* (2012). 2. Jeukendrup, A., Saris, W. H., Brouns, F. & Kester, A. D. A new validated endurance performance test. *Medicine & Science in Sports & Exercise* 28, 266–270 (1996).

### CORRELATION BETWEEN HANDGRIP STRENGTH AND PERFORMANCE IN NON-PROFESSIONAL BOXERS

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Introduction Handgrip is a popular test used to predict performance in different sports (Garrido et al., 2012), like boxing. In fact, it has been shown that among the main determinants of boxing performance in elite middleweight boxers, handgrip strength is well correlated with ranking in boxing competition (Guidetti et al., 2002). Based on this study, we sought to investigate whether other parameters, such as maximal strength of non-dominant hand and endurance strength could be also related to boxing performance, measured as percentage of total victories (%TV) and knock-out victories (%KO). Methods Twelve non-professional boxers (age 27±4 years, height 173.2±8.9 cm, body mass 68.3±6.6 kg, years of practice 7±4) were recruited for this study. After submaximal contractions as warm-up, each participant performed 3 maximal isometric voluntary contraction of both dominant (dMIVC) and non-dominant (ndMIVC) hands on a hydraulic handgrip dynamometer. Each contraction was sustained for 5 s and separated by 5 min rest. Subsequently, 3 trials of dMIVC and ndMIVC were performed until exhaustion. Time to reach 50% of MIVC (dT50 and ndT50) was measured to assess endurance strength. 15 min rest was given between trials. In both tests the best performance of the 3 trials was considered. Differences between dominant and non-dominant hands were evaluated as well as correlations between MIVCs and T50s with %TV and %KO. RESULTS There was a significant 9% difference between dMIVC and ndMIVC (58.1±10.1 vs 52.9±4.5 kg, respectively, p<0.01). dMIVC was significantly correlated with %TV and %KO (r=0.58 and 0.61, respectively, p<0.05). No differences between dT50 and ndT50 nor other correlations were found (p>0.05). Discussion In accordance with the literature, handgrip strength was significantly related with boxing performance (Guidetti et al., 2002). Additionally, we showed that the correlation concerned the dominant hand which was stronger than the non-dominant one, and it was related to %TV and %KO in our sample of. In conclusion, dominant handgrip strength could be used as an acceptable parameter to predict non-professional boxers level of preparation. References 1. Garrido ND, Silva AJ, Fernandes RJ, Barbosa TM, Costa AM, Marinho DA, Marques MC. High level swimming performance and its relation to non-specific parameters: a cross-sectional study on maximum handgrip isometric strength. *Percept Mot Skills*. 2012 Jun;114(3):936-48. 2. Guidetti L, Musulin A, Baldari C. Physiological factors in middleweight boxing performance. *J Sports Med Phys Fitness*. 2002 Sep;42(3):309-14.

**KIMARTOP: NEW TECHNOLOGY TO OPTIMIZE THE TRAINING OF THE "BASE" IN ACROBATICS.**

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**Introduction** The acrobatics disciplines, has experienced a significant growth in Sports as well in Arts. Particularly in group acrobatics practices we highlight the role of the Base, responsible to support/raise/throw, and the Top responsible to balance, figures or aerial acrobatics (BROZAS; NOWOTYNSKI, 2002). These protagonists assume different roles in acrobatics, performing part of their training in group and also individually, trying to develop specific abilities and skills (FEDEC, 2006). The present investigation brings the first advances of the new technology KIMARTOP (LEÓN; BORTOLETO, 2012) which main function is to simulate the Top on static position allowing the planning and systematization of the Base training. **Methods** The methodology can be described in four moments: a) problem identification; b) concept development and device design; c) prototype confection; d) tests performance. It has been developed tests with 3 experienced Bases (2 men and 1 woman – all adults), in different days. They performed 4 different basic exercises with 10 repetitions each with no load, followed by 10 and 25% of the Top weight. **Results** - from the four exercises proposed, 3 has permitted a very close technical simulation; - it was suggested to modify the inferior support to allow the exercise execution from the floor with the Base in dorsal recumbent position; - a better loads control and also other practice variables; - the possibility to practice with lower loads in relation to the Top weight; - more safety and autonomy to the Base, once the device allow the use of lunge system. **Discussion** It has been used two different supports for this research: hand and foot. The experts indicated the need of other kinds of support, trying to adapt the grab to the variance of each acrobatic technique and ergonomics. The experts suggest the need of development of others structures as well as flexible devices to support the loads trying to perform a closer simulation the Top real body. It was also observed the possibility to apply the device to the practice of the Bases (or Catchers) of Banquine, as well as "head to head", "foot to head", "hand to head" exercises. The KIMARTOP presents itself as an important resource to clubs where the training of the group acrobatics exists, specially the Hand to Hand modality. **References** BROZAS, M. P.; NOWOTYNSKI, W. (2002). Los portes como componente técnico específico del acrosport. *Revista Rendimiento Deportivo*, N°2. LEÓN, K.; BORTOLETO, MAC. (2012). Simulador mecánico de entrenamiento de acrobacia colectiva. *Oficina Española de Patentes*: ES201201193. FEDEC - FEDERACIÓN EUROPEA DE ESCUELAS DE CIRCO (2006). *Pedagogical Exchangers*. Bruselas.

**PHYSIOLOGICAL AND PHYSICAL DEMANDS OF A WOMEN'S FOOTBALL MATCH**

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**Introduction** Despite the increased popularity of women's football worldwide, scientific research regarding its physiological and physical requirements is still scarce. For this reason, the purpose of the present study was to investigate for the first time the physiological and physical demands of a women's football match by means of simultaneous portable spirometry and GPS (Global Positioning System) measurements. **Methods** After proper familiarisation, a full 90 min competitive friendly match (11 vs. 11) was organised for continuous assessment of physiological and physical variables among 10 outfield German female football players (21.3±2.9 yrs, 163.1±7.2 cm, 60.0±4.6 kg). The physiological variables that were evaluated consisted in oxygen uptake (VO<sub>2</sub>), heart rate (HR) and blood lactate concentration (La, measured every 15 min). The physical variables measured through the GPS devices included total distance (D<sub>total</sub>), distance covered at >16 km/h (D>16km/h), and speed. Players' maximal VO<sub>2</sub> and HR values were determined under laboratory conditions. Dependent t-tests were used to assess differences between the game halves. **Results** The average VO<sub>2</sub>, HR, La, D<sub>total</sub>, and D>16km/h during the full match were 28.3±4.6 ml/min/kg (52% VO<sub>2</sub>max), 152±10 bpm (79% HRmax), 2.17±0.81 mmol/l, 7230±1474 m and 631±358 m (9% D<sub>total</sub>), respectively. There was a large individual variability among these variables ranging from 7-57% (mainly due to the positional role). All mean values, except for La and D>16km/h, decreased significantly in the 2nd compared to the 1st half (6-11% reduction, p<0.01). The mean peak VO<sub>2</sub> and HR values achieved during the match were 53.0±3.8 ml/min/kg (98% VO<sub>2</sub>max) and 182±8 bpm (94% HRmax). The average and peak speed attained throughout the game corresponded to 4.9±0.9 km/h and 24.3±2.4 km/h. **Discussion** Similar to other authors [2-4], we also found a large individual variability and a significant reduction in match demands in the 2nd compared to the 1st half. However, our results are lower than published data on VO<sub>2</sub> values of male football players collected through portable spirometry during friendly games [2] and on HR [3, 4], La [1] and GPS physical data [4] of female football players during competitive matches. Possible reasons for these differences may include player characteristics, game conditions, methodological differences, and movement impairment due to the measuring equipment. Further studies using a larger sample size (players and games) should be conducted in order to verify these results. **References** 1. Davis, JA, et al. (1993). *Sports Med*, 16(3), 180-189. 2. Ferrauti, A, et al. (2006). *Dt Z Sportmed*, 57(5), 142-146. 3. Krustup, P, et al. (2005). *Med Sci Sports Exerc*, 37(7), 1242-1248. 4. Martínez-Lagunas, V, et al. (2010). *Book of Abstracts*, 501-502. ECSS, Antalya.

**THE VALIDITY OF THE MULTISTAGE FITNESS TEST IN ACTIVE 8-12 YEAR OLDS**

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**Introduction** The multistage fitness test (MSFT) (Ramsbottom et al, 1988) provides participants with an estimated maximal oxygen uptake (VO<sub>2</sub>max) and is regarded as a valid field-based test to estimate cardiorespiratory fitness (Castro-Pinero et al, 2010). The MSFT has become very popular in schools because of its low cost and its limited need for equipment. The aim of this investigation was to assess the predicative validity of the MSFT using several speed and strength variables in active young people. **Methods** Sixty active young people between the ages of 8-12 year olds (Boys, n = 25; Girls, n = 35) were recruited from a local athletics club. Anthropometric data was collected including height, weight, BMI, body mass, free fat mass and total body water using tanita scales (BC41MA Segmental, Cranlea). Isokinetic strength was measured using a back and leg digital dynamometer (Takei A5402) and a hand grip dynamometer (Takei A5401). Sprint speed was recorded using electronic light gates (Brower test centre systems, Cranlea). Aerobic fitness was assessed using the MSFT (Ramsbottom et al, 1988). **Results** Significant relationships were observed in all young people between the MSFT scores and both 10m (r = -0.42, P < 0.05) and 40m (r = -0.47, P < 0.05) sprint times. Significant relationships were also observed in gender specific groups for 40m sprint in both boys (r = -0.57, P < 0.05) and girls (r = -0.40, P < 0.05) however, only girls had a significant relationship in 10m sprint performance (r = 0.48, P < 0.05) whereas boys did not (r = -0.35, P > 0.05). A relationship between MSFT scores and maximal hand grip strength was significant in all subjects (r = 0.40; P < 0.05) and girls (r = 0.49; P < 0.05) however, not significant in boys (r = 0.29; P > 0.05). **Discussion** The results of this study show that MSFT scores are related to speed and strength performance measurements in young people. This suggests that in young people aged 8-12 years old, a single 10m and 40m sprint can be a good predictor of aerobic fitness as demonstrated by their performance on the MSFT. While the MSFT scores may therefore, be a relevant indicator of aerobic fitness in

young people, the results also suggest that those who are active in more anaerobically demanding exercise such as team sports may develop both aerobic and anaerobic fitness compare to those young people who are less active. References Castro-Pinero J, Artero, EG, Espana-Romero V, Ortega FB, Sjostrom M, Suni J, Ruiz JR. (2010) *Brit J Sports Med*, 44: 934-943. Ramsbottom R, Brewer J, Williams C. (1988) *Brit J Sports Med*, 22(4), 141-144.

### CHANGES OF SPEED IN PUBERTAL SOCCER PLAYERS

Radziemiński, Ł., Jastrzębski, Z., Jaskulska, E., Konieczna, A., Ignatiuk, W., Bichowska, M.

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**Introduction** Many authors (Williams and Reilly, 2000; Reilly et al., 2000) claims that speed is one of the strongest predictors of talent in soccer. Therefore, systematic verification of sprinting ability is one of the most important elements of training process at all levels of competition. The aim of the present study was to compare sprint test performances of pubertal soccer players in five different time points. **Methods** Twelve young soccer players (age:  $12.04 \pm 0.36$  yrs, height:  $152.58 \pm 5.16$  kg, weight:  $39.71 \pm 5.99$ ) from Arka Gdynia football club performed five sprint tests during a 20-month period. Each attempt took place in the indoor facility with synthetic running surface during competitive season. Times were recorded by photocells positioned at the start line and at the finish lines of each run. All sprints were performed from the standing position on a distance of 5 m, 10 m, 15m and 30 m from the start line (S) and 5 m and 10 m from the line situated 2 meters behind the start line (2 meters run-up - R). ANOVA for repeated measures and post-hoc Tukey test were used to find any significant differences. **Results** During analyzed 20 month period, significant ( $p < 0.05$ ) improvements in sprint times were noted in all distances. Interestingly the regression of speed level was observed between trials 3 and in distances of 5 m (S), 10 m (S), 10 m (R) and 15 m. **Discussion** Due to logistic and methodical difficulties there are not many publications presenting results of cyclical researches of speed development. Papaiaikovou et al. (2009) observed that significant improvements of speed level occurred after every 2-3 years, what is in line with our results. However, cited study was conducted on different subjects. At the age of 12-14 during puberty when boys are growing very fast, disharmony of maturation is often observed what has a negative influence on the neuro-muscular coordination. At this age speed development might be disturbed and individualization of physical loads seems to be very important part of the training process. The greatest dimension of disharmony in speed development of this study subjects was observed in Test 4 what might explain adverse comparisons with other authors' findings (Wong et al., 2010). References Papaiaikovou G, Giannakos A, Michailidis C, Patikas D, Bassa E, Kalopisis V, Anthrakidis N, and Kotzamanidis C. (2009). *J Strength Cond Res* 23(9), 2568–2573 Williams A. M., Reilly T. (2000). *J Sports Sci*, Sep; 18(9), 657-667. Reilly T., Williams A. M., Nevill A., Franks A. (2000). *J Sports Sci*, Sep 18(9), 695-702 Wong P-L, Chamari K, and Wisløff U. (2010). *J Strength Cond Res* 2010 24(3), 644–652. Do not insert authors here

### ANTHROPOMETRIC, TECHNICAL AND CONDITIONAL MEASURES ON VOLLEYBALL WOMEN PLAYERS SCHOOL SPORTS

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**Introduction** The present study was carried out in order to identify and analyze the anthropometric, conditional and technical indicators of athletes during the training process. **Methods** The sample is composed of  $n=17$  female athletes with an average age of ( $13.88 \pm 0.33$  years), participants in the 14-under category of the Girls National Volleyball Championship within School Sports. The anthropometric indicators, conditional components and the technical service indicator were evaluated. To verify the existence of statistically significant differences between athletes of different ages and specific positions, we used the One-way ANOVA, followed by the Tukey's Post Hoc Test from multiple comparisons. The Pearson's  $r$  Correlation Coefficient was also used in this study. In order to analyze the technical service indicator three games were observed, corresponding to a total of 199 actions. Descriptive statistics were used through frequencies and percentages and inferential statistics using the  $\chi^2$  Chi-square to determine the degree of dependence. **Results** The obtained results indicate significant differences, exclusively, in the variable body mass between the different specific positions. Although there are no significant differences in height and wingspan, these factors are still pointed out to be important to the Volleyball sport. A strong relationship of dependence between the anthropometric variables and several conditional components has also been denoted. **Discussion** Regarding the evaluation of the service it was noticed that the service zone most used by the athletes was zone 6 and the service direction with the highest percentage was the parallel, being the middle player and outside player, the female players that most contributed to the predominance of the same. The study on the relationship between the variables zone and service direction and their effectiveness has shown that the majority of services have allowed the construction of any type of attack, which is carried out from zone 6 and with parallel trajectory. Finally, we can emphasize that the service zone and the service direction showed significant association with the specific position. However, none of the analyzed variables (service zone, service direction and specialized player) interfered in a determinant way with the service efficiency. References Arias, A., Álvarez, F., Domínguez, A., González, L., & Arroyo, M. P. (2011). *Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte*, 11(44), 721-737. Ciccarone, G., Croisier, J. L., Fontani, G., Martelli, G., Albert, A., et al. (2008). *Medicina Dello Sport*, 61(1), 29-43.

### MATURITY-ASSOCIATED DEVELOPMENTAL CHANGES IN CHANGE OF DIRECTION AND DRIBBLING SPEED IN YOUNG SOCCER PLAYERS

Duarte, J.1, Valente-dos-Santos, J.1, Pereira, J.1, Simões, F.1, Rebelo-Gonçalves, R.1, Severino, V.1, Vaz, V.1, Figueiredo, A.1, Elferink-Gemser, M.1, Malina, R.M.2, Coelho-e-Silva, M.1

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**INTRODUCTION:** The purpose of the current study was to assess the developmental changes in change of direction and dribbling speed in youth soccer players taking into account skeletal age (SA), maturity status, body size, estimated fat mass, aerobic endurance, lower limb explosive strength and annual volume of training. **METHODS:** Eighty-three male soccer players aged 10-15 years (SA) at baseline were annually followed over 5 years, resulting in an average 4.4 observations per player. After testing for multicollinearity, multi-level regression modeling was used to examine the longitudinal developmental changes on change of direction and dribbling speed. **RESULTS:** Maturity-associated variability was significant in change of direction and also dribbling speed among young soccer players aged 12-14 years with better scores being performed by late maturers. Moreover, the predicted longitudinal scores for change of direction and dribbling speed improved with SA ( $P < 0.01$ ), SA2 ( $P < 0.01$ ) and skeletal maturity status entered as an additional developmental predictor ( $P < 0.05$ ). Estimated fat-free mass ( $P < 0.01$ ), aerobic endurance ( $P < 0.01$ ) and lower limb strength ( $P < 0.01$ ) were additional predictors in both models. The soccer-specific skill, dribbling speed, was also explained by annual volume of training ( $P < 0.05$ ). **CONCLUSION:** Skeletal ma-

turity status explains inter-individual variability on maximal short-term run performances with and without the ball possession at early ages of participation in competitive soccer. The effects tend to persist across ages combined with longitudinal changes in body composition and functional fitness. In the particular case of the ball test, annual volume of training was also a longitudinal performance predictor.

### PSYCHOSOCIAL STRESS AND RECOVERY ARE RELATED TO PERFORMANCE IN ELITE RUNNERS

Otter, R., Brink, M.S., Lemmink, K.A.P.M.

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**Introduction** Elite runners enhance performance by means of a physical training program leading to alternately physical stress and recovery. However, it is suggested that psychosocial stress and recovery can also influence performance (Kentta & Hassmen, 1998). The purpose of this study was to analyze the relationship between changes in psychosocial stress and recovery and changes in performance in elite runners. **Methods** Thirteen elite runners (9 male/4 female; age:  $24 \pm 6$  years; height:  $176 \pm 11$ cm; weight:  $64.1 \pm 10.1$ kg) completed two HR based sub-maximal tests with 7 weeks in between. Based on the LSCT protocol for cyclists, runners performed 6 minutes at 70% of maximal heart rate (HRmax) followed by 6 minutes at 80%HRmax and 3 minutes at 90%HRmax (Lamberts et al., 2011). Heart rate recovery (HRR) was determined over the first minute of passive rest as performance indicator. Both tests were performed under standardized environmental conditions (temperature:  $19 \pm 1^\circ\text{C}$ , humidity:  $39 \pm 8\%$ ). Psychosocial stress and recovery were measured before each submaximal test using the RESTQ-sport (Nederhof et al., 2008). **Results** On average HRR decreased with  $2.3 \pm 12$  bpm. Changes in general stress, general recovery, sport specific stress and sport specific recovery were  $-0.6 \pm 2.5$ ,  $0.3 \pm 1.1$ ,  $0.5 \pm 2.0$  and  $0.5 \pm 2.7$ , respectively. Higher general stress and lower general recovery were significantly related to a change in HRR ( $r = -0.581$ ,  $p = 0.037$ ;  $r = 0.582$ ,  $p = 0.037$ , respectively). **Discussion** Non-sports related psychosocial stress and recovery play an important role when optimizing performance of elite runners. When psychosocial factors are carefully monitored, it can provide insights that can lead to appropriate interventions to optimize performance of elite runners. Examples of interventions are adapting training load or implementing recovery enhancing strategies. **References** Lamberts, R. P., Swart, J., Noakes, T. D., & Lambert, M. I. (2011). *Br J Sports Med*, 45(10), 797-804. Nederhof, E., Brink, M. S., & Lemmink, K. A. P. M. (2008). *Int J Sport Psy*, 39(4), 301-311. Kentta, G., & Hassmen, P. (1998). *Sports Med*, 26(1), 1-16.

14:00 - 15:00

### Mini-Orals

#### PP-PM86 Training and Testing [TT] 21

### PREDICTION OF RACE TIME DECREASE, DUE TO THE PERFORMANCE -OFF, IN RUNNING 3000M TO MARATHON

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**INTRODUCTION:** It is crucial for runners to set, as a training goal, the finish time for a given race compatibly with the available fraction of their metabolic power for that distance. But, is the decay in the available power the same for best results of a runner (PB) competing in all distances (3000, 5000, 10000, 21097 and 42195 m) as in world records (WR) often set by different, specifically trained, athletes? In case, a mathematical model of that decay could suggest, on the basis of a known performance, the racing time at which to train for the other distances. The literature reported different power decay models, linearly (Saltin 1973) or curvilinearly (Peronnet & Thibault 1989) related to the racing time. Since the running cost is reported as constant in this range of distances (Minetti 2004), the speed decay is supposed to reflect the decrease of the available aerobic power fraction. Here we: 1) check the speed decay model, 2) test whether the decay 'slope' is similar in WR and PB and, 3) construct a prediction equation for finish times. **METHODS and RESULTS:** The PB from 3000m to marathon of 16 top-class marathon runners and the WR in the same distances were examined. After realizing that the speed decay with distance was not linear, the equation by Peronnet & Thibault (1989) was adapted as:  $(v/v_{map}-1)*100=E*\ln(td/t_{map})$ , where  $v$  is the running speed at the distance  $d$  (m) and at 3000m (at which we suppose that 100% of the maximum aerobic power ( $v_{map}$ ) is available),  $t$  is the PB (s) and  $E$  is the 'endurance capability index' (%) proposed by the authors. The analysis of actual WR with that equation brought to  $E=-5.692\%$ , while for the more reliable athletes (9 out of 16, when  $R^2>0.97$ ) we obtained  $E=-5.194\pm 0.702\%$ . **DISCUSSION:** Metabolic power decrease at increasing distance better follows a non-linear (logarithmic) path and is substantially the same for PB and WR. To predict the finish time we need to rearrange the above equation according to  $v=d/t$  and  $v_{map}=map/t_{map}$ . We obtain:  $d=map*(td/t_{map})*(1+E/100*\ln(td/t_{map}))$  where  $E=-5.692$ ,  $map=3000m$  and  $t_{map}$  is the 3000m PB (s). The use of a graphic program allows to read the predicted finish time for whichever distance in the range 3000m to the marathon. When WR for 3000m is used ( $t_{3000}=440s$ ) we obtain  $t_{5000}=759s$  (WR=757.4s),  $t_{10000}=1589s$  (WR=1577.5s),  $t_{21097}=3531s$  (WR= 3503s) and  $t_{42195}=7444s$  (WR=7418s). A (wrong) linear interpolation should have brought to 795, 1686, 3661 and 7417s, respectively. The file with the complete model will be downloadable at the website [albertminetti.it](http://albertminetti.it). **REFERENCES** Saltin B (1973). Limiting factors of physical performance, 235-52. Thieme, Stuttgart. Peronnet F, Thibault G. (1989) *J Appl Physiol*, 67(1), 453-465. Minetti AE (2004). *J Exp Biol*, 207, 1265-1272.

### THE RESEARCH OF PREFERENCE FACTORS IN FOOTBALL PENALTY SHOOTOUT

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The aim of the training was examining the choice factors in penalty shootout which is effective. The students, who studies in Yasar Dogu Physical Education and Sports High School, and the student athlete, who plays licensed football in Regional Amateur League in Super Amateur teams in Samsun city, were exercised. While video cameras and speedometer are used in shootouts, some surveys were applied in the cause of psychological factors. Furthermore a survey was applied to get the knowledge of which footed are the athlete. Statistically one way variance, chi-square and Scheffe tests are examined on evaluation of penalty shootouts and descriptive statistics was used for the research about psychological factors. Obtained informations were named via frequency and percent. A statistical evaluation was done among the players as to their positions whether they are effected by the goalkeeper or not. As a result of this evaluation, it is

determined that nothing but the's physical appearance and experience made difference on players' performance ( $P < 0.05$ ). There is no meaningful difference between players as to their position about when a player is coming to shoot the ball, if he changes his decision or not according to the statistical evaluations ( $P > 0.05$ ). However when importance level ( $P = 0.067$ ) is taken, it is determined that attacking players' possibility of changing decision are more likely than others like % 23-34. There were some players who is not in favour of shooting penalty and feeling uncomfortable. Even there is no statistically difference, it was defined that defending players are more nervous about shooting critical penalties. It was observed that in between players having l stress, right handeds are having less stres that left handeds or both handeds during shootout ( $p < 0.01$ ). Among 330 shoots, %68,2 of them scored and %31.8 of them failed. %54.6 of penalties were taken by the inside of right foot. It was noticed that success or failure of the penalty depends on shooting technique, speed ( $p < 0.05$ ) and does not depend on the color of the keeper's sportsgear ( $p > 0.05$ ). Last of all, coaches should prepare his players fully on psychological and tactical areas, should apply special training schedule in order to help players on improving these skills.

## QUANTIFICATION OF ANAEROBIC CAPACITY OF YOUNG ATHLETES OF FUTSAL THROUGH TEST RAST

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**INTRODUCTION** The indoor football or futsal is an intermittent sport, with acceleration, deceleration and re-acceleration in very short distances. In these actions, the player is required to change directions or make maneuvers over the opponent. Then, the capacity of production of power in high levels during a prolonged time is important for players performance improvement. The running anaerobic sprint test (RAST) is a very simple method that can be used to evaluate performance of futsal players, due to the possibility of estimating neuromuscular and energy determinants of maximal anaerobic performance (ZAGATTO et al., 2009). It could also be used to establish parameters for prescribing training and for getting full potential of the players or preserving them from fatigue during an official match. The aim of this study was to quantify the anaerobic parameters in young futsal athletes with the RAST method, not commonly used in this modality of sport. **METHODS** The volunteers used in this study were all male ( $N=07$ ), with an average age of  $16,4 \pm 0,8$  years old, weighing  $65,8 \text{ kg} (\pm 9\text{kg})$  and mean height of  $172,4 \text{ cm} (\pm 0,06 \text{ cm})$ . They were students of a futsal school organized by the Sports Department of the city hall of Guaxupé (MG, Brazil), practicing the modality three times per week in sessions of 1.5 hour. The volunteers were accompanied along four consecutive weeks, and then their anaerobic capacity was compared with the influence of practice time of futsal. **RESULTS** Comparing the initial values with values obtained after four weeks of training, statistic significant difference was not found in peak power (watts) ( $509,6 \pm 111$  vs  $562,5 \pm 138,6$ ) or mean power (watts) ( $421,6 \pm 81,2$  vs  $400,7 \pm 84,4$ ). The relation between peak power and weight was also not different, however, statistic difference was found in mean power per weight after the four weeks of training ( $6,4 \pm 0,85$  vs  $7,17 \pm 0,95^*$ ). **DISCUSSION** The dynamic of the futsal game, with alternations of rhythm, direction and distance of each race performed, demands high levels of aerobic and anaerobic capacity. Expanding and diversifying the number of methods used in futsal players evaluation can help coaches and trainers in the formation of a better team (ARINS et al., 2007). The anaerobic capacity is a very simple test with a low cost that is not commonly applied. This study characterized anaerobic capacity in young athletes, showing that difference can be found in a short period of time. More tests should be done in other groups of ages and levels of training in order to implant this test more widely. **REFERENCES** Arins FB, Silva RCR. (2007). Rev. Bras. Cineantropom Desempenho Humana, 9(3) 291-6. Zagatto AM, Beck WR, Gobatto CA. (2009). J Strength Cond Res, 23(6), 1820-7.

## POTENTIAL PERFORMANCE ENHANCEMENT IN ELITE FLATWATER KAYAKING WITH NEW TECHNIQUE FOR BIOMECHANICAL ANALYSIS

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**Introduction** With a greater understanding of the kinetics and kinematic factors involved in the modern paddling technique, performance enhancement may be reached. For this purpose force-measuring systems are needed in kayaking. No studies have examined the specific forces developed within the kayak on the foot-bar and seat (Michael et al. 2009). Accordingly, the aim of the present project was to develop the necessary technique. **Methods** Equipment setup was designed to make it possible to store the force data from the foot-bar, seat and paddle together with data from a GPS, a 3-D accelerometer and electrogoniometers in a portable data-acquisition system (DaqCube). The whole force recording system can be fitted into a racing kayak. Furthermore, a jig and procedures for calibration of the paddle force transducers was developed, devices for measuring forces on the kayak foot-bar and on the seat during on-water kayak paddling were constructed and evaluated thoroughly and software for analysis of the recordings developed. **Results and Discussion** The current preliminary results indicate that the data-acquisition system is functional in a practical setting. The new foot-bar and seat force devices allow recording of forces within functional limits with high validity and reliability. Reliability of both devices was tested in a laboratory setting in a test-retest design and the coefficient of variation (CV) for foot-bar push and pull forces ranged from 0.1 to 0.8% while the CV for the seat forces varied between 0.6 - 2.2%. Validity was supported by a strong linearity found between the transducer output signal and load force in the push and pull directions for both foot-bar transducers and the seat-force measuring device. Overall, the present study opens up for new applied research of the forces generated during on water paddling and within the kayak and thus new ways to optimize kayak paddling performance can be obtained. **References** Michael JS, Smith R, Rooney KB (2009) Sports Biomech, International Society of Biomechanics in Sports, 8: 167-179 Nilsson J and Rosdahl H (2013) New devices for measuring forces on the kayak foot-bar and on the seat during flat-water kayak paddling. Manuscript under revision.

## A NEW APPROACH TO MONITOR STRESS AND FATIGUE DURING ALTITUDE TRAINING IN ELITE ATHLETES

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**INTRODUCTION** The total score of fatigue, a self-reported 8-items questionnaire (TSF-8), is a valid indicator of training stress and fatigue in swimmers (Aitlaoui et al., 2007). However, it does not include relevant issues such as arms tiredness or appetite. We aimed to contrast the validity of a derived 10-items questionnaire (TSF-10) by comparing both methods with session RPE and altitude-related clinical symptoms in elite athletes during altitude training (AT). **METHODS** 34 elite swimmers participating on an AT camp (CAR Sierra Nevada, 2.320 m) during three weeks (W1 to W3, 6 days/wk, 3 sessions/d). Subjects answered three self-reported questionnaires: 1) session RPE (Foster et al. 2001), within 30 min after each workout, with scores weighted for the day (s-RPEw); 2) TSF-10, based on TSF-8 with two added items

(arms tiredness and appetite); and 3) Lake Louise (LL) for acute mountain sickness symptoms. RESULTS Data were obtained from 673 questionnaires corresponding to 1,350 training sessions. Mean ( $\pm$ sd) s-RPEw was higher at W2 (5.30 $\pm$ 1.77) compared to W1 (4.57 $\pm$ 1.90) and W3 (4.80 $\pm$ 1.99) ( $p < 0.05$ ). LL scores reported in W1 (2.02 $\pm$ 1.6) were higher than in W2 (1.83 $\pm$ 1.6) and W3 (1.61 $\pm$ 1.6) ( $P < 0.05$ ). TSF-8 (18.0 $\pm$ 5.9) and TSF-10 (23.2 $\pm$ 7.0) scores in W1 were higher than in W2 and W3 (TSF-8: 16.9 $\pm$ 5.3 and 16.6 $\pm$ 6.6; TSF-10: 22.3 $\pm$ 6.4 and 21.7 $\pm$ 8.0, respectively) ( $p = 0.025$ ). LL scores showed good association with both TSF-8 ( $r = 0.46$ ) and TSF-10 ( $r = 0.49$ ) ( $p < 0.001$ ) values, peaking at W3. Items added to TSF-10 showed a moderate association with LL scores ( $r = 0.34$  and  $0.22$  for arms tiredness and appetite, respectively) ( $p < 0.001$ ). DISCUSSION Both TSF-8 and TSF-10 are equally valid tools for assessing training stress and fatigue during AT. Likewise, LL is useful to ascertain dis-acclimatization health disturbances (Calderon et al., 2011). The observed link between appetite scores in LL and TSF-10 justifies the inclusion of this item. We conclude that the extended version of the fatigue questionnaire (TSF-10) adds further information and, combined with the LL questionnaire for hypoxia-related health disturbances, can be considered a useful approach to assess well being and fatigue during AT in elite swimming athletes. REFERENCES Atlaoui et al. (2004). *Med Sci Sports Exerc*, 36(2), 218-224. Foster et al. (2001). *J Strength Cond Res*, 15, 109-115. Calderón et al. (2011) 16th ECSS Annual Congress, Liverpool.

### AGREEMENT BETWEEN MATURITY STATUS DERIVED FROM INVASIVE AND NON-INVASIVE INDICATORS OF BIOLOGICAL MATURATION IN ADOLESCENT MALE SOCCER PLAYERS

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INTRODUCTION: Grouping players by maturity status has long been a focus of research in youth sports and more recently has been included as central to long term athlete development model. The second objective addresses the issue of concordance between classifications based on the non-invasive methods and skeletal maturity METHODS: The sample included 181 players aged 11-14 years. The Fels method (Roche et al. 1988) was used to determine skeletal age (SA). Players were classified into three categories based on the difference between SA and chronological age (CA). On time maturity status was an SA within  $\pm 1.0$  year of CA, late maturing was an SA behind CA by more than 1.0 year, and early maturing was an SA in advance of CA by more than 1.0 year. Predicted ages at PHV were obtained using the algorithm labeled maturity offset (Mirwald et al., 2002) were classified relative to the three samples upon which the protocol was developed. On time was defined as a predicted age at PHV within 1 SD of the overall mean age at PHV (12.9 to 14.7 yrs), late as an age at PHV  $> 14.7$  years and early as an age at PHV  $< 12.9$  yrs. Cross-tabulations of maturity status classifications were calculated. Cohen kappa coefficients were calculated to evaluate the concordance of maturity classifications with pairs of maturity indicators. RESULTS: Concordance between SA-CA classifications and the non-invasive classification was 55% among players 11-12 years and 57% (predicted age at PHV) among players 13-14 years. Expected chance agreements between classifications were 51% in players 11-12 years, and 52% in players 13-14 years. Kappa coefficients were low in the two age groups, respectively, 0.11 and 0.13. The coefficients indicate relatively poor agreement between maturity classifications. Spearman rank-order correlations between maturity classifications, though significant ( $p < 0.01$ ) are low to moderate, 0.43 among players 11-12 years and 0.29 among players 13-14 years. CONCLUSIONS: Although the indicators were related, concordance of maturity classifications between SA and predicted APHV was poor. Talent development programs call for the classification of youth as early, average, and late maturing for the purpose of designing training and competition programs. Non-invasive indicators of maturity status have limitations for this purpose. REFERENCES: Malina et al. (2004). *Growth, Maturation, and Physical Activity*. Human Kinetics Champaign, Illinois. Roche et al (1988). *Assessing the Skeletal Maturity of the Hand-Wrist*. C.C. Thomas. Springfield, Illinois Mirwald et al (2002). *Med Sci Sport Exer*, 34, 689-694.

### BASIC MOTOR ABILITIES VS. BASKETBALL SPECIFIC SKILLS

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Introduction Basketball is a complex motor activity consisting of a combination of basic motor skills and specific basketball movements that are performed at high speed in a short time. The purpose of the study was to determine to what extent there is a correlation between basic motor abilities and specific basketball skills. Methods Twenty-seven female basketball players (age: 13.84 $\pm$ 0.92) performed motor and specific basketball tests. Three basic motor abilities were assessed: anaerobic endurance (300 yard test), speed (T test of agility) and explosive strength (vertical jump). Control dribble (CD), shooting (SH) and defensive movement (DM) tests were conducted to evaluate specific basketball skills. Measurements were performed three times over a period of 18 months (every six months) in order to ensure validity of results. Correlation statistics was used for result analysis. Results For the evaluation of parameters we used the measurement (of possible three) with the best results. Achieved values for 300 yard test, agility (AG) and vertical jump were 76.78 $\pm$ 4.44 s, 12.44 $\pm$ 0.68 s and 30.96 $\pm$ 4.13 cm, respectively. Performance in CD (20.57 $\pm$ 1.92 s), SH (6.28 $\pm$ 0.54 scores for 30 s) and DM (27.79 $\pm$ 2.06 times for total time of 2x30 s) was correlated with anaerobic endurance (AE), agility and explosive strength (ES). The correlations between CD and AE, AG and ES were:  $r = 0.28$ ,  $r = 0.68$  and  $r = -0.11$ , respectively. Considering SH skills following correlations with AE, AG and ES were obtained:  $r = -0.33$ ,  $r = -0.64$  and  $r = 0.11$ , respectively. In the end, DM was correlated with AE ( $r = -0.40$ ), AG ( $r = -0.60$ ) and ES ( $r = 0.32$ ). Discussion The obtained results showed strong correlation between agility and all three specific basketball skills, which points the importance of this motor ability for on-court basketball performance. Regarding AE there was medium correlation of this motor ability with specific skills. Considering the short duration and high intensity of performed basketball tests, this result is logical since the energy for this work is provided by creatine phosphate energy system rather than lactate one. Small correlation between vertical jump and specific basketball skills specifies that this motor ability does not affect mentioned basketball skills in a highly manner. Of course there is an unquestionable importance of vertical jump in other aspects of basketball. Conclusion Success in basketball certainly depends on genetic potential of an individual to develop both motor and specific basketball skills. Whether the genetic potential is going to be fully realized largely depends on adequate training. Working on basic motor skills, especially in younger age, with the emphasize on agility, greatly contributes to the improvement of specific basketball skills which is a prerequisite for becoming a top basketball player.

14:00 - 15:00

## Mini-Orals

## PP-BN08 Biomechanics [BM] 8

**INTRAMUSCULAR DIFFERENCES IN FASCICLE LENGTH, SARCOMERE LENGTH AND SERIES SARCOMERE NUMBER OF THE HUMAN QUADRICEPS FEMORIS: A CADAVERIC STUDY**

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Introduction Skeletal muscles are characterized for its force-velocity-power potentials by the number and length of muscle fibers. Cadaveric studies have provided information on muscle fiber or fascicle length (LF) and the number of sarcomeres in series in a fiber (NS) of various muscles, from which the average sarcomere length (LS) has been estimated (e.g., Wickiewicz et al., 1983). Few studies however have clarified intra-muscular differences in LF or NS, although it has been shown that regional differences in architectural parameters within a muscle could influence its length-force-velocity relationship (Blazevich et al., 2006). We aimed to examine in a cadaver study intramuscular differences in LF, LS and NS of the four muscles of the human quadriceps femoris (rectus femoris: RF, vastus lateralis: VL, vastus intermedius: VI, and vastus medialis: VM). Methods The quadriceps femoris was dissected from the left leg of a cadaver (sex: male, body height: 153 cm, body mass: 59.6 kg, hip and knee joint angle: anatomical position). The lengths of fascicles removed from five sites of RF (proximal, medial, central, lateral and distal sites), four sites of VL (medial side of proximal, lateral side of proximal, central and distal sites), three sites of VI (proximal, central and distal sites), two sites of VM (proximal and distal sites) were determined with a caliper. Several muscle fibers were isolated from each fascicle at each site, and in the microscopic image of each fiber, sarcomere lengths were measured at five positions (0%, 25%, 50%, 75% and 100% fiber length). The LS was determined as the average of the sarcomere lengths at five positions. The NS was determined by dividing LF by LS. Results & Discussion The LF, LS and NS of each muscle ranged from 60.5 - 74.6 mm, 1.86 - 2.30  $\mu$ m and 30692 - 36124 in RF, 59.7 - 80.5 mm, 1.72 - 2.00  $\mu$ m and 33512 - 43593 in VL, 37.4 - 62.2 mm, 1.75 - 2.34  $\mu$ m and 17614 - 34397 in VI, and 61.7 - 87.1 mm, 1.81 - 2.02  $\mu$ m and 32435 - 47270 in VM, respectively. The LF showed significant regional differences in all muscles of quadriceps femoris. On the other hand, there was no significant variation in LS among the sites of each muscle. The intramuscular differences in NS corresponded well to those in LF, suggesting that intramuscular differences in LF are matched with NS while LS is kept constant throughout a muscle. We conclude that LS change can be estimated from the measurement of LF change that has been carried out in vivo. References Wickiewicz TL, Roy RR, Powell PL and Edgerton VR (1983). Clin Orthop Relat Res, 179, 275-283 Blazevich AJ, Gill ND and Zhou S (2006). J Anat, 209(3), 289-310

**BILATERAL STRENGTH ASYMMETRY DURING VERTICAL JUMP IN VOLLEYBALL PLAYERS**

Borras, X., Balias, X., Drobnic, F.

*Universitat de Vic*

BILATERAL STRENGTH ASYMMETRY DURING VERTICAL JUMP IN VOLLEYBALL PLAYERS Borràs, X.1, 2, Balias, X.2, Drobnic, F.2 1: Uvic (Spain), 2: GIRSANE. CAR (Spain) Introduction Bilateral imbalances may affect performance. Asymmetry between limbs is considered predisposing factor for injury when differences are greater than 15% (Knapiak, 1991). Double leg vertical jump has been observed as a reliable functional task to assess limb functional limitations (Impellizzeri et al., 2007). The purpose of this study was to evaluate the bilateral strength symmetry in volleyball players applying a vertical jump test protocol. Methods Sixteen male of the Spanish National volleyball team performed a squat jump (SJ), a countermovement jump (CMJ), and a CMJ with arms (CMJa). Jumps were recorded simultaneously in a two force platforms (Kistler), one under each leg. Symmetry index was calculated using the formula (stronger-weaker)/stronger x 100. Parameters used for comparison were maximum peak force and total impulse. Results Peak force symmetry index values for each type of jump were: SJ 4.0%, CMJ 5.5%, CMJa 4.2%. Symmetry index for total impulse values were SJ 8.1%, CMJ 8.8%, CMJa 11.9%. All differences between strong and weak limb are statistically different ( $p < 0.05$ ). Discussion With respect the peak force values, the symmetry index oscillates among 4.0% and 5.5% and is statistically different. This agrees with the results found by Newton et al (2006) in softball players and is discordant with Lawson et al (2006). Nevertheless, Lawson et al (2006) compare right - left leg, and this comparison may hide asymmetry due to leg compensations (Newton et al 2006). Total impulse symmetry index are slightly higher, oscillating among 8.1% and 11.9% and are also statistically different. In conclusion, volleyball players present strength asymmetry between limbs although it can not be considered as a risk factor for injury. References Impellizzeri FM, Rampinini E, Maffiuletti N, Marcora SM (2007) Med Sci Sport Ex, 39 (11), 2044-2050. Knapiak JJ, Baurman CL, Jones BH, Harris JM, Vaughan L (1991). Am J Sports Med, 19 (1), 76-81. Lawson BR, Stephens TM, DeVoe DE, Reiser RF (2006). JSCR, 20 (3), 608-619. Newton RU, Gerber A, Nimphius S, Shim JK, Doan BK, Robertson M, Pearson DR, Craig BW, Hakkinen K, Kraemer WJ (2006). JSCR, 20 (4), 971-977.

**THE EFFECT OF A 6-WEEK PNF STRETCHING TRAINING ON VARIOUS MUSCLE-TENDON PARAMETERS**

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Introduction There is only one study (Mahieu et al., 2009) that analyzed the effect of long-term PNF stretching on muscle-tendon properties. They reported an increase in range of motion (ROM) but no changes in passive resistive torque and Achilles tendon stiffness. Thus, ROM increase was explained with increased stretch tolerance. However, muscle and tendon stiffness during passive movements was not measured and results are in contrast to findings by Kato (2009) who reported a change in passive tendon stiffness following a static stretching program. Therefore, we performed a PNF stretching training and included the missing muscle and tendon parameters in our analysis. Methods 49 subjects agreed to participate in the study. The group was divided into 25 subjects who performed a PNF stretching training of the calf muscles 5x/week and controls that did not perform any stretching training. Before and following a six-week stretching intervention, we determined maximum dorsiflexion with a goniometer and muscle fascicle length and pennation angle at neutral ankle position (90°) and maximum dorsiflexion with ultrasound. Furthermore, ankle joints were passively moved with a dynamometer and the displacement of the muscle-tendon junction was simultaneously observed with ultrasound. This allowed determining length changes in

tendon and muscle and hence calculating stiffness by dividing force change by length change. Furthermore, joint stiffness was calculated by dividing change in passive torque by change in ankle angle. Mean values before and following the six weeks were compared with paired t-test. Results Due to minor quality of ultrasound videos five subjects from the ROM measurement and seven subjects from the dynamometer measurement had to be excluded. In the intervention group mean ROM (n=20) increased from 31.45+/-7.3° to 33.50+/-7.3° (p=0.02). Pennation angle increased from 18.5+/-1.8 to 19.5+/-2.1° (p=0.01) in neutral but not in the maximum dorsiflexion position. Fascicle length did not change in either position. Although joint and muscle stiffness did not change, mean tendon stiffness (n=18) decreased significantly from 10.58+/-3.42 to 9.10+/-2.89 N/mm (p=0.03). No parameter changes were observed in the control group. Discussion We conclude that PNF stretching for 6 weeks increases ROM and affects the stiffness of the Achilles tendon during passive movements. Furthermore, muscle fascicle angle is increased in resting position (90°). Since Mahieu et al. (2009) did not observe changes of tendon stiffness during MVC measurements it seems that tendon properties and muscle geometry are rather altered when muscles are not voluntarily activated. References Kato E. (2009): ECSS Abstracts, 194-195. Mahieu NN, Cools A., De Wilde B, Boon E, Witvrouw E (2009) Scand J Med & Sci Sports, 19, 553-560.

## EFFECTS OF ANKLE BRACES ON GROUND REACTION FORCE AND ELECTROMYOGRAMS DURING LANDING MOVEMENT

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Introduction Percentage of ankle injuries in total sports injuries are about 15%. Percentage of ankle sprains in total ankle injuries are about 85%. Furthermore, it was reported that most of people who have had ankle sprains have them again within a year. Ankle braces are used for prevention of sprains and prevention of recurrence of injury. Recently, various types of braces are developed and sold. The new featured brace developed by company D is 15g. This brace is mounted so as to wind around the ankle, consists of a movable pad made from foam material and has a stretching belt. The brace works by adding pressure to the tibia and fibula, and on the muscles relating to plantar flexion and dorsiflexion. Therefore, the aim of this study was to verify the effect of ankle braces on ground reaction force (GRF) and electromyograms (EMG) during landing movement. Methods Ten young healthy males subjects (Height:171.8±3.7cm, Weight:62.2±6.2kg, Age:21.4±1.9yr) were chosen. All subjects gave informed consent. Two conditions were set, one with a brace on the right ankle and one without. And physical tasks measured were landing movement from a box of 30cm and 50cm in both conditions. All subjects performed each task three times in all conditions. Ground reaction force and electromyograms during landing movement were measured. Muscles to be examined were the long fibular muscle, lateral head of gastrocnemius muscle, interior head of gastrocnemius muscle, soleus and anterior tibia muscle. Results On GRF during landing movement, comparing the condition of wearing a brace and without, showed no significant differences. When subjects were measured without a brace, GRF condition of 30cm was significantly lower than at 50cm(p<0.05). On EMG of all examined muscles during landing movement from 30cm, comparing the condition of wearing a brace and without showed no significant differences. On EMG of interior head of gastrocnemius muscle during landing movement from 50cm, the condition of wearing a brace was significantly lower than without(p<0.05). Discussion On 30cm, GRF when subjects wore a brace was higher than without. Subjects landed from the same place but the GRF was different. When people land on the floor, ankles pronate and supinate. Maeda reported that the angle of ankles pronate and supinate landing on one foot were larger than on both. From these, this brace possibly makes the angle of the ankles pronate and supinate limitary. On 50cm, EMG of interior head of gastrocnemius muscle when subjects wore a brace was lower than without. Kameda reported that muscle activity at lateral head of gastrocnemius muscle, and interior head decrease with greater angle of the knee. From these, this brace supported buffer action during landing movement.

## THE EFFECTS OF GRADED SLOPES AND THE USE OF HIKING POLES ON LOWER EXTREMITY MUSCLE ACTIVITY

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University of Salzburg

Introduction Walking on graded slopes requires exertion of greater forces across lower extremity joints. In the course of walking downwards, the knee joint absorbs up to 70 percent of the total negative work. The use of hiking poles as a tool to reduce lower extremity joint load as well as muscle activity is widely accepted. Especially when the hiking poles are used technically right, the load on the ankle and knee joint can be reduced by up to 56 and 25 percent, respectively (Schwameder, 1999). Despite increased attention to effects of inclination on human gait during the last years, many questions remain unresolved. Therefore, the goal of the present study was to identify the muscular response to walking with hiking poles. Methods Twenty-six healthy male students of the University of Salzburg with average age, height and weight of 25.4 (±2.5) years, 178.9 (±6.5) cm and 75.4 (±9.2) kg respectively, volunteered to complete this study. All participants were instructed to walk up and downhill on a treadmill at four, eight and twelve degrees. Furthermore, the double poling technique was performed as participants walked downwards with the hiking poles. Muscle activity was recorded of tibialis anterior (TA), soleus (SO), medial gastrocnemius (GA) and vastus (VA), medial (SM) and lateral hamstring (BF), rectus femoris (RF) as well as gluteus maximus (GL). Gait characteristics were obtained with Novel® Pedar insoles. Data was processed with a custom written Matlab® code and statistically analysed applying one-way ANOVA with repeated measures (Bonferroni,  $\alpha=0.05$ ). Results Regarding both mean activity and burst duration, no significant differences were observed between walking with and without hiking poles. Nonetheless, tendential differences are apparent. When walking downwards, the mean muscle activity of TA, GA, SM, BF, RF and GL increased while the activity of SO and VA decreased. In terms of the burst duration, tendential increases were found regarding TA and SM. Decreases were observed concerning GA, BF, VA, RF and GL. Discussion The present study revealed that using hiking poles is not beneficial to unload the lower extremity joints and muscles. In fact, hiking poles expose inexperienced or recreational hikers to increased muscle fatigue and consequently increased injury risk. References Schwameder H, Roithner R, Müller E, Niessen W, Raschner C. (1999). J Sport Science, 17, 969-978.

## INNOVATIVE TECHNOLOGIES FOR KNEE REHABILITATION IN SUBJECTS WITH ANTERIOR CRUCIATE LIGAMENT INJURIES

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Introduction Recent theoretical studies indicate that during leg extension exercises the tibiofemoral shear forces and the ACL strain-forces can be externally modulated. These modulations can be obtained by a controlled displacement of the application point of the resistance

force along the lower-leg during the knee flexion/extension (Biscarini, 2008), or through an external compressive force applied on the knee joint (Fleming et al., 2007). Methods We have designed and developed two innovative leg extension prototypes which integrate these functions. In the first prototype, the resistance lever of a standard leg-extension equipment was replaced by a linear guide along with the resistance pad can slide. The pad movement along the guide is generated by an electric motor controlled by an angular encoder placed on the rotation axis of the equipment, and a linear encoder installed along the linear guide. A feedback control algorithm was developed to provide an accurate and fast dynamic control of the pad positioning. In the second prototype, a foot platform was inserted at the distal side of the resistance lever to exert a controlled axial compression on the lower limb during the exercise. Two protocols for surface EMG and imaging techniques measurement were designed to assess and compare the levels of hamstring co-contraction (which is known to represent a protective factor for the ACL) and the anterior tibial translation (which is proportional to the ACL strain-force), during the exercise with these two new prototypes and the standard equipment, at different levels of external resistances. Each trial was also repeated encouraging the subjects to intentionally enhance hamstring co-activation during the exercise. Results EMG data collected on seventeen healthy subjects indicate that hamstring co-activation is not influenced by pad movement and axial compression. However, the hamstring co-activation was increased from two to four times when the subjects were encouraged to intentionally co-contraction the knee flexor muscles during the leg extension exercise. Discussion Intentional hamstring co-contraction in leg extension exercises can be an effective strategy for ACL protection and tibiofemoral joint stability in ACL deficient patients, and in rehabilitation programs after cruciate ligament reconstruction. Further investigations with imaging techniques will definitely assess the effectiveness of the two prototypes. References Biscarini (2008). Medical Engineering & Physics 30(8), 1032-1041 Fleming et al. (2003). Am J Sports Med 31(5), 701-707

### CONTRIBUTION OF THE PLANTAR FLEXION TO MAXIMUM FOOT GRIP FORCE

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[Introduction] An understanding of force generating mechanism of foot was important key to understand human bipedal locomotion. Foot muscles are divided into two muscle groups: plantar intrinsic foot muscles (PIFM) and the extrinsic foot muscles (EFM). These muscle complex supports the foot arches and generate force during the bipedal movement (Fiolkowski et al., 2003); however, it is still unclear how PIFM and EFM separately contribute to the total force generating capacity of foot. It is well known that, in order to prevent a re-injuring, using arthrodesis materials such as taping and cast can limit the range of motion (ROM) of joint (Rovere et al., 1998). While, this technique may be useful to isolate each muscle generation force in the complex muscle movement. From this point of view, ankle cast induced reduction of ROM in ankle may reduce EFM availability and this may be able to determine the contribution of PIFM and EFM separately to foot muscle function. [Purpose] This study was to investigate how plantar flexion contributes to the foot muscle strength by using ankle cast arthrodesis technique. [Methods] Seven healthy subjects (age, 24.2±3.1year; height, 1.70±0.09 m; body weight, 67.7±24.3 kg; mean±SD) participated and were measured active ROM in ankle, maximum foot grip force (FGF) and plantar flexion force (PFF) on the goniometer (NIHONKOHDEN, Japan), the foot grip dynamometer (Takei Scientific Instruments, Japan) and the manual dynamometer (NIHON MEDIX, Japan), respectively, in two conditions; barefoot (BAR) and reduced ROM of ankle by cast (CAS; CASTLIGHT-α, ALCARE, Japan). ROM was determined from maximum range of dorsiflexion to plantarflexion. For the measurement of PFF, subjects sat with 90, 180 and 90 degrees of ankle, knee and hip joint, respectively, and placed their arm in front of the chest and pressed their fore-foot on the dynamometer maximally. For the measurement of FGF, subjects optimally graded the grip-handle bar of the dynamometer by toe and finger of foot in a sitting position and exerted maximum force. Both PFF and FGF measurements were performed three trials and used best trial for a further analysis. [Results] FGF and PFF were significantly ( $p<0.05$ ) decreased in CAS as comparable with BAR (FGF; CAS: 10.4±3.1 kg vs. BAR: 13.6±4.5 kg, PFF; CAS: 458.7±81.2 N vs. BAR: 514.5±93.6 N). ROM was significantly decreased in CAS (CAS: 23.0±5.3 deg vs. BAR: 52.0±11.8 deg,  $p<0.01$ ). [Discussion] These results of the present study suggest that muscle force from plantar flexion contributes to foot grip force generation to some extent. Extrinsic foot muscles embedded in foot and ankle joint may have some functional role to generate foot muscles. [References] Rovere GD, Clarke TJ, Yates CS, Burley K. (1988). Am J Sports Med, 16, 228-233. Fiolkowski P, Brunt D, Bishop M, Woo R, Horodyski M. (2003). J Foot Ankle Surg, 42(6), 327-33.

### TIMING OF MUSCLE CONTRACTION INFLUENCES FUNCTION OF MUSCLE FIBERS

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Introduction When a physical activity is performed quite timely, a quick and accurate response is produced. However, it is hard for us to get high performance if the timing is upset. The present study was designed to examine how a gap of timing to perform maximal voluntary knee extension affects functions of the vastus lateralis muscle fibers (VL). Methods Eighteen male subjects performed a 10-consecutive isokinetic knee extension (90 deg/s) that comprised 7 passive and 3 maximal voluntary contractions (MVC). It was repeated 8 sets with intervals of 2 minutes. They were asked to relax their muscles and exert MVC as quickly as possible only when a light turned on at 60 deg of the knee joint angle (0deg = full extension) in the 3rd, 6th and 9th extensions (C60). Only in the 4th and 8th sets, the timing of light stimulus was changed from 60deg to 50deg (C50) or 70deg (C70). The subjects did not inform of it. VL-EMG activity was monitored to check relaxation before the light stimulus. Pre-motor time (PMT), electromechanical delay (EMD), total reaction time (TRT) and movement time to the peak torque (MTPT) were calculated. A point (P) where a fascicle arose from the deep aponeurosis and pennation angle (PA) were measured on VL ultrasonic images. The subjects classified their MVC performance into 5 grades after each set. Results PMT and TRT were significantly longer in C70 than in C60. EMD was significantly longer in C50 than in C60. There were no significant differences in MTPT. The time delay was the largest at the first MVC that the timing of light stimulus was changed, and gradually decreased with the repetitions. Changes in PA near the deep aponeurosis from the light stimulus to the peak torque tended to be larger in C50 or C70 than in C60. The subject's self-evaluation on MVC performance remained unchanged. Discussion When the timing of muscle contraction was unexpectedly changed, the reaction time lengthened. This is similar to results obtained when the visual information was interrupted (Takase et al., 2009). The delay would be mainly caused by the central nervous system if the timing is hastened. On the other hand, it might be related to the knee joint movement if the timing was delayed. VL contracted so that the fascicle might bite at the deep aponeurosis tightly. It looked as if VL tried to make up for the delay in response. However, the muscular movement like snapping may cause irregular strain of the deep aponeurosis and result in muscle strain injuries at myotendinous junction (Garrett, 1990). The subjects could not recognize differences in the timing of muscle contraction. This suggests that the subject's kinesthesia does not always agree with the actual movement. Reference Garrett WE (1996) Am J Sports Med, 24(6): S2-8. Takase K, Taguchi M, Kakimoto M. (2009) Meio university research institute, (14): 11-16.

## IN VIVO MUSCLE FIBER BEHAVIOR DURING A 100-CONSECUTIVE JUMP

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**Introduction** An exhausting SSC exercise decreases EMG activity and joint stiffness (Horita et al., 1999a, b) during the 1st half of the ground contact phase, which results in the decrease in positive work during the following concentric phase. The present study was designed to examine how an exhausted SSC jump affects functions of the gastrocnemius lateralis muscle (GL). **Methods** Fourteen healthy males were volunteered in this study. They performed a maximal 100-consecutive both-legs jump without information of number of the repetitions. They were instructed to put both hands on the waist and to make the contact time as short as possible. Longitudinal sectional images of GL were obtained. A point (P) where a fascicle arose from the deep aponeurosis and the other 4 points on the fascicle and deep aponeurosis 1cm and 2cm away from the point P were digitized. From the coordinates, pennation angle (PA) and movement of point P was measured for the ground contact phase. Electromyographic activity was measured from 8 leg muscles. The EMG was full-wave rectified and averaged (aEMG) for the ground contact phase. Jumping movement was filmed at 300Hz to calculate the leg joint angles. Blood samples were collected to measure the blood lactate (BLa) concentration before and after the jump. **Results** Jumping height was significantly lower in 91-100th jump ( $17.1 \pm 4.8$ cm) than in 1-10th jump ( $25.5 \pm 5.7$ cm), whereas ground contact time tended to increase from  $204.7 \pm 31.2$ ms to  $238.9 \pm 49.1$ ms. Movement of point P tended to decrease from  $0.28 \pm 0.18$ cm to  $0.18 \pm 0.14$ cm. PA remained unchanged at land-on and take-off, but changes in PA tended to decrease from  $3.4 \pm 1.9$ deg to  $2.6 \pm 1.1$ deg. aEMG tended to decrease in every muscle. Changes in the ankle joint angle significantly decreased for the ground contact phase. In the 2nd half, it tended to decrease, whereas changes in the hip joint angle tended to increase. BLa was significantly increased after jumping ( $1.8 \pm 0.5$  mmol/L to  $5.9 \pm 2.3$  mmol/L). **Discussion** The present study demonstrated that GL had not been able to contract smoothly by an exhausted SSC jump. This is in agreement with results obtained by the other repeated exercise (Sakuma et al., 2009). Fatigue caused by a 100-consecutive jump hindered shortening of the muscle and change in PA, which lengthened the ground contact time and finally decreased the jumping height. It is probable that the hip extension was emphasized in the 2nd half of ground contact phase to compensate the decrease in GL function in the latter half of the jump. **References** Horita T, Komi PV, Nicol C, Kyröläinen H. (1999a) *Eur J Appl Physiol Occup Physiol*, 73: 393-403. Horita T, Komi PV, Nicol C, Kyröläinen H. (1999b) *Eur J Appl Physiol Occup Physiol*, 79(2): 160-167. Sakuma J, Kurihara T, Yanai T, Kanehisa H, Kawakami Y. (2009) *Sport Sci Research* 6: 97-110.

## EFFECT OF RELAXATION RESPONSE TIME BASED ON DIFFERENT TONIC LEVELS

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**Introduction:** Response time of relaxation reflects an important role in the execution of movement in humans (Buccolieri et al., 2003; 2004). However, effects of different tonic levels on response time are not well understood. We examined relaxation response time in the triceps surae muscle and assessed the effects of different tonic levels. **Method:** Eight healthy male athletes (mean age,  $23 \pm 2$  yrs) were studied using simple visual reaction tasks. The tasks, an isometric contraction or relaxation of the right triceps surae muscle, were performed as quickly as possible in response to a visual signal. Contraction response time (C-RT) was measured from the visual signal to electromyogram (EMG) activity onset of the triceps surae muscle. The relaxation tasks used three tonic levels, that is, 25%, 50%, or 75% of the maximum voluntary contraction (MVC). Relaxation response time (R-RT) was measured from the visual signal to the termination of EMG activity. EMG was recorded from the right-lateral gastrocnemius (LG), medial gastrocnemius (MG), and soleus (SOL) muscle simultaneously with production of the light signal. **Results:** R-RT in LG, MG, and SOL muscle showed a tendency to become longer in order of 75%MVC to 25%MVC as the tonic level increased. R-RT of 25%MVC was significantly longer than C-RT in the MG and SOL muscles ( $P < 0.05$ ). Moreover, the R-RT of 50%MVC or 75%MVC was significantly longer than C-RT in all three muscles ( $P < 0.05$ ). The relative increase in R-RT of 75%MVC to C-RT (100%) did not differ significantly between muscles. However, the relative increase in R-RT of 25%MVC was significantly lower in the LG muscle than in the MG or SOL muscles ( $P < 0.05$ ). **Conclusion:** These results suggest that R-RT in the triceps surae muscle increases as the tonic level increases. In addition, compared with C-RT, the R-RT has different effects in different muscles depending on the tonic level. **References:** Buccolieri A., Avanzino L., Trompetto C., Abbruzzese G. (2003) Relaxation in distal and proximal arm muscles: a reaction time study. *Clin. Neurophysiol.*, 114, 313-8. Buccolieri A., Avanzino L., Marinelli L., Trompetto C., Marchese R., Abbruzzese G. (2004) Muscle relaxation is impaired in dystonia: a reaction time study. *Mov. Disord.*, 19, 681-7.

## INFLUENCE OF QUADRICEPS FORCE EXERTION ON TRICEPS SURAE ACTIVITY DURING PLANTAR FLEXION

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**Introduction** Leg lengthening is fundamental for various activities of daily living, such as sit-to-stand and walking. Leg lengthening is composed of hip extension, knee extension and plantar flexion. Some recent studies have reported that activation of knee extensors and flexors provoked changes in activities of the plantar and dorsiflexors, and vice versa (Aruin, 2001; Hwang et al., 2001). We therefore investigated changes in triceps surae activity with quadriceps activation during isometric voluntary plantar flexion. **Methods** Nine healthy male subjects produced 10 - 100% of the maximum voluntary plantar flexion torque (% MVC) every 10% MVC. For each plantar flexion, the subjects were asked to perform the force exertion of the quadriceps at 0%, 50%, and 100% of the maximum voluntary knee extension (% KEMVC). Electromyographic activity was recorded from the triceps surae during all the tasks. **Results** The integrated electromyographic activity (IEMG) significantly altered ( $p < 0.05$ ) for the Sol with quadriceps activation, but not for the medial ( $p = 0.79$ ) and lateral gastrocnemius ( $p = 0.29$ ). The significant increases in the IEMG of the Sol were observed between 0% and 50%, 50% and 100%, 0% and 100% KEMVC. **Discussion** The novel finding was that Sol activity increased under quadriceps activation during isometric plantar flexion. In physiological point of view, the central drive may provoke an increase in Sol activity and a decrease in the activities of the other plantar flexors to maintain a given plantar flexion torque. Because there are a facilitatory heteronymous projection from the quadriceps to the Sol and inhibitory pathways from the quadriceps to the other plantar flexors such as the peroneus brevis (Meunier et al., 1993), it is possible that these peripheral neural inputs are related to observed modulation of the activities of the plantar flexors. **References** Aruin AS. 2001. *Percept Mot Skills*, 92(2), 563-8. Hwang IS, Abraham LD. 2001. *J Electromyogr Kinesiol*, 11(5), 319-25. Meunier S, Pierrot-Deseilligny E, Simonetta M. 1993. *Exp Brain Res*, 96(3), 534-44.

**IMPORTANCE OF TENDINOUS TISSUE LENGTHENING DURING THE INITIAL PHASE OF EXPLOSIVE POWER EXERTION**

Edamatsu, C., Kusumoto, K., Yamaguchi, H., Iida, T., Yamano, C., Kawakami, M.

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**Introduction:** Explosive power is required during dynamic movement in sports. Studies on the mechanism underlying explosive power have clarified the importance of tendinous tissue (TT) during movement with the help of ultrasonography. This study aimed to examine the mechanism underlying explosive power by observing the behavior of the muscle-tendinous complex during the drop jump (DJ) in athletes and non-athletes. **Methods:** Five male athletes who were long or triple jumpers (age,  $24.4 \pm 4.1$  y; height,  $169.5 \pm 6.5$  cm; weight,  $61.4 \pm 5.3$  kg; personal best record,  $7.35 \pm 0.52$  m or  $14.93 \pm 0.78$  m) and 5 male non-athletes (age,  $20.0 \pm 1.0$  y; height,  $168.6 \pm 3.3$  cm; weight,  $54.6 \pm 4.6$  kg) volunteered to participate in this study. Change in the TT length of the gastrocnemius medialis (GM; the distance from the muscle tendon junction to the calcaneus along the line of action of the tendon) during DJ from a height of 0.3 m was measured using a high-speed camera and ultrasonography equipment. Electromyographic parameters and ground reaction force were measured in synchrony with the camera and ultrasonography equipment. **Results and Discussion:** The reactive strength index (RSI) was greater in athletes ( $2.95 \pm 0.22$ ) than in non-athletes ( $1.18 \pm 0.24$ ). Athletes pre-activated the GM muscle and increased the TT length during the subsequent braking phase of DJ. In contrast, non-athletes hypoactivated the GM during the contact phase. Therefore, non-athletes could not sufficiently increase the TT length during the subsequent braking phase. A significant difference was noted in TT lengthening during the braking phase between athletes and non-athletes, but there was no significant difference in maximum lengthening of the TT during the push-off phase. However, individual differences in the TT stiffness were noted. Therefore, we compared the correlation between the RSI and TT-lengthening of individuals. The RSI correlated significantly with TT lengthening during the braking phase ( $r = 0.758$ ,  $p < 0.05$ ), but no correlation was found between RSI and maximum TT lengthening during the push-off phase. **Conclusion:** These results suggest that lengthening of the TT is extremely important during the initial phase of exertion of explosive power.

**EFFECTS OF DIFFERENT LOADS IN A SLED TOWING SPRINT ON STIFFNESS. A PILOT STUDY**

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**INTRODUCTION** Sled towing training has become a popular method for speed training. However, its effects on running kinetics remain unclear. Few studies have been performed on how resisted training can affect vertical and leg stiffness (Brughelli et al., 2008; Alcaraz et al., 2012). The purpose of this study was to investigate how stiffness is affected by different sled towing loads during sprint. **METHODS** Twelve healthy active volunteered men ( $24.9 \pm 2.6$  years;  $81.0 \pm 8.1$  kg;  $1.79 \pm 0.06$  m) participated in this study. After a specific warm-up, subjects performed 10 x 10m sprints in different conditions: unresisted, and by towing 10, 15, 20 and 30% of their body mass (Bm) added on the sled. Two trials were performed under each condition. The order for the trials was randomized and a 3-min rest period was allocated to remove the effects of fatigue. Vertical (Kvert) and leg (Kleg) stiffness in the 8-10 m interval were estimated based on the modelling proposed by Morin et al., (2005), from mechanical parameters: body mass, forward velocity, leg length, flight time and contact time. Flight and contact times were obtained from a 4-m contact platform, and forward velocity was calculated by a photocells system. **RESULTS** Repeated-measures ANOVA revealed significant differences in vertical stiffness between unresisted sprints and all loaded sprints ( $p \leq 0.05$  for all trials). Similarly, there were differences between lower (10, 15% Bm) and higher (30%) loads ( $p = 0.05$  and  $0.02$ , respectively). However, no statistical differences were found in leg stiffness ( $p > 0.05$ ). **DISCUSSION** These data showed that load on sled causes a decrease in Kvert compared with an unresisted sprint. Furthermore, differences between lower and higher loads were found, which may indicate that magnitude of load will provoke different effects on stiffness. That may be explained due to an increase of contact time in stance phase, and a greater CM vertical displacement when load increases (Morin et al., 2005). However, Kleg is not affected by external load added on the sled. Non significant changes in displacement of the leg spring (from the initial leg length) may explain these results (Morin et al., 2005). Nowadays, only one study (Alcaraz et al., 2012) has focused on effects of weighted sled training on stiffness, but no significant differences were found after applying the training protocol. Future studies are needed to determine whether these acute effects will produce stiffness adaptations when sled towing training protocols were applied. **REFERENCES** Alcaraz PE, Elvira JL, Palao JM. (2012). *Scand J Med Sci Sports*. Brughelli M, Cronin J. (2008). *Sports Med*. 38(8), 647-57. Morin JB, Dalleau G, Kyröläinen H, Jeannin T, Belli A. (2005). *J Appl Biomech*. 21(2), 167-80.

**14:00 - 15:00****Mini-Orals****PP-BN14 Motor Learning [ML] 3****EXAMINE THE PROCESS OF TRANSITION ON LEARNING THE WHOLE BODY MOVEMENT COORDINATION**

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**Introduction** The sudden change of progress from unable to able to perform a motor task is one of the most interesting topics in motor learning. It has been found that the learning condition affects the dynamics of learning system. To investigate the process of transition and the effect of learning condition on the whole body movement coordination, the present study manipulated the task difficulty in learning the novel task of riding the bicycle on a roller training plate and analyzed the coordination of whole body movement during the process of acquisition of this skill. **Methods** Sixteen male college students and four elite cyclers participated as the learners and experts respectively. The learners will be grouped into two (8 per group) in terms of learning condition of difficult and easy when they practice to ride. The goal frequency for rotation of wheel was modified as the learner can ride continually. The transfer tests of easy/difficult condition were implemented immediately after practice. The successful riding time, the difference of speed between the goals and riding (error of goal speed, EGS) and the kinematics of markers attached on whole body segments were record for analyses. **Results & discussion** Compared to the experts, no significant difference of EGS was found for the learners indicated the skill of task in this study was obtained by most of the learners. Three types of progress (typical, fast and slow) at the beginning of practice in terms of successful time at the begin-

ning of learning were found. There were 7 learners in the typical s shape learning curve in which an abrupt change from 0 second of riding time to more than 10s riding time was shown. The slower learners (4) also show s shape learning curve but with more trails between unable and able riding. The fast learners (5) could ride more than 10s in about two trials. Subsequently, the learners rode under goal of speed in the exponential curve implicated the stable movement coordination has been formed. PCA on the kinematics data reveals that 6 components could explain 86% of variance in whole body movement. The indicator of components showed that the coordination of up and down motion of legs and the balance of whole body changed during transition related to the progress curves for the representative learners. No difference of EGS was found between easy and difficult learning condition was found in transfer tests. The transition of whole body movement coordination in the present study seems to correspond to what was found in literatures and could be explained by the saddle node transition. The influence of learning condition on the application of skill instruction will be discussed.

### ROBOT-GUIDED IMPLICIT SENSORIMOTOR LEARNING CAN SHAPE THE MOVEMENT PATTERN

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Background: Facilitating and accelerating motor (re-)learning is the goal of coaches, teachers and therapists. In neurorehabilitation, end-effector robot-aided rehabilitation devices have been successfully tested, e.g. to improve gait in stroke patients (Merholz 2009). However, it is not clear whether robotic devices guiding the learner through the trajectory of a movement (such as a tennis stroke or a golf swing) can facilitate motor learning in healthy subjects. In addition, it is not known if robot-guided learning requires the learner to be aware of the intended movement trajectory (explicit learning) or not (implicit learning). The aim of this study was to investigate if robotic guidance can be used to implicitly shape the movement pattern of a golf swing. Methods: 34 healthy participants were assigned to one of the following 3 groups: the first and second group (EA, n=12; LA, n=11) practised golf swings, whereas the control group (CON, n=11) did not practice. The difference between the two intervention groups was that in the EA group, the wrist was bent early during the upswing phase of the robot-guided swings, whereas in the LA group, it was bent late in the upswing phase. The participants were unaware of the existence of these different interventions. The two-week training period comprised 5 sessions. Each session consisted of 5x10 robot-guided golf swings with 5x2 non-guided golf swings in between. To divert the participants' focus of attention from the wrist angle, they were instructed to focus on the correct start position, the velocity of the golf swing and the correct position at the end of the upswing. Before (PRE) and one day after the end of the training period (POST), 6 non-guided golf swings were recorded with a motion analysis system. Results: The analysis of variance (3x2, group x time) revealed a significant group x time interaction effect for the wrist angle during the upswing phase. In the early upswing phase, the wrist angle decreased in EA only (PRE 163±9° to POST 153±18°,  $p < 0.05$ ), whereas no significant differences emerged in LA (PRE 157±13°; Post 158±14°) or CON (PRE 160±6°; Post 162±9°). Discussion: The robot-guided training intervention was successful in implicitly shaping the intended movement pattern, here the time-course of the wrist angle. This might have implications for the motor skill learning of complex motor tasks in general: as beginners do not have an internal model of the correct movement yet, the actual movement cannot be compared to the internal model of the correct movement (Sanger 2004). Robotic guidance might provide the beginner with such a model, potentially accelerating the learning process.

### IMITATION OF BIOLOGICAL AND NON-BIOLOGICAL MOTION DISPLAYED IN A NON-HUMAN AGENT IS MODULATED BY SELECTIVE ATTENTION

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Introduction The acquisition of new motor behaviours requires a person to copy a movement that is not already represented in their own repertoire. This process is known as voluntary imitation and depending on environmental context and nature of the observed stimulus, lower-level (sensorimotor) and top-down (attention) processes are engaged. Here, we examined whether selective attention (attention directed to a specific aspect of a movement) and end-state goals modulate lower-level processes that code biological (unnatural or natural velocity generated by a human) and non-biological (constant velocity generated by a computer) motion. Methods Thirty-six participants were assigned to a general-attention or specific-attention group. The general-attention group was instructed to reproduce the agent, whereas the specific-attention group was instructed to imitate the exact motion trajectory profile of the agent. During 84 trials each group imitated a non-human agent (white dot) in a goal-directed (moved to a target) or goal-less (moved to no-target) context. The motion trajectory profile of the agent was manipulated across trials to display natural, unnatural or constant velocity. The dependent variables were analysed using repeated measures ANOVAs. Results The performance data revealed a main effect of attention:  $F(1,34) = 4.734$ ,  $P = 0.036$ . Post-hoc testing showed the general-attention group, irrespective of motion trajectory and target presence, was more accurate ( $p < 0.05$ ) at replicating movement time than the specific-attention group. The kinematic data showed that both groups replicated the different motion trajectory profiles,  $F(2,68) = 115.345$ ,  $P < 0.01$ . Importantly, a Group x Motion interaction  $F(2,68) = 4.673$ ,  $P = 0.013$  indicated the specific-attention group was more accurate at replicating the natural and constant velocity motion trajectory profiles than the general-attention group. Discussion The findings show that biological (unnatural velocity) and non-biological (constant velocity) motion are coded during voluntary imitation. Moreover, the ability to imitate movement time and movement kinematics was modulated differentially as a function of attention. Top-down factors (attention) were shown to affect lower-level visuo-motor processes in automatic imitation (Heyes, 2011), but the current data set are the first to show this interaction during complex imitation. References Heyes, C. (2011). Psychological Bulletin, 137(3), 463-483.

### EFFECTS OF PLAYING BEHAVIOUR ON MENTAL REPRESENTATIONS AND BALANCING SKILLS IN PRESCHOOL CHILDREN

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*University of Augsburg*

Introduction For preschoolers associations between coordination and cognitive abilities have been demonstrated, especially in the sector of visual and spatial perception and spatial thinking (Payr, 2011). In the context of decreasing movement occasions for nowadays children, the present study aims to investigate the influence of playing behaviour on mental body representations and coordination skills. Methods As part of the School Entry Health Examination 1,489 children (726 female, 763 male, Mage = 5.8 years, SD = 0.3) completed a balancing test (backwards on a 6 cm wide beam) and a man drawing test (MZT) (Brosat & Töttemeyer, 2007). Children's outdoor playing behaviour and playing time with electronic devices were recorded by a parental questionnaire. Using a path model, the influence of these two variables on cognitive representations of the human body (MZT) and to the balancing skills was tested. Results All paths in the

model were significant ( $p < .004$ ,  $\chi^2 = 52.4$ ,  $df = 9$ ,  $CFI = .97$ ,  $RMSEA = .057$ ). Increased playing time with electronic devices was significantly associated with a reduced outdoors playing time ( $\beta = -.17$ ) and had a negative impact on the performance in the MZT ( $\beta = -.08$ ). Both a high level of outdoors playing time ( $\beta = .07$ ) as well as a good score in the MZT ( $\beta = .11$ ) were associated with better performance in balancing. Discussion A well-developed coordination and mental representation of the body are important enrolment requirements. The findings underline that in kindergarten long term use of electronic media have a negative effect on it. By contrast, pre-schoolers, who frequently have motion-based interactions in the direct environment, generate skills that are supportive for the cognitive and motor development. Literatur Brosat, H. & Töttemeyer, N. (2007). Der Mannzeichen-Test nach Hermann Ziler. Münster: Aschendorff. Payr, A. (2011). Der Zusammenhang zwischen der motorischen und kognitiven Entwicklung im Kindesalter. Eine Metaanalyse. Konstanz: Universität Konstanz.

### SENSORIMOTOR ADAPTATION AND TRANSFER AFTER ONE-SIDED AND ALTERNATING PRACTICE: EXTENSION OF THE STANDARD STATE-SPACE MODEL AND INSIGHT INTO CORTICAL PROCESSES

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Introduction: Sport-specific studies addressing bilateral training practices have shown that a training of the non-dominant extremity can enhance the performance of the dominant extremity not only for beginners, but also for experienced athletes (e. g. Haaland and Hoff 2003). This effect is typically attributed to a contralateral transfer of motor learning. The aim of the present study was to investigate the mechanisms underlying sensorimotor adaptation and transfer after one-sided and alternating practice. Methods: Sensorimotor adaptation experiments have been performed to quantify the rates of adaptation and transfer after one-sided and alternating practice. In parallel, the electrocortical activity of the subjects was measured by electroencephalography (EEG). A mathematical model for the adaptation process in the brain was set up and evaluated by fitting to the experimental data. Results: It was found that intermanual transfer occurs for both unilateral as well as alternating practice. The adaptation process did not differ significantly for one-sided training with the dominant or the non-dominant hand, but for alternating training. Extending the standard state-space model for sensorimotor adaptation (Thoroughman and Shadmehr 2000, Taylor and Ivry 2011) to the alternating practice, the mental representation of the adaptation could be addressed. The data suggests that for alternating practice different learning rates for the two hands apply, that are furthermore different from the unilateral learning rates of the respective hand. The EEG data revealed within and between group differences in the alpha band over contralateral and ipsilateral sensorimotor areas during adaptation. Discussion and Outlook: Our results contribute to the understanding of the general underlying principles effective during contralateral motor transfer. This can help to optimize bilateral training practices in sports and might also be used in the rehabilitation of patients with hemiplegia. Thus, the use of the non-dominant hand can be used as a specific impulse in movement acquisition. References: E. Haaland, J. Hoff (2003). *Scand. J. Med. Sci. Sports*, 13:179–184, 2003 K. A. Thoroughman, R. Shadmehr (2000). *Nature*, 407:742–747 J. A. Taylor, R. B. Ivry (2011). *PLOS Comput. Biol.*, 7:e1001096

### BENEFITS OF THE QUIET EYE: IT IS THE SEEING, AND NOT THE LOOKING

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Introduction Although the performance-enhancing effect of the quiet eye (QE) is well documented (e.g. Vickers, 2011), until now, underpinning mechanisms have been studied only rudimentarily. Therefore, an inhibition hypothesis is proposed, postulating that the QE period is crucial for the inhibition of movement variants so that the most appropriate variant can be optimally parameterized (Klostermann, 2012). The aim of this study was to test a central prediction of this hypothesis by examining whether QE effects depend on the availability of relevant visual information over the QE period. Methods In a within-subject design both, QE onset and information availability were manipulated using an experimental paradigm in which 20 participants had to throw balls as accurate as possible at a virtual target disk (Klostermann et al., in press). The manipulation consisted of a peripheral flicker cue to evoke a final fixation earlier or later at one of four possible target positions at which correspondingly the target disk was presented earlier or later. QE onset and offset – i.e. beginning and end of the last fixation on the target position before movement initiation – as well as the radial error (RE) were calculated as dependent variables and analyzed by 2 (QE onset) x 2 (target onset) ANOVAs with repeated measures and planned t-tests. Results The QE manipulation was successful as, independent of target onset, earlier QE onsets were found in the early compared to the late QE onset conditions,  $F(1, 19) = 34.7$ ,  $p < .001$ ,  $\eta^2 = .65$ . No differences in QE offset were revealed. Beyond that, RE was significantly lower in the early compared to the late target onset condition,  $F(1, 19) = 4.6$ ,  $p < .05$ ,  $\eta^2 = .19$ . Finally, a significant QE onset x target onset interaction was found,  $F(1, 19) = 5.4$ ,  $p < .05$ ,  $\eta^2 = .22$ , revealing performance differences only between the early QE / target onset condition and the remaining three conditions (all  $ps < .05$ ). Discussion The results support the inhibition hypothesis in so far as throwing performance did not depend on the QE duration per se but on the duration in which information about the actual target position was displayed over the QE period. This finding indicates that QE benefits are based on the effective use of task relevant visual information, further emphasizing the functionality of the QE for offline parameterization processes (e.g. Klostermann et al., in press) as being proposed in the inhibition hypothesis. References Klostermann, A. (2012). Submitted for publication. Klostermann A, Kredel R, Hossner EJ (in press). *J Exp Psychol Human*. Vickers JN (2011). *Cogn Process*, 12, 219-222.

### ADEQUACY LEVEL IN CHILDREN FOR VARIABLES OF STATIC AND DYNAMIC BALANCE IN RELATION TO THE NUTRITIONAL STATUS

Dorst, D.G.B.1, Barbeta, C.J.1, Dorst, L.M.2, Roman, E.P.1, Barbeta, V.J.1, Alves, A.C.3, Barros Filho, A.A.4

1: FAG(Cascavel, Brasil) e UNICAMP (Campinas, Brasil), 2: FAG (Cascavel, Brasil) e Secretaria de Estado do Esporte (Curitiba, Brasil), 3: FAG(Cascavel, Brasil), 4: UNICAMP (Campinas, Brasil).

Introduction Current children are impaired, because they have a few daily tasks, due the high demand of technological advances, computers, games, TVs, finally, any task that demands a low physical effort is considered sedentary. These aspects have been causing problems of growth and motor development of children. The aim of this study was to associate static and dynamic balance with nutritional status of children in preschool age. Methods The sample consisted of 201 preschool age children (mean age of 3.95 months) enrolled at the Childhood Education Center and public schools of the city of Cascavel – Paraná. For BMI assess, was used the formula: height divided by squared weight. The Age Classification of Center for Disease Control and Prevention was used as reference for data comparison (CDC-NCHS, 2000). To verify neurofunctional development, the Neurological Exam of Lefèvre (1972) was performed, specifi-

cally for static and dynamic balance. The study was accepted by the Ethics Committee of Assis Gurgacz Faculty, nº 112/2011. The statistical analyses were processed by SPSS, version 15.0 for descriptive statistic with percentage calculation and qui-squared test, with a level of significance of 5%. Results No significant difference was found between the balance proportions when compared with BMI groups. The best index of adequacy was verified at tests of static and dynamic balance for children with a proper classification of BMI, and the worst results were found for those who were with percentile above 85, which already requires care. 34% presented inadequacy at tests of static balance (18% female, 16% male), 43% inadequacy at tests of dynamic balance (16% female, 27% male). 16% of children are obese (5.5% female, 11% male). Discussion High levels of body mass are observed, which harms a good motor development, also of balance, although not significant statistically, but should be an expressive factor to settle in long-term. References Lefèvre AB.(1972) Exame Neurológico Evolutivo do pré-escolar normal de 3 a 4 anos. Primeira edição. Série Monografias Pediátricas. São Paulo, Sarvier.

### **NUTRITIONAL STATUS OF CHILDREN FROM CHILDHOOD EDUCATION CENTER OF THE CITY OF CASCAVEL-PARANÁ**

Dorst, D.G.B.1, Barbeta, C.J.1, Dorst, L.M.2, Roman, E.P.1, Barbeta, V.J.1, Barros Filho, A.A.3

1: FAG(Cascavel, Brasil) e UNICAMP (Campinas, Brasil), 2: FAG (Cascavel, Brasil) e Secretaria de Estado do Esporte (Curitiba, Brasil), 3: UNICAMP (Campinas, Brasil).

Introduction The rhythm of nutritional transition at developing countries is a much debated issue, which many study shows very rapid changes from innutrition to obesity between children and adolescents, while others studies shows an evident coexistence of innutrition and obesity (Clemente, 2011). The aim of this study was to verify the nutritional status of children enrolled at Childhood Education Center of the city of Cascavel-Paraná. Methods The sample consisted of 209 children (102 females and 107 males) from 24 Educational Centers, with age from 3 to 5 years. The age classification from the Center for Disease Control and Prevention CDC-NCHS, 2000) established the proper BMI for children between ages of 2 to 20 years. Results 90% of children presented ideal weight, 6% requires care and 3% weighting a little less than ideal. 75% optimum height, 11% requires care, 6% demands attention and 7% above the height. Weight was appropriate for both sexes (68%), 18% with overweight risk, 11% with underweight risk and 3% with underweight. According to the BMI percentile classification, from females, 1% of underweight, 4% of underweight risk, 67% normal, 17% overweight and 11% obese. For males, 6% underweight, 11% underweight risk, 55% normal, 7% overweight and 21% obese. Discussion The majority sample was within the normal range. Significant Index was of 17% of children that presented overweight risk to height and 11% with obesity, for female, and for male 7% with overweight and 21% with obesity. Reinforcing data found at Foschini study, Campos (2010) with 38.37% of overweight. The obesity prevalence was 15.78%. These data shows a trend to obesity in Brazilian children, requiring an urgent attitude from the public health. References Campos JADB, Foschini ALR. (2010) Indicadores Antropométricos do Estado Nutricional de Pré – Escolares em Araraquara – SP. Alim. Nutr. Araraquara ISSN 0103-4235 v. 21, n. 3, p. 349-355, jul./set. 2010. Disponível em: <http://200.145.71.150/seer/index.php/alimentos/article/viewFile/1103/1103>. Acessado em 12 de setemb.. Clemente APG, Santos CDL, Martins VJB, Silva AAB, Albuquerque MP, Sawaya AL. (2011). A baixa estatura leve está associada a índices mais elevados de gordura corporal: estudo de uma população de baixa renda. J. Pediatr. (Rio J). Porto Alegre, v. 87, n. 2, Apr.

### **EFFECTS OF A PRE-PERFORMANCE ROUTINE ON BASKETBALL FREE-THROW TRAINING IN A COLLEGE PHYSICAL EDUCATION CLASS**

Nagata, N.

*Keio University*

Introduction Pre-performance routine (PPR) is a cognitive and behavioral strategy used to obtain the optimal state relative to the performance of successful tasks. Previous research reveals that, for non-experts attending college golf classes for 8 weeks (3 times a week; 24 sessions in total), skills training with a PPR improved the objective assessment (Crews & Boutcher, 1996). The purpose of this study was to examine whether the PPR on basketball free-throw training in a college physical education class can improve performance in a shorter period than that arrived at in Crews and Boutcher's research. Method The participants in this study were 19 undergraduate students enrolling in two college basketball classes (class A = 12, class B = 7). The classes comprised 14weeks (held once a week; 14 sessions in total). In the first session, 20 foul shots were performed as a pretest after obtaining the participants' informed consent. In the second session, the participants enrolled in class A were given an explanation about the PPR, and each participant established a consistency behavior as a PPR executed prior to each shot. Next, they performed 20 free throws as an instruction test. The participants enrolled in class A performed the instruction test along with the PPR. In contrast, the participants enrolled in class B performed the instruction test with no PPR. From the third to twelfth sessions, each participant was given a free-throw training for 5 minutes. In the thirteenth and fourteenth sessions, the participants performed 20 shots each as a post-training test; the higher result from the two post-training sessions was taken as the posttest score. The results of the pretest, instruction test, and posttest in each class were compared using a Friedman test. Result The mean and standard deviation of successful shots in class A in each test were pretest:  $7.75 \pm 3.52$ , instruction test:  $7.67 \pm 3.87$ , and posttest:  $10.33 \pm 2.84$ . On the other hand, the corresponding results in class B were pretest :  $6.29 \pm 3.68$ , instruction test:  $6.43 \pm 5.06$ , and posttest:  $9.00 \pm 4.51$ . The Friedman test revealed that there was a significant difference in the performance of class A ( $p < .05$ ). A post-hoc analysis indicated that the result of the posttest was higher than that in the instruction test ( $p < .05$ ). Discussion The results of this study show that including PPR in skill training increases the number of successful shots performed in spite of fewer sessions. Cohn (1990) suggests that PPR is utilized for establishing and selecting motor parameters on the basis of the schema theory; this suggestion was also included in the participant interviews in this study. Therefore, it is assumed that including PPR in skill training would be useful in the efficient learning of skills. References Cohn, P. J. (1990) Preperformance routine in sport: Theoretical support and practical application. *The Sport Psychologist*, 4, 301–312. Crews, D. J., & Boutcher, S. H. (1986) Effects of structured preshot behaviors on beginning golf performance. *Perceptual and Motor Skills*, 62, 291–294.

### **A NEW APPROACH TO DECISION-MAKING ABILITY INTRODUCING A NEW CONCEPT "KAN" AS THE DECISION-MAKING ABILITY**

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*Numazu College of Technology*

In ball games, it is important that the player always grasps the constantly changing game situations and copes with each situation by optimal actions. Such ability is called the decision-making ability. Although a large number of studies have been made on the decision-making ability in a field of sports psychology, the results of those researches do not function effectively in practice (Akira, N., 1985; Hiroshi,

A., 2012). Therefore the aims of this study are to critically examine the previous researches on decision-making, clarify the problem of such researches, and show the validity of a new concept "KAN" for the decision-making ability. Through a comparative examination, the central issue in the previous researches was made clear. This issue was to break up the decision-making ability into the tactical thinking ability (to analyze a game situation and to select a play) and the execution ability in a play. In this case (to consider a play selection to the exclusion of a play execution), the best play in each game situation becomes the standard for the selection. For that reason, if a player does not select the best play, it is a wrong selection. However, the optimal play selection in each game situation should be different depending on the player's skill (the execution ability in a play). In short, the optimal play in a game situation must be considered based on the player's execution ability. As opposed to the above-mentioned approach, the term "Kan" can be defined as the unified ability to select the optimal play (action) in a game situation and execute this play (action) (Akitomo, K., 2005). "Kan" is the concept which is considered from a player's standpoint. In this concept "Kan", the relationship between the tactical thinking ability and the execution ability in a play is considered to be like the two sides of the same coin. For that reason, the player can select only the action (play) in accord with his execution ability. This idea has an important meaning from a decision-making training point of view, because it should be possible to set a criterion for the decision-making ability by way of the execution ability, and to train the decision-making ability along with the training of the execution ability. It follows from what has been said that introducing a new concept "Kan" will produce a new course of action on decision-making studies in the future. References Akira, N. (1985). *Japan Journal of Physical Education*, 30-2, 105-115. Hiroshi, A. (2012). *Japan Journal of Sports Movement and Behaviour*, 25.17-28. Akitomo, K. (2005). *Sintaichi no Keisei [GE]*, 24-31. Meiwa Shuppan. Tokyo

## 14:00 - 15:00

### Mini-Orals

#### PP-SH06 Physical Education and Pedagogics [PP] 4

##### IMPORTANCE AND USE OF NEW TECHNOLOGIES BY GENDER AND AGE FOR TEACHERS THAT WORK IN EXTRACURRICULAR SPORTS ACTIVITIES

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**Introduction** Today, the new technologies take a very important role in the field of physical activity and sport in general and more specifically in the educational system. (Cabero et al, 2000). The aim of this study is to analyze the importance of extracurricular sports activities teachers attributed to the new technologies, and to know they use the new technologies by gender and age. **Methods** The quantitative methodology consisted of a cross-sectional survey. Cluster sampling was used. The final sample size was 188 teachers that work in extracurricular sports activities in schools in Spain. Data was collected through structured questionnaires with face-to-face interview. All the statistical analyses were done using the SPSS/Windows 19.0 statistical software. The inferential analysis with Cronbach's was .802. Signification levels were set at  $p < 0.05$ . **Results** The 53.28% of men considered very important to apply new technologies recognizing 45.2% use new technologies frequently. With respect to women, a 52.94% considered very important to apply and 37.25% use them frequently. By age 30, 45.24% considered very important to apply new technologies, between 30 and 44 years, 89.58% and from 45, 64.28%. Finally, comparing the old with the frequency of use, 38.89% use technology resources and internet very often up to 30 years, 56.25% between 30 and 44 years and 42.86% of those older than 45 years recognizes to use rarely or never. **Discussion** Men considered more important to apply new technologies than women and recognize use them more often. Between 30 and 44 years when greater importance attributed to new technologies coincide also when they use more. Recent studies have examined gender differences in a variety of contexts, including the internet use and these studies have revealed interesting differences in how men and women perceive the new technologies (Ilie, Van Slyke, Green & Lou, 2005). **References** Cabero, J., Salinas, J., Duarte, A.M., Domingo, J. (2000). *Nuevas tecnologías aplicadas a la educación*. Madrid: Síntesis. Ilie, V., Van Slyke, C., Green, G., Lou, H. (2005). *Gender Differences in Perceptions and Use of communication Technologies: A Diffusion of Innovation Approach*. *Information Resources Management Journal*, 18(3), 13-31. The research reported is a part of the Fundamental Research Project I+D+i DEP2009-12 828 funded by Ministry of Science and Innovation.

##### A PROGRAM FOR RESOLVING STUDENT DILEMMAS IN UNIVERSITY PHYSICAL EDUCATION CLASSES

Yuko, T.

*Keio University*

**Introduction** This study develops and verifies new life skill acquisition programs for high-level life skill students (high-skill group) in university physical education (P.E.) classes. Unlike middle- and low-skill groups, the high-skill group can apply pre-acquired life skills to P.E. class activities, thereby not acquiring new life skills in classes (Tokairin, 2012). Prior to beginning this study we assigned high-skill group students sport leadership roles within classes and gave them roles in leading others outside classes using online notes. The high-skill group's leadership facilitated communication throughout the class, and we found that high-skill group students acquired new life skills. **Methods** This study utilized 192 first-years in eight P.E. classes (104 male, 88 female) at private universities in Kanagawa prefecture. To monitor life skill level transition through classes we conducted surveys before and after the program. The interposition program involved group or class leadership through active communication with others using online notes. We used thirty items in the five subscales from 5 Life Skills Inventory. **Results** Using K-means clustering we categorized three groups: the high-skill group (intervention n31 / control n24), the low-skill group (intervention n20 / control n14), and the middle-skill group (intervention n50 / control n53). We reviewed the life skill level transition through P.E. classes by variance analysis using three factors: program (online notes intervention group / control group) x skill levels (high / middle / low) x timing (before / after). We confirmed secondary interactions at timing x program x skill level ( $F(1,181)=7.661$ ,  $p < .01$ ) in "choosing." In the "choosing" acquisition level before and after physical activities we confirmed a significant difference in the average of the high-skill group's intervention sub-group (25.16 → 27.26,  $p < .001$ ). **Discussion** In P.E. classes students have different skill levels and dilemmas occur between the high-skill group who are good at sports and the low-skill group who are not. For low-level students, it is rational to choose uncooperative behavior as a consequence of their strong feelings of inadequacy toward physical activity and interaction with others, and they cannot share the same goals with others at the beginning of the class. Additionally,

a dilemma can arise for the high-skill group when over-consideration of the low-skill group prevents them from fully performing. There is a class program for the low-skill group who are not good at physical activity to resolve these dilemmas, but there is no effective program for the high-skill group. In this study we discuss an effective program for the high-skill group based on the above issues. References Tokairin Yuko, 2012. "Influence of University Physical Education Classes on Students' Acquisition of Life Skills - Focusing on Students' Original Skill Level at The Beginning of the Course ". Keio SFC Journal 89-108.

### OPEN UNIVERSITY OF BRAZIL, DOES NECESSITY OVERCOME QUALITY?

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*Universidade de Brasília e Universidade Federal do Rio Grande do Norte*

In Brazil, there are teachers working with Physical Education and other subjects without having a college degree. In 2005, the Open University of Brazil (Universidade Aberta do Brasil, UAB) was established, with many distance degree courses, in order to supply needs in cities where there are not qualified professionals, colleges or universities in their vicinity. The Physical Education College in the University of Brasília (FEF/UnB) has joined his experience and, in July 2007, it released a selection process for the distance physical education degree course, through the Pro-College Degree (only public system teachers who do not have graduation degree) and UAB (open to the general public). In the end of 2011, the course already had more than 500 frequent students in the North, Northeast, Midwest and Southeast areas of Brazil; and in January 2013, 200 new vacancies were opened for the referred course, beyond 1385 places for 6 other degree courses and 1 specialization course. Most students in the Physical Education course are teachers already, and they comply with a hard working journey, which – consequently – may cause doctent evasion and low performance during the course by students. EAD (Distance Education) researchers and workers are continuously trying to reduce these issues, however – and beyond – it is necessary for the workers' study and qualification, who deal with this category of teaching, to be better prized by public managers, making official the profession and the remuneration for the EAD professionals. Unquestionably, it will promote a good and significant reflection for the quality of basic and superior teaching of Physical Education in Brazil. References Fernandes, M. L. B. *Trajetória das Licenciaturas da UnB. EaD em Foco*. Editora UnB. Brasília, 2012. Universidade Aberta do Brasil - UAB. Available: . Access: February 2013. Available www.uab.unb.br

### THE EDUCATIONAL PHILOSOPHIES OF PRE-SERVICE AND IN-SERVICE PHYSICAL EDUCATION TEACHERS

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Introduction The development of a philosophy can aid a physical education teacher in dealing with various professional issues encountered. Employers often request that a teacher candidate present their professional philosophy of teaching. Therefore, physical education pedagogy professionals suggest that a philosophy be developed during one's educational preparation and modified based on knowledge and experience (Wuest & Bucher, 2009). The purpose of the present study was to analyze the educational philosophies of pre-service and in-service physical educators. Methods Current beliefs of physical educators toward five modern, educational philosophies as they were applied to physical education were investigated. A survey was constructed to identify educational philosophies of physical educators. The Inventory of Physical Education Philosophies Survey consisted of 30 close-ended statements, which required the participant to respond on a five-point Likert scale, ranging from Strongly Agree (5) to Strongly Disagree (1). Scores were added in order to have a final score of agreement toward each philosophy. A 6 was the lowest score possible and 30 was the highest score possible. A total scores of 23 or more showed strong agreement with a particular philosophy and total scores of 15 or less demonstrated strong disagreement with a particular philosophy. Seventy participants (35 pre-service and 35 in-service) completed the survey. Results Measures were evaluated on the total mean scores of each philosophical category between groups. Progressivism was found to be the category with the highest mean scores of agreement for both groups followed by social reconstructivism, existentialism, essentialism, and perennialism. Significant differences were found between the in-service and pre-service groups for the philosophies of perennialism, social reconstructivism, and existentialism ( $p < .05$ ). Discussion Findings of the study indicated that pre-service teachers' tend to move toward more progressive philosophical positions that support the findings by Ryan (2007). A high prevalence of student-centered philosophies implies that physical educators place a great deal of responsibility for learning on the students. Such findings may be a result of the promotion of democratic classrooms. Results further suggest that pre-service physical educators support student-centered philosophies to higher levels of agreement compared to in-service physical educators. References Ryan, T. G. (2007). The identification of pre-service teachers' philosophical orientation. *New Zealand Journal of Teachers' Work*, 4(1), 39-47. Wuest, D. A. & Bucher, C. A. (2009). *Foundations of Physical Education, Exercise Science, and Sport Studies* (16th. ed.). New York, NY: The McGraw-Hill Companies, Inc.

### PRE-SERVICE TEACHERS' PERCEPTIONS OF TEACHER EDUCATION PROGRAMS AND CONTRIBUTIONS FOR THEIR PROFESSIONAL LIFE

Sousa, T., Cunha, M., Batista, P.

*Faculty of Sport*

Introduction Teaching education should give practical and theoretical tools to assist students making the transition from academic education to professional training (Azevedo, Pereira & Sá, 2011). Usually, the practicum, in the context of initial training, seems to be a process that implies a conflict between what the pre-service teachers have and what they need to face the reality of the school context. In this way, a better understanding of this process can contribute to improve and renew the initial training programs. This study is the first step (an exploratory one) of a questionnaire validation to Portuguese language about student teachers' perceptions concerning teacher education and its contribution for their professional life. Methods Seventy two pre-service teachers participated in the study (39 women's) with a range age between 22 to 38 years old ( $24,18 \pm 0,37$ ). A preliminary Portuguese version of the questionnaire developed by Ezer, Gilat, and Sagee (2010) was used to collect data. The instrument contains five components: i) agents of training; ii) components of teacher training; iii) roles of teachers; iv) motivation for teaching; and v) conceptions of the teaching and learning process. A rank system of 1 to 7 was used in two leading components and a six point Lickert scale in the following sections. In data analysis descriptive statistics (mean and standard deviation) and Independent-Samples T-Test were used. Results and discussion The student-teachers ( $n=66$ ) mostly valued the cooperative teacher ( $2,80 \pm 2,23$ ) and the specific didactic teachers ( $3,50 \pm 1,89$ ). They also rate the teaching experience ( $2,39 \pm 1,96$ ) and the didactic classes ( $2,85 \pm 1,53$ ) as the most significant components of training. Concerning to teacher role they consider that is more relevant to develop the students' unique personal abilities ( $3,00 \pm 1,93$ ). Results also showed that the students-teachers are more extrinsi-

cally motivated for teaching ( $3,95\pm 0,79$ ) and to traditional conceptions ( $4,52\pm 0,68$ ) about the teaching-learning process contrasting, therefore with Ezer, Gilat and Sage's (2010) findings which highlighted more intrinsically motivations and constructivist conceptions about teaching and learning. On the other hand, the same ranking was found concerning to the components of teacher training. In this case the elements more valued for both in teaching experience were the cooperating teacher and the teachers from didactics. Acknowledgements This study is part of a project funded by University of Porto, multidisciplinary projects with the following reference: PP\_UJUP2011 69

### **VALIDATION OF A QUESTIONNAIRE TO ASSESS TEACHER SUPPORT OF POSITIVE BEHAVIORS IN PHYSICAL EDUCATION**

Sánchez-Oliva, D., Leo, F.M., Amado, D., Chamorro, J.M., García-Calvo, T.

*UNIVERSITY OF EXTREMADURA*

**Introduction** Education has been one of the main center of attention for public administrations, trying to reach the integration of the new generations in the society as the principal aim. Thus, there are numerous authors who emphasize physical education context as an ideal frame to personal and social development in adolescents, where physical education teacher is considered as a fundamental key in the positive development of adolescents (Armour et al., 2012). **Methods** Participants included 357 Spanish teachers (231 males and 126 females) aged 28 to 61 years (Mage = 39.41 years; SD = 8.61), and an average experience of 15.3 years. To carry out the aim of the study, an adapted version of the Questionnaire of Positive Behaviors in Physical Education (CCPEF: Sánchez-Oliva et al., in press) was used, adapting either the introduction sentence and the items included in that questionnaire. **Confirmatory factor analyses (CFA)** were also conducted on the study to test the psychometric properties with maximum likelihood estimation, including 18 questionnaire items as indicators and 5 factors as latent variables. Results Results analysis emphasized a structure formed by 18 items, grouped in five factors: Respect for rules and materials Support, Respect to others Support, Self-Control Support, Assessment of effort Support and Cooperation Support. The model fit indexes from the CFA were:  $\chi^2/df = 6.81$ ; CFI = .95; TLI = .94; SRMR = .05 and RMSEA = .06. The regression weights between items and latent variables ranged from .63 to .78. Moreover, self-report measures showed acceptable levels of reliability ( $\alpha > .70$ ). **Discussion** The current study provides an instrument that let examine teacher support about the development of positive behaviors in physical education pupils. Results are consistent with those found by Sánchez-Oliva et al. (in press), emphasizing a questionnaire with a structure formed by 18 items and 5 first order factors, which let assess to what extent teacher promotes personal (Self-Control and Assessment of effort) or social (Respect for rules and materials, Respect to others and Cooperation) adaptive behaviors. **References** Armour, K., Sandford, R., & Duncombe, R. (2012). Positive youth development and physical activity/sport interventions: mechanisms leading to sustained impact. *Physical Education and Sport Pedagogy*, 1–26. Sánchez-Oliva, D., Sánchez-Miguel, P. A., Leo, F. M., Amado, D., & García-Calvo, T. (in press). Desarrollo y validación de un cuestionario para analizar la percepción de comportamientos positivos en las clases de educación física [Development and validation of a questionnaire to examine perception of positive behaviors in physical education classes]. *Cultura y Educación*.

### **TO BE A TEACHER: THE ANTICIPATORY SOCIALIZATION IN PROFESSIONAL DECISION**

Queirós, P., Batista, P., Gomes, P.

*University of Porto / Faculty of Sport*

**Introduction** The practice is a central element in the process of teacher's socialization, but the way of life of each individual is also plays an important role in how they achieve his profession (Flores & Day, 2006). Regarding this evidences it is important to examine how the anticipatory socialization influences student's decision to come to an undergraduate program of Teacher Education. **Methods** For data collection, semi-structured biographic interviews were conducted with 10 student teachers that are in the first year of Teacher Education program, at the Faculty of Sport, University of Porto. The statements were audio recorded and transcribed verbatim. The transcriptions were submitted to a content analysis using the Nvivo10. This paper only focused the content about their motivations for coming to an undergraduate program of Teacher Education, in particular the socialization agents. **Results and discussion** Through the speeches of the participants were identified several socializing factors. These include experiences in PE classes and in sport practices out of the school (Curtner-Smith, 1999), success in sport (Evans et al. 1995) and interactions with PE teachers (Mawer, 1996). Specifically we can state that: i) Physical Education (PE) teachers emerged as the main socialization agent. Their exigency, motivation, knowledge, proximity, companionship and confidence are characteristics identified by the participants, awakening them the desire to be, in the future, PE teachers; ii) family seems to adversely affect this choice, feeding a duality between satisfactory professional achievement and the largest number of professional outlets; iii) PE classes and sports practice left significant marks in participants, and they usually tend to identify themselves with the main stakeholders (teachers and coaches). The feeling of satisfaction and skilful in the practice where they obtained recognition; iv) individual reflection, provided by some specific situations, revealed a crucial element in the decision process (worked like a booster). The history of the subject emerged as the stronger factor that influence how each student becomes a teacher. **Acknowledgements** This study is part of a funded project-Foundation for Science and Technology (FCT) with the following reference: PTDC/DES/115922/2009. **References** Curtner-Smith, M. D. (1999). The more things change the more they stay the same: factors influencing teachers' interpretations and delivery of National Curriculum Physical Education. *Sport, Education and Society*, 4 (1), 75-97. Evans, J., Davies, B. and Penney, D. (1995). Pedagogy, identity and difference in physical education. Paper presented at the European Educational Research Association Annual Conference, Bath, September. Flores, A. & Day, C. (2006). Contexts which shape and reshape new teachers' identities. A multiperspective study. *Teaching and Teacher Education*, 22, 219-232. Mawer, M. (1996). *Mentoring in physical education: issues and insights*. London: Longman.

### **INCIDENCE OF THE EXPERIENCE AND ECONOMIC REMUNERATION ABOUT THE TYPE OF MOTIVATION IN COACHES IN SCHOLAR SPORT**

Pulido, J., Sanchez-Oliva, D., Leo, F.M., Gonzalez-Ponce, I., Sanchez-Miguel, P.A.

*UNIVERSIDAD DE EXTREMADURA*

**Introduction** In the sport context, there are numerous significant that spend their time on make the physical activity practice possible in scholar age. The coach, who is considered an important key in the integral teaching of children and adolescents who practice any affiliate sport (Jowett and Cokerill, 2003). Thus, this significant become a direct agent of socializing influences. Therefore, the main aim of the study is focused on the analysis of motivations which deals with a sport coach, as well as examines the influence of the experience and

economic remuneration of themselves. Methods Participated, a total amount of 154 voluntary coaches, 124 male and 30 female trainers (M = 32,4 years; SD = 6,51). To select the motives that coaches indicate to carry out their function, the adaptation into sport of the Work Motivation Inventory (WMI: Blais et al., 1993) was used. This instrument is composed by six types of motivational regulations: intrinsic, integrated, identified, introjected, external and amotivated. Moreover, an open question was used to measure the experience: "How many years are you working as a coach?". After analyzed the median of every sample, two different groups of coaches were selected regarding experience: coaches with experience (six years or more than six years of experience; n = 82) and coaches without experience (less than six years of experience; n = 72). The economic remuneration was assessed by a dichotomy question: Do you receive any economy incentive to train?" with two possible answers, "YES" (n = 46) or "NO" (n = 108). Results Coaches who received any economy incentive to train had significant higher scores in every reason to train (intrinsic, integrated, identified, introjected and external) than those coaches who did not receive any incentive, with the exception of amotivation. Furthermore, taking into account the experience as independent variable, there was not found any significant differences in the motivational regulations. Discussion Respecting the obtained results and taking into account the main aim of the study, motivational regulations showed significant differences with regard to a remunerated coach or a non remunerated coach, not only in those motivations referring to something external to the activity, such as introjected or external, but also those more self-determined regulations, such as intrinsic, integrated and identified. Therefore, coaches' motives to train will be influenced by the economy incentive, being crucial to show high self-determination levels. On the other side, there were not significant differences with respect to motivations because coaches' level of experience was considered. A coach with or without experience will not be difference in his/her impetus to develop the trainings. References Blais, R. et al., (1993). L'inventaire des motivations au travail. *Reveu québécoise de psychologic*, 14(3), 21-23. Jowett, S. and Cockerill, I.M. (2003). Olympic medalists' perspective of the athlete-coach relationship. *Psychology of Sport and Exercise*, 4, 313-331.

### STATUS PROFESSIONAL OF TEACHERS THAT WORK IN EXTRACURRICULAR SPORTS ACTIVITIES IN SCHOOLS IN SPAIN: PERMANENT TRAINING BY AGE

González-Rivera, M.D.1, Campos-Izquierdo, A.2

1: *University of Alcalá (Alcalá de Henares, Spain)*, 2: *Technical University of Madrid (Madrid, Spain)*

Introduction The permanent training of teachers is essential to be able to adapt to all situations and deal successfully working. Therefore, the aim of this study is to explore the permanent training according age of teachers that work in extracurricular sports activities in schools in Spain. Methods The quantitative methodology consisted of a cross-sectional survey. Cluster sampling was used. The final sample size was 188 teachers that work in extracurricular sports activities in schools in Spain. Data was collected through structured questionnaires with face-to-face interview. All the statistical analyses were done using the SPSS/Windows 19.0 statistical software. The inferential analysis with Cronbach's was .802. Signification levels were set at  $p < 0.05$ . Results The study shows very low percentages of training of teachers of extracurricular sports activities in schools in Spain in the last four years (less than 32%). The main training activity that these teachers do is attending courses (31.9%), followed by 23,9% attending seminars, 10.6% attending congresses, 4.3% doing postgraduate or master's degrees, and only 2.1% carried working groups. By age 30, 25.2% of teachers attend courses, 25.2% seminars, 2.8% congresses, 0.3% do postgraduate courses and 1% do working groups. Between 30 and 44 years, 8.1% attend courses, 14.4% seminars, 1% congresses and working groups and do no postgraduate courses. Teachers older than 45 years, 2.4% attend courses, 3.6% seminars, 0.2% congresses and do no postgraduate courses and working groups. Discussion Data obtained shows lower percentages, in all age groups, than data obtained in studies of Campos-Izquierdo (2007) and González-Rivera (2008) in different regions of Spain, Valencia and Madrid, respectively. Younger teachers do more permanent training, data that differ from the two previously mentioned studies. References Campos-Izquierdo, A. (2005). Situación profesional de las personas que trabajan en funciones de actividad física y deporte en la Comunidad Autónoma Valenciana (2004). doctoral thesis. University of Valencia. Valencia. González-Rivera, MD. (2008). El deporte escolar en la comunidad autónoma de Madrid: intervención didáctica y recursos humanos en las actividades físico-deportivas extraescolares en los centros educativos. doctoral thesis. University of Valencia. Valencia. The research reported is a part of the Research Project I+D+i DEP2009-12828 which has been funded by the Ministry of Science and Innovation (Spain).

### STATUS LABOUR OF TEACHERS THAT WORK IN EXTRACURRICULAR SPORTS ACTIVITIES IN SCHOOLS IN SPAIN

Campos, A.1, González, M.D.2

1: *Technical University of Madrid (Madrid, Spain)*, 2: *Alcalá University (Madrid, Spain)*

Introduction The importance of professionals that develop physical activity and sport is essential for safe and effective implementation and to ensure the benefits of physical activity (Campos, 2010). The employment status of teachers that work in extracurricular sports activities is important practice healthy physical sports of young (González & Campos, 2010). The objective is study of status labour (contracts, salary and entities) of teachers of extracurricular sport activities in the Schools in Spain. Methods The quantitative methodology consisted of a cross-sectional survey. Cluster sampling was used. The final sample size was 188 teachers of extracurricular sport activities in Schools in Spain. Data was collected through structured questionnaires with face-to-face interview between January and November 2011. All the statistical analyses were done using the SPSS/Windows 19.0 statistical software. The inferential analysis with Cronbach's was .802. Results The results of the labour relations o teachers of extracurricular sport activities in Schools in Spain reveals that the 60,3% of labour relations have no contract whatsoever and 2,1% of labour relations are of self-employment type. The type of contract of teachers of extracurricular sport activities is mainly of permanent contracts (51,9%) and temporary contract are 48,1%. Most of the contracts of these teachers are part-time contracts (55,1%), while full-time contracts are 44,9%. According to hours worked, earnings are highly diversified, 54,6% the teachers earn less than 300 euros a month, 25,7% between 300 and 1000 euros, 17,6% between 100,01 and 2000 euros and 2,1% earn more than 2000 euros a month. The entities for which those teachers we obtain that these are different. Among these entities, private entities are the majority as they are 82,3% and public entities are 17,7%. Discussion Most teachers of extracurricular sport activities in Schools in Spain don't have a contract and earn less than 300 euros a month. Also the teachers with contracts have permanent contracts and are part-time. In this job there are higher situations of precarious employment (Campos, 2010). It is therefore necessary to improve the employment status of teachers of extracurricular sport activities but to ensure the benefits of physical activity and practice healthy physical sports. References Campos A. (2010). Dirección de recursos humanos en las organizaciones de la actividad física y del deporte. Síntesis, Madrid. González, M.D. & Campos, A. (2010). Teacher s Methodology of the Schooler School According to his Initial Qualificatio. *Journal of Psychodidactics*, 15(1), 101-120. The research reported is a part of the Research Project I+D+i DEP2009-12828 which has been funded by the Ministry of Science and Innovation (Spain).

## STUDENTS' PERCEPTION OF THE NEW PHYSICAL ACTIVITY AND SPORT SCIENCES DEGREE IN SPAIN

Coterón, J., Franco, E., Gil, J.

*Universidad Politécnica de Madrid*

**Introduction** The implementation of the European Higher Education Area (EHEA) in Spain has not been a controversy free process. It's required monitoring and evaluation to know its strengths and weaknesses in order to do the change process successfully. The aim of this study was to analyze how undergraduate students of Physical Activity and Sport Sciences perceive the implementation of the new system. **Methods** A validated questionnaire (Coterón & Franco, 2012) was administered to 478 Physical Activity and Sport science students in order to know their opinion about new studies' quality respect to 4 areas: general aspects (GA), academic organization (AO), teaching (T) and Bologna Process (B). A multiple linear regression was performed (backwards method) for rejecting low significance variables and determining which school organization variables (GA, AO and B) influence students' perception about B. Significant level was set at .05 **Results** Descriptive statistics were: GA (M=3.77, DT=.72), AO (M=3.34, DT=.68), T (M=3.18, DT=.61), B (M=2.22, DT=1.02). Variable T was significant ( $t = 5.62, p < 0.001$ ) in predicting the perception of B explaining 27% of the variance. Variables GA ( $t = 0.64, p > 0.05$ ) and AO ( $t = 1.23, p > 0.05$ ) were excluded from the model as not being significant. **Discussion** This study shows how methodology is considered the main strength on the Bologna process perception. According to existing literature students perceive participatory methods, one of the main basis of the new plan, as positive for their learning (Montaño & Palou, 2008; Ruiz & Oliveros, 2006; Sáez, 2000). Descriptive statistics analysis show a high satisfaction level with the new Degree, higher than found in a similar study among students of bachelor's previous plan (Coterón et al., 2012). However, there's a low overall assessment respect the Bologna process mainly due to the late start in Spain and the lack of information received (Castaño et al., 2007). The results of this study suggest, according to the findings the literature, the need to implement better information systems. **References** Castaño, E., Benito, A., Portela, A., Rodríguez, R. M. (2007). *Revista Complutense de Educación*, 18(1), 199-216. Coterón, J., Franco, E., Gil, J. (2012). *Revista Complutense de Educación*, 23(3), 191-206. Méndez, R. (2008). *Educatio Siglo XXI*, 26, 197 - 224. Montaño, J. J., Palou, M. (2008). *Revista Electrónica Investigació Innovació Educativa i Socioeducativa*, 1(0), 24-46. Ruiz, C., Oliveros, L. (2006). *Revista Complutense de Educación*, 17(1), 29-48. Sáez, F. J. (2000). *Revista de Investigación Educativa*, 18(1), 157-182.

## PHYSICAL EDUCATION TEACHER'S TRAINING: UNIFYING BACHELOR AND DEGREE

Molina Neto, V., Branco Fraga, A., Kreuzburg Molina, R.

*Universidade Federal do Rio Grande do Sul*

**Introduction** In Brazil, the training of physical education teachers (EFI) is organized in two ways: Bachelor of EFI to work in non-school and Degree in EFI to work in school settings. This model is the subject of intense academic debate, whose harshest criticism come from the students and some professors who regard the epistemological basis of initial training in EFI is the same for both types of training. This paper discusses the process of curriculum in the School of Physical Education (ESEF) Federal University of Rio Grande do Sul (UFRGS), Brazil, which includes the formation of the two modalities in a single platform professional curriculum. The question is: how to organize a curriculum that ensures a unified initial training, qualified and ensuring the right to work of graduates in teaching spaces, where the EFI/Sport Science gains visibility, while maintaining the integrity of the epistemological basis and incorporating scientific and technological innovations? **Method** From 2010 to 2012, the organization of the curriculum involved two contexts, the formulation and another of the action (Ball, 1989). We used to collect information from discussion groups: mixed groups (teachers and students), specific groups, sometimes with teachers, students and sometimes with groups of subareas of knowledge. These groups worked on two lines of action: reinterpretation of legal issues and reorganization of cores knowledge curriculum, which are: a) Fundamentals of School Education; b) Sociocultural Studies; c) Development and Learning; d) Practice Body systematized; e) Fundamentals Biodynamic; f) Training oriented Physical Education; g) Training Oriented Recreation and Health; h) Oriented Training for Sport and Leisure. **Results** In the context of formulating curriculum was debated theoretical assumptions, we analyze the situation and was recovered the socio-historical perspective in decision making. In the action's context, the project was sited again in the academic community context of, to define levels of the teaching programme and the human resources. It was in the context of the action that the resistance and criticism gained visibility and transfigured into organizational problems and vital to the curriculum being implemented. Resistances in the institutional (in conjunction with other academic units) in the field of knowledge (selection and organization of content); internal dynamics (community college). **Discussions** This curriculum, educational project unfinished by definition, has little more than one semester of 'life' and we can already anticipate some changes in your organization. However, something that became clear in the process is that it is not possible to do curriculum changes without continuing education policy of the protagonists involved, without the participation of students and teachers (SARASON, 2003), without to know their stories of life and knowledge. **References** BALL, S. (1989) *La la escuela micropolitica*. Madrid: Paidós. SARASON, S. *El predecible fracaso de las reformas educativas*. Barcelona: Octaedron, 2003.

## LEGISLATIVE COHERENCE IN COMBINING STUDIES WITH HIGH-LEVEL SPORT

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*Facultat de Psicologia, Ciències de l'Educació i de l'Esport Blanquerna*

**Introduction** In recent years, the regional and state governments have drawn up measures for combining studies with high-level sport. Bearing in mind the political sensitivity regarding this issue, the measures presented are not always coherent when comparing educational and sports legislation. Time management is a condition which limits two extremely demanding parallel activities. **Method** A qualitative approach with the aim of understanding the legislative coherence in combining academic training and dedication to high-level sport. **Exploratory - descriptive design** in order to examine the internal logic of current regulations regarding educational grants for athletes, and predict individual attention quota for each level of education. **Gathering information** relating to educational laws (LOE, LEC) and sports (RD 971/2007, Decree 337/2002), the data has been subjected to a double content analysis in order to compare the proposed funding and follow its coherence at different educational levels. **Results** Regulatory inconsistencies have been found such as providing better academic grants for lower-level athletes or the recognition of Physical Education always prevents them from achieving their true grade. The determining factor is time management. Documents of concurrent studies in music or dance demonstrate this. Music offers a differentiated curriculum adaptation threshold of 4h-5h and dance a threshold of 7h-15h. The list of music and dance schools that certify the hours of work are also made public, contrary to the opacity of the list of centres of attention to sport and the oversight of schools which run serious programmes that combine sport with academic life. **Discussion** It is difficult to justify the exemption of young athletes from Physical Education, regardless of average final grade. The curricular objectives of the subject are fully taken on in a voluntary commitment to the sport of 10-12 hours on average (Sola, 2010). Sports give real lessons in discipline of effort, taking care of oneself, or values

of respect when the opponent is better. At the same educational level, there is no difference between the hours spent training or geographic variables of competition (meetings, international travel ...). The lack of reference of the grants in relation to the level of time demand for different sports gives rise to ridiculous situations such as students aged just 12 and without excessive training being able to enjoy very similar grants to those offered to high school students aged 18 with double the demands of study and high amounts of training. References DECREE 337/2002, of 3rd December, regarding high-level sports performance. ORGANIC LAW 2/2006, of 3rd May, of Education. LAW 12/2009, of 10th July, of education. ROYAL DECREE 971/2007, of 13th July, regarding high level sportsmen and performance. Solà, J. (2010). Academic Rigor and Dedication to Competitive Sport in Young People 12-18 Years: Major Social Issues. *Physical Culture and Sports Studies and Research*, Vol. 1, 100-109.

### **PHYSICAL EDUCATION UNDERGRADUATE COURSE IN DISTANCE MODE OFFERED BY THE BRAZILIAN OPEN UNIVERSITY SYSTEM: EVALUATION OF THE MEDIATED COMMUNICATION IN THE VIRTUAL LEARNING ENVIRONMENT FORUMS**

Feres, A., Zambeli, M., Almeida, G.

*Brasilia University*

Introduction Teacher education in Physical Education in Brazil in distance mode began in 2007 with the establishment of the Open University of Brazil in order to institutionalize a public policy in distance learning. This research examines mediation in the Moodle Virtual Learning Environment through the forum messages posted by academic advisors and students at the Physical Education undergraduate course in distance mode at Goiás Federal University. In particular it was examined the pedagogical methodology of mediation used by teachers, especially in the disciplines of the initial training courses in Physical Education, as well as how the students dialogue and appropriate mediated knowledge, and finally address comparatively the development of these disciplines in the classroom and in distance learning. Methods A bibliographical research was conducted addressing the integration of educational technologies and the influence of behavioral theory. This research is featured as a descriptive and exploratory study that uses as empirical data the course's Political-Pedagogical Project and the forums of the following disciplines: Track and Field, Volleyball, Dance, Sport's Theory, Physical Education and Health. A protocol was developed to analyze indicators of computer mediated communication in the application of content analysis, which allowed the grouping of the messages in context units both for the messages from the academic advisors as well as from the messages posted by the students. Results Preliminary results indicate that in some disciplines (Example: Anatomy) forums are not used and has little contribution in other disciplines. Interaction and collaborative learning are more related to the tutor's level of intervention. In this sense it is important to focus on appropriate pedagogical mediation that stimulates dialogue, debates and thus strengthening interaction/interactivity and therefore collaborative learning. Discussion This research indicates that both presential and distance education are important for the learning process, for the fact that each one contributes in a collaborative way to it, being that the first one is essential for issues 'on the ground', such as movement technics, feedbacks and motivation, and the second one can be really helpful to broaden and deepen the discussion on theory, allow media to contribute to illustrate the learning topics etc. Therefore, it is understood that more research is needed to explore the potentials of the combinations of these two modes, in special in Physical Education undergraduate courses.

**14:00 - 15:00**

### **Mini-Orals**

#### **PP-SH11 Psychology [PS] 4**

### **INITIAL EXAMINATION OF THE PSYCHOMETRIC PROPERTIES OF THE MULTIDIMENSIONAL MOTIVATIONAL CLIMATE OBSERVATION SYSTEM**

Smith, N.1, Tzioumakis, Y.2, Tessier, D.3, Appleton, P.1, Quested, E.1, Duda, J.L.1

*1: University of Birmingham (UK), 2: University of Thessaly (Greece), 3: University of Grenoble, (France)*

Introduction Research examining the coach-created motivational environment from achievement goal (AGT) and self-determination (SDT) theory perspectives has relied almost exclusively on players' perceptions of the climate. Duda and Balaguer (2007) have suggested that developing objective rating systems to assess facets of the coach-created motivational environment may prove valuable in validating existing self-report measures and aid in the evaluation of coach education programs that attempt to modify the social environment. However, no single instrument is available that rates dimensions of the environment emphasised within AGT and SDT, and validated in sport contexts. As a result, the Multidimensional Motivational Climate Observation System (MMCOS) was developed to address this void in the literature. The MMCOS moves beyond previous behavioural coach observation systems by enabling an objective, theory-based interpretation of the motivational meaning of the multi-faceted climate created by the coach. The purpose of the present study is to examine the psychometric properties of the MMCOS. Method 57 grassroots-level football coaches from UK (17), France (18) and Greece (22) provided consent to be filmed and audio-recorded during a training session. 9 observers (3 England, 3 France, 3 Greece) completed the MMCOS coder-training programme. Recordings were split into four equal time-periods and coaching environments were rated on the prevalence of seven dimensions of the coach-created motivational environment (autonomy support, controlling, task-involving, ego-involving, relatedness supportive, relatedness thwarting and structure). Results Trained observers demonstrated a moderate degree of reliability when using the MMCOS. Exploratory factor analysis (EFA) supported a two-level hierarchical structure. The seven MMCOS dimensions loaded onto two factors accounting for 74.5% of the variance in the rated features of the environment. Autonomy Support (.66), Task-involving (.84), Relatedness Support (.82) and Structure (.81) loaded exclusively onto the first factor, whilst Controlling (.89) and Relatedness Thwarting (.78) loaded onto the second factor. The Ego-involving dimension cross-loaded onto both factors (.52/.43). Discussion Findings provide evidence for the reliability and structural validity of the MMCOS. Results of the EFA are aligned with theoretical predictions. An exception is with the cross-loading of ego-involving, which will be further examined in future studies. These findings have implications for sport-based researchers that choose to collect objective as well as subjective assessments of the motivational climate in sport via an AGT and SDT lens. Duda, J. L., Balaguer, I. (2007). *Social Psych in Sport*. Human Kinetics. Champaign, IL

## MOTIVATIONAL GOAL CLIMATE, AUTONOMY SUPPORT, AND MOTIVATIONAL RESPONSES ACROSS TRAINING AND COMPETITION IN INDIVIDUAL- AND TEAM SPORTS.

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*Behavioural Science Institute, Radboud University Nijmegen*

Motivational Goal Climate, Autonomy Support, and Motivational Responses across Training and Competition in Individual- and Team Sports. Pepijn van de Pol (1), Maria Kavussanu (2), Christopher Ring (2), and Michiel Kompier (1) (1)Department of Work and Organizational Psychology, Behavioural Science Institute, Radboud University Nijmegen, The Netherlands; (2)School of Sport and Exercise Sciences, University of Birmingham, Birmingham, UK. Objectives: This study had two purposes: first, to examine differences in athletes' perceptions of coach-created goal climate and autonomy support across training and competition contexts and individual- and team sports; and second, to determine whether context and sport type moderate the relationships between goal climate, autonomy support, and motivational outcomes: effort, enjoyment, anxiety, and activation skills. Method: Participants were 145 individual- and 203 team-sport athletes, who completed questionnaires measuring task-involving and ego-involving goal climate, autonomy support (interest in athlete's input and praise for autonomous behaviour), effort, enjoyment, cognitive and somatic trait anxiety, and activation skills, in training and competition. We examined our study purposes using Multilevel Modeling (MLM). Results: Perceived task and ego goal climate were higher in competition than in training; the contextual difference in ego goal climate was greater for individual- than for team-sport athletes. Interest in athlete's input and praise for autonomous behaviour did not differ across the two contexts; however, interest in athlete's input was lower in team- than in individual-sport athletes. Effort and enjoyment were associated positively with task goal climate, and praise for autonomous behaviour but only in training. Furthermore, effort was negatively related to interest in athlete's input, while enjoyment was inversely related to ego goal climate only in training. Somatic anxiety was associated positively with ego goal climate in competition, and negatively with task goal climate only in individual sports. Somatic anxiety was also positively associated with interest in athlete's input, but only in individual sports. Cognitive anxiety was unrelated to all outcomes. Activation was associated positively with praise for autonomous behaviour, and with ego goal climate but only in team sports. Finally, activation was negatively related to interest in athlete's input in both contexts. Conclusion: The results of this study indicate that athletes' perceptions of goal climate and autonomy support may differ across training and competition contexts and/or individual- and team sports, and that relationships between goal climate and autonomy support and motivational outcomes may vary depending on the context and/or sport type. Hence, the present findings highlight the importance of making the distinction between training and competition, and individual- and team sports, when examining motivational processes in sport.

## THE RELATIONSHIP BETWEEN MOTIVATION, PERFORMANCE AND AFFECT ON A SITUATIONAL LEVEL

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Introduction The purpose of this study was to test some predictions of the model forwarded by self-determination theory related literature, on a situational level. Specifically, we wanted to test the relations between the autonomous and controlled styles of self-regulation, measured before competition, and cognitive and affective outcomes measured after competition. Methods Therefore, we analysed 94 national competitions of 19 athletes (6 females and 13 males; Mage = 24.58, SD = 4.89) in several team (water polo, soccer basketball and handball) and individual (swimming, triathlon and athletics) sports. Our participants answered to single item scales based on validated questionnaires which assess behavioural regulation, self-talk and emotions. Results Our results generally revealed the expected relations among the different scales of each questionnaire. Moreover, regarding the autonomous types of self-regulation (i.e., intrinsic, integrated and identified), we found positive relations with both positive emotions (i.e., excitement and happiness; both  $r > .29$ ,  $p < .01$ ) and with most positive types of ST (specially, psych up and confidence; both  $r > .20$ ,  $p < .05$ ). Regarding the controlled types of self-regulation (i.e., introjected and extrinsic), we found a positive relation between extrinsic regulation and anger ( $r = .32$ ,  $p = .002$ ), negative relations of extrinsic regulation with both positive emotions (both  $r < -.22$ ,  $p < .05$ ), only two positive relations of extrinsic regulation with negative ST (fatigue and disengagement, both  $r > .37$ ,  $p < .001$ ), and a negative relation between extrinsic regulation and confidence ( $r = -.27$ ,  $p = .010$ ). Finally, we calculated the SDT-index and mean scores for ST and emotions and performed separate lineal regression analysis. According to our results, self-determined motivation predicted positively positive ST ( $R^2 = .07$ ,  $\beta = .28$ ,  $p = .007$ ) and positive emotions ( $R^2 = .31$ ,  $\beta = .55$ ,  $p < .001$ ), and negatively negative emotions ( $R^2 = .15$ ,  $\beta = -.39$ ,  $p < .001$ ). Discussion Consequently, the results of this study evidence the importance of autonomous self-regulation in competitive sport settings, especially for well-being and positive affect.

## EXPLORING ATHLETES' AUTOMATIC SELF INSTRUCTIONS

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Introduction In self-talk (ST) literature, some authors distinguished automatic ST and automatic self-instructions. They argue that the latter serves a clear purpose, while the former emerges from the situation. The aim of this study was to explore athletes' automatic self-instructions. Therefore, we used Latinjak's (2012) three-dimensional model of core affect which is defined by valence, arousal and time perspective and describes eight main affective states, commonly called sadness, anger, resignation, fear, relieve, elatedness, confidence and excitement. Methods Fifty-five athletes from different individual and team sports agreed to take part in this study. We asked them to remember one situation they had experienced for each affective state. For each state, we further asked them what they thought in the specific situation when they felt ... (e.g., fear), in order to improve their performance or cope with their emotions. Results Using qualitative content analysis ten categories of automatic self-instructions emerged. Firstly, four categories emerged that were similar to those found by Hatzigeorgiadis, Chroni, Theodorakis and Papaioannou (2009) on a contextual level: some statements referred to self-confidence building (I can do it), some statements referred to psyching up or motivation (Let's go!), some statements referred to positive deactivation (Calm down), and some statements referred to game-specific instructions (Pass the ball). Secondly, a group of three categories comprised statements which referred to coping with specific game circumstances: coping with adversity and negative feelings (Don't be angry), coping with success and positive feelings (Don't relax) and coping with general practice and competition (Keep going). Finally, three more categories referred to self-regulation and achievement orientation: some instructions aimed at creating task involvement (Learn this), some instructions aimed at creating ego involvement (Show them who you are) and some instructions aimed at self-regulation at an introjected level (Don't let your team down). Discussion Regarding the described categories, one should take into consid-

eration that future studies have to test the described categories against new evidence, without discarding the creation of new categories or the redefinition of the presented ones. References Latinjak, A. T. (2012). The underlying structure of emotions: A tri-dimensional model of core affect and emotion concepts for sports. *Revista Iberoamericana de Psicología del Ejercicio y el Deporte*, 7(1), 71-87. Zourbanos, N., Hatzigeorgiadis, A., Chroni, S., Theodorakis, Y., y Papaioannou, A (2009). Automatic self-talk questionnaire for sports (ASTQS): Development and preliminary validation of a measure identifying the structure of athletes' self-talk. *The Sport Psychologist*, 23, 233-251.

### THE RELATIONSHIP BETWEEN MOTIVATION AND SELF TALK

Juan Tavira, B., Ballart, P., Garcia, P., Latinjak, A.T.

*EUSES*

**INTRODUCTION** The aim of this study was to inquire into the relationship between self regulated motivation and automatic self talk (ST). Our hypothesis was that autonomic forms of self regulation would predict positive types of ST, and that controlled forms of self regulation would predict negative ST. **METHOD** One-hundred eighty-nine athletes of several team and individual sports agreed to participate in this study. They answered the Behavioral Regulation in Sport Questionnaire (BRSQ, Lonsdale, Hodge, & Rose, 2008) and the Automatic Self-Talk Questionnaire for Sports (ASTQS; Zourbanos, Hatzigeorgiadis, Chroni, Theodorakis, & Papaioannou, 2009). **RESULTS** Firstly, all scales showed adequate  $\alpha$  values for reliability ( $\alpha > .70$ ) and confirmatory factor analysis showed adequate fit for both instruments:  $\chi^2(731) = 1159.77$ ,  $p < .001$ , RMSEA = .07, CFI = .94 and TLI = .93 for the BRSQ; and  $\chi^2(731) = 1159.77$ ,  $p < .001$ , RMSEA = .06, CFI = .91 and TLI = .91 for the ASTQS. Secondly, we found positive correlations between the self determined types of regulation (i.e., intrinsic, integrated and identified; all  $p < .01$ ), and positive relations between the controlled types of regulations (i.e., introjected and extrinsic) and the amotivation (all  $p < .001$ ). Further, we found negative relations between some self determined types of regulation (i.e., intrinsic and integrated) and introjected regulation (all  $p < .05$ ), and intrinsic regulation and extrinsic and non-regulation (all  $p < .001$ ). Thirdly, we found positive relations among all positive ST scales (all  $p < .01$ ), positive relations among all negative ST scales (all  $p < .05$ ) and positive relations between some types of positive ST (i.e., instruction and anxiety control) and some types of negative ST (i.e., worry and somatic fatigue). Lastly, we calculated the SDT index and found that higher degrees of self-determined regulation are positively related to some types of positive ST (i.e., confidence and psych up; all  $p < .01$ ) and that higher degrees of controlled regulation are positively related to all types of negative ST (all  $p < .01$ ). **DISCUSSION** Overall, these results evidence the relationship between the why of sport engagement and the what of automatic thought content and, therefore, emphasize the importance of promoting self-determined types of motivation. **BIBLIOGRAPHY** Lonsdale, C., Hodge, K., y Rose, E.A. (2008). The behavioural regulation in sport questionnaire (BRSQ): Instrument development and initial validity evidence. *Journal of Sport and Exercise Psychology*, 30, 323-355. Zourbanos, N., Hatzigeorgiadis, A., Chroni, S., Theodorakis, Y., & Papaioannou, A (2009). Automatic self-talk questionnaire for sports (ASTQS): Development and preliminary validation of a measure identifying the structure of athletes' self-talk. *The Sport Psychologist*, 23, 233-251.

### EXPLORING ATHLETES' AUTOMATIC SELF-TALK

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**Introduction** In self-talk (ST) literature, two main research paradigms have been described: (a) the study of the contents and the structure of automatic ST and (b) the effects of ST interventions on performance and performance-related outcome measures (Hardy, Oliver, & Tod, 2009). The purpose of this study was to explore athletes' automatic ST on a situational level. Therefore, we a conceptual model of emotions and core affect (Latinjak, 2012) which is defined eight main affective states, commonly called sadness, anger, resignation, fear, relieve, elatedness, confidence and excitement. **Methods** Thirty-two athletes from different individual and team sports agreed to take part in this study. After introducing to our participants the conceptual framework of emotions, we asked them, for each emotion, what they thought in a specific situation when they felt ... (e.g., fear). **Results** Using qualitative content analysis a two-dimensional structure of thought content emerged: on the one hand, the athletes' ST ranged in terms of valence from positive to negative and in terms of time perspective from retrospective to anticipatory. Combining both dimensions, we found four main interactions: positive-anticipatory ST (I will win/ I want to play), positive-retrospective ST (I played well/ I was lucky), negative-anticipatory ST (I will lose/ I don't want to play), and negative -retrospective ST (I played bad/ I was unlucky). In between positive and negative were statements we denoted neutral (I will play/ the game is over). In between retrospective and anticipatory we found statements that could be considered miscellaneous in time perspective. These miscellaneous statements could further be differentiated into present-related statements (I play well/ I play bad) and contextual or global statements (I am good/ I suck). **Discussion** Generally, there can be reasonable confidence that the two dimensions proposed are exhaustive, in a sense that all human automatic ST could be located in this structure. Nevertheless, the two-dimensional structure could lack specificity or a different structure could constitute a more useful model of automatic ST. Consequently, there is space for a discussion about the number and nature of the automatic ST dimensions. References Hardy, J., Oliver, E., y Tod, D. (2009). A framework for the study and application of self-talk in sport. In S.D. Mellalieu y S. Hanton (Eds.), *Advances in applied sport psychology: A review* (pp. 37-74). London: Routledge. Latinjak, A. T. (2012). The underlying structure of emotions: A tri-dimensional model of core affect and emotion concepts for sports. *Revista Iberoamericana de Psicología del Ejercicio y el Deporte*, 7(1), 71-87.

### THE CHINESE VERSION OF SCALE FOR EFFECTIVE COMMUNICATION IN TEAM SPORTS - A CROSS-CULTURAL REVISING AND STRUCTURE RE-EXAMINATION

Liao, C., Lee, C., Huang, L.

*National Taiwan Sport University*

**Introduction** In team sports, good team functioning depends on effective team communication. Based on the social exchange theory, Sullivan and colleagues (Sullivan & Feltz, 2003; Sullivan & Short, 2011) have developed a sport-specific multidimensional tool (Scale for Effective Communication in Team Sports; SECTS and SECTS-2) to measure the effectiveness of communication of sport teams. SECTS-2 consists of four subscales, which are Acceptance (acceptance of each other), Distinctiveness (distinctiveness from other social units), Positive Conflict (constructive intra-team conflict), and Negative Conflict (destructive intra-team conflict). The purpose of this study was to develop a Chinese version SECTS based on SECTS-2 and examine its structure. **Methods** SECTS-2 was translated to Chinese (The Chinese version SECTS, C-SECTS) via a standard back-translation protocol with necessary minor revisions. C-SECTS was then administered to 210 youth athletes (male=144, female=66) from 17 elementary school varsity teams of 9 different sports (mean age=11.56, SD=1.03). Item analysis and confirmatory factor analysis (CFA) were conducted to examine the structural validity of C-SECTS. **Results** After deleting one

item from Distinctiveness subscale in the item analysis process, all subscales showed adequate internal consistency (Cronbach's alpha=.80-.88). As data of all items were normally distributed, maximum likelihood method was performed in conducting the CFA. Results showed a good fit of the measurement model (Chi square=182.67, df=84,  $p<.05$ , CFI=.96, NNFI=.95, PNFI=.75, RMSEA=.075), good reliability, convergent validity, as well as discriminant validity ( $\lambda=.63-.91$ ;  $R\ square=.40-.82$ ;  $pc=.81-.89$ ;  $pv=.51-.66$ ). Discussion The results supported the concept of effective team communication proposed by Sullivan and colleagues (Sullivan & Feltz, 2003; Sullivan & Short, 2011). The structure of SECTS was confirmed despite a sample from a different culture. It is worth noting that, in Sullivan and Short' work (2011), Negative conflict was found positively correlated with Acceptance and Distinctiveness. In our work, however, Negative conflict was negatively correlated with Acceptance and Positive conflict. Our data showed more reasonable inter-subscale correlations as Negative conflict, in concept, was destructive in nature. In general, C-SECTS appears to be a valid measurement for cross-culture studies in effective team communication in sport. References Sullivan, P. J., & Feltz, D. L. (2003). Journal of Applied Social Psychology, 33, 1693-1715. Sullivan, P. J., & Short, S. (2011). Journal of Applied Social Psychology, 41, 471-487.

### EFFECTS OF SCHULTZ AUTOGENIC TRAINING ON PSYCHOLOGICAL VARIABLES AND HEART RATE VARIABILITY

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Introduction Anxiety is one of the most important psychological factors that can affect sports performances. Athletes have a lot of techniques in order to control anxiety before competition. Autogenic training is one of these techniques that could be used by athletes in order to relax before competition (Schultz and Luthe, 1969). Moreover, heart rate variability is a non-invasive index of the autonomic control of the heart, which has been extensively studied in anxiety (Friedman et al., 1998). The aim of this study is to investigate the effects of the Schultz Autogenic Training (SAT) on psychological and physiological variables. Methods We measured psychological variables by POMS questionnaire on a dedicated software Sphinx © and heart rate using an on-board electrocardiograph (Vital Jacket, Biodevices, Portugal) in 14 subjects before and after a SAT session. Time domain, frequency domain and non-linear analysis of heart rate variability were analysed on dedicated software (Kubios, University of Eastern Finland, Finland). Results State anxiety ( $9.8 \pm 7.1$  versus  $3.3 \pm 3.8$ ,  $p<0.05$ ), depression ( $7.1 \pm 7.5$  versus  $2.0 \pm 3.6$ ,  $p<0.05$ ) and confusion ( $9.6 \pm 4.4$  versus  $6.2 \pm 2.4$ ,  $p<0.05$ ) were significantly reduced after SAT session. Heart rate was not affected by SAT session ( $63.8 \pm 10.1$  bpm versus  $64.6 \pm 8.9$  bpm, NS) whereas non-linear analysis of heart rate variability was increased after SAT session ( $97.6 \pm 45.7$  versus  $146.3 \pm 61.3$ ,  $p<0.05$ ). Discussion SAT session have a positive effect on state psychological factors as anxiety, depression and confusion as previously describe by Friedman et al. (1998). Moreover, our results suggested that SAT session could also increase heart rate variability probably due to a greater parasympathetic influence (Gorman and Sloan, 2000). SAT could represent an easy method in order to reduce psychological and physiological stress before a competition and so increase sports performances. References Friedman BH, Thayer JF. (1998). Anxiety and autonomic flexibility: a cardiovascular approach. Biol Psychol, 49(3), 303-323. Gorman JM, Sloan RP. (2000). Heart rate variability in depressive and anxiety disorders. Am Heart J, 140, 77-83. Schultz JH, Luthe W. (1969). Autogenic methods. New York: Grune & Stratton.

### POTENTIAL EFFECTS OF THE HYPOPRESIVE METHOD ON PHYSICAL AND PSYCHOLOGICAL COMPONENTS OF SPORTS PERFORMANCE

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INTRODUCTION Scientific evidence of improvements in performance through the use of the Hypopressive Method (HM) already exists (Caufriez, 2010). The objective of this study was to analyze the potential of HM in improving physical and chemical parameters directly related to sports performance: body alignment, flexibility, respiratory parameters and aerobic endurance. From the psychological perspective the objective was to observe modifications in cognitive and somatic anxiety levels in young male athletes who train using the Hypopressive Method in comparison to those who do not. METHODS The participants were young male athletes, ages 17-31, divided into the HM group and the control group. The assessments included body alignment with photographs, flexibility with the Sit and Reach test, respiratory parameters with the measurement of rib cage flare and spirometry, aerobic endurance with sub aquatic apneas measuring static apnea after a full exhale, static apnea with a full inhalation, and time and distance during a dynamic breast stroke swim under water after a full inhalation. A VO<sub>2</sub>max value was also calculated based on the results of the Navette test. The psychological assessments were divided into two phases. The first phase used CSAI-2 evaluation tool prior to commencing HM training. The second phase included observing modifications in somatic and cognitive anxiety and self confidence scores from the CSAI-2 before the Navette and aquatic tests. RESULTS The photos of the intervention group showed a clear improvement in body alignment between the pre and post assessments. The sit and reach test improved by 98,3%, the spirometry values improved by 3% and the rib flare by 2%. These improvements were confirmed for all subjects in the endurance tests: Navette values increased by 1+/-0,5 period, aquatic apnea tests showed an increase of 10+/-0,5 seconds in the static and 15+/-0,5m in the dynamic versions. The HM group had a significant modification in cognitive anxiety levels and self confidence. DISCUSSION The control group did not show any significant changes in any of the variables measured. The HM group showed the following changes: normalization of muscular tensions in the posterior chain which allowed for improvements in body alignment and flexibility; enhancement of respiratory muscle function which explains the improvements in rib flare, spirometry values, Navette test results, and aquatic tests. The psychological tests showed a significant improvement in cognitive anxiety and self confidence after applying HM. REFERENCES Herrera, M (2013) Factores psicológicos presentes en alto rendimiento y el entrenamiento psicofísico. (pendiente de publicación) Caufriez, M., Pinsach, P, Fernandez J. (2010). Abdominaux et perinee, mythes et réalités. MC Editions. Riera, T (2012). El doble beneficio del Método Hipopresivo (pendiente de publicación)

### SELF-CONCEPT ORGANIZATION AND MENTAL TOUGHNESS IN SPORT

Meggs, J., Ditzfeld, C., Golby, J.

*Abertay University*

Mental toughness is a rapidly evolving construct and has generated widespread research interest because of the constructs proposed theoretical links with successful sport performance. This study extended these research enquiries and examined the relationship between individual differences in evaluative self-organization and mental toughness in sport. The purpose of the study was to show that qualities of mental toughness proposed to underlie emotional resiliency in sport extend from difference at the core self. A cross-sectional assessment of 102 athletes competing at a range of performance levels took part in an online study including measures of self-reported

mental toughness (SMTQ) and self-organization (self-descriptive attribute task). As anticipated, overall mental toughness was associated with self-concept positivity, which particularly was true of individuals with positively integrative self-organization, who distribute positive and negative self-attributes evenly across multiple selves. Specifically, positive integration appears to promote constancy, presumably stemming from the emotional stability associated with this self-organization. The potential advancements of the current study include a more subtle understanding of the cognitive-affective variables that underlie mental toughness, subsequently resulting in a more holistic understanding of this salient construct.

### THE RELATIONSHIP OF VOLLEYBALL AND LEVELS OF ANXIETY AND RESILIENCE OF ACTIVE SENIORS.

Fernandes, P.T., Pupo, L.C.A., Yoshida, H.M., Borin, J.P.

*UNICAMP*

**Introduction** The increased longevity is configured as a world reality. Currently, the aging process has an important emphasis in several areas of knowledge, and physical exercise appears as the protagonist relating to better quality of life, including physical, social and psychological areas. But, when the focus is elderly populations, there is little scientific knowledge about it. So, this study aimed to investigate the influence of physical exercise, through volleyball, in anxiety and resilience of the elderly people. **Methods** We performed a survey in 23 healthy athletes (13 male), older than 60 years (60-72 years, SD = 4.65) with average period of training of 49 months (5-168 months). All these subjects were members of the adapted volleyball of Nova Odessa-SP/Brazil. The methodology initiates with a literature research to get a theoretical framework, followed by a survey with the follow instruments: Beck Anxiety Inventory (BAI) and Resilience Scale, composed respectively of 21 and 25 items, which determine scores of anxiety and psychological resilience. The questionnaires were performed in three points: in the first month of training (P1); at three (P2) and six months (P3) after the first application. **Results** The results showed that training, over the six-months, contributed in a positive way to improve the psychological aspects: decreasing the levels of anxiety and increasing resilience scores. Anxiety: P1=9.91 (SD=8.46); P2=7.57 (SD=4.76); P3=4.91(SD=4.11), p=0.03. Resilience: P1=121.30 (SD=37.46); P2=137.04 (SD=20.93); P3=144.65(SD=14.47), p=0.01. **Discussion** With these results, we can say that this specific sport training could help to obtain and maintain the psychological and mental well-being of elderly people. This study enriches a research about this theme and can promote a new way to deal with this population.

**14:00 - 15:00**

## Mini-Orals

### PP-SH15 Psychology [PS] 8

#### GAME METHOD AS A WAY TO CORRECT THE PSYCHO-EMOTIONAL STATE

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**Introduction** Nowadays it is noticed that aggravation of physical conditions shown by teenagers with musculoskeletal system diseases is connected with their psycho-emotional health. To solve this problem we propose to use game forms of physical activity. It helps to create emotional stability, to strengthen good posture, and to form the stereotype of physical activity. The high level of motional activity has a positive influence on the neuropsychiatric processes and the psycho-emotional background; it improves the effectiveness of complex treatment. **Methods** Sixty-nine 11-13 year-old teenagers with scoliosis of the first, second, third and fourth degree were tested. All of them were on a 28-day treatment in an orthopedic sanatorium. The game method used in these experiments was aimed at improving the adaptation ability, developing the stereotype of physical activity and the right perception of the disease and its treatment. To explore the change in psycho-emotional state we carried out prompt estimations of the feeling of well-being, the activity and the mood (Zabrodin, 2010). **Results** The experiments resulted in the following: the well-being index increased in 16.8%, the mood index increased in 16%, the activity index increased in 9.2%. The index values in different age-groups ranged: the well-being index for 11-year-olds was 5.7 points, for 12-year-olds – 5.59 points, for 13-year-olds – 5.77 points. The activity index for 11-year-olds was 5.09 points, for 12-year-olds – 5.1 points, for 13-year-olds – 5.5 points. The index of mood for the 11-year-old was 6.0 points, for the 12-year-old – 5.89 points, for the 13-year-old – 5.5 points. **Discussion** The significant increase in the well-being index and the mood index proves that the game method allows to optimize psycho-emotional state of teenagers. Moreover, the activity index increases, as well. These data correspond with the research by other scientists. The analysis of the ratio of functional indicators under the rise of fatigue in the group of 11-year-olds shows the relative decrease of the well-being and activity as compared with the mood. The fatigue trend has its minimum value for the group of 12-year-olds, and is lacking for the group of 13-year-olds, which shows the optimal suitability of this method for children aged 12 and older. Apart from that, we registered that the feeling of well-being and the mood enhance while the activity tends to significantly lower increase. Considering the specific character of this method, we emphasize the fact that teenagers get accustomed to the stereotype of physical activity, as the children tested conceive the high level of physical activity as norma. **References** Zabrodin Yu. 2010. Moscow, p. 334-412. Stephens M. (2002). *American Family Physician*, 15, p.1033-1035.

#### PSYCHOLOGICAL EVALUATION OF THE JAPANESE NATIONAL TENNIS PLAYERS

Murakami, K., Hirata, D.

*Tokyo University of Science, Senshu University*

**Introduction** Players, coach, and sport psychologists all agree that the contribution of psychology to successful tennis play is significant. This consensus is borne out of game analysis, as well as the mental skills that players and coaches consider important for tennis play. In Japanese Tennis Association (JTA), as a part of the medical and fitness checkup in the training camps, mental skills of the athletes were assessed. One key factor in bringing an athlete's capability into full play is mental skills. Therefore, the purpose of this study was to examine the mental skills of the Japanese national tennis players. **Methods** A total of 26 players were assessed. The national group was

composed of 10 players who were members of a Davis Cup Team at the time of the study. The Universiade group was composed of 16 players who were currently on a university tennis team. The instrument used was the Diagnostic Inventory of Psychological Competitive Ability for athletes (DIPCA.3, Tokunaga, 2001). The questionnaire includes 52 items and 12 mental skills scales grouped under five broader conceptual components. The DIPCA.3 was applied in youth and open players selected for their national teams, while they were either in training camps or on tour. Results Results of analysis revealed several differences between psychological characteristics of athletes as function of their performance level. Significant differences appeared in aggressiveness:  $F(1, 24)=4.75, p<.05$ , volition for self-realization:  $F(1, 24)=6.32, p<.05$ , concentration :  $F(1, 24)=4.64, p<.05$ , confidence:  $F(1, 24)=8.76, p<.01$ , decisiveness:  $F(1, 24)=6.87, p<.05$ , and judgment:  $F(1, 24)=5.61, p<.05$ . Means comparisons revealed that the national players exhibited superior mental skills than universiade players in aggressiveness, volition for self-realization, concentration, confidence, decisiveness, and judgment. Discussion Results indicate clearly that athletes' psychological characteristics differed depending on their performance level. National level tennis players were better than universiade players in aggressiveness, volition for self-realization, concentration, confidence, decisiveness, and judgment. Findings corroborate the results of previous studies (Gould et al., 2002) comparing mental skills of elite and non-elite athletes. These mental skills may be important differentiating variables between elite and non-elite athletes. References Gould D, Greenleaf C, Chung Y, and uinan D 2002 A Survey of U.S. Atlanta and Nagano Olympians: Variables Perceived to influence Performance. *Research Quarterly for Exercise and Sport*, 73(2), 175-186. Tokunaga, M (2001) Evaluation scales for athletes' psychological competitive ability: development and systematization of the scales. *Japan Journal of Physical Education, Health and Sport Sciences*, 46(1), 1-19.

## EMOTIONAL REGULATION IN SPORT USING E.M.D.R.

Mate, D.1, Cavallerio, F.2

1: UNITO (Torino, Italy), 2: UR (London, UK)

Introduction Sport psychologists often have to help athletes regulate their emotions. Feelings like pre-competitive anxiety and re-injury worries influence performance negatively and athletes need to develop strategies which will allow them to successfully deal with these emotions. Several strategies try to regulate the arousal through exercises based on the body (e.g., relaxation, imagery) or on rational cognition (e.g., goal setting, self talk). Unfortunately these techniques do not reflect the complexity of human mind and brain, and the role of intra-personal beliefs and emotions, and when the level of stress is particularly high these techniques only become useful after a long time. Nowadays a relatively new therapeutic technique has started to be used with athletes, even though only few cases are reported in the current literature (Graham and Robinson, 2007; Shearer et al., 2011). The Eye Movement Desensitisation and Reprocessing (E.M.D.R., Shapiro, 1989) was originally created to deal with psychological traumas (e.g., Post-traumatic stress disorders), but its protocol has been adapted with the goal of improving sport performance (Foster and Lendl, 1995). This psychotherapeutic technique can reach deep inside the intra-personal beliefs and images of life-events, and appears to regulate emotional activation in a more stable and functional way than other techniques. Methods The E.M.D.R. protocol (i.e., a bilateral stimulation that aims to connect different areas of the brain, with the final goal of helping the person to identify some mental images and guide them through the restructuring of their cognitions, turning those which are negative and counterproductive during performance into positive and empowering ones) was applied during a five session program with a hockey player that was struggling with anxiety during matches. Results The E.M.D.R. protocol has helped the athlete to analyse his own feelings of anxiety during matches and to explain them, and come to terms with what was causing them (being afraid of his father judging and criticising him). The global result was that the athlete reprocessed his disturbing beliefs extremely rapidly, and regulated his arousal without any specific intervention on the body. Results were stable during the follow-up sessions too. Discussion The use of the E.M.D.R. protocol opens new possibilities for sport applied psychologists. This tool offers a chance to obtain quick results in short times, which is a positive aspect when working with athletes who might need to be ready to go back on the competition floor in weeks, or even just days. References Foster S, Lendl J. (1995). *J of Appl Sports Psychol*, 7 (Suppl.), 63. Graham LB, Robinson EM. (2007). *J Swim Res*, 17, 1-9. Shapiro F. (1989). *J Behav Ther Exp Psy*, 20, 211-217. Shearer DA, Mellalieu SD, Shearer CR. (2011). *J Clin Sport Psychol*, 5, 134-147.

## EXPLORING THE EFFECTS OF EMOTIONS ON DECISION MAKING

Ballart, P., Juan, B., Latinjak, A.T.

EUSES

Introduction The purpose of this study was to explore the effects of different emotions on decision making. Methods In regard to the emotions, we used a dimensional model of core affect as a conceptual framework for this study, and selected the eight main affective states represented in the model: these states are commonly referred to as sadness, anger, dejection, fear, relieve, elatedness, confidence and excitement. In regard to the decisions, we presented our participants ( $n = 90$ ; 80 males and 10 females;  $Mage = 19.56$ ,  $SD = 1.85$ ) eight times the same situation where a basketball player had to choose between four different options at the end of a match: (1) keep the ball and wait; (2) perform an easy pass to the best player in the team which, however, is in a worse position; (3) perform a difficult pass to another teammate which is in a good position; or (4) perform a difficult through by yourself. Each time, the situation was introduced by a stem (The player feels ... [e.g., relieved]), that varied in regard to the emotion concept. Moreover, we clearly stated that the chances of scoring are at 15% for each choice, and our participants could choose more than one if they believed they were equally adequate. Results Our results revealed similar choices for different types of emotions. Firstly, when angry or euphoric (both retrospective and highly activated states) most participants (80% and 97%, respectively) would have tried to score themselves. Secondly, when confident or excited (both anticipatory and positive states) our participants would have chosen to try to score (73% and 66%, respectively), perform a difficult pass (51% and 52%, respectively) or even maintain the ball (33% and 30%, respectively). Thirdly, when sad, dejected or anxious (all negative states) most participants (80%, 76% and 78%, respectively) would have tried to perform a simple pass to the best player of the team. Lastly, when relieved most participants (78%) would have maintained the ball and waited for a better option. Overall, our results suggest that affective states not only influence the quality of decisions, the time we spent to take them or the options we consider before we take them, but also the type of decision we take, regarding responsibility and social interactions. Discussion Based on these results, we formulated four hypothesis for future studies: (1) when euphoric or angry athletes tend to assume responsibility so as to proof their value, (2) when experiencing any negative emotion but anger athletes tend to avoid responsibility, (3) when experiencing confidence or motivation athletes tend to assume or share responsibility and (4) when relieved athletes tend to be patient and evaluate before taking their choices.

## THE EFFECT OF EMOTIONAL INTELLIGENCE ON SPORTS EFFECTIVENESS AT HANDBALL TEAMS

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*Sport School of Debrecen*

**Introduction** This research examines what role the EQ has in the multifactor sports' efficiency system. The study was conducted on four professional handball team, with the assumption that those players who has high emotional intelligence has decisive role in the team. We supposed that the high EQ is associated with high self-confidence. Further question that what is the relation of performance in situation and between the EQ. The study aims to explore – what psychological factors influence the success of the athlete. **Methods** Two first-class men and two women handball team (N = 65, 34 men and 31 women) took part. During the study four types of questionnaires have been evaluated: The Bar-On Emotional Quotient Inventory animals, Athletic Experiences Survey (ACSI-28/2), State testing meter - (CSAI-27), and more precisely in terms of sociometry. The SPSS statistical program has done the data processing. During the entered variables we used the statistical analysis of the one-sample Kolmogorov-Smirnov test, descriptive statistics, Mann-Whitney test, analysis of variance, and Kruskal-Valis correlation analysis was used. **Results** The comparative statistical calculations resulted in average of 66.15% of the subjects EQ (EQ Sample average = 450). Our hypothesis that the players who have higher EQ than the average have more relationships in the team was not proved. Those who have high EQ has minimum relationship with at the least (1.27 = number of contacts/person), supposedly marginalized. The low EQ players have most relation (2.36 = number of contacts/person). Thus, the hypothesis that a player with high EQ has a decisive role in the team atmosphere was not proved. However, the players who have higher emotional intelligence can struggle with stress, the anxiety-clarity is higher in their case. The EQ and the difficulties have significant relation. There is also a significant relationship between the performance situation and the self-confidence. Moreover, there is a strong correlation between the performance situation and between the optimism. **Discussion** Based on the results we can conclude that the emotional intelligence plays an important role in the view of the athletes' effectiveness. Although, apparently there is no relation between the atmosphere of the team and between the emotional intelligence, but even then in individual level it's improving is quite important. The EQ shows relation with the individual abilities and features that help the athlete to face with the problems, which comes from the competition. The high EQ helps to fight against the surrounding requirements, or to solve the stressful situations. **References** Mayer, J. D., Salovey, P. (1993): *The Intelligence of Emotional Intelligence*. Intelligence 17. 433-442. Goleman D. (2002): *Érzelmi intelligencia a munkahelyen*. SHL Hungary Kft Kiadó. Budapest

## VALIDITY AND RELIABILITY OF THE GREEK VERSION OF THE SATISFACTION WITH LIFE SCALE : EVIDENCE FROM PHYSICALLY ACTIVE COLLEGE STUDENTS

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**Introduction** Physical activity was positively associated with life satisfaction (McAuley et al., 2008). Such studies frequently used the Satisfaction with Life Scale (SWLS) to assess life satisfaction (McAuley et al., 2008), which is one of the most widely used instruments (Pavot & Diener, 1993). Although this scale has been established to have sound psychometric properties, the validity of this instrument has not been examined in Greece. Therefore, the aims of the current study were to examine the factorial validity and reliability of the SWLS. **Methods** Participants were 340 students that attended the physical education classes. To test the factorial validity, two samples were used. The first sample (N=150) were 77 men and 73 women (24.28±6.32 yrs), whereas the second sample (N=150) consisted of 86 men and 64 women (22.85±5.64 yrs). An Exploratory Factor Analysis (EFA) was conducted with the first sample. The extraction method employed was principal axis factor followed by promax rotation. A Confirmatory Factor Analysis (CFA) (maximum likelihood method) was performed with the second sample to confirm the fit of the model found in EFA. The CFA was conducted using the AMOS 16.0 statistical software (Arbuckle, 2007). Assessment of model fit was based on  $\chi^2$ ,  $\chi^2/df$ , CFI, GFI, IFI, TLI and RMSEA indices. To test the internal consistency, the Cronbach's alpha coefficient was used. To examine the test-retest reliability, 40 students, 21 men and 19 women (28.78±5.647 yrs), completed the scale twice with an interval of 15 days between the two assessments. **Results** EFA yielded one factor accounted for 71.81% of the variance of the model. The item factor loadings ranged from 0.68 to 0.90 (Cronbach's alpha=0.90). Similarly, CFA showed that this model presented a good fit ( $\chi^2=6.214$ ,  $df=4$ ,  $p=0.184$ ,  $\chi^2/df=1.554$ , CFI=0.996, GFI=0.983, IFI=0.996, TLI=0.991, RMSEA=0.062). The item factor loadings ranged from 0.75 to 0.92. The Cronbach's alpha coefficient was 0.93 whereas the intra class correlation coefficient of the scale was 0.77 (0.61-0.87 95% CI). **Discussion** The results of the study indicated that the Greek version of the SWLS was a valid and reliable instrument in physically active students. These findings are consistent with those of previous studies. Future studies are proposed in other physical activity settings in order to increase the knowledge about the validity and reliability of the SWLS. **References** Arbuckle JL. (2007). *Amos 16 user's guide*. Amos Development Corporation, USA. McAuley E, et al. (2008). *Ann Behav Med*, 36, 13-20. Pavot W, Diener E. (1993). *Psychol Assess*, 5(2), 164-172.

## MENTAL TOUGHNESS IN AN RFU ENGLAND RUGBY ACADEMY

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Mental Toughness (MT) is frequently used term in sport but its conceptualisation remains rather ambiguous (Andersen, 2011). Frequently defined in the literature in terms of various aggregates of widely differing aspects of elite performance, it remains unconvincing as a clearly defined psychological construct. This lack of clarity may be the result of MT differing across sports. As such, it is important to clearly establish what MT means in particular sports. The aim of this study was to investigate MT in rugby by exploring the perceptions and experiences of MT and its development in players and coaches at a Rugby Football Union (RFU) academy. **Methods** A purposeful sample of participants (four players and two coaches) were selected from an England RFU Academy. These participants were identified as being the mentally toughest players in the academy, by other players, coaches and the use of a Sports Mental Toughness Questionnaire (SMTQ). All participants were interviewed using a semi-structured format and questioned about their perceptions and experiences of MT and its development in rugby. Interviews were transcribed verbatim. Data were analysed thematically using Interpretive Phenomenological Analysis with trustworthiness established using bracketing and member checking. **Results** Themes and clusters identified a number of characteristics that were associated with MT for Rugby, including confidence, hardiness and the use of specific mental skills. Relishing completion, facing challenges and social support were seen as important in developing MT in Rugby. **Discussion** Findings highlight the importance of key mental characteristics in rugby. A number of these characteristics are shared by other contact sports such as Australian Football (Gucciardi, 2008). In developing MT for Rugby situational factors and social support played a key role at different stages of

players' development, supporting previous findings (Finn & McKenna, 2010). Overcoming setbacks, facing adversity dealing with pressure were important factors. Our findings highlight the importance of coaches creating challenging situations in practice, peers providing rivalry and support in training and competition, and more established players acting as role models. Overall, the findings suggest that to enhance MT at a developmental stage, players should be gradually exposed to, rather than shielded from, demanding situations in a supportive training and competition environment (Parkes and Mallett, 2011). References Andersen, M.B. (2011) In Gucciardi, D.F. & Gordon, S. Mental toughness in sport : developments in theory and research. Oxon: Routledge Finn, J. and McKenna, J. (2010) *Int J Sports Sci Coach* 5(2), 257-279 Gucciardi, D. F., Gordon, S., and Dimmock, J. A. (2008) *J Appl Sport Psychol*, 20, 261-281. Parkes, J. F. and Mallett, C. J. (2011) *Sport Psychol*, 25, 269-287.

### CHILDHOOD HYPERACTIVE TEMPERAMENT PREDICTS LOW PHYSICAL ACTIVITY AND HIGH SCREEN TIME IN ADULTHOOD: THE YOUNG FINNS STUDY

Yang, X.1, Hirvensalo, M.2, Pulkki-Råback, L.3,4, Hintsanen, M.3, Hintsala, T.3, Keltikangas-Järvinen, L.3, Telama, R.1,2, Viikari, J.S.A.5, Raitakari, O.T.5, Tammelin, T.1

1: LIKES – RCHSH (Jyväskylä, Finland), 2: UJ (Jyväskylä, Finland), 3: UH (Helsinki, Finland); 4: FIOH (Helsinki, Finland); 5: UT (Turku, Finland)

**Introduction** No research has investigated the long-term effects of hyperactive temperament in childhood on physical activity and screen time in adulthood. The aim of the present study was to examine an association of childhood hyperactivity with physical activity and screen time later in life based on a population-based sample of boys and girls who have been followed up during 27 years. **Methods** Participants (424 boys and 500 girls) in the three youngest age cohorts (3, 6 and 9 years) were initially enrolled in 1980 and followed up over 27 years until 2007 (aged 30-36 years) as a part of the Young Finns Study in Finland. Hyperactive component of temperament was rated by mother's report at two consecutive time points from 1980 to 1983. Physical activity was measured by mother's reports of 3- and 6-year-olds and by self-reports of 9-year-olds or later until the age of 30-36 years. Screen time was dichotomized into <2 hours/day and ≥2 hours/day. **Results** High hyperactivity temperament in childhood predicted lower physical activity in women and higher screen time for both genders. Girls with a high hyperactivity had a 2.6-fold decrease in adult physical activity than those with a low hyperactivity. Both high hyperactive boys and girls had 2.1- and 1.9-fold higher in adult screen time, respectively, compared to their low activity temperament counterparts. These associations remained significant after adjustment for potential covariates from childhood and adulthood. **Discussion** High hyperactive temperament in childhood is identified as an independent risk factor for the prevalence of unhealthy lifestyle behaviors over 27 years. High hyperactivity in early years predicts lower physical activity and higher screen time in adulthood. A significant dose-response relation is also observed between level of childhood hyperactivity and adult physical activity and screen time. Being high hyperactivity is associated with an increased risk of physical inactivity and sedentary. The effects of childhood hyperactivity on adult physical activity are more pronounced for women than men. Our findings suggest that hyperactivity established during the early years, particularly their maintenance, may be contributing to the problem of the decline in physical activity and the increase in screen time later in life, especially among women.

### PSYCHOMOTOR PERFORMANCE AFTER 30 HOURS OF SLEEP DEPRIVATION AND EXERCISE OF MODERATE INTENSITY

Dabrowski, J.1, Ziemia, A.1, Bogdan, A.2, Zwolinska, M.2, Kozacz, A.1, Mikulski, T.1

1 Mossakowski Medical Research Centre, Polish Academy of Sciences, Poland. 2 Central Institute for Labour Protection – National Research Institute, Poland.

**Introduction** Testing of the psychomotor performance is a good and simple method to evaluate central fatigue in humans. It determines visual motor coordination, speed and accuracy of perception, decision-making under time pressure and fatigue resistance. Such factors play an important role in ultra-endurance exercises, especially ones combined with sleep deprivation. **Methods** Eleven endurance-trained men  $31.4 \pm 2.1$  [yr] performed graded test to volitional exhaustion with workload increased by 50 Watts every 3 min) before (trial B) and immediately after (trial A) 30 hours of prolonged exercise (simulated adventure race) combined with complete sleep deprivation. Subjects were cycling, running, roller-skating, kayaking and swimming with an average heart rate of 100-120/min and a maximum not exceeding 170/min. Multiple choice reaction time (MCRT) testing was conducted at rest and during last 2 minutes of each workload of graded exercise test. In MCRT test subjects are expected to react as fast as possible to 15 positive light and sound stimuli emitted in different time intervals by pressing the corresponding button placed on handlebars of cycloergometer and to ignore 15 negative impulses. **Results** There were no statistically significant differences in MCRT at rest between trial B ( $339.2 \pm 9.5$  ms) and trial A ( $323.1 \pm 11.7$  ms). During graded exercise test MCRT was also similar in trials B and A,  $329.5 \pm 9.5$  ms vs.  $326.5 \pm 7.7$  ms, respectively. **Discussion** Results of the present study are consistent with our previous findings (Mikulski 2006; Dabrowski 2012) involving prolonged exercises of different kind and intensity. Subjects accustomed to sleep deprivation, although suffering from central fatigue, are still capable to concentrate properly, even at rest, on short, slightly complex task like MCRT test. During exercise additional stimulation of sympathetic nervous system improves psychomotor performance. **In conclusion**, healthy, trained men are able to fulfill short tasks involving psychomotor abilities independently from some extent of central fatigue. **References** 1. Mikulski T, Tomczak A, Lejk P, Klukowski K. (2006). *Med Sport*: vol. 10 (4): 98-101. 2. Dabrowski J, Ziemia A, Tomczak A, Mikulski T. (2012). *Med Sport*, 16 (1): 6-11.

### INDIVIDUAL AND TYPOLOGICAL FEATURES OF UNIVERSITY STUDENTS, ENGAGED IN AMATEUR SPORT ACTIVITIES

Tukaiev, S., Vasheka, T., Dolgova, O., Zima, I.

National Taras Shevchenko University of Kyiv

The aim of the given research is to detect the typological and personal differences of the university students, who are engaged in amateur sports. It is well-known that going in for sports, as well as other physical activities in general, contribute to a healthy lifestyle, help to prevent numerous chronic diseases (such as cardiovascular diseases, obesity, hypertension, etc.), and give a therapeutic effect in preventing mental status disorders (such as depression, distorted body image and self-perception, low self-esteem etc.) The first-year students who entered the University having higher level of physical training can be better adapted to new environment and lifestyle what can have a positive effect on their educational results, their feelings and psychological state. 67 students (34 women and 33 men, 17-23 age range, 20.5 mean age) of National Taras Shevchenko University of Kyiv, Ukraine participated in this research. The control group included 281 students (220 women and 61 men) with no prior sport experience except Physical Education classes at schools and universities. The following procedures of tests have been applied: Temperament Diagnostics Test by J.Strelau, EPI Test by H.Eysenck, Manifest Anxiety Scale by J.Taylor, State-Trait Anxiety Inventory by C.Spielberger, Y.Hanin, Differential Diagnostics of Depression by V.A.Zhmurov,

Diagnostics of Neurotization Level by L.Wasserman, Diagnostics of Emotional Response to Environmental Stimuli by V.Boyko, Boston Stress Resistance Test, Psychological Stress Measure (PSM-25), Aggressive Behaviour Test by E.P.Ilyin and P.A.Kovalev, Syndrome of Emotional Burnout test by V.Boyko, Maslach Burnout Inventory, the V.D.Mendelevich Anticipation Consistence Test (TAC), and L.A. Regush technique to diagnose the ability to predict. The experiment has proved that the students who regularly go in for amateur sports demonstrated higher level of activity and mobility of neural processes, and lower level of neuroticism, lower level of neurotization, anxiety, psychic tension and depression. It has been also found that these students had pronounced outward euphoric and less pronounced outward dysphoric reactions to external stimuli, and were more inclined to direct physical aggression. We also found demonstrated significant levels of both general and spatial anticipation. The latter was more pronounced among those practicing team sports (football, volleyball, and basketball). This allows us to conclude that the type of nervous system may define the disposition towards the physical activity, and the strength of nervous system determines the ability to achieve results in sports. Our data indicate that practicing sports prevents the development of burnout, reduces the negative impact of daily emotional stress, and provides a socially acceptable way to express aggression.

**14:00 - 15:00**

## Mini-Orals

### PP-SH24 Sport Statistics and Analyses [SA] 3

#### **INFLUENCE OF PERIOD ON THE DISTANCE FROM THE GOAL LINE TO THE LESS ADVANCED OUTFIELD PLAYER IN SPANISH FIRST DIVISION SOCCER TEAMS.**

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*GRANADA UNIVERSITY*

**INTRODUCTION** A variable like the distance from the goal line to the less advanced outfield player may help to describe a team's pattern of play (Carling et al., 2005). Teams using an offensive style may play closer to the opposing goal whereas those using a more defensive style may play closer to their own goal (Zubillaga et al., 2011). The venue period of the match could have an influence on his tactical variable like had in other physical components (Bangsbo, Mohr, Krstrup, 2006). The aims of the present study was to analyse the influence of the period of the match on the distance from the goal line to the less advanced outfield defender. **METHODS** A multiple-camera player tracking system (AMISCO Pro, Sport-Universal Process, Nice, France) was used to record the existing distance from the goal line to the less advanced outfield player of the analysed team (metres). A total of 25 matches, 5 per team, of the First Spanish Division were analysed. The matches were recorded and digitalized and the player's position and movements were registered with a frequency of twenty-five records per second (see Zubillaga et al., 2007). A total of 17546 data were collected. **RESULTS** A one-way ANOVA revealed that the distance from the goal line to the less advanced outfield player was significantly smaller in the second period ( $28.85 \pm 13.15$ ) than the first period ( $30.40 \pm 12.47$ ). **DISCUSSION** The distance from the goal line to the less advanced outfield player was found as a tactical variable influenced for the period of the match. Therefore, the different moments of the match could be a factor that doing these different distances from outfield players to their own goal This variable could be a consequence of teams' defensive or offensive minded styles of play (Zubillaga et al., 2011). Results of the present study could be interesting in the preparation of the defensive and offensive phases of matches and its training process Future studies could analyse the influence of other factors, like the result or the local or visitors condition, with the goal to know the football in depth and to improve the training process. **References** 1. Bangbo, J.; Mohr, M.; Krstrup, P. (2006). Physical and metabolic demands of training and match-play in the elite football player. *Journal of sport science*, 24, 665-674. 2. Carling C, Williams AM, Reilly T. (2005). *The Handbook of Soccer Match Analysis*, 3. Routledge, London. 3. Zubillaga A, Gorospe G, Hernández A, Blanco A. (2007). *J Sports Sci Med, suppl.* 10. 20. 4. Zubillaga, A.; Caro, O.; Ruiz, C.; Fernández-García, A.; Fradua, L. (2011). A comparison of the distance from the goal line to the less advanced outfield player between five spanish first division soccer teams. *European College of Sport Science 16th annual Congress of the ECSS. Liverpool 2011.*

#### **THE EFFECT OF TEAM AND OPPOSITION QUALITY ON SELECTED ACTION VARIABLES IN PROFESSIONAL RUGBY LEAGUE**

Parmar, N., James, N., Greenhalgh, A., Hughes, M.D.

*Middlesex University*

**Introduction** There is a lack of research on performance analysis in professional rugby league, even though Gabbett (2005) identified performance analysis as an emerging tool for gaining a further understanding of this sport. Hughes and Bartlett (2002) suggested that studies in performance analysis should provide comparisons of data by relating the observed teams' performances to opposition values. Therefore this study aims to analyse the differences in selected actions, between top, middle and bottom ranked professional rugby league teams in relation to opposition quality. **Methods** OPTA Sports data (<http://www.optasports.com/>) collected from 27 rounds of the 2012 Super League season, amounting to 189 matches, were processed in Microsoft Excel and analysed using a series of analysis of variance (ANOVA) tests using the IBM SPSS statistics package (v19, SPSS Inc., 2010). Teams were ranked based on their final league standings at the end of the 2012 Super League season as being top four (teams finishing in places 1-4), middle six (teams finishing in places 5-10) and bottom four (teams finishing in places 11-14). **Actions analysed in attack** were the number of carries, metres gained, line breaks and successful and unsuccessful offloads and in defence the number of completed and missed tackles. **Results** ANOVA results showed that the top four teams had a greater number of carries, gained more metres, made more line breaks and missed less tackles than the middle six who also performed better than the bottom four teams. The effect of the opposition quality had the same effect i.e. the greater the opposition quality the less well the team performed on each variable. In comparison the frequency of successful and unsuccessful offloads in attack were similar irrespective of the quality of the team or opposition. The top four and middle six ranked teams completed a similar number of tackles however this frequency increased in line with the opposition quality. In comparison the bottom four teams made more completed tackles as the opposition quality decreased. **Discussion** This preliminary analysis of selected variables collected by OPTA over a full season of professional rugby league suggests that significant differences are evident between action variables depending on the quality of both the observed team and opposition. Further independent variables such as match venue and match out-

come need to be analysed in the future. This work will be extended to examine which variables relate to successful performance and hence be deemed performance indicators. References Gabbett T.J. (2005). *Journal of Sports Sciences*, 23(9), 961-976. Hughes M. & Bartlett R. (2002). *Journal of Sports Sciences*, 20, 735-737.

### THE ANALYSIS ON ACTIVITY LEVEL AND NATURE OF THE ORGANIZED TRAINING AND SELF-ORGANIZED TRAINING IN SOCCER

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**Introduction** Both the number of children participating in organized soccer and the number of organized sessions per child, has increased in Norway during the last 10 years. The idea behind this is that by recruiting more children to a structured training environment, this in the long run will help to improve the standard of soccer. The purpose of this study was to compare organized soccer training (Deliberate practice, DPR) with children's self organized football activity (Deliberate play, DPL). One have to ask, in what sense is the organized training sessions different form and potentially more effective for skill development, than children's self organized soccer activities? **Methods** 6 boys playing soccer in their local teams, age 11 to 12 years, volunteered to participate with consent from their parents. The boys were observed in 9 sessions in organized and self-organized soccer activity at different venues. The children's base team coach organized 3 of the DPR-sessions, and the coach for a team of selected young talents (ST) another 3 DPR. The remaining 3 sessions were self-organized trainings in a small sized pitch (Deliberate play). The training sessions for observation were selected randomly within a period of 2 months, registered in a log, and recorded on video. Total observation time was 2650 minutes. Registrations were focused on kind of activity, number of cases, intensity, and time spent in different activities. **Results** The main results of the survey shows differences in what exercises kids choose in self-organized activity (DPL), as compared to activity organized by their trainers (DPR). Differences were found in time to play against each other 90% vs 38 %, activity period attacking the goal 92% vs 53 %, and games in small group 74% vs 19 %. These categories overlap. Another striking result is that the number of ball touches for DPL situation is higher than in the DRL situation, 25,74 against 9,62 (ST) on average per 5 minutes played. Also it is observed 6 times more ball transports, 2,5 times more finishing on goal, and 2,8 times more involvement in 1:1 situations, in the DRL as compared to the DPR. In DPL also higher intensity and considerably less breaks were observed compared to DPR. In DPR the most of the time is spend in set situations for receiving and passing the ball. **Discussion** The results of this study indicate that DPL and DPR activities are very different in many respects. The activity level, the intensity and variability in the activities are higher in the deliberate play as compared to the deliberate practice situations. Based on the findings in this study, previous research (Côté et al, 2003, 2007) and theories of motor development (Vereijken, 2005), one can hardly see that DPR will lead to a greater variability of practice (Schmidt, 1991), as compared to DPL. Higher number of organized sessions at the expense of self-organized activity, might be negative for the quality of the talent development; unless DPL variability is adapted into DPR.

### THE PROFICIENCY OF SPIKING AND BLOCKING OF ADOLESCENT MALE VOLLEYBALLERS' IN ESTONIAN CHAMPIONSHIPS IN 2005 AND 2008

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*Institute of Health Sciences and Sports*

**Introduction** The study analyses volleyballers' performance at Estonian championships for U16 (boys up to 16 year-olds) in two tournaments– Tartu 2005 and Rakvere 2008. The participants were members of eight best teams of Estonia at the moment. **Methods** To record the games an original computer program Game was used, which was first introduced in the *International Journal of Volleyball Researches* (Stamm et.al 2000). For simultaneous recording of the performance of two opposing teams, two computers equipped with the program Game were used. Parallel recordings were made by volleyball experts. All together 56 games were analyzed. **Results** From our data we can conclude that the quality of spike has a tendency of improving. In 2005 there were 1221 spikes which earned a point. and in 2008- 1276 spikes. These data were not statistically significant. When we look at the mistakes during the spike we can see that there were also less mistakes in 2008–552 mistakes (SD=10,15) and in 2005–566 mistakes (SD=9,11) The same thing appears when we look at the average of the proficiency index. It has been increased from 0,54 (SD=0,19) to 0,58 (SD=0,18), although the difference was not statistically significant. Now when we look at the blocking values then we can see that the amount of blocks is statistically significantly increased, in 2005–938 (SD=14,75) and in 2008–1057 (SD=17,08). Also the amount of successful blocks in one game in average have increased from 3,81 times (SD=5,01) in 2005 and to 4,75 times in 2008 (SD=5,19). We find out the average of the mistakes during the blocking, that amount was also statistically significantly increased 4,25 (SD=4,33) and 6,85 (SD=5,76). But in conclusion, when we look at the index of proficiency we can see that it is still increased - 0,36 (SD=0,24) in 2005 and 0,44 (SD=0,25) in 2008, although the last date were not statistically significant. **Discussion** The quality of spike has a trend of improving. There were more successful spikes, less mistakes and average proficiency index was higher in 2008 than in 2005, although the difference was not statistically significant. The amount of blocking increased, which is by itself a good indicator already for adolescent players (Gabbet et.al 2007), also increased the amount of successful blocks, but surprisingly increased the amount of the mistakes also and even statistically significantly. But in conclusion when we look at the average of proficiency index we can see that, it was higher in 2008 than in 2005 Championship. **References** Gabbett, T., Georgieff, B., Domrow, N. (2007). *Journal of Sports Sciences*, 2, 1337 – 1344. Stamm R.,Stamm M., Oja A. (2000). *Int. J Volleyball Res*, 2 (1), 18 – 22.

### ANOTHER TEAM TIMEOUT IN HANDBALL WHAT'S THE DIFFERENCE COMPARING WINNERS AND LOSERS TEAMS?

Prudente, J., Cardoso, A., Lopes, H., Fernando, C.

*University of Madeira*

**Introduction** Since the introduction of the team timeout in handball at the Olympic Games in 1996, until the actual situation with three team timeout, some discussion has been made about important is the team timeout in the performance. Despite this discussion, there are scarce studies about the team timeout in Team Handball, namely about the reasons to lead the coaches to call timeout and try to understand how they manage the possibility to call them during the game and verify if there is any differences between winners and losers teams. **Methods** Sixteen games, from the final phase were analyzed using the play-by-play-related statistics from the International Handball Federation (IHF). For each time-out, the events and goals scored in the previous and post 5 ball possessions were registered for the teams that called timeout and for the opponents. Each half time game was divided in 5 periods: 0-10', 10'-20', 20'-25',25'-28', 28'30'. **Results** In all 16 games never the teams called 6 timeouts and only in 9 games (56, 3%) they call for 5 timeouts. The difference

between winners and losers teams is significant concerning the n° of timeouts they call ( $p=0,04$ , losers;  $p=0,06$ , winners), but there are no significant difference between winners and losers teams concerning the period of the game when they call timeout ( $p=0,240$ ). No significant difference exist between winners and losers teams in relation of the effects on the score in the end of the 5 ball possession post timeout ( $p=0,102$ ). Discussion Teams defeated call more for timeouts that the winners teams, and the 3thd team timeout is not considered in the majority of the games by the winning teams. The totality of timeouts possible is not always utilized (Taborsky & Sevim, 2004; Prudente, 2009). The teams call timeouts in the same periods of the game. There is no significant difference as winners and defeated teams call timeout and this result is influenced by the fact that a negative partial score is associated with the coach decision to request a timeout (Prudente, 2009). The greater the difference between goals scored and received at the end of the game larger the number of requests timeouts. However the analysis of the partial score obtained between the moments of the timeout requested and the post 5 ball possessions indicate that is no difference between the winning and the defeated teams, i.e., seemingly does not influence the final result. References Prudente, J., Lopes, H., Fernando, C. (2009). Colección Congresos, 9, Editorial altotrendimiento, Universidad de Coruña Taborsky, F., & Sevim, Y. (2004). Handball- Periodical for Coaches, Referees and Lecturers, 2, 10-27.

### **ANALYSIS OF PACING PROFILES BY MEANS OF MIXED LINEAR MODELLING: NEW INSIGHTS WITH AN ALTERNATIVE STATISTICAL APPROACH?**

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Introduction: Studies focusing on the stability of pacing from one competition to the next are mostly comparing absolute lap-times between two events. However, in this approach it might occur that the average split times are similar, although the individual athlete shows high variation between events. Therefore, another approach could be analysing the change score between the laps and defining the variance of these scores in different competitions. Furthermore, to estimate the variability in a change, general mixed effect modelling seems to be the proper analytical approach, since it provides modelling of variance and covariance. Hence, the aim of the study was the analysis of pacing pattern by calculating change scores and estimate the variability with mixed general modelling. Methods: Split times of 132 elite male swimmers (age:  $22.8 \pm 2.9$ y) in all 200m strokes (freestyle, butterfly, backstroke, breaststroke) in 2 competitions were downloaded from swimrankings.net. These data was used due to the large number of competitive events and the availability of these data from the internet. Pacing patterns were analysed using the change score between the laps in percent, by calculating the difference between every split time as percent of the preceding lap (e.g.  $\Delta$ lap 1-2 for the difference between split time 1 and 2). Variations of lap changes were analyzed with general mixed effect modelling, according to Vandenberg et al. (2012). Competition was included as fixed effect. The random effects were athlete's identity (between subject variability), lap time and residual (within-subject variability). An additional model was calculated including style and split time as random effects. Results: Mean lap change between competitions ranged between -13.4% ( $\Delta$ lap 1-2; 200m butterfly) and -0.5% ( $\Delta$ lap 5-6; 200m backstroke). The model provided estimates of other effects, as follows: within-athlete SD in lap change ranged between 0.9% and 2.6% (range in 90% CI: 0.8–3.2%), between-athlete SD among <0.001% and 1.8% (CI: < 0.001 and 5.3%). Furthermore, absolute lap time estimates 75%, the different strokes 12.9% of the lap change and residuals are 13%. Conclusion: Analyzing lap changes with mixed general modeling seems to improve the estimation of individual changes in pacing patterns, since within- and between-subject variations can be calculated. The models can, hence, be used as a powerful research design to analyze variations in pacing. The design provides outcomes that explain variation in lap changes more accurately and precise than traditional analysis, by providing random variables which are assumed to affect variability of the data. References Vandenberg TJ, Hopkins WG, Pyne DB (2012). Med Sci Sport Exerc

### **ORIGIN AND TARGET THROWS IN ELITE LEVEL GOALBALL**

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Introduction Goalball is a paralympic team sport that has been receiving growing attention of researchers worldwide, however few have focused on the match analysis of elite players. The knowledge of ball origin (OR) and target (TA) should help determining the most common places of action in the court, providing coaches essential information to organize their teams. The purpose of this study was to verify the OR and TA throws in elite level goalball. Methods Two evaluator with at least 3 years of goalball experience went through a comprehensive training to assure standardization of the observational assessment criteria (Anguera, 1999). The protocol consisted of scoring ball OR (first touch on the floor after throwing) and TA (crossing of defense line) to each attack. Starting from the right wing, both team and landing areas were divided in 6 sectors (SE) of 1.5m (width) and labeled 1 to 6. We analyzed 20 randomly selected matches, 10 per gender, from Beijing 2008 Paralympic Games. A total of 1491 women (W) and 1560 men (M) throws was investigated. Penalty shots were not recorded. The Kappa index for intra and interobserver reliability was 0.94 - 0.89 for OR and 0.95 - 0.91 for TA, respectively. Descriptive analysis was used to determine OR and TA incidence. Results OR incidence in W (SE): (1)24%, (2)18%, (3)8%, (4)11%, (5)17%, (6)21%; in M: (1)24%, (2)20%, (3)10%, (4)9%, (5)19%, (6)17%. TA incidence in W: (1)12%, (2)20%, (3)21%, (4)17%, (5)15%, (6)19%; in M (SE): (1)8%, (2)17%, (3)19%, (4) 20%, (5)17% and (6)12%. The balls thrown out was 7% in both genders. Discussion Our results shows higher OR incidence in the wing sectors for both gender, which was also reported by Amorim et al. (2010) from M European championships. It can be explained due to player position, as the wing players are usually responsible for offensive actions as confirmed by Mora (1993) with a M regional team. TA results demonstrate higher incidence of balls arriving in the central region of the team area (SE3 in W and SE4 in M) and decreases to the extremes. These findings corroborate the defensive balance concept proposed by Morato, Gomes and Almeida (2012). They suggested that teams should organize their defensive system with the wings closer to the center player and move like a triple block accordingly to the throwing OR. References Amorim M et al. (2010). REIFOP, 13(3), 47-57. Anguera MT (Ed) (1999). Barcelona: Edicions de La UB. Mora DH (1993). Barcelona: Revista do INEF. Morato MP, Gomes MSP, Almeida JGG (2012). Rev. Bras. Cienc. Esporte, 34(3), 741-760.

### **BETWEEN MATCH VARIABILITY IN PROFESSIONAL RUGBY LEAGUE COMPETITION**

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Introduction The purpose of this study was to assess between match variability of physical performance measures over both the total and sub sections of the match in professional rugby league competition. Methods Global positioning system (GPS) data were collected from 24 players from the same team competing in the National Rugby League (NRL) competition over 23 matches during 2011 season. The GPS

data were categorised into total distance, high-speed running (>15 km h<sup>-1</sup>) and very high-speed running (>21 km h<sup>-1</sup>) distance for discrete reference periods (10 min, 20 min, 40 min and 80 min). The data was then log transformed to provide the coefficient of variation (CV) and the between subject standard deviation (both expressed as percentages). Results The data show that the between match variability is greater for high-speed (CV 14.6 %) and very-high speed (CV 37.0 %) running compared to total distance (CV 3.6 %). Within each speed category, the variability of performance tended to increase as the duration of the reference period decreased. Conclusion While global measures of physical performance such as total distance are relatively stable, higher-speed activities exhibit a large degree of between match variability. In addition, when segmenting the match into short periods of time for analysis, all physical performance measures increased in variability. These findings have implications for determining sample size, identifying reliable performance measures and selecting appropriate time periods for future applied studies that involve observational match analysis.

### WHAT ACTUALLY HAPPENS IN JUNIOR RUGBY LEAGUE: GAME ANALYSIS ACROSS AGE GROUPS

Cotton, W., O'Connor, D.

*The University of Sydney*

Introduction Rugby League is a game played by over 30 nations around the world. In Australia, Rugby League has a strong junior base, with over 100,000 registered junior players. Despite this popularity very little is known about what actually occurs during the junior games. Therefore the aim of this study was to analyse the skills performed, the effectiveness of the performed skills and the errors made during junior Rugby League games and to compare these findings across 5 different age groups. Methods This study was conducted as part of the larger 2012 Rugby League Participation Pathways Review (Australian Rugby League Commission, 2012). This aspect of the review involved the systematic video analysis of 104 junior Rugby League games across 5 age groups: the under 8s, 9s, 10s, 11s and 12s. Forty five different variables were observed and coded for each game. To allow for game time variations, both within and across age groups, the number of variables per game was scaled to a 20min time period. A series of one-way ANOVA's were conducted to compare the variables across the age groups. Results Initial results suggest that there was a statistically significant difference at the  $p < 0.05$  level in the total skill opportunities that junior players have in a 20min period [ $F(6, 205) = 22.09, p = 0.000$ ]. Post hoc comparisons using the Tukey HSD test revealed that these total skill opportunities increased from the under 8s to under 10s, but then plateaued with under 11s and under 12s. A further breakdown of these results and the number and types of errors made will be provided during the presentation. Discussion The results of this study provided a deeper understanding of the skills performed and the number and type of errors made within specific age groups in junior Rugby League. The study also enabled comparisons to be made between age groups and to track how the number and type of skills and errors changed across age groups. This is perhaps the first vital step in obtaining reliable baseline data to inform future interventions and possible rule change experiments with the hope of maximising the true potential of all junior players. References Australian Rugby League Commission (2012) Rugby League Participation Pathways Review

### OFFENSIVE TECHNICAL TACTICAL VARIABLES THAT DISCRIMINATE BETWEEN WINNING AND LOSING TEAMS IN THE U17 WORLD CUP MEXICO 2011

Fritzler, W., Roldan, J., Manzano, J.A.

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Introduction The technical-tactical characterization of successful soccer teams allows the establishment of training objectives (Carling et al., 2005). Although research on tactical aspects has increased in recent years, there is little information on youth soccer. This justifies an exploratory study in order to identify some of the technical-tactical aspects that discriminate statistically between winning and losing teams in the U17 World Cup Mexico 2011 (WC). Methods Using video-analysis, a systematic observation of 10 games in the WC's second phase was conducted. Variables on shots on goal, crosses into the penalty box, corner and free kicks, and offensive duels in opponent's half were assessed. Each of the variables was analyzed by a trained expert, recording the frequency, main characteristics, and outcome of the actions. For statistical analysis, a database was created with details of all actions, grouped by winning and losing teams, regardless of what games were held. Differences were evaluated by testing hypotheses regarding differences in proportions (Hernandez et al., 2006). Results The players of winning teams shot at goal from shorter distances, but with the same overall efficiency as the losing teams. However, most often they shot from zones of greater efficiency. Winning teams crossed more often and with much greater efficiency. Losers crossed more on diagonal, while winners did it from the height of the penalty box. On corner kicks, winners manage to connect with a teammate in half of the cases, while losers only in a quarter, but with no significant difference in the frequency of these kicks. In free kicks, the efficiency of the winners was higher too, but without statistical significance. The offensive duel efficiency of the winners was significantly better, especially in the vertical direction. Winners won more duels in zones close to the goal than losers. Discussion Success in matches was related to the effective implementation of corner kicks, winning offensive duels, and vertical play to cross and shoot on goal. In terms of shots on goal, winning teams did not shoot better, but more often and from shorter distances, that increased the probability to score. In general, teams won their matches because they repeated more often those actions they perform more efficiently than losing teams. According to these conclusions, the offensive tactical training of youth teams should focus on the efficiency of corner and free kicks, on the ability to get closer to the goal by individual and group means, and on penetrating along the sideline before crossing. References Carling C, Williams AM, Reilly T (2005). Handbook of Soccer Match Analysis. London: Routledge. Hernandez R, Fernandez C, Baptista P (2006). Research Methodology (4th ed.; original in Spanish). Mexico: McGraw Hill.

### ANALYSIS OF THE ATTACK TEMPO IN DIFFERENT GAME-COMPLEX IN HIGH-STANDARD MEN'S VOLLEYBALL

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Introduction The tempo of the setting pass is a relevant factor for block construction and attack efficacy in high-standard volleyball (Alfonso & Mesquita, 2011; Buscà & Febrer, 2012). In modern volleyball, game is categorized in five phases (game-complex K1 to K5) taking the first ball contact of the team as a reference (Hileno & Buscà, 2012). In the second ball contact, the setter builds the attack of the team depending on the game-complex and the rally development. The aim of the study was to examine the differences in attack tempo between the different game-complexes. Methods 1418 actions were recorded and analyzed from a randomized sample of the 2010 Panamerican Cup male tournament, held in San Juan (Puerto Rico). Frame by frame analysis was performed to determine the attack tempo while attack was completed. To compare attack tempo means for different game complexes, the nonparametric two-sided Mann-Whitney U test for independent samples was used. All statistical analyses were performed using SPSS. Statistical significance was set at P

< 0.05. Results Mean time ( $\pm$ SD) of the attack tempo in K1, K2, K3, K4 and K5 were  $0.97\pm 0.37$ ,  $1.39\pm 0.34$ ,  $1.34\pm 0.40$ ,  $1.31\pm 0.25$  and  $1.06\pm 0.15$  s, respectively. We found significant differences between attack tempos in K1 and K2, K1 and K3, and K1 and K4 ( $p < 0.001$ ). Moreover, we found significant differences between K5 and K2, K5 and K3 and K5 and K4 ( $p < 0.001$ ). Discussion Performance and game structure are conditioned by the game-complex. Thus, a specific training for the different characteristics of each complex is required (Palao, 2001). In the present study, we didn't find differences between the attack tempos used in K1 and K5, by one side, and between K2, K3 and K4 by the other side. Therefore, training the attack tempo grouping K1-K5 and K2-K3-K4 could be a good strategy for attack performance improvement. Observing the attack tempo of K1 and K5, we didn't find significant differences of the mean values but different SD. This high level of dispersion could be explained by the differences in the quick tempos. In K5, quick tempos are played farther from the setter, respect K1 tendency. References Afonso, J., Mesquita, I. (2011). Determinants of block cohesiveness and attack efficacy in high-level women's volleyball. *Eur J Sport Sci*, 11(1), 69-75. Buscà, B., Febrer, J. (2012). Temporal fight between the middle blocker and the setter in high level volleyball. *Rev Int Med Cienc AC*, 12(46), 313-327. Hileno, R., Buscà, B. (2012). Observational tool for analyzing attack coverage in volleyball. *Rev Int Med Cienc AC*, 12(47), 557-570. Palao, J. M. (2001). Incidencia de las rotaciones sobre el rendimiento del ataque y el bloqueo en voleibol. Unpublished doctoral thesis, University of Granada, Spain.

### SHOOTING IN FOOTBALL: FAST OR SLOW, HOW TO DECIDE?

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Introduction Winning games in football is about scoring more than the opponent. But opportunities to score tend to scarce nowadays. And when they do happen they cannot be wasted. Therefore shooting is crucial. It is easy to admit that shooting players (mainly strikers) need to be fast to be successful (shoot with high speeds or dribble faster, for example). However, previous studies (e.g. Vicente et al., 2012) showed that there are time relations between players that must be taken into account in football. Players need to be aware of the opponent's actions (stimulus) and possibilities in order to take decisions and make the right choice. The aim of this study was to verify whether a correlation exists between the velocity of the stimulus in a shooting situation in football and the player's response. Methods We've used a software (MeSIRI.3) designed to measure the relation between the velocity of the stimulus and the time to respond it. The test was based on a stimulus - a goalkeeper (GK) - that moved from the center of the goal to each side at different velocities (1 and 3 meters per second (m/s) randomly). The players (55 university football players) had to press one of four matching letters in the keyboard, previously known, opposite to the goalkeeper displacement (B or V when GK moved right; N or M when GK moved left) for two possible ball velocities (B & N - 50km/h; V & M - 100km/h) for 20 trials. Each test data was automatically collected by the software which provided the response time (and correspondent direction and ball velocity) to each stimulus velocity. Results From the 1100 trials performed, the results showed that players took the right decision (ball to opposite GK displacement) in 86% of the situations. In those, for the fastest stimulus the average response time was 315 milliseconds (ms), and for the slowest stimulus the average time to respond was 362 ms. Players choose the faster ball velocity in 73% of the fastest stimulus, and 76% of the times the slowest ball speed in the parallel slowest stimulus. Discussion The results showed that the stimulus velocity influenced the response time and the response itself (shooting ball velocity). As the stimulus was faster or slower, the response was also faster or slower respectively; also as the stimulus was faster or slower, the ball velocity chosen was also faster or slower; which corroborates previous studies about penalty kick situations (Vicente et al., 2011) and other ecological studies that we are still carrying out. This may suggest that in shooting in football players should be trained to relate with the opponents being aware that they can influence their actions and their response time in order to take advantage and increase the efficiency in shooting. References Vicente A., Fernando C., Lopes H., (2012). 17th ECSS, Bruges. Vicente A., Lopes H., Fernando C. (2011). 7th WCSF, Nagoya.

### PASSING AND DRIBBLING PLAYS LEADING TO SCORING SHOTS AND SCORING CHANCES: ASSESSMENT OF OFFENSIVE PLAYS OF THE JAPAN NATIONAL TEAM IN THE 16TH FIBA WOMEN'S WORLD CHAMPIONSHIPS

Sakuragi, K., Aoyagi, O., Yaita, A.

*Fukuoka University*

Purpose Many kinds of passing and dribbling plays come before shooting the ball in basketball games. Some passing and dribbling plays effectively lead to scoring shots, whereas others contribute to scoring chances that do not result in a score. This study aimed to identify passing and dribbling plays that lead to scoring shots and scoring chances. Methods Sampled offensive plays included 1084 plays conducted by the Japan National Team during 6 games in which they competed with 6 teams at the 16th FIBA Women's World Championships. We examined the following offensive plays: 1) Forward pass moving the ball in the backcourt (fb), 2) Pass changing the side or angle to create a scoring opportunity in the backcourt (pb), 3) Pass to escape the risk in the backcourt (rb), 4) Before-shooting pass (sp), 5) Pass leading to a 1-on-1 situation (po), and so on. In addition, whether the players could make scoring shots (in/out) and whether the players could make scoring chances regardless of a scoring or failed shot (go/not) were examined. These 25 items were cross-tabled by "go/not" and "in/out." Chi-square test was applied to the cross-table, and an adjusted residual was computed if a significant difference was found. Relational trends were estimated considering significantly larger or smaller cells. Results In the cross-table crossed by "go/not" and 25 items, the cell crossed by "go" and the plays of sp, po, dp, da, lb, and or were significantly greater than values expected by marginal frequencies, and that of hp, db, th, pp, and cs were significantly less. The cell crossed by "not" and the plays of hp, db, th, pp, and cs were significantly greater than values expected by marginal frequencies, and that of sp, po, dp, lb, and or were significantly less. The frequencies of other cells were not significant. In the cross-table crossed by "in/out" and 25 items, the cell crossed by "in" and the plays of sp, po, dp, or, and ca were significantly greater than values expected by marginal frequencies, and that of pa was significantly less. The cell crossed by "out" and the plays of sp and dp were significantly greater than values expected by marginal frequencies, and that of pp was significantly less. The frequencies of other cells were not significant. Discussion The fact that the frequencies of "not" and db, pp, and cs were significantly lower indicated that these plays did not lead to scoring shots, even though they are used frequently. For example, in the case of db, it should not be used frequently, and is most successful when used only once. The significant relationship between "in" and ca indicated that when ca was observed, even only once during a game, the defense had already broken their defensive line, so this pass was considered to result in better conditions for a scoring shot.

15:00 - 16:00

## Mini-Orals

## PP-PM32 Nutrition [NU] 6

**A SIX MONTH PROGRAM OF PHYSICAL ACTIVITY AND NUTRITIONAL EDUCATION CAN IMPROVE PARAMETERS RELATED TO HEALTH IN CHILDREN.**

Muros, J.1, Zabala, M.2, Morente, J.2, Molina-López, M.1, Oliveras-López, M.J.3, Knox, E.4, López-García de la Serrana, H.1  
 1.University of Granada 2.University of Granada 3.University of Seville 4.University of Loughborough (UK)

**Introduction** Lipid profile is an important predictor of morbidity and mortality, and some studies have shown that it can be optimized by means of physical activity and nutrition programs. The aim of our study was to determine the effects of nutritional education and vigorous extracurricular physical activity both individually and in combination on the lipid profile in children. **Methods** The sample group consisted of 88 children (9-11 years) divided between three groups: 41 students in the control group (G0), 28 students in the physical activity group (G1), and 18 students in the physical activity and nutritional education group with additional substitution of normally used oil for EVOO (G2). The moderate-to-vigorous physical activity intervention program was carried out over 6 months using two weekly lessons of 60 minutes. G2 completed 6 sessions of nutrition education alongside their parents, which lasted approximately 2 hours each. In addition each pupil's parent received 2 liters of EVOO per week in the last month of intervention. The following measurements were taken: glycemia (GL), total cholesterol (TC), HDL cholesterol (cHDL), LDL cholesterol (cLDL), triglycerides (TG), systolic blood pressure (SBP) and diastolic blood pressure (DBP). We performed T tests and Wilcoxon tests for two related samples to compare blood composition, blood pressure, and dietary changes. DietSource 3.0 was used to evaluate macronutrients. All analyses were conducted using the SPSS 19.0 statistics package. Results SBP increased in G0 and decreased in G1 and G2 ( $p < 0.01$ ). DBP increased in G0 and decreased in G1 and G2, with significant reductions in G1 ( $p < 0.05$ ). G1 and G2 achieved reductions in GL ( $p < 0.05$ ) and TC ( $p < 0.05$ ). G2 was the only group showing significant changes in HDL ( $p < 0.05$ ). The LDL level increased in G0 and decreased in G1 and G2 ( $p < 0.01$ ). TG showed a reduction in G1 and G2 ( $p < 0.05$ ) while G0 did not show significant changes. Throughout the intervention, G2 experienced changes in calorie profile, making it more congruent with the Spanish recommended levels. At post-test G2 showed reductions in cholesterol ( $p < 0.01$ ) and fats ( $p < 0.01$ ), and increases in carbs ( $p < 0.01$ ). **Conclusions** Previous studies have shown that level of aerobic fitness in children is inversely associated with body fatness, impairment of several cardiovascular disease risk factors and hypertension (Runhaar et al., 2010). Our research shows that the pupils who increased their vigorous physical activity also experienced reductions in body fatness, SBP and DBP, and parameters related with cardiovascular risk e.g. CT, c-LDL and TG. Interestingly, aerobic fitness level is still not well recognized as a screening tool in pediatric populations. **References** Runhaar J, Collard DC, Singh AS, Kemper HC, van Mechelen W, Chinapaw M. (2010) *J Sci Med Sport*.13(3):323-8.

**A 6 MONTH PROGRAM OF PHYSICAL ACTIVITY AND NUTRITIONAL EDUCATION CAN IMPROVE THE ANTHROPOMETRIC PROFILE OF CHILDREN.**

Muros, J.1, Zabala, M.2, Sánchez-Muñoz, C.2, Garzón, M.2, Oliveras-López, M.J.3, Knox, E.4, López-García de la Serrana, H.1

1. University of Granada 2. University of Granada 3. University of Seville 4. University of Loughborough (UK)

**Introduction** Physical inactivity is considered to be one of the main threats to public health of the 21st century (Blair., 2009) and nutrition has been labeled as one of the main modifiable determinants of chronic diseases (WHO., 2003). The aim of our study was to determine the effects of nutritional education and vigorous extracurricular physical activity both individually and in combination on anthropometric parameters in children. **Methods** The sample group consisted of 88 children (9-11 years) divided between three groups: 41 students in the control group (G0), 28 students in the physical activity group (G1), and 18 students in the physical activity and nutritional education group with additional substitution of normally used oil for EVOO (G2). The intervention program was carried out over 6 months. G1 received two 60 minute lessons a week of moderate-to-vigorous physical activity. G2 received 6 sessions of nutrition education alongside their parents, which lasted approximately 2 hours each. In addition each pupil's parent received 2 liters of EVOO per week in the last month of intervention. The following measurements were taken: height, weight, skinfolds (triceps, biceps, subscapular, suprailiac, supraspinal, abdominal, thigh, and calf), perimeters (waist, hip, relaxed biceps, flexed and contracted biceps, thigh and calf), and diameters (bicondylar humerus, bistoloid and bicondylar femur). We performed T tests and Wilcoxon tests for two related samples to compare anthropometric parameters changes. All analyses were conducted using the SPSS 19.0 statistics package. Results All groups experienced an increase in weight between the pre- and post-test with G0 experiencing the greatest increase ( $p < 0.001$ ). BMI significantly increased in group G0 only ( $p < 0.01$ ). G0 showed a significant increase in the sum of the 8 skinfolds and in fat percentage at post-test. Conversely, we observed a significant decrease in the sum of the skinfolds and fat percentage in G1 and G2. At the same time these groups significantly increased their muscle percentage ( $p < 0.01$ ). G1 and G2 experienced significant decreases in waist circumference and waist-hip ratio (WHR). **Conclusions** A child can improve their body composition with no significant reduction in weight or BMI (DeStefano et al., 2000). This may have occurred during the present study as no significant changes in BMI were detected yet weight increased. We therefore suggest that other body composition indices may be more appropriate for use in future studies. **References** DeStefano RA, Caprio S, Fahey JT, Tamborlane WV, Goldberg B. (2000). *Pediatr Diabetes*. 1:61-5. Blair SN. (2009). *Br J Sports Med*. 43:1-2. World Health Organisation. (2003). Technical Report Series no. 916. Geneva: WHO.

**ENERGY BALANCE DURING AN ULTRA-ENDURANCE TRIATHLON**

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**Introduction** The popularity of ultra-endurance triathlon (UET) races (3.8-km swim, 180-km cycle, 42.2-km run) has greatly increased since the first Ironman was held in 1978. The primary determinant of success is the ability to sustain a high rate of energy expenditure (EE) for

prolonged periods of time (O'Toole & Douglas, 1995). We could find only one study reporting data from real competition (Kimber et al., 2002), though lacking direct assessment of the swimming section. This study aimed to provide the first comprehensive characterization of the energy balance during real competition in male triathletes during a complete UET race. Methods Eleven well-trained non-professional ultra-endurance triathletes (mean  $\pm$  SD: age  $36.8 \pm 5.1$  years, mass  $75.5 \pm 6.4$  kg, height  $174 \pm 6$  cm, BMI  $24.8 \pm 1.7$  kg/m<sup>2</sup>, VO<sub>2</sub>max  $66.9 \pm 4.1$  mL•kg<sup>-1</sup>•min<sup>-1</sup>) competed in the Extreme Man Salou-Costa Daurada UET 2011. EE was estimated from heart rate (HR) recordings during the race (Polar RCX5), using the individual HR-VO<sub>2</sub> regressions developed from three incremental tests on the cycle ergometer (Excalibur Sport, Lode, Netherlands), running treadmill (h/p/Cosmos Pulsar, Germany), and 50-m swimming pool. VO<sub>2</sub> was measured using a portable gas analyser (K4 b2, Cosmed, Italy). An observational design, which included weighing and recording all food and fluid ingested and posterior nutritional analysis, was used to assess the energy intake (EI) during the race. Results Mean competition time was  $755 \pm 69$  min at an average HR of  $137 \pm 6$  beats/min. Mean EE ( $46.1 \pm 2.8$  MJ,  $11,009 \pm 664$  kcal) was significantly greater than EI ( $16.9 \pm 4.8$  MJ,  $4,043 \pm 1,141$  kcal;  $P < 0.001$ ). Mean EE rate was  $3.8 \pm 4.8$  MJ/h ( $738 \pm 69$  kcal/h). Energy deficit was  $37 \pm 0.1\%$  of total EE. Solid food provided 83% of EI, and fluids the remaining 17%. Discussion Both total EE and EI were greater than previously reported by Kimber et al. (2002) during an Ironman race (42.0 and 15.5 MJ, respectively), but energy deficit was smaller (40%). Compared to data on a 24-h cycling race competitor (Bescós et al. 2012), EE and EI were smaller (65.0 and 23.3 MJ, respectively), but EE rate was greater (2.7 MJ/h), resulting in a similar energy deficit (36% of EE). Our results confirm the high energy demands of UET races, which are not compensated by nutritional and fluid intake, resulting in a large energy deficit and dehydration which is likely to lead to early fatigue and impaired physical performance, particularly at the end of the race. References O'Toole ML, Douglas PS. (1995) *Sports Med* 19(4), 251-267. Kimber NE, Ross JJ, Mason SL, Speedy DB (2002). *Int J Sport Nutr Exerc Metab* 12(1), 47. Bescós R, Rodríguez FA, Iglesias X, Knechtle B, et al. (2012) *Proc (Bayl Univ Med Cent)* 25(2), 124-128.

### INFLUENCE OF ACID OR ALKALINE FORMING NUTRITION ON PHYSICAL PERFORMANCE AT MODERATE ALTITUDE

Limmer, M., Platen, P.

*Ruhr-University Bochum*

Introduction Exposure to moderate and high altitude induces alterations in the acid-base balance which interfere with physical performance. The present pilot study was conducted to examine the effects of acid or alkaline forming nutrition on physical performance during moderate altitude exposure by the analysis of parameters of the aerobic and anaerobic energy metabolism and on acid-base blood and urine parameters. Methods 12 moderately trained, healthy adults (n=10 males; n=2 females) were exposed to moderate hypobaric altitude (MA, 2434 m to 3772 m) for seven days. Physical performance at altitude was compared between two groups consuming different types of nutrition: ALK (n=6) consumed mainly alkaline forming and ACID (n=6) acid forming nutrition. In order to assess anaerobic and aerobic performance all subjects performed a 15 s skipping test (SKIP) and a modified mCAFT (STEP) to maximal exertion pre MA, during MA and post MA, respectively. Blood acid-base parameters (pH, saO<sub>2</sub>, [HCO<sub>3</sub>]<sup>-</sup>, pO<sub>2</sub>, pCO<sub>2</sub> and ABE) were determined in morning and pre- and post- exercise capillary blood samples. Urine pH values were controlled daily in early morning, post-exercise and evening spontaneous urine samples (pHu). The parameters maximal lactate production rate (VLamax) for SKIP and step frequency, heart rate, RPE value and sO<sub>2</sub> at 2 and 4 mmol/l lactate for STEP were calculated for each subject. Statistical analysis was performed using repeated measures ANOVA and Student's t-test. Results Urine pH showed significantly higher values for ALK versus ACID and declined significantly at MA (morning pHu:  $6.18 \pm 0.55$  to  $5.47 \pm 0.41$ ; evening pHu:  $6.88 \pm 0.74$  to  $5.85 \pm 0.52$ ). No significant difference was found between ACID and ALK in aerobic and anaerobic performance as well as in blood acid-base status. For the total group, VLamax and [HCO<sub>3</sub>]<sup>-</sup> decreased significantly at moderate altitude exposure (VLamax  $0.76 \pm 0.10$  to  $0.60 \pm 0.12$  mmol/l/sec; [HCO<sub>3</sub>]<sup>-</sup>  $25.2 \pm 3.8$  to  $20.0 \pm 1.4$ ) whereas maximum performance during STEP increased after MA ( $120.7 \pm 12.2$  to  $132.2 \pm 9.8$  bpm). Discussion and Conclusions As expected, aerobic performance improved after MA but maximum lactate production rate declined continuously during MA. ACID or ALK did not affect anaerobic or aerobic performance during moderate altitude exposure. The modification of nutrition had a clear impact on urine pH values indicating the influence of the dietary intervention on acid-base homeostasis, however it did not significantly affect blood pH values or bicarbonate concentration.

### ENERGY SUBSTRATE UTILISATION DURING ENDURANCE EXERCISE AFTER 5 DAYS ON HIGH CARBOHYDRATE WITH HIGH AND LOW GLYCAEMIC INDEX DIETS

Hamzah, S.

*University of Malaya*

Introduction Several studies have suggested that glycaemic index (GI) of single high carbohydrate (CHO) meal consumed few hours prior endurance exercise and of mixed high CHO meals during 24 hours recovery between bouts of prolonged exercise might influence energy substrate utilisation (Wu et al., 2003; Trenell et al., 2008). However, limited evidence suggests that energy substrate selection is not influenced by the GI of high CHO diets consumed for 3 days (Chen et al., 2008). The aim of this study was to determine whether the utilisation of energy from fat and CHO during run in the fasted state is influenced by the GI of high CHO diets consumed over 5 days. Methods 9 healthy physically active men and 9 healthy physically active women performed three treadmill runs at 65% of maximum oxygen consumption for 90 min after their habitual diet (Control trial), after 5 days on a high CHO high GI diet (HC-HGI trial), and after 5 days on high CHO low GI diet (HC-LGI trial), in a randomised counterbalanced order. Expired air samples for rates of fat and CHO oxidation measurements and blood samples for glucose, insulin, glycerol and non-esterified fatty acids (NEFA) measurements were obtained at 15, 30, 45, 60, 75, 90 minutes. Statistical analyses were conducted using one-way and two-way ANOVA with a Tukey post hoc test to allocate the differences (Statistica for Window version 6.0). Significance was set at  $P < 0.05$ . Results In men and women, GI of the HC-HGI diet was significantly higher ( $P < 0.001$ ) than HC-LGI diet. The GI in the HC-HGI diet was significantly higher ( $P < 0.001$ ) and GI of the HC-LGI diet was significantly lower ( $P < 0.001$ ) than in the habitual diet. During 90 min run, no significant differences were observed in the rates of fat and CHO oxidation, concentrations of plasma glucose, insulin, glycerol and NEFA between the HC-HGI and HC-LGI trials in both men and women. In comparison to Control trial, in men concentrations of plasma glycerol and rate of fat oxidation were lower ( $P < 0.05$ ) and rate of CHO oxidation was higher ( $P < 0.05$ ) in both the HC-LGI and HC-LGI trials during 90 min run. However in women, plasma glycerol concentration was significantly lower ( $P < 0.05$ ) in both high CHO trials while the rate of fat oxidation was significantly lower ( $P < 0.05$ ) only in the HC-LGI trial. Discussion The consideration of the GI of high CHO diets consumed by the physically active men and women for 5 days had no impact on energy substrate utilisation during endurance running conducted in the fasted state. References Wu CL, Williams C (2006). *British J Nutrition*, 90, 1049-1056. Trenell MI, Stevenson E, Stockman K, Brand-Miller J (2008). *British J Nutrition*, 99, 326-332. Chen Y, Wong SHS, Xu X, Hao X, Wong CK, Lam CW (2008). *Int J Sports Med*, 29, 598-606

### **ELITE SYNCHRONIZED SWIMMERS DISPLAY LOW ENERGY AVAILABILITY AND DO NOT INCREASE FOOD INTAKE DURING INTENSIFIED TRAINING**

Schaal, K., Le Meur, Y., Rebeyrol, J., Louis, J., Casazza, G., Petit, O., Hellard, P., Hausswirth, C.

*National Institute of Sport, Expertise and Performance*

**INTRODUCTION:** Female athletes specializing in sports which emphasize leanness as a key to successful performance often display low energy intake (EI) relative to daily energy expenditure (I). Elite synchronized swimmers endure high volume, high intensity training regimen while facing the pressure of an aesthetic, judged sport; and may be particularly prone to presenting low EI despite intense physical training. This study aimed to quantify changes in the energy availability, (EA, defined as EI – energy expenditure of exercise, ExEE) of elite synchronized swimmers through a typical pre-competition period. We aimed to describe whether EA would decrease below 30 kcal/kg of lean body mass (LBM)/day during IT, a threshold amount below which normal metabolic and hormonal functions become suppressed, in a dose-dependent manner, in order to conserve energy (2,3). **METHODS:** After 1 week of normal training (BASE), 10 elite synchronized swimmers entered a 4-week phase of high intensity training (IT), during which ExEE was increased by 25%. Swimmers wore a heart rate monitor for all exercise sessions during BASE and during the first week of IT to assess ExEE. All subsequent weeks of IT were programmed similarly. Dietary analysis was performed over 4 consecutive days during BASE and at the end of IT using photographs of all meals pre- and post-consumption. Fasted, waking saliva samples were obtained on the first and last day of each week to measure salivary cortisol [Cs] and leptin [Ls] concentrations. Body composition was measured at BASE and IT week 4 using 7-site skinfolds. **Results:** While the IT phase induced a 25% increase in weekly ExEE (21.5±2 vs 26.8± 1.6kcal/kgLBM/day), swimmers did not alter energy intake significantly (44.4±10.9 vs 42.1±2.0 kcal/kgLBM/day during BASE and IT, respectively). Consequently, mean EA decreased from 26.8±3.4 at BASE to 19.9±4.5 kcal/kgLBM/day. [Ls] decreased significantly (-23.7±9.9%), along with body fat percentage (17.3±0.6% vs 16.4± 0.6%), suggesting a state of energy conservation. [Cs] increased significantly from beginning to end of each intensive week, but returned to baseline after 2 days of rest while [Ls] remained suppressed. **CONCLUSION:** During normal training, elite synchronized swimmers display a baseline EA slightly below the previously defined threshold of 30 kcal/kgLBM/day (I), below which signs of energy conservation, including reduced resting metabolic rate, suppressed ovarian function and impaired bone turnover have been reported (1,2). Importantly, the swimmers' failure to increase energy intake during IT, resulting in significantly lower EA, warrants further investigation into the consequences this may have on training adaptations and fatigue in the short term, and on health aspects, such as bone health, in the longer term. 1 Hausswirth and Le Meur (2011) *Sports Med.* 41(10):861-882 2 Loucks et al (2003) *J Clin Endocrinol Metab.* 88(1):297-311. 3 Ihle and Loucks (2004) *J Bone Min Res.* 19(8) 1231-1240.

### **EATING ATTITUDES, HEALTH AND NUTRITION HISTORY AT KING SAUD UNIVERSITY**

Kamel, K.

*King Saud University*

**Introduction:** The EAT-26 has been particularly useful a screening tool to assess 'eating disorder risk' (Garner, Rosen and Barry, 1998). More information collected in health and nutrition history helps nutrition professionals make a thorough assessment of the individual needs and subsequently develop a nutritional program. The purpose of the present study was to estimate two stage screening an eating attitudes, health and Nutrition history for employees and student at King Saud University (KSU). **Methods:** A representative sample of (KSU) Male and Female Employees (N= 123); (N= 64) with mean age (35.9 + 11.2); (30.2 + 6.8) respectively, and Male and Female student (N= 152); (N= 110) with mean age (23.9 + 5.8); (21.7 + 4.0) respectively, were screened using the Arabic version of the EAT-26, and interviewed by a Health and Nutrition History Questionnaire (HNHQ) in order to determine if Male and Female employees and student at King Saud University have an eating disorder risk that needs professional attention. **Results:** Of the total sample, 36.7% were identified as having abnormal eating attitudes. In terms of occupation the Female Employees were found to have the significantly highest rate (56.2%) of positive EAT-26 scores. The mean body mass index (BMI) for Male and Female employees was (31.7 + 6.9); (28.6 + 4.7), and for Male and Female student was (27.6 + 6.5); (27.5 + 6.3) respectively. Of the total sample, 71% reported that they consider themselves overweight, 66% would like to lose weight, 32% have been on a diet for weight loss, and only 16% are currently engaged in an exercise program for 1.8 days per week, 75 minutes light to moderate intensity. **Conclusion:** The Arabic version of the EAT- 26 was found to be a useful tool for screening and identifying eating disorder risk, and there is a need for developing a nutritional and physical activity program for both male and female employees and student at King Saud University.

### **EFFECT OF NUTRITIONAL EDUCATION PROGRAM ON ADHERENCE TO DESIRABLE DIETARY BEHAVIOR IN ELITE ADOLESCENT FOOTBALL PLAYERS**

Urara, S.

*Meiji Co., Ltd.*

**Introduction** It is important for adolescent football players to develop the requisite dietary habits for improving their physical performance and growth. However, there is a lack of effective instructional methods to achieve this goal. In this study, we developed a nutritional education program for elite adolescent football players and evaluated its effect on adherence to desirable dietary behavior. **Methods** This educational program was provided to 23 U-15 elite football players for one year using the print media. The program consisted of a 5-item quiz on the desirable diet for youth football players. This paper was offered every other Wednesday. During nutritional intervention, the lecture for adherence to desirable eating behavior was held 3 times. For their parents, written information on diet and nutrition was provided every other week. After one year, eight of the 23 players (35%) moved on to the next category (U-18) in the same team (Grp 1), and others went to another team because they were eliminated from the selection (Grp 2). Only the subjects in Grp 1 continued to provide information as per the education program in the next year. Twelve of the 23 subjects (52%) completed the self-administered questionnaire consisting of stage of change, decisional balance, self-efficacy, behavioral skills, and social support for proper diet before T1 intervention, immediately after T2 intervention and six months after the T3 intervention program. Data was analyzed using two-way repeated measures ANOVA, and the differences were considered significant when  $p < 0.05$ . **Results** Distributions of stage of change for desirable diet in both groups were not significantly different. Two-way repeated measures ANOVA results indicated that the score of pros, which was a predictor of benefit of changing, self-efficacy, and behavioral skills, was not significantly different between both groups. In Grp 1, the score of cons, which was a predictor of cost of changing at T3, was significantly lower than that at T1. However, this difference was not observed in Grp 2. In Grp 2, the score of social support at T3 was lower than that at T2, but not significantly. **Discussion** These results suggested that the nutritional education program was effective for adherence to desirable dietary behavior. During the intervention

period, distributions of stage of change in later stage increased in both the groups. In Grp 2, distribution of stage of change was maintained through the six month follow-up period. A decrease in the score of social support and increase in the score of cons was observed in this period. Thus, these predictors might be indicators of transition from an early stage of change to a later stage for desirable diet. Reference Sakai K, Ohta A, Sugiura K, Akamatsu R. (2009). JSHEP, 17(4), 248-256 (in Japanese).

### **ANTHROPOMETRIC PARAMETERS AND NUTRITIONAL INDICES IN CHRONIC DISEASE - PERITONEAL DIALYSIS PATIENTS**

Pajek, J., Bren, A.F., Lindic, J., Bucar Pajek, M.

*University Medical Centre Ljubljana and Faculty of Sport, University of Ljubljana*

**INTRODUCTION** Nutritional status is of critical importance in chronic human disease. It crucially influences physical performance and outcome. Patients on dialysis are one of the best examples of long-term chronic disease. They are daily exposed to glucose load because of glucose contained in peritoneal dialysis (PD) solutions. Several markers of nutrition are available, however many of them have not been validated in the peritoneal dialysis population. Aim of this cross-sectional study was to explore the validity of anthropometric measurements in dialysis patients in relation to standard biochemical parameters of nutrition and to evaluate the impact of peritoneal glucose absorption on nutritional indices. **METHODS** Twenty-three stable patients (9 women) treated with PD were included, their average age was  $54 \pm 12$  years and PD duration was  $28 \pm 25$  months (range 3-81). Exclusion criteria were malignant disease, chronic or acute inflammatory disease, immunosuppressive therapy or recent (less than 3 months) peritonitis. At the regular office visit anthropometric, clinical and laboratory parameters were measured and peritoneal equilibration test was performed which allows the calculation of normalized protein catabolic rate (nPCR). Daily peritoneal glucose exposure and absorption were determined. Using the mid-upper arm circumference and triceps skinfold thickness (TST), the fat-free mid-upper arm surface area (FFSA) and mid-upper arm fat surface area (FSA) were calculated and normalized to  $1.73 \text{ m}^2$  body surface. **RESULTS** Median BMI (range) was 25 (19-30,6) and median values of laboratory parameters were: serum albumin 40 g/l (31-48), high sensitive (hs) CRP 3,37 g/dl (0,24-13,9), total cholesterol 4,8 mmol/l (2,9-7,2), triglycerides 2,1 mmol/l (1-4) and nPCR 0,96 g/kg/day (0,6-1,5). FFSA showed borderline correlation ( $r=0,37$ ,  $p=0,08$ ) with nPCR and no significant correlation with daily glucose exposure or absorption, protein or albumin levels. Albumin and protein levels correlated significantly positively with nPCR and significantly negative correlation was found with hypervolemia and total  $\text{CO}_2$  level (a marker of acidosis). FSA showed significant correlations with triglyceride level ( $r=0,56$ ,  $p=0,006$ ) and borderline correlation with total cholesterol ( $r=0,38$ ,  $p=0,074$ ). Similar results were found for TST. BMI correlated significantly with triglyceride level ( $r=0,45$ ,  $p=0,03$ ) and phosphate ( $r=0,41$ ,  $p=0,05$ ), but not with total cholesterol level. **CONCLUSION** Our results show that TST or FSA are significantly associated with triglyceride levels and as such may be useful in assessing caloric over-nutrition especially as a follow-up parameter. FFSA was statistically borderline related to nPCR as a marker of protein intake. Surveillance of anthropometric indices FSA and FFSA may be useful for long-term management of PD patients. In this study no impact of peritoneal glucose exposure or absorption could be found on protein malnutrition or caloric over-nutrition.

### **A CASE STUDY OF THE NUTRITIONAL PRACTICES OF CLUB LEVEL CYCLISTS BEFORE AND DURING A CYCLOCROSS RACE**

Dixon, D.

*University of East London*

**Introduction** Cyclo cross is an outdoor winter sport consisting of a closed circuit that is 2.5-3.5km long and includes rough terrain, forest paths, steep, muddy hills and man-made obstacles (British Cycling, 2011). This study investigated the pre- and during-race dietary intake of club-level cyclocross cyclist and its effects on performance. **Methods** Eleven male cyclists (age:  $42 \text{ s} \pm 4$  years, stature:  $1.78 \text{ s} \pm 0.08 \text{ m}$ , mass:  $73.2 \text{ s} \pm 9.3 \text{ kg}$ ) took part in this dietary survey and completed a 3-day food and training diary in the days leading up to a field-based cyclocross race (Havemann & Goedecke, 2008). Finishing time was used to measure performance. Mean energy intake (EI), energy expenditure (EE), energy balance and macronutrient intake was calculated for each day. These variables were each compared between days using repeated measures ANOVA with post-hoc Bonferroni adjustment. Pearson correlation was used to identify any relationships between performance and macronutrient intake. Paired samples t-tests were used to compare EI and EE and statistical significance was set at  $P \leq 0.05$ . Results EI was significantly greater 1 day before the race than EE ( $P=0.031$ ), while EI was significantly lower than EE on race day ( $P=0.000$ ). Mean carbohydrate (CHO) intake during the 3 days before the race was  $5.1 \text{ s} \pm 1.7 \text{ g.kg}^{-1} \text{ BM}$  and at the lower limit of the recommendations of 5-7  $\text{g.kg}^{-1} \text{ BM}$  for endurance athletes. Pearson correlation revealed a strong negative relationship between average CHO intake ( $\text{g.kg}^{-1} \text{ BM}$ ) before the event and race time ( $r=-0.821$ ;  $P=0.024$ ). **Conclusion** The results suggest that there appears to be a lack of nutritional strategy amongst cyclist and gaps in their nutritional knowledge were also highlighted (Worme et al., 1990). Thus, the nutritional knowledge of sub-elite athletes must be developed. **References** British Cycling (2011) Cyclo Cross Specific Regulations. [Online]. Havemann, L., Goedecke, J.H. (2008) IJSEM, 18, pp. 551-566. Worme, J.D., Doubt, T.J., Singh, A., Ryan, C.J., Moses, F.M., Deuster, P.A. (1990) AJCN 51, pp. 690-697.

### **NUTRITIONAL PREPARATION OF IRONMAN TRIATHLETES**

Mc Enery, I., Jawadwala, R.

*University of Chester*

**Purpose** 1. To monitor the energy intake (EI) and energy expenditure (EE) of a group of triathletes as they prepare for an Ironman (IM) race. 2. To establish and compare the composition as a percentage and grams per kilogram of bodyweight ( $\text{g.kg}^{-1}$ ) of carbohydrates (CHO), fat and protein and intakes of key micronutrients, iron and calcium. 3. Compare results to the current sports nutrition recommendations. **Method** A longitudinal study design was adopted. Seven day diet diaries, physical activity diaries and training data were used to establish their EI and EE. Five male athletes took part in the study, whose experience of training for an IM race varied from beginners to completing 11 IM races. A case study approach was carried out on each participant, where their EI v's EE was assessed. **Results** The average composition of macronutrients of each participant's diet was 49.84% CHO, 14.87% Protein, and 33.27% fat. When expressed as  $\text{g.kg}^{-1}$  of their body weight CHO was  $4.48 \text{ g.kg}^{-1}$  and protein was  $1.29 \text{ g.kg}^{-1}$ . The average intake of iron and calcium was 16.23 mg and 1276.24 mg. The average EI for the monitoring period was 19706.73 kcal/week and ranged from 17383.33 kcal – 21333.34 kcal/week. The average EE was 25657.03 kcal/week and ranged from 20057.48 – 30673.19 kcal/week. There was a gradual decline in EI over the monitoring period even in the light of increases in EE. **Conclusion** The percentage composition of macronutrients in the participant's diet was more

representative of the recommendations for the general public. However when expressed as g.kg<sup>-1</sup> of bodyweight the intake of CHO and protein were more representative of the current sports nutrition guidelines.

### EXERCISE-INDUCED ANOREXIA IN OBESE TEENAGE GIRLS

Lofrano-Prado, M., Tenório, T.R.S., Calazans, C.T., Barros, T.A.T., Hill, J.O., Prado, W.L.

*University of Pernambuco*

**Introduction** Increasing physical activity is a common strategy to weight loss. However the negative energy balance imposed by exercise may stimulate compensatory eating behaviors which could contribute to countering the exercise-induced energy deficit. The changes in energy intake following exercise may be dependent on changes in circulating appetite-regulating peptides. The aim of this study was to examine the acute effects of aerobic exercise on hunger, leptin, PYY and 24-h energy intake (EI) in obese adolescents. **Methods** This is a crossover study. Nine obese teenage girls (age: 13-18y, BMI: 33.74 + 4.04 Kg/m<sup>2</sup>) randomly underwent two experimental trials: 1) Control, seated for 30 min; and 2) Exercise - exercise at 10% above ventilatory threshold I. Subjective hunger, leptin and PYY were assessed at baseline, immediately after the session and after 2 hours. Afterwards 24h EI was estimated. **Results** After the control session there was an increase in hunger that was accompanied by a reduction in leptin levels; After exercise session, no changes were found for hunger or leptin levels, but there was an increase in PYY (p=0.000) and in protein and carbohydrate intake. **Discussion** The results from this study provide new evidence that the hunger feelings is response to aerobic exercise may be modulated by maintenance of leptin and by increases on PYY levels. However, this transient anorexigenic effect can be reversed by a compensatory increase in carbohydrate and protein intake over the following 24 hours. It is suggested that high intensity exercise reduces the neuronal brain response in food reward brain regions which have a central role in the regulation of eating behavior, in a direction expected to decrease food intake (Evero, 2012). Aerobic exercise improves the central action of some appetite-regulating hormones increasing the responsiveness of the AMP-activated protein kinase (AMPK) and mammalian Target of Rapamycin (mTOR) pathway, contributing to appetite suppression (Ropelle, 2008). In addition, aerobic exercise can make the blood-brain-barrier more permeable to plasma proteins (Hollmann, 2000), as well as to increase leptin receptors binding and leptin gene expression in the arcuate nucleus (Patterson, 2009). Based on these results we suggest that aerobic exercise performed at high intensity induces acute anorexia in obese girls. **References** Evero N, Hackett LC, Clark RD, Phelan S, Hagobian TA. Aerobic exercise reduces neuronal responses in food reward brain regions. *J Appl Physiol* 2012; 112:1612-1619. Ropelle ER, Fernandes MF, Flores MB, Uemo M, Rocco S, Marin R, et al (2008). *PlosOne*, 3: e3856. Hollmann W, Struder HK (2000). *Orthopade*, 29: 948-956. Patterson CM, Bouret SG, Dunn-Meynell AA, Levin BE (2009). *Am J Physiol Regul Integr Comp Physiol*, 296: R537-548.

### THE EFFECTS OF HIGH INTENSITY AEROBIC TRAINING ON FOOD INTAKE IN OBESE ADOLESCENTS ARE MEDIATED BY CHANGES IN PYY LEVELS

Prado, W.L., Gomes, P.P., Freitas, C.R.M., Souza, V.H., Silva, H.J.G., Hill, J.O., Lofrano-Prado, M.C.

*University of Pernambuco*

**Introduction** Physical exercise is a key component of obesity therapy. However the current literature provides very few data regarding the impact of aerobic exercise training on energy intake and peptides involved in central control of food intake in obese adolescents. The aim of this study was to compare the effects of high intensity (HIT) vs. low intensity (LIT) aerobic training on food intake and on anorexigenic and orexigenic hormones in obese adolescents. **Methods** Randomized exercise intervention study. Fortythree obese adolescents (age: 15.72±1.34y, BMI: 34.3±4.1kg/m<sup>2</sup>) participated in a randomized trial of either HIT (above ventilatory threshold I -VTI) or LIT (20% below VTI) for 12 weeks. HIT and LIT sessions were isocaloric (energy expenditure set at 350 kcal). All participants received the same nutritional, psychological and clinical counseling. At baseline and after 12 weeks (12 w) of intervention insulin, leptin, PYY3-36, total ghrelin and food intake were assessed. **Results** Adolescents in the HIT reported a significant reduction in energy intake (p=0.020) and increase in PYY values (p=0.048). Ghrelin values were reduced in both LIT (p=0.001) and HIT (p=0.050) groups. A negative correlation between changes on energy intake and PYY was observed for adolescents participating in HIT (r= -.548; p=0.023). **Discussion** These data provide new evidences that high intensity aerobic training may be able to inhibit food intake in long-term, and that this decrease is mediated by changes in PYY levels. It has been suggested that increased energy expenditure through aerobic exercise, results in no detectable acute increase in energy intake in obese children (Moore, 2004; Dodd, 2008). Alternatively, Thivel et al. (2012) showed that high intensity exercise (75% VO<sub>2</sub>max) promotes a pronounced reduction in 24 hours energy intake in obese adolescents boys. In response to aerobic training, the blood-brain-barrier can become more permeable to plasma proteins (Patterson et al., 2009), improving the anorectic and thermogenic effect of peripheral peptides. The results from the present study should encourage health professionals to prescribe high intensity aerobic exercise aiming not only to increase energy expenditure, but to enhance central control of energy intake. **References** Dodd CJ, Welsman JR, Armstrong N (2008). *Appetite*, 51:482-488. Thivel D, Isacco L, Montaurier C, et al. (2012). *Plos One*, 7(1): 29840. Moore MS, Dodd CJ, Welsman JR, Armstrong N. *Appetite*, 43(2):127-134. Patterson CM, Bouret SG, Dunn-Meynell AA, et al. (2009). *Am J Physiol Regul Integr Comp Physiol*, 296(3): R537-R548. Kriemler S, Hebestreit H, Mikami S, et al (1999). *Pediatr Res*, 46(1): 40-4.

**15:00 - 16:00**

## Mini-Orals

### PP-PM33 Nutrition [NU] 7

#### FACTORS ASSOCIATED WITH SEVERE GASTRO-INTESTINAL DISTRESS AND MARATHON RUNNING

Pahnke, M.1, Stofan, J.1, Del Campo, J.2, Nyman, L.1, Chiampas, G.3, Jeukendrup, A.1

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1. Gatorade Sports Science Institute (Barrington, U.S.A.), 2. PepsiCo (New Haven, U.S.A.), 3. Northwestern University (Chicago, U.S.A.) Gastro-intestinal (GI) distress is frequently reported by runners and endurance athletes during competition. A variety of causes for GI distress have been proposed such as nutrition, sex, and genetics. The purpose of this field study was to investigate factors associated with GI

distress during a marathon. Approximately 800 runners (399 females, 397 males) participating in the 2012 Bank of America Chicago Marathon completed surveys prior to and following the race. Survey information included self-reported racing history and frequency of GI discomfort during previous races. Incidence of discomfort was reported as at least "fairly frequently" reports of nausea, stomach cramps, intestinal cramps, diarrhea, loose stool, abdominal pain or any reports of vomiting or intestinal bleeding. Participants also self-reported measures of GI comfort and nutritional intake during the 2012 race. Severe GI distress was measured as a score of at least five ("serious problems") on a scale from zero to nine ("no problem at all" to "the worst it has ever been") for the same variables as the pre-survey or of any reports of vomiting or intestinal bleeding. Research participants completed the marathon in 4:20:43±0:52:07 (mean±SD) and 9.4% of the runners reported severe GI distress during the race. Females had a higher ranking of severe GI distress than males ( $p=0.016$ ). During the race, participants consumed 36.9±19.7 g carbohydrate/h and 730.8±1040 ml water/h from a variety of sources (e.g. sports drink, gel). There was a significant relationship between prior history of GI distress and ratings of severe GI distress during the race ( $r=0.247$ ,  $p=0.001$ ). There was also a small, significant relationship between reports of severe GI distress and finishing time ( $r=0.097$ ,  $p=0.006$ ) and a small, negative association between severe GI distress and rate of carbohydrate intake during the race ( $r=-0.078$ ,  $p=0.028$ ). Both rate of carbohydrate and water intake were negatively associated with race finish time ( $r=-0.154$ ,  $p=0.001$  and  $r=-0.134$ ,  $p=0.001$ , respectively). While severe GI distress is likely multi-faceted, during the marathon it was associated with prior incidences of GI distress, rate of carbohydrate intake during the race, and finish time. Finish time was also associated with rate of nutritional intake. Additional research is warranted on potential genetic factors (analysis forthcoming) and on the effect of increasing nutritional intake to current recommendations (up to 90 g multi-transportable carbohydrate/h, Jeukendrup 2011) as lower GI distress and faster finishing times were both associated with higher rates of carbohydrate intake. Jeukendrup A. (2011). *J Sports Sci*, 29:sup1, S91-99.

### CHANGES IN THE RELATIONSHIPS BETWEEN AEROBIC CAPACITY AND HEMATOLOGICAL VARIABLES AFTER A DIET AND EXERCISE INTERVENTION

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**Introduction** The relationships between maximum oxygen uptake (VO<sub>2</sub>max) and hematological variables related to oxygen transportation are obviously established, but it is unknown if these associations are different between responders and non-responders to VO<sub>2</sub>max. The aim of this study was to evaluate whether VO<sub>2</sub>max relate to hemoglobin and hematocrit measured before and after a weight loss program (WLP) intervention, in responders and non-responders to VO<sub>2</sub>max. **Methods** One hundred eighty-six overweight (W) and obesity (O) (body mass index [BMI] 25-34.9 kg/m<sup>2</sup>), aged from 18 to 50 years, performed an incremental test until exhaustion on a treadmill, using a modified Bruce protocol, before (pre) and after (post) the 22 weeks of diet and exercise intervention. Blood samples were taken to measure hematological parameters (1). Responders to VO<sub>2</sub>max were defined as those who achieved an increase higher than 5% in VO<sub>2</sub>max and non-responders those who achieved less than 5%. Relationships between VO<sub>2</sub>max, hemoglobin and hematocrit were measured using Pearson's correlation coefficient in responders and non-responders. The significant level was set at 0.05. **Results** Maximum oxygen uptake was associated with hemoglobin in non-responders, both pre intervention ( $r=0.606$ ,  $p<0.001$ ) and post intervention ( $r=0.596$ ,  $p<0.001$ ). There was also a positive relationship between VO<sub>2</sub>max and hemoglobin in responders, even though this association was greater both pre and post intervention ( $r=0.754$ ,  $p<0.001$ ;  $r=0.623$ ,  $p<0.001$ , respectively). Non-responders had lower correlations between VO<sub>2</sub>max and hematocrit than responders pre weight loss program (WLP) ( $r=0.574$ ,  $p<0.001$ ;  $r=0.732$ ,  $p<0.001$ , respectively), while the relationship was similar in both groups post WLP ( $r=0.567$ ,  $p<0.001$ ;  $r=0.555$ ,  $p<0.001$ ). **Discussion** Applying Fick's law, these results suggest that the improvements in VO<sub>2</sub>max obtained post WLP in responder group could be due to an increase in the use of oxygen and / or an improvement of local vascularization. **References** 1. Zapico et al.: Nutrition and physical activity programs for obesity treatment (PRONAF study). Methodological approach of the project. *BMC Public Health* 2012 12:1100.

### SEX DIFFERENCES IN THE EFFECTS OF MENTAL WORK AND MODERATE-INTENSITY PHYSICAL ACTIVITY ON ENERGY INTAKE IN YOUNG ADULTS

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The aim of this study was to examine the acute effects of mental work and moderate-intensity physical activity on various components of energy balance in young and healthy adults. With the use of a randomized crossover design, 35 participants aged 24±3 years completed three 45-min conditions, namely (i) resting in a sitting position (control), (ii) reading-writing (mental work (MW)), and (iii) exercising on a treadmill at 40% of peak oxygen uptake (exercise), followed by an ad libitum lunch. The endpoints were spontaneous energy intake (EI), energy expenditure (EE), appetite sensations, and EI for the remaining day. We observed that the energy cost of the control and MW conditions was about the same whereas the exercise condition increased EE to a greater extent in men than women. Exercise induced a decrease in EI relative to EE compared to the control condition that was more pronounced in men than women. However, women tended to increase their energy intake after the MW condition compared to the control one whereas an opposite trend was observed in men. None of the appetite sensation markers differed significantly between both sexes. In conclusion, men and women have specific food intake patterns when submitted to cognitive and physical stimuli.

### ASSOCIATION BETWEEN OBJECTIVELY MEASURED PHYSICAL ACTIVITY AND SERUM 25-HYDROXYVITAMIN D CONCENTRATION IN JAPANESE ADULTS

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**Introduction:** Although some studies have found an association between physical activity (PA) and serum vitamin D status, most of these studies assessed PA using self-reported measures. Self-reported PA measures are subject to social desirability and recall biases and are inability to accurately assess unstructured and incidental PA. Less is known about the association between objectively measured PA and serum vitamin D status. This may represent one reason why associations of PA with serum 25-hydroxyvitamin D [25(OH)D] levels show weak and inconsistent results. The aim of this study was to examine the association of accelerometer-based PA levels with serum 25(OH)D concentration in Japanese adults. **Methods:** Ninety participants aged 20–69 years took part in this study (57 females and 33 males), and their blood samples were collected at the same laboratory in April. Serum 25(OH)D concentration measured by ELISA, was defined as sufficient ( $\geq 75$  nmol/L), insufficient ( $\geq 50 < 75$  nmol/L), or deficient ( $< 50$  nmol/L). PA was measured by accelerometry, and

outcome variables were time spent (min/day) in light, moderate, and vigorous PA intensities and total PA. Multiple linear regressions were used to assess whether PA was associated with serum 25(OH)D concentrations adjusted for potential confounding variables (gender, age, percentage body fat, smoking status, and vitamin D intake). Results: The prevalence of vitamin D deficiency was 61% in males and 83% in females. Moreover, 33% of males and 16% of females were vitamin D insufficient. After adjustment for potential confounding, total PA ( $P = 0.006$ ) and both light ( $P = 0.003$ ) and vigorous PA ( $P = 0.004$ ) were significantly associated with serum 25(OH)D, but not moderate PA. When all PA intensity components were entered in the same model, light ( $P = 0.02$ ) and vigorous PA ( $P = 0.02$ ) were each independently associated with serum 25(OH)D. Conclusion: Overall, vitamin D deficiency is highly prevalent in our study sample. Objectively measured PA is positively related to serum vitamin D status. In addition, both light and vigorous PA were independent predictors for serum vitamin D concentration. These findings indicate that PA, especially light and vigorous PA, may have important modifiable roles in maintaining an adequate vitamin D levels. Acknowledgement: This study was supported by Grants-in-Aid for Scientific Research (C) from the Ministry of Education Culture, Sports, Science and Technology of Japan (no.23500864).

### EFFECTS OF 2 DAYS SODIUM BICARBONATE LOADING ON SIMULATED FOOTBALL PERFORMANCE TEST

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There is considerable research looking at the role of sodium bicarbonate in sport performance. However, not many studies have examined the effectiveness of this ergogenic aid during a sport specific performance test. The primary purpose of this study was to determine whether a short-term (2 days) supplementation of sodium bicarbonate ( $\text{NaHCO}_3$ ) enhances repeated sprint performance and time to exhaustion in a simulated football performance test (Loughborough Intermittent Sprint Test) which lasts for 90 minutes. Seven healthy males (Mean age =  $24 \pm 1.6$  years and predicted mean  $\text{VO}_2\text{max} = 49.4 \text{ ml kg}^{-1} \text{ min}^{-1}$ ) participated in this experimental study. A double-blind, randomized, crossover study design was used. All participants completed three conditions. Except the control condition, the others included test drinks followed by a 5-day washout period between these two conditions: 1) control (no drinks), 2) placebo/supplement (PI;  $\text{NaCl}$ ;  $0.045 \text{ g.kg}^{-1}$ , Supp;  $0.5\text{g/kg bw NaHCO}_3$ ), and 3) same as 2nd condition. During each condition, sprint times, exhaustion times and rating perceived exertion (RPE) were assessed. In addition to this, before the test day, gastro intestinal (GI) distress questionnaires were used to assess the number and severity of symptoms during the supplementation period. The main findings were; 1) Sodium bicarbonate loading produced slightly (3.2%) but significantly greater ( $p = 0.000$ ) sprint performance than the placebo in some periods of the exercise session (LIST) and 2) Two days of Sb supplementation was sufficient to increase repeated sprint performance compared to the placebo trial. However, in contrast to hypotheses, no benefits from supplementation were observed for time to exhaustion and perception of fatigue (RPE). Considering that this current study found benefits from sodium bicarbonate loading during the 90 minutes simulated football performance test, it suggests that 2 days of sodium bicarbonate supplementation may improve repeated sprint performance. Future research on a larger sample size, a specific athletic population (professionals), and various exercise modes including ball activities would be beneficial in determining if this supplementation is worthwhile.

### SWIMMING EXERCISE INCREASES MAGNESIUM REQUIREMENT IN RATS

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Introduction Magnesium (Mg) is an abundant mineral in the human body, and plays a role as a co-factor to activate various enzymes, particularly gluco-regulated kinases. The activities of these enzymes are known to be affected by exercise exertion. However, Mg balance has not been sufficiently elucidated even under sedentary conditions. The present study evaluated Mg requirements in rats with different types of exercise by measuring apparent absorption and urinary excretion, concentrations in serum and skeletal muscle, and expression of TRPM7, which has been identified as a Mg-permeable ion channel that primarily is required for cellular Mg homeostasis in skeletal muscle. Methods Thirty-three 6-week-old male Wistar-Hannover rats were randomly assigned to three equal groups, and fed a purified diet of AIN-93G composition for 15 days (15 g/day). Rats in one group ( $n=11$ ) were housed under sedentary conditions during the experimental period (SED), while the remaining were divided into two exercise-trained groups. One was a low-intensity prolonged exercise group (LIT) and the other was a high-intensity intermittent exercise group (HIT). Rats in LIT swam continuously for 2 h without a load (6 days/week), and rats in HIT swam 14 times for 20 s each time with a load equivalent to 14% of their body weight. Between each 20-s bout of exercise, a 10-s pause was allowed (6 days/week). On day 15, rats were sacrificed and their blood and gastrocnemius muscle quickly removed. Mg levels in serum and muscle were determined using a sequential plasma spectrometer. Amount of TRPM7 expression in muscle was detected with Western blotting analysis. Apparent Mg absorption was calculated from amounts of Mg intake and fecal excretion. Results Blood lactate levels immediately after swimming exertion were 1.05 mM (SED), 5.74 mM (LIT), and 11.09 mM (HIT). Activities of citrate synthase were higher in the exercise-trained groups than in the SED. Apparent Mg absorption in exercise-trained rats was also higher than in sedentary rats. Skeletal muscle Mg level in exercise-trained rats was also higher, whereas serum levels were lower compared to sedentary rats. However, no significant differences in these variables were apparent between LIT and HIT. Amounts of TRPM7 expression in LIT and HIT were higher than in SED. Discussion The present investigation demonstrated that swimming exercise increased the apparent absorption of Mg in rats, regardless of exercise pattern. These results suggest that exercise would enhance Mg requirements in rats. Moreover, we observed the elevation of TRPM7 expression and amounts of Mg contents in exercise-trained rat skeletal muscle, revealing a significant positive correlation between these variables. TRPM7 might represent one of the important ion channels for regulating Mg homeostasis in exercise-trained rat skeletal muscle.

### CARBOHYDRATE INGESTION IMPROVES GROSS CYCLING EFFICIENCY AND SUBSEQUENT TIME-TRIAL PERFORMANCE

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Introduction: Whilst many research studies monitor and report improvements in cycling efficiency (Coyle et al., 2005; Hopker et al., 2009), none state whether nutritional intake was controlled or recorded across the period of assessment. Also, improvements in gross efficiency potentially improve performance (Jeukendrup & Martin, 2001) yet little is known about the impact of carbohydrate ingestion on this. Therefore the aim of this study was to determine whether manipulation of carbohydrate intake would influence gross cycling efficiency and/or time trial performance. Methods: Six trained male cyclists (Age:  $44 \pm 5$  years, Mass:  $81.4 \pm 2.3 \text{ kg}$ ,  $\text{VO}_2\text{max}$ :  $55.7 \pm 8.3 \text{ ml.kg}^{-1} \text{ min}^{-1}$ ) completed two sets of two exercise tests at a steady-state submaximal exercise intensity (60% of Power at  $\text{VO}_2\text{max}$ ). In each set, partici-

pants were required to cycle for 2-hours and a day later, cycle for 1-hour followed by a 16.1km time-trial. These tests were repeated 1-week later. In a randomised cross-over design, participants consumed isocaloric diets (~4000kcal) that contained either a high (70%) or low (20%) proportion of carbohydrate in the 3-days preceding, and 24-h recovery period from, the first cycling tests. Additionally, participants were also provided with 300ml of either water (low) or a 6.4% carbohydrate solution (high) every 30mins during each test. During all submaximal tests, expired air was measured at 30 minute intervals in order to calculate gross efficiency (GE). Results: Mean GE across both days was significantly greater under high carbohydrate conditions (High Carbohydrate GE = 23.75 ± 1.86%; Low Carbohydrate GE = 22.64 ± 1.48%, p<0.001). Additionally, cyclists completed the performance time trial ~5% faster under high carbohydrate conditions (High Carbohydrate = 1490 ± 96secs; Low Carbohydrate = 1568 ± 128secs, p<0.05). Accordingly, when performance was corrected with workload as a covariate, ~49% of the variance in time trial time was explained by changes in performance efficiency. Discussion: Differences in gross efficiency were obtained following alteration of nutritional intake in the 3-days preceding, during and in recovery from, exercise. This suggests that careful control of nutritional intake is required to ensure the validity of gross efficiency measures. Also, the improvement in gross efficiency under high carbohydrate conditions enhanced time trial performance. This strengthens existing evidence that cyclists should increase carbohydrate availability to ensure optimal gross efficiency and performance. References: Coyle, E.F. (2005). *J Appl Physiol*, 98, 2191-96. Hopker, J.G. et al., (2009). *Med Sci Sports Exerc*, 41(4), 912-9. Jeukendrup, A.E. & Martin J. (2001). *Sports Med*, 31(7), 559-69.

## PREFERENCES OF DIETARY SUPPLEMENTS IN LONG DISTANCE TRIATHLON

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**Introduction** The number of triathletes is steadily increasing. Due to the huge energetic requirements of long endurance performances athletes tend to take dietary supplements. The aim of this survey was to examine dietary supplements intake among long distance triathletes with focus on prevalence, overdose, reason(s), recommendation, increased performance and guidance by experts. **Methods** The link of our online-questionnaire, which was translated into five different languages, was sent to 30,000 athletes by email. We did this in cooperation with the Austrian Triathlon Association and organizers of several long distance triathlon events. The questionnaire was answered by 1158 athletes, 990 (85%) male and 168 (15%) female, from 43 nations. The survey took place between July 2011 and February 2012. **Results** Sixty six percent of the athletes reported having taken dietary supplements at least once in their life. Those ingredients, which strengthen the immune system and have a scavengers (antioxidative) function are in the first half of the ranking. Surprisingly, those ingredients that are well known in triathlon sport through advertising are not well-used among the long distance triathletes and are found in the last third of the ranking. This is also true for L-carnitine and coenzyme Q10, which are important for long endurance performances (lipometabolism). A clear gender difference in favour of male participants is clear to see in the case of essential amino acids, especially BCAAs, which support muscle generation and regeneration. Thirty nine percent of all participants take dietary supplements on a regular base, 17% straight before competition and 10% as a block dietary course. Concerning the reasons for taking dietary supplements, 67% take them to improve their regeneration, 45% to increase their resistance to disease and 32% in order to prevent injuries. 40% of the participants noticed an improvement in their performance as a result of taking dietary supplements. The intake is mostly governed by the athletes themselves (48%) and/or supported by literature (36%), followed by counselling from a physician, trainer, pharmacist or physiotherapist. Overall, only 12% of the male and 19% of the female participants take dietary supplements under physician supervision and there is in general a tendency of an overdose. **Conclusion** Dietary supplement intake is widely spread among long distance triathletes mainly with the purpose to improve the regeneration. However, overdose of the used dietary supplements occur. As overdose can place an extra burden on the body and can have negative effects, guidance by experts is strongly recommended and more research is needed in this area.

## BODY COMPOSITION AND NUTRITIONAL STATUS IN ELITE SYNCHRONIZED SWIMMERS

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**Introduction** Information about the nutritional status and dietary practices and requirements of synchronized swimming (SS) athletes is very scarce (Lundy, 2011). The body composition and somatic profile of current top young elite SS athletes need to be updated (Bante et al., 2007). This study examines the body composition and nutritional status of young elite synchronized swimmers aiming to ascertain whether there are risks associated to their health and performance. **Method** 15 swimmers of the junior Spanish national team (15,8±1,0 y; 54,9±4,3 kg; 168,4±5.0 cm; BMI 19,4±2,0 kg/m<sup>2</sup>) completed anthropometric assessment (ISAK), seven-day food intake record, and haematology and blood biochemistry analysis during a pre-competition period. Food intake was quantified using PCN-GRAMS 1.1 CESNID® software and compared with the European Food Safety Authority (EFSA) recommendations to assess nutritional status. Energy requirements were estimated using the Harris-Benedict formula and Ainsworth's compendium of physical activities. **Results** Anthropometry (mean±SD): Σ6 skinfolds 70,6±10,5 mm; body fat mass 17,7±2,1%; skeletal muscle mass 43,1±2,2%; somatotype 2,8±0,5 / 3,5±0,9 / 3,7±1,1 for endo-, meso- and ectomorph components, respectively. Nutrition: energy intake 2184±406 kcal/d; CHO consumed 4,6±1,1 g/kg; protein consumed 2,1±0,4 g/kg; energy intake from fat 32,8±5,3%. Haematology and biochemistry: haematocrit 37,±1,8%; haemoglobin 12,4±0,5 g/dl; transferrin 261±36 mg/dl; ferritin 24,7±16,4 ng/ml. Estimated energy requirements were 2871±358 kcal/d (12,02±1,5 MJ/d). All the swimmers were not in intake/expenditure energy balance. A high percentage of swimmers failed to meet macro- (CHO: 85,7%; Protein: 64,3%; Fat: 78,6%) and/or micronutrient (Fe, Mg: 92,9%; Zn: 100,0%) recommendations for the general population of their age. **Discussion** SS is characterized by high and complex physiological demands (Rodríguez-Zamora et al., 2012). Young synchronized swimmers must be properly conditioned and properly nourished to perform optimally and to meet developmental requirements. A high proportion of the young elite swimmers studied were not in energy balance and/or failed to meet macro- and/or micronutrient recommendations, which may negatively impact performance and physiological development. More research is needed to understand the unique nutrition needs of this population and to propose general guidelines or recommendations for this high-risk athletic population. **References** Bante S, Bogdanis GC, Chairapoulou C, Maridaki M (2007). *J Sports Med & Phys Fitness* 47, 291-299. Lundy B (2011). *Int J Sport Nutr Exerc Metab* 21, 436-445. Rodríguez-Zamora L, Iglesias X, Barrero A, Chaverri D, Erola P, Rodriguez, FA. (2012). *PLoS One* 7(11), e49098.

### EFFECTS OF A-GALACTO-OLIGOSACCHARIDES <A-GOS> AND TRAINING ON IMMUNE CELLS IN STREPTOZOTOCIN-DIABETIC RATS

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1Laboratory M2S, Rennes,, France. 2 Sojasun Technologies, Noyal/Vilaine, France Introduction: Type 1 diabetes mellitus (T1DM), a T cell-mediated autoimmune disease, results from the loss of tolerance to insulin and other  $\beta$ -cell-specific antigens. T1DM is associated with an increased risk of death from infectious disease. The etiology of this disease is multifactorial and a recent theory incriminates an autoimmune process which results from disturbed microbiota, leaky gut and altered mucosal immunity. The development and progression of diabetes is linked to changes in B and T cells. Moreover, the therapy management includes nutritional recommendations and exercise training. Training is known to improve glycemia, inflammation and immune response. More interestingly,  $\alpha$ -GOS are prebiotics that selectively alter the composition of gut microbiota and exhibit anti-inflammatory and insulin-sensitive effects in vitro (Efstathiou and Fathi 2010) and in vivo (Boucher et al. 2003). Thus,  $\alpha$ -GOS is a potential functional food for the treatment of diabetes. But, less is known about the effect of training and  $\alpha$ -GOS on immune response in diabetes. In this context, the aim of this work was to study the immune response in a streptozotocin-induced T1DM with two therapeutic means: training and  $\alpha$ -GOS alone or combined. Methods: Forty-eight male Wistar rats were divided into control placebo, streptozotocin-diabetic rat (STZ) groups supplemented or not with  $\alpha$ -GOS (20 mg/kg/day) for 8 weeks and/or following endurance training. The training program was individualized and consisted in a 1h/day, 5d/week running during 8 weeks on a motor-driven treadmill. At the end of the protocol, blood was obtained to measure glucose, insulin, fructosamine and immune responses. Results: STZ rats exhibited higher glycemia, plasma fructosamine levels (a marker of glycated proteins), natural killers (NK), lower T and B cells level and insulin concentration.  $\alpha$ -GOS treatment reduced plasma fructosamine levels and increased B cells compared to STZ rats. Training induced a decrease in plasma glucose, T cells and an increase in B cells and NK in STZ rats. The combined effect of  $\alpha$ -GOS and training didn't potentiate the immune response on B and T cells but inhibited the effects of training on NK Discussion: Our results suggest that training and  $\alpha$ -GOS alter positively plasma glucose and/or fructosamine and the immune response. But the effects of combined treatments only concern limited parameters.  $\alpha$ -GOS effects could be partly attributable to its immunomodulatory activity. Keywords:  $\alpha$ -GOS, training, immune cells, diabetes. Acknowledgment : Brittany region References Efstathiou, T. and D. Fathi. Sojasun Technologies. 2010 Boucher J et al. J Physiol Biochem. 59(3):169-73, 2003

### EFFECTS OF EXERCISE ON 24-H FAT OXIDATION DEPEND ON WHEN IT IS PERFORMED.

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Introduction In emerging 24-hour non-stop societies, people exercise in the morning, afternoon or evening, according to their life style. Depending on nutritional state, exercise performed in the post-absorptive state oxidizes more fat than that performed in the postprandial state. As pointed by Melanson et al., it is also important to account post-exercise changes in energy metabolism to evaluate effect of exercise on body fat balance (J Appl Physiol 2002). Our recent study comparing the effect of exercise performed before and after breakfast on 24-h fat oxidation suggested that exercise performed at low carbohydrate and/or energy balance stimulated 24-h fat oxidation (Shimada et al. Metabolism 2013 in press). This led to the hypothesis that exercise at night, which became a common practice among working people in Japan, might be the least beneficial to reduce body fat. The aim of the present study is to examine how timing of exercise relative to meal ingestion affects 24-h substrate oxidation. Method Healthy men stayed in a room-size respiratory chamber 4 times: control or exercise before breakfast, after lunch and after dinner trials, in a randomized repeated design. Exercise was performed for 60 min at 50% maximal oxygen consumption beginning at 0630h, 1430h or 2030h. Breakfast, lunch and dinner were served at 0800h, 1200h and 1800h, respectively. 24-h substrate oxidation (from 0600h of the exercise day to 0600h of the next day) was compared among the four trials. Results Fat oxidation during exercise gradually decreased as it was performed at later time of the day (before breakfast: 159, after lunch: 67, and after dinner: 42 kcal/h). 24-h fat oxidation of exercise after dinner was also lower than that of exercise before breakfast (before breakfast: 839, and after dinner: 531 kcal/24h). Interestingly, exercise performed after lunch tended to increase 24-h fat oxidation (886 kcal/day). Discussion It is conceivable that exercise performed at the nadir of carbohydrate and/or energy balance (before breakfast) is suitable to oxidize more fat than that performed at the zenith (after dinner). Beneficial effects of exercise to reduce body fat seem to be related to glycogen level when exercise is performed. Unexpectedly, 24-h fat oxidations of pre-breakfast and post-lunch exercise conditions were similar even though post-lunch period was at positive energy balance compared with pre-breakfast period. Factors other than glycogen level to modify exercise-induced 24 h fat oxidation remain to be identified.

### THE INDEPENDENT EFFECT OF EXERCISE INTENSITY ON APPETITE, ENERGY INTAKE AND ENERGY EXPENDITURE: IS THERE A GENDER DIFFERENCE?

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Appetite control (i.e. control of energy intake) is important for weight maintenance. Exercise contributes to the most variable component of energy expenditure but its impact is beyond the energy cost of exercise including physiological, behavioural, and appetite effects (1). Exercise is known to acutely influence effect appetite but evidence as to the independent effect of intensity is lacking (2). This study investigated the role of exercise intensity on appetite, energy intake (EI), appetite related hormones, fat utilisation and subjective measures of appetite. One hour after a standardised breakfast, 14 healthy normal-weight volunteers subjects undertook either 8 repeated 60 second bouts of cycling at 95% VO<sub>2</sub> max (high intensity) or 30 minutes of continuous cycling, at a fixed cadence, equivalent to 50% of the participant's VO<sub>2</sub> max (low intensity) in a randomised crossover design. Glucose, insulin, triacylglycerol (TAG), nonsaturated fatty acids (NEFAs) and glucagon-like peptide-1 (GLP-1) were measured fasted, postprandial, and pre and post exercise. Satiety was assessed Subjectively throughout the study using visual analogue scales. Ad libitum intake of a pasta meal was measured at the end (3-h post-breakfast). No significant effect of exercise was observed on the ad libitum meal or 24 hour energy intake post-exercise. Hunger scores were significantly decreased following high intensity (HI) only. No significant differences in glucose, insulin and TAG between both intensities were observed. HI significantly increased fat oxidation compared to low intensity (LI) at 15 minutes post-exercise with a significant difference in NEFAs level. No significant differences were observed in energy intake of fat for 2 days post-exercise between two intensities. In conclusion, there are mechanisms and consequences of exercise in short and long-term appetite control; however, these mechanisms warrant

further explanation. These results support the need for future research in to the role of in regulation energy balance, especially for obese people. References: 1. Spiegelman BM, Flier JS. Obesity and the Regulation of Energy Balance. *Cell*. 2001;104(4):531-43. 2. Martins C, Kulseng B, King NA, Holst JJ, Blundell JE. The Effects of Exercise-Induced Weight Loss on Appetite-Related Peptides and Motivation to Eat. *J Clin Endocrinol Metab*. 2010;95(4):1609-16.

### THE EFFECT OF SHORT-TERM CALORIE RESTRICTION ON EXERCISE PERFORMANCE AND EFFICIENCY IN CYCLISTS

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**Introduction:** Gross efficiency is a measure of the ability to convert stored energy into power and is, considered a key determinant of cycling performance. Gross efficiency has been reported to improve by 9% in sedentary participants following four months of calorie restriction combined with exercise (Amati et al, 2008). It is yet to be established if improvements in gross efficiency (GE) and net efficiency (NE) can be achieved with only short-term fat mass reduction in habitual cyclists and the effect on time-trial (TT) performance. **Methods:** Seventeen male cyclists; age  $42 \pm 9$  yrs, BMI  $25.6 \pm 3.1$  kg.m<sup>2</sup>, body fat  $22.3 \pm 5$  % were recruited from local cycling clubs. Participants completed four pre intervention baseline visits one week apart and were instructed to maintain their body mass. Resting energy expenditure (REE) and 4-site skinfold were conducted prior to a 16.1km TT on an SRM® cycle ergometer. Gases were measured using the Oxycon® Pro metabolic cart. The intervention consisted of a randomised crossover design where participants either maintained their usual calorie intake or reduced their intake by 500 kcal.day<sup>-1</sup> for a 14 day period. Tests were repeated after each of the two week periods. **Results:** There was a significant reduction in body mass (1.24kg), body fat (0.64%) and fat mass (0.81kg) when comparing immediately pre to post intervention ( $p < 0.05$ , in all cases), with no significant reduction in lean mass ( $p = 0.12$ ). There was also no significant difference in REE ( $p = 0.65$ ), blood urea nitrogen ( $p = 0.55$ ), TT power ( $p = 0.58$ ) or TT power expressed relative to body mass ( $W.kg^{-1}.s^{-1}$ ), ( $p = 0.28$ ). There was a significant increase in TT GE (2.9%) ( $p = 0.008$ ) and NE (2.4%) ( $p = 0.017$ ) following the 14 day intervention. **Discussion:** This study found a significant improvement in both GE and NE following short term calorie restriction, equivalent to approximately 60% of the improvement in GE reported by Amati et al. (2008) in their four month calorie restriction period. Although, a reduction in REE has been reported during more severe calorie restriction and over longer periods (Dulloo & Jacquet, 1998), this study failed to find a significant reduction. Increases in GE and NE did not result in improved 16.1km TT performance, and despite the reduction in body mass the cyclists TT power to weight ratio was also not significantly altered. This data suggests that following short term energy restriction, TT exercise capacity is not compromised in club cyclists. However a reduction in energy expenditure during the performance task is apparent; this has potential implications for the estimation of energy expenditure following reductions in body mass. **References:** Amati F, Dubé JJ, Shay C, Goodpaster BH. (2008). *J. Appl Physiol*, 105, 825-6. Dulloo AG, Jacquet J. (1998). *Am J Clin Nutr*. 68, 599-606.

### SUBSTRATE METABOLISM DURING EXERCISE FOLLOWING TWO WEEKS OF DIETARY CALCIUM SUPPLEMENTATION

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**Introduction** Dietary calcium intake is associated with reduced body fat percentage (Tidwell and Valliant 2011) and supplementation with calcium and vitamin D can accelerate fat loss under energy restriction (Zhu et al. 2013). The underlying mechanisms behind these effects are currently unclear. An increase in whole-body lipid oxidation following high-calcium intakes could (in part) account for the relationship with body fat (Gonzalez et al. 2012). Whether the increase in lipid oxidation is evident during exercise is not entirely clear. Accordingly the present study aimed to assess the impact of 2 weeks of calcium supplementation on substrate metabolism during exercise. **Methods** In a randomized, double blind, crossover design, 13 males completed two 14-d supplemental periods during which a control (CON; 400 mg calcium) or high-calcium (CON; 1400 mg calcium) milkshake was consumed daily. A washout period of  $\geq 4$  weeks separated supplemental periods. Prior to and following each supplementation period, substrate metabolism was investigated during an incremental exercise test using indirect calorimetry. Venous blood samples were also collected at the end of each stage in order to determine plasma non-esterified fatty acid (NEFA), glycerol, glucose and lactate concentrations. Values are expressed as means  $\pm$  SEM. **Results** Lipid and carbohydrate oxidation rates were not significantly different between trials at any exercise intensity (all  $P > 0.05$ ). The change in lipid and carbohydrate oxidation did not significantly differ between CON and CAL ( $P > 0.05$ ) Maximal rates of lipid oxidation were  $21 \pm 2$  and  $20 \pm 2$   $\mu\text{mol}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  at baseline, and  $20 \pm 2$  and  $20 \pm 3$   $\mu\text{mol}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  post-supplementation for CON and CAL respectively ( $P > 0.05$ ). The exercise intensity that elicited the maximal rate of fat oxidation did not differ significantly between interventions (baseline, CON:  $52 \pm 2$ , CAL:  $47 \pm 1$  %  $\text{VO}_2\text{peak}$ ; post-supplementation: CON:  $49 \pm 2$ , CAL:  $48 \pm 1$  %  $\text{VO}_2\text{peak}$ ;  $P > 0.05$ ). No significant differences were detected in plasma glucose or lactate concentrations between trials or between interventions as change from baseline (all  $P > 0.05$ ). NEFA and glycerol analysis is currently ongoing but will be completed prior to presentation. **Conclusion** These data indicate that 2 weeks of dietary calcium supplementation does not influence the maximal rate of lipid oxidation, nor does it influence substrate metabolism, across a range of exercise intensities. **References** Gonzalez JT, Rumbold PLS, Stevenson EJ (2012). *Obes Rev*, 13, 848-857. Tidwell DK, Valliant MW (2011). *Nutr Res*, 31: 527-536. Zhu W, Cai D, Wang, Y, Lin N, Hu Q, Qi Y, et al. (2013). *Nutr J*, 12: 8.

### MEAL AND BETA-ALANINE CO-INGESTION ENHANCES MUSCLE CARNOSINE LOADING.

Stegen, S.1, Blancquaert, L.1, Everaert, I.1, Bex, T.1, Taes, Y.2, Calders, P.3, Achten, E.4, Derave, W.1

*Ghent University*

1 Department of Movement and Sports Sciences, Ghent University, Ghent, Belgium 2 Department of Endocrinology, Ghent University Hospital, Ghent, Belgium 3 Department of Rehabilitation Sciences and Physiotherapy, Ghent University, Belgium 4 Department of Radiology, Ghent Institute for Functional and Metabolic Imaging, Ghent University, Ghent, Belgium **Introduction.** Beta-alanine (BA) is a popular ergogenic supplement as it can induce muscle carnosine loading. We hypothesize that, by analogy with creatine supplementation, 1) an inverse relationship between urinary excretion and muscle loading is present, and 2) the latter is stimulated by carbohydrate- and protein-induced insulin action. **Methods.** In study A, the effect of 5 weeks slow-release BA (SRBA) supplementation (4.8g/day) on whole body BA retention was determined in 7 men. We further determined whether co-ingestion of carbohydrates and proteins with SRBA would improve retention. In study B (34 subjects), we explored the effect of meal-timing on muscle carnosine loading (3.2g/day during 6-7 weeks). One group received pure BA (PBA) in between the meals, the other received PBA at start of the meals, in order to explore the effect of meal-induced insulin release. Further, we compared with a third group receiving SRBA at start of the meals. **Results and conclusion.** Orally ingested SRBA has a very high whole body retention (97-98%), that is not declining throughout the 5 weeks supplementation

period, nor is it influenced by co-ingestion of macronutrients. Thus, a very small portion (1-2%) is lost through urinary excretion, and equally only a small portion is incorporated into muscle carnosine (~3%), indicating that the majority of ingested BA is metabolized (possibly through oxidation). Secondly, in soleus muscles, the efficiency of carnosine loading is significantly higher when PBA is co-ingested with a meal (+64%), compared to in between the meals (+41%), suggesting that insulin stimulates muscle carnosine loading. Finally, chronic supplementation of SRBA versus PBA seem equally effective.

## 15:00 - 16:00

### Mini-Orals

#### PP-PM44 Physiology [PH] 11

##### **NEGATIVE EFFECTS OF AIR POLLUTION EXPOSURE ON THE EXERCISE-INDUCED INCREASE OF BDNF GENE EXPRESSION IN THE RAT HIPPOCAMPUS**

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1, 5: *Vrije Universiteit Brussel*; 2: *VITO*; 3, 4: *Hasselt University*

**Introduction** Growing evidence suggests that exercise stimulates synaptic plasticity and cognition by increasing the level of neurotrophic factors, e.g. brain-derived neurotrophic factor (BDNF) (1, 2). Exposure to particulate matter (PM), a component of air pollution, is associated with neuroinflammation and cognitive decline (3). The aim is to investigate the acute effect of PM exposure during exercise on the gene expression of neurotrophic factors (BDNF, IGF-I, VEGFa), a marker of synaptic plasticity (SYN1), and inflammatory and oxidative stress markers (IL1a, IL1b, TNFa, COX-2, NOS2, NOS3, NFE2L2) in the hippocampus of rats. **Methods** Male, Wistar rats (n=6/group) were exposed for 90 min to: ambient air + exercise (group 1), polluted air + exercise (group 2), polluted air + rest (group 3), ambient air + rest (control). A peak PM concentration of 10 000 000 particles/ml was generated by the miniCAST sootgenerator and monitored by the DMS50 Fast Particulate Spectrometer inside an exposure chamber containing a motorized treadmill. The exercise consisted of running at 20 m/min. The hippocampus was collected 24 h after exposure. Gene expression was analyzed with qPCR. The gene expression ratios (R) were calculated for group 1, 2 and 3 relative to the control group and statistically analyzed with the Relative Expression Software Tool using the Pair Wise Fixed Reallocation Randomization Test with 2000 permutations (4). **Results** In group 1, gene expression of BDNF (R=1.54, p=0.03) and NFE2L2 (R=1.41, p=0.03) was increased, and COX-2 decreased (R=0.079, p=0.001) compared to the control. In group 2, there was no increase of BDNF and NFE2L2 gene expression, but a decrease of SYN1 (R=0.67, p=0.008), VEGFa (R=0.68, p=0.045) and COX-2 (R=0.65, p=0.02) gene expression compared to the control. In group 3, gene expression of SYN1 (R=0.67, p=0.03), VEGFa (R=0.41, p=0.007), COX-2 (R=0.53, p=0.006) and NFE2L2 (R=0.58, p=0.02) was decreased and there was a trend towards a decrease of BDNF (R=0.66, p=0.059) expression compared to the control. **Discussion** The expression of genes involved in inflammation and oxidative stress was not increased 24 h after PM exposure. This is the first study that shows a negative effect of air pollution exposure on the expression of genes important for neural plasticity and on the exercise-induced up-regulation of BDNF gene expression in the hippocampus of rats. **References** (1) Christie BR et al. (2008). *Neuromol Med*, 10, 47-58. (2) Vaynman S et al. (2004). *Eur J Neurosci*, 20, 2580-90. (3) Calderón-Garcidueñas L et al. (2008). *Brain Cogn*, 68, 117-27. (4) Pfaffl MW et al. (2002) *Nucleic Acids Res* 30(9), e36.

##### **POLYMORPHISM OF THE IGF-2 GENE SPECIFIES COMPETITIVE CAPACITY OF JAPANESE JUDO PLAYERS**

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1: *Graduate School of Physical Education*, 2: *School of physical Education*, 3: *Sport Medical Science Research Institute*

**【Introduction】** Many previous studies have reported positive associations between genetic polymorphisms and competitive capacity and/or its-related traits, such as skeletal muscle mass. Insulin-like growth factor-2 (IGF-2) is involved in the differentiation and enlargement of skeletal muscle. A polymorphism of the IGF-2 gene is reported to be associated with skeletal muscle mass, fat mass, and muscle strength. Because judo is an event with body weight divisions, skeletal muscle mass by body weight plays an important role in the competitive capacity. This study aimed to clarify the relationships between the competition levels and IGF-2 gene polymorphism in Japanese judo players. **【Methods】** The subjects were 122 male judo players belonging to top-level universities in Japan. Those who were top-level players of international tournaments, representative players for Japan, and others were classified into S-rank (n=9), A-rank (n=9), and C-rank (n=104), respectively. DNA was extracted from their saliva and genotyping analysis was performed by use of PCR-RFLP technique with Apal to detect the IGF-2 gene polymorphism (rs680) according to the previous study (1). In addition, relationship between IGF-2 gene polymorphism and back muscle strength was investigated. **【Results】** The polymorphism of the IGF-2 gene from the 122 Japanese judo players was composed of 32.8%, 53.3%, and 13.9% of GG, AG, and AA genotypes, respectively. The polymorphism in the S-ranked players was composed of 66.7% (6/9), 33.3% (3/9), and 0% of GG, AG, and AA genotypes, indicating that all subjects possessed G allele. Frequencies of G allele in each competitive capacity are 83.3%, 55.6%, and 41.3% in S-, A-, and C- ranks, respectively, showing high frequency of this allele in top-level judo players. In addition, the judo players with GG (p < 0.05) or AG (p < 0.01) genotype showed significantly higher back muscle strength than those with AA genotype, indicating the correlation between IGF-2 gene polymorphism and back muscle strength. **【Discussion】** A high percentage of skeletal muscle mass in body weight is considered to be an advantage in judo performance, an event with weight divisions. A previous study reported that G allele in the IGF-2 gene polymorphism (rs680) was related to skeletal muscle mass in the general young individuals. In addition of this finding, we observed that the frequency of G allele was not only higher competitive capacity but also higher back muscle strength in judo player of the present study. Thus, IGF-2 gene polymorphism (rs680) is likely to specify competition levels of male Japanese judo players. **【Reference】** 1. Chen J et al, *Obstet Gynecol Int*, 2010, Article ID 965905.

## PLASMA AND SALIVARY INTERLEUKIN-6 RESPONSES TO EXERCISE ARE NOT CORRELATED

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**Introduction** Interleukin-6 (IL-6) is widely recognized as an important measure of metabolic, inflammatory and immune responses to exercise stimuli (Fischer 2006). The use of saliva would be an attractive alternative to measuring levels of this protein in plasma, which requires the invasive procedures associated with venous blood sampling. Previous research has demonstrated that there is no correlation between salivary and plasma values of IL-6 pre or post exercise (Minetto et al., 2007). Cox et al., 2008 also measured resting plasma and salivary IL-6 and while they found no correlation, they suggested that the pattern of regulation could be related in response to exercise. This study aimed to investigate the relationship between plasma and salivary IL-6 responses to exercise. **Methods** Five male and five females (mean SD  $\text{VO}_2\text{peak} = 48.4 \pm 7.1 \text{ ml kg}^{-1} \text{ min}^{-1}$ , body mass =  $67.7 \pm 13.7 \text{ kg}$ , age =  $24.4 \pm 3.4 \text{ yrs}$ ) completed a standardised exercise test on a cycle ergometer: 5 x 4 min, 80%  $\text{VO}_2\text{peak}$  interspersed with 3 min relative recovery at 50%  $\text{VO}_2\text{peak}$ . Blood and saliva samples were obtained immediately pre and post exercise. Blood samples were obtained using standard venepuncture techniques. Saliva samples (approx. 1ml) were collected using passive drool techniques. Plasma and salivary IL-6 values were determined using a high-sensitivity enzyme-linked immunosorbent assay (ELISA). Results Plasma IL-6 increased significantly  $2.7 \pm 1.4$  fold post exercise ( $P < 0.01$ ). There was no significant change in salivary IL-6 pre to post exercise ( $P = 0.12$ ). There was no significant correlation between plasma and salivary IL-6 pre ( $r = -0.383$ ,  $P = 0.27$ ), post exercise ( $r = 0.488$ ,  $P = 0.153$ ) or when expressed as a fold change ( $r = -0.491$ ,  $P = 0.149$ ). **Discussion** In this study plasma and salivary IL-6 values are not related pre or post exercise and do not show the same relationship in the context of a standardized exercise stimulus. It is possible that the regulatory pattern of systemic IL-6, produced from working muscles, is different to that found in the saliva. On this evidence saliva samples should not be used as a marker for IL-6 responses when examining the systemic response to exercise. **References** Fischer CP. *Exerc Immunol Rev.* 2006;12:6–33. Minetto MA. Gazzoni M. Lanfranco F. Baldi M. Saba L. Pedrola R. Komi PK. Rainoldi A. *Eur J Appl Physiol* (2007) 101:249–256. Cox AJ, Pyne DB, Gleeson M, Callister R. *Eur J Appl Physiol* (2008) 103:477–479.

## THE EFFECT OF KINESIO TAPING AND CRYOTHERAPY ON PEAK ANAEROBIC POWER RECOVERY AFTER DOWNHILL RUNNING

Szygula, Z., Maciejczyk, M., Wiecek, M., Szymura, J., Kepinska, M., Wiecha, S., Maciejczyk, G., Ochalek, K.

*University School of Physical Education*

**Introduction** It is necessary to apply the evidence-based sports medicine in controlling and planning physical training in sports. That is why currently used methods should be verified and basing on scientific knowledge the new methods should be developed (Barnett, 2006; Hausswirth et al., 2011; Howatson & Someren, 2008; Viithouk et al., 2010). The aim of the study was to evaluate the effectiveness of kinesio taping and whole-body cryotherapy (WBC) on the peak anaerobic power (PP) recovery after downhill running. **Methods** The study was conducted on 9 healthy men aged  $21.2 \pm 1.39$  years old. The mean body height was  $179.7 \pm 4.8 \text{ cm}$ , body mass  $79.9 \pm 14.7 \text{ kg}$ , BMI  $24.5 \pm 3.2$ . The maximal oxygen uptake was measured using incremental test until exhaustion ( $\text{VO}_2\text{max}$ :  $53.23 \pm 5.87 \text{ ml.kg}^{-1}$ ). The peak anaerobic power was measured using Wingate Anaerobic Test (20 seconds, 7.5% body mass) before and next following downhill running (DH): immediately after (20 min), 1h, 24h, 48h and 1 week later. The downhill running (60 minutes) was performed at slope angled 10% with an intensity of approximately 60%  $\text{VO}_2\text{max}$ . The peak anaerobic power recovery was observed after DH when the kinesio taping (quadriceps femoris and gastrocnemius), whole-body cryotherapy ( $-130^\circ\text{C}$ , 3 minutes) and passive recovery were applied after DH (in random order). Kinesio taping was applied for first 48 hours after DH and WBC was done three times (after DH, 24 and 48 hours later). Differences in mean changes between consecutive measures and between 3 methods were analyzed using Friedmans' ANOVA and post-hoc Wilcoxon's signed-rank test ( $p < 0.05$ ). **Results** The peak anaerobic power was significantly decreased after DH. During the passive recovery significantly lowered level of PP was noted till 24 hours. After kinesio taping application the PP was at similar level to baseline already after 1 hour after DH. When WBC was applied the PP recovery time was significantly longer: the PP significantly decreased after 48 hours. **Conclusions** The most effective method of renewal treatment was kinesio taping. Whole-body cryotherapy should not be used for improvement of peak anaerobic power recovery. **References:** Barnett A. (2006). *Sports Med*, 36 (9), 781-796. Hausswirth Ch, Louis J, Bieuzen F, Pournot H, Fournier J, Filliard J-R, Brisswalter J. (2011). *PLoS ONE* 6(12): e27749. Howatson G, Someren K, van Someren KA. (2008). *Sports Med*, 38 (6), 483-503. Viithouk I, Beneka A, Malliou P, Aggelousis N, Karatsolis K, Diamantopoulos K. (2010). *Isokinetics and Exercise Science*, 18 (1), 1-6.

## COLD WATER IMMERSION RECOVERY FROM HIGH-INTENSITY SPRINT CYCLING: AN EXAMINATION USING THE CARDIOVASCULAR SYSTEM

Warmington, S.A., Twaddell, C., Gastin, P.

*Deakin University*

**Introduction** Cold water immersion (CWI) is proposed to affect muscle blood flow to enhance recovery from exercise via some unknown mechanism [1, 2]. However, evidence to support any effect of CWI on the cardiovascular system remains speculative. No study has measured cardiac function (cardiac output, CO; stroke volume, SV) in response to CWI during recovery, despite evidence that CWI accelerates post-exercise parasympathetic reactivation [3]. With this in mind it would seem sensible to monitor recovery by assessing aspects of cardiovascular function, rather than often-cited methods of monitoring circulating factors such as blood lactate that repeatedly fail to discern between recovery interventions [4]. Therefore, this study examined CO, SV, HR and BP during CWI following high-intensity sprint cycling exercise, while also attempting to distinguish between recovery interventions by measuring HR kinetics in response to a low-intensity recovery test (LIRT; 100 W cycling) as a non-invasive, non-performance test prior to exercise. **Methods** Participants ( $n=12$ ) completed two exercise trials (randomised cross-over design). Each trial comprised two exercise bouts (Ex1, Ex2) separated by a 30-min recovery period. Exercise comprised a 5-min LIRT followed by three 30-s Wingate tests. Recovery comprised 30 min passive rest (CON) or 15 min CWI plus 15 min passive rest (COLD). HR kinetics were examined during LIRT, and CO and SV at 4 stages during recovery (via rebreathing technique - Innocor, Innovision, DK). **Results** In both trials Ex2 Wingate performance did not return to baseline (Ex1) after recovery. CO and SV during recovery were similar between trials. However, MAP was increased by 5.0% and HR reduced by 6.9% in COLD compared with CON at end-recovery. HR kinetic parameters during LIRT were different between Ex1 and Ex2 as HR did not return to baseline over the 30-min recovery. However, for Ex2 HR at baseline was similar between CON and COLD, yet despite this the plateau was 4.6 bpm lower in COLD compared with CON, with no differences in other kinetic parameters. **Discussion** CWI did not appear to affect

cardiac function during recovery despite a higher blood pressure and lower HR in COLD than in CON at end-recovery. Interestingly, HR kinetics during LIRT provided a means by which different recovery strategies may be detected and, therefore, suggests HR kinetics may be a potential tool to monitor/measure athlete recovery. References 1. Vaile J, et al., (2011). *Br J Sports Med.* 45(10), 825-9. 2. Gregson W, et al. (2011). *Am J Sports Med.* 39(6), 1316-23. 3. Buchheit M, et al., (2009). *Am J Physiol-Heart C.* 296(2), H421-H7. 4. Wilcock IM, et al., (2006). *Sports Med.* 36(9), 747-65.

### EXERCISE-INDUCED INFLAMMATORY AND GLUCOSE RESPONSES IN INDIGENOUS AUSTRALIAN AND CAUCASIAN POPULATIONS

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*Charles Sturt University*

**Introduction** Many Indigenous populations have increased prevalence of non-communicable chronic diseases, which contribute to a lower life expectancy compared to non-indigenous populations (Albert 2007; Shaw et al., 2010). However, few studies report cross-ethnicity comparative physiology that underlies these epidemiological phenomena (Albert 2007). This study reports the acute post-exercise inflammatory and glucose responses to aerobic exercise within and between Australian Indigenous and Caucasian populations matched for fitness and body composition. **Method** Sedentary, middle-aged Indigenous (n=10) and Caucasian (n=9) Australian males volunteered to participate who were free from diagnosed cardiovascular disease or diabetes. Following baseline testing, participants completed 1 x 40 min cycle ergometry protocol at 80% maximal heart rate. Fasting venous blood was collected pre, 0, 30, 60 min and then 240 min post-exercise for analysis of glucose, insulin, cortisol, tumor necrosis factor (TNF- $\alpha$ ), interleukin (IL)-1 $\beta$ , IL-6, IL-1 receptor agonist (Ira) and C-reactive protein (CRP). **Results** Resting TNF- $\alpha$  and glucose concentrations were significantly higher in the Indigenous group (P<0.05). IL-6 increased (P<0.05) from 30 to 60 min post-exercise in the Caucasian group, whilst IL-1ra concentration remained elevated 240 min post-exercise for the Caucasian (P<0.05), but not Indigenous group (P>0.05). TNF- $\alpha$ , IL-1 $\beta$  and CRP showed no exercise-induced responses within either group (P>0.05). The immediate (0 min) post-exercise cortisol and glucose increase for Caucasians was significantly (P<0.05) higher than the attenuated responses observed within the Indigenous group (P>0.05). **Discussion** The present study showed that despite the two groups representing their respective middle-aged populations and being matched for aerobic fitness and body composition, differences in baseline pro-inflammatory and glucose concentrations exist between Indigenous Australians and Caucasians. This disparity may have contributed to the post-exercise differences between groups to cycle ergometry; specifically, the blunted post-exercise anti-inflammatory (IL-6 and IL-1ra) and glucose regulatory (glucose and cortisol) response within the Indigenous group. As such, exercise interventions may be of benefit for both groups and should be tailored respective to the cultural and health characteristics present within Indigenous Australian and Caucasian populations. **References** Albert MA. (2007). *Nutrition Rev.* 65, S234-S8. Shaw JE, Sicree RA, Zimmet PZ (2010). *Research Clin Prac.* 87, 4-14.

### EFFICIENCY OF SKELETAL MUSCLE MITOCHONDRIAL COUPLING IS A CRITICAL FACTOR FOR MAXIMAL EXERCISE CAPACITY AND OXYGEN UPTAKE IN RATS

Schlagowski, A., Schlagowski, A.I., Singh, F., Charles, A.L., Favret, F., Piquard, F., Geny, B., Zoll, J.

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**Efficiency of skeletal muscle mitochondrial coupling is a critical factor for maximal exercise capacity and oxygen uptake in rats** **Introduction** The role of mitochondrial uncoupling in the determination of maximal oxygen uptake ( $\dot{V}O_{2max}$ ) and maximal exercise capacity is still unknown. Both, the heart's ability to pump blood and each step in the O<sub>2</sub> cascade, particularly, the mitochondrial level in skeletal muscle seem to be crucial for the determination of endurance performance as well as  $\dot{V}O_{2max}$  (Zoll et al., 2002). Showing the effects of mitochondrial uncoupling on exercise parameters could help to better understand the significance of mitochondrial function for  $\dot{V}O_{2max}$  and maximal running speed. **Methods** Rats were divided in a control group and a group treated with 2-4-dinitrophenol, a mitochondrial uncoupler, for 28 days (DNP; 30 mg/kg/day in drinking water). Gas exchanges were measured during an incremental treadmill test. Basal ( $\dot{V}O$ ) and maximal ( $\dot{V}max$ ) mitochondrial respiration of skinned fibres were measured in the gastrocnemius muscle, and the effects of DNP were tested in L6 myoblasts. **Results** The DNP group presented significantly lower body mass (p<0.05) and a higher resting  $\dot{V}O_2$  (p<0.005). Maximal running speed and running economy (p<0.01) were lower, whereas  $\dot{V}O_{2max}$  was higher in DNP rats during incremental treadmill test, without changes of basal glycogen and triglycerides content. In gastrocnemius skinned fibres,  $\dot{V}O$  was higher (p<0.01), whereas the acceptor control ratio (ACR,  $\dot{V}max/\dot{V}O$ ) was significantly lower in DNP animals (p<0.05), showing a reduction of the OXPHOS efficiency further supported by a positive correlation between ACR and running speed. In condition of high ADP concentration, DNP reduced the mitochondrial capacity of myoblasts to produce ATP (p<0.01). **Discussion** DNP treatment induces a mild mitochondrial uncoupling resulting in the augmentation of basal O<sub>2</sub> uptake and a reduction of weight gain. It has been shown that the efficiency of ATP production is diminished in the absence of the inner mitochondrial membrane solute transporter (SLC25A25), resulting in the reduction of endurance capacities in animals (Anunciado-Koza et al., 2011). This work indicates the importance of mitochondrial ATP production for maintaining the endurance capacity. Our results, and particularly the ACR suggest that an impairment of mitochondrial OXPHOS efficiency in skeletal muscle, independently of oxygen transport system, is sufficient to reduce the maximal exercise capacities. **References** Zoll J, Sanchez H, N'Guessan B, Ribera F, Lampert E, Bigard X, Serrurier B, Fortin D, Geny B, Veksler V, Ventura-Clapier R, Mottauer B (2002). *J. Physiol. (Lond.)* 543: 191-200. Anunciado-Koza RP, Zhang J, Ukropec J, Bajpeyi S, Koza RA, Rogers RC, Cefalu WT, Mynatt RL, Kozak LP (2011). *J. Biol. Chem.* 286: 11659-11671.

### EXPLOSIVE ATHLETES ARE CHARACTERIZED BY A LOWERED SERUM CARNOSINASE ACTIVITY AND PROTEIN CONTENT

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1 Department of Movement and Sports Sciences, Ghent University, Ghent, Belgium 2 Department of Medicine, University Medical Center Mannheim, University of Heidelberg, Mannheim, Germany 3 Department of Pathology, Leiden University Medical Center, Leiden, The Netherlands **Introduction** Serum carnosinase (CNI), the enzyme responsible for the hydrolysis of the dipeptide carnosine into its constituent amino acids beta-alanine and L-histidine, is highly active in human blood. Circulating carnosine has several health-protective biochemical properties and could possibly attenuate acidosis and oxidative stress in blood during exercise. Therefore, one could expect that a low carnosinase activity is beneficial to athletes who are involved in high-intensity and sprint-type exercise. The aim of this study was to compare different types of elite athletes with controls regarding CNI activity and content. **Methods** A total of 251 subjects (166 males and

85 females) participated in this cross-sectional study. The study population consisted of a not-specifically trained control group (n= 156) and a group Belgian elite athletes (n=95), who all were or had been competing at international level. The 'explosive group' (n=50) included athletes from explosive track-and-field disciplines, short track, judo, gymnastics and short distance swimming. The 'middle to long distance group' (n=45) consisted of middle and long distance runners, long distance swimmers, triathletes and rowers. In all subjects, heparin blood samples were collected to quantify CN1 protein content (by ELISA; Everaert et al. 2012) and activity (by the method described in Teufel et al 2003). Results In the total study population, women had significantly higher CN1 activity (6.11 vs 5.12  $\mu\text{mol/mL/h}$ ,  $p=0.003$ ) and CN1 content (85.61 vs 68.64  $\mu\text{g/mL}$ ,  $p<0.001$ ) than men. Both in males ( $p=0.002$ ) and in females ( $p=0.035$ ) explosive athletes had a lower (27.5 % in males; 30 % in females) CN1 activity compared to controls, within a similar age range. Similar differences were found with regard to CN1 protein content (males  $p=0.002$ , 29.2 % lower; females  $p=0.021$ , 32.7 % lower). Conclusion In conclusion, explosive elite athletes have a lowered CN1 activity and protein content compared to untrained controls. This observation raises the questions whether this characteristic is beneficial for high-intensity exercise and whether this is the result of selection (nature) or training (nurture). References Everaert I et al. (2012) *Am J Physiol Renal Physiol* 302: F1537–F1544. Teufel M et al. (2003) *J Biol Chem* 278: 6521-6531.

### **CALCITONIN-GENE RELATED PEPTIDE PLASMA LEVELS DECREASE DURING A MAXIMAL TEST IN TRAINED INDIVIDUALS**

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**Introduction** The potential contribution of calcitonin-gene related peptide (CGRP) to the acute hemodynamic responses to maximal exercise is unknown. Here we report the preliminary data of a pilot descriptive study aimed to quantify the plasma concentrations of CGRP ([CGRP]p) during a cycle ergometer maximal test, and to correlate them with blood pressure. **Methods** Three trained males (25,3±4,9 years) were subjected to a maximal ergoespirometric test (Cosmed K4b2) on a cycle ergometer (Monark E839), following a modified Bruce protocol. An intravenous catheter was placed at the right antecubital vein connected to a three gauge valve, and blood pressure was measured on the left brachial artery using an automated sphygmomanometer (Tango, Suntech Medical). Before starting, at the maximum and after recovery, blood samples were taken and transferred to tubes containing EDTA. Blood was centrifuged and plasma supernatants were collected and frozen at -80°C up to the moment they were assayed for the quantification of CGRP (human CGRP ELISA kit, SpiBio, France). Blood pressure at the same moments of blood removal was also registered. Results VO2max of the subjects was 50,4±4 ml/Kg/min. In comparison with the pre-exercise measurements, at the maximum: a) SBP increased (188±18 vs 136±10 mmHg;  $p=0,0046$ , paired T test); b) mean arterial pressure (MAP) increased (99,6±8,2 vs 109,8±18 mmHg;  $p=0,0048$ , paired T test); and c) [CGRP]p decreased by around 45% (78,5±36,9 vs 43,9±24,2 pg/ml;  $p=0,0025$ ; paired T test). After recovery, in comparison with the maximum: a) systolic blood pressure (SBP) decreased (136±10 vs 122,7±11,6 mmHg;  $p=0,031$ , paired T test); b) mean arterial pressure (MAP) tended to decrease (109,8±18 vs 80,7 ±10,7 mmHg;  $p=0,088$ , paired T test); and c) [CGRP]p didn't change (43,9±24,2 vs 43,0±23,4 pg/ml; NS, paired T test). After a linear regression fitting, both SBP and MAP tended to decrease with increasing [CGRP]p (SBP:  $y=-0,324x+166$ ;  $R^2=0,0940$ ); MAP:  $y=-0,118x+103$ ;  $R^2=0,044$ ). **Discussion** In contrast with previous reports (Brooks, et al, 1990; Schiffer, et al, 1995) that have found that [CGRP]p increased or didn't change with exercise, in the preliminary experiments described here a sustained reduction of [CGRP]p that correlated with an increase of SBP at maximal exercise was found. This could suggest a role for CGRP in the acute hemodynamic responses to exercise. The mechanism by which exercise decreases [CGRP]p, the duration of this effect and the possibility of a compensatory elevation of CGRP after exercise are other questions arising from this observations. References Brooks, S, et al. *Eur J Physiol* 1990;60:144-8 Schiffer, S, et al. *Horm Metabol Res* 1995;27:473-5

### **MITOCHONDRIAL FUNCTION ADAPTATIONS IN RAT SKELETAL MUSCLE: A COMPARISON BETWEEN CONCENTRIC AND TWO ECCENTRIC TRAINING PROGRAMS.**

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**Introduction** A large range of training programs can be performed to trigger mechanical and metabolic signals leading to muscle function adaptations. Most of the studies investigating acute or chronic muscle adaptations to exercise use a combination of concentric and eccentric contractions. If it is well-known that eccentric mode generates a lower oxygen cost compared to the concentric mode at the same mechanical intensity, very little data is available concerning muscle metabolic adaptations following an eccentric program. The aim of this study was to compare mitochondrial function adaptations after a concentric and an eccentric training realized either at a same metabolic power (VO2) or at a same mechanical power (Pw). We hypothesized that 1-both eccentric trainings may improve mitochondrial function in skeletal muscle and 2-eccentric training realized at a same metabolic power than concentric training will induce similar adaptations. **Methods** Fifty six rats male were randomly divided in four groups: Control (CONT), Concentric + 15° (CONC +15; slope + 15°) Eccentric - 15° (ECC -15; slope-15°) and Eccentric - 30° (ECC -30). Speed (15m/min) and slope were previously determined to respect same metabolic responses (VO2) in ECC - 30 and CONC +15. Training sessions (60 min) were performed daily for 26 days. Mitochondrial respiration in permeabilized fibers of Gastrocnemius (Gas) and Vastus Intermedius (VI) muscles was studied. Oxygraphic measurements were performed allowing for maximal ADP-stimulated mitochondrial respiration (Vmax) and ADP sensitivity (Km) assessment. Moreover, expression of genes involved in mitochondrial biogenesis (PGC1- $\alpha$ , PPAR- $\beta$ , Tfam, Nrf-1) and functional regulation (Desmin) was assessed by RT q-PCR. Results After 26 days of training, Km and Vmax were significantly higher in EXC -30 and CONC +15 compared with CONT in Gas and VI ( $p<0.05$ ). No significant change was highlighted in EXC -15 group for mitochondrial respiration. No difference appeared in Km and Vmax between CONC +15 and EXC -30. Quantification of gene expression in VI revealed a higher expression of PPAR- $\beta$  in EXC -15 compare with CONT. Increased PGC-1 $\alpha$  expression was noted in Gas EXC -30 compare with CONT. No difference appeared between CONC +15 and EXC -30. **Conclusion** Our finding supports the idea that eccentric training may induce adaptations of mitochondrial function in similar proportions than the concentric training when performing at the same metabolic power. As weak changes were observed in gene expressions, other investigation should be achieved to deepen the signaling pathways leading to mitochondrial function adaptations following eccentric exercise.

## HIGH INTENSITY TRAINING DECREASES MITOCHONDRIAL ADP SENSITIVITY IN HUMAN ADIPOSE AND SKELETAL MUSCLE TISSUE

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**Introduction** It has previously been reported that mitochondrial ADP sensitivity decreases (higher  $K_m$ ) with endurance training in human skeletal muscle. This decrease was accompanied by an increased maximal ADP stimulated respiration and an increased maximal oxygen uptake ( $VO_{2MAX}$ ). It is not known whether high intensity training (HIT) has the same effect on mitochondria and if these changes also occur in mitochondria from human adipose tissue. The aim of this project was to investigate mitochondrial ADP sensitivity and maximal ADP stimulated respiration in human adipose and skeletal muscle tissue after six weeks of HIT. **Methods** Eight healthy overweight subjects (6F/2M) (age:  $40 \pm 3$  yrs, BMI:  $32 \pm 2$ ,  $VO_{2MAX}$ :  $2383 \pm 115$  ml/min) were included in the study. The subjects underwent six weeks (3 times a week) of HIT.  $VO_{2MAX}$  was measured pre and post training. Mitochondrial ADP sensitivity ( $K_m$ ) and maximal ADP stimulated respiration ( $V_{max}$ ) was measured pre and post HIT in adipose tissue and permeabilized muscle fibers by high resolution respirometry (Oxygraph-2k, Oroboros, Innsbruck, Austria). The adipose tissue was permeabilized with digitonin and the skeletal muscle fibers with saponin. The protocol used for respirometry was as follows: Malate (2 mM), Glutamate (10 mM) and ADP titrated in the following steps (0.05 – 0.10 – 0.25 – 0.50 – 1.00 – 2.50 – 5.00 mM). SigmaPlot was used to determine  $K_m$  and  $V_{max}$  for ADP. **Results**  $VO_{2MAX}$  was not improved after HIT. Mitochondrial ADP sensitivity was significantly ( $P=0.007$ ) decreased (higher  $K_m$ ) after HIT in permeabilized skeletal muscle ( $0.15 \pm 0.02$  mM vs.  $0.27 \pm 0.03$  mM), and the same trend was seen in adipose tissue although not significant ( $P=0.125$ ) ( $0.12 \pm 0.05$  mM vs.  $0.20 \pm 0.07$  mM). Maximal ADP stimulated respiration ( $V_{max}$ ) was similar after HIT in permeabilized skeletal muscle ( $20 \pm 1$  pmol/mg/sec vs.  $21 \pm 1$  pmol/mg/sec) as well as in adipose tissue ( $0.38 \pm 0.07$  pmol/mg/sec vs.  $0.39 \pm 0.05$  pmol/mg/sec), before vs. after, respectively. **Conclusions** ADP sensitivity decreased in permeabilized human skeletal muscle and the same trend was seen in adipose tissue. This was accompanied by a similar maximal ADP stimulated respiration pre and post training in both skeletal muscle and adipose tissue. This is the first time that ADP sensitivity has been investigated in adipose tissue, and interestingly the HIT training adaptation in adipose tissue mitochondria is similar to that observed in skeletal muscle. The project is financially funded by the EU FP7 program.

## CHANGES IN HAEMATOLOGICAL PARAMETERS OF SCOTTISH PROFESSIONAL YOUNG FOOTBALLERS OF PREMIER LEAGUE DURING PRE COMPETITIVE SEASON

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*University of Glasgow*

**Introduction** Previous evidence suggest that intense sporting activities result in iron deficiency (ID) (Schumacher et al., 2002) which may lead to anaemia: a decrease in the amount of red blood cells or lower than normal amounts of haemoglobin in the blood. In males, non-anaemic ID is defined as ferritin  $<20$  ng/mL and Hb  $>13$ g/dL and anaemic ID as ferritin  $<20$  ng/mL and Hb  $<13$ g/dL (Rowland, 2012). Signs of ID vary from fatigue, headache, to impairment in exercise performance (Landahl et al., 2005). The aim of this study was to investigate blood markers of iron status and anaemia and of Scottish young professional football players prior their competitive year and after a month of intensive training. **Methods** The study participants were 30 footballers aged  $17.4 \pm 0.8$  years and with body fatness of  $8.84 \pm 3.2$  % (values means  $\pm$  SDs). Blood samples were drawn and body composition was measured prior the start of competitive season (PRE) and 4 weeks after participation in intense training of approximately 50 hours per week (POST). Blood samples were analysed for serum ferritin, iron, haemoglobin (Hb), haematocrit (Hct), red blood cell count (RBC). Statistical analysis were performed by applying paired t-test **Results** Participation in training induced significant decrease in concentration of ferritin (PRE:  $65.37 \pm 35.53$  ng/mL; post:  $48.5 \pm 22.2$  ng/mL,  $P < 0.05$ ), Hb (PRE:  $15.3 \pm 1.0$  g/dL; POST:  $14.7 \pm 1.0$  g/dL,  $P < 0.001$ ), Hct (PRE:  $44.8 \pm 2.1$  %; POST:  $43.7 \pm 2.5$  %,  $P < 0.05$ ), RBC (PRE:  $44.8 \pm 2.1$  million cells/mcL; POST:  $43.7 \pm 2.5$  million cells/mcL,  $P < 0.001$ ), but had no effect on concentration of serum iron (PRE:  $18.30 \pm 6.29$  umol/L; POST:  $20.07 \pm 7.79$  umol/L,  $P > 0.05$ ). None of the athletes were found to have either anaemia or ID at both pre and post preseason training periods. **Discussion** This study confirms that intense physical activity leads to significant decreased levels of ferritin, RBC, Hb and Hct. In our study, following one month training markers of ID and anaemia were still above cut-offs for ID which is in agreement with some (Schumacher et al., 2002) but not all studies (Landahl et al., 2005). Taking into consideration that development of ID is quite a slow process and occurs over periods of time, it is extremely important athletes to be monitored for their iron status. Research on mechanisms involved in modification of markers of iron status and anaemia should be considered by future studies. **References** Landahl G, Adolfsson P, Börjesson M, Mannheimer C, Rödger S, (2005), *Int J Sport Nutr Exerc Metab.* 15(6):689-94 Rowland T, (2012), *Am J Lifestyle Med* 6(4):319-327 Schumacher YO, Schmid A, Grathwohl D, Bültermann D, Berg A., (2002), *Med Sci Sports Exerc.* 34(5):869-75

## THE EFFECT OF HIT EXERCISE ON PLASMA VOLUME AND PLASMA VISCOSITY.

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*CATHOLIC UNIVERSITY OF VALENCIA1, UNIVERSITY OF STUDIES OF MILAN2*

**PURPOSE:** High intensity interval training (HIT) is an exercise model that has been seen to cause similar muscle adaptations and improvements in exercise performance to traditional exercise models. This study aimed to examine the effects of low-volume HIT exercise on a hemorheological parameter, the plasma viscosity. **METHODS:** Ten healthy male subjects ( $25.80(3.39)$  years) randomly performed either a HIT exercise protocol (2-min warm up at 8 km/h, 5 2-min bouts at 90% maximal heart rate, separated by 2-min at 8 km/h, finished with another 2-min period at 8 km/h) or an aerobic (AER) exercise (60' running at 55%  $VO_{2max}$ ). Blood samples were drawn before and after exercise, and after 30-minute recovery. Plasma viscosity, hematocrit, fibrinogen, total proteins, triglycerides, total cholesterol and glucose levels were analyzed. Plasma volume loss was calculated from changes in hemoglobin and hematocrit. **RESULTS:** Plasma viscosity rose after HIT ( $p < 0.05$ ) but did not after AER ( $p > 0.05$ ) while hematocrit rose after both exercises. Plasma volume lowered more after HIT ( $-6.35(3.47)$  %) than after AER ( $-3.11(2.49)$  %) ( $p = 0.045$ ). Total-proteins ( $p < 0.001$ ), triglycerides ( $p = 0.013$ ), total-cholesterol ( $p < 0.001$ ) and glucose ( $p = 0.001$ ) concentrations increased after HIT. After AER exercise no statistically significant differences were found in plasma constituents concentrations ( $p > 0.05$ ). **CONCLUSIONS:** A session of low-volume HIT promotes a loss in plasma volume enough to cause a significant increment of plasma constituents concentrations and, therefore, a mild transient rise in plasma viscosity.

15:00 - 16:00

## Mini-Orals

## PP-PM50 Physiology [PH] 16

**TAPERING STRATEGIES IN ELITE BRITISH ENDURANCE RUNNERS**

Spilsbury, K.L.1,2, Fudge, B.W.2, Ingham, S.A.2, Pringle, J.S.M.2, King, J.A.1, Saini, A.1, Nimmo, M.A.1

*1: Loughborough University 2: English Institute of Sport*

**Introduction** It is common for elite endurance athletes to undertake a period of reduced training load prior to major competition, a practice known as tapering. Despite a plethora of anecdotal evidence, there is a lack of scientific data describing the tapering strategies employed by elite endurance runners. **Purpose** To explore the current tapering practices of elite British runners in events ranging from 800 m to marathon. **Methods** Training information typical of a regular training phase (RTP) and of a tapering period (TP) was obtained from a survey. Inclusion criteria specified that participants had competed at national, international and/or Olympic level in 800 m, 1,500 m, 3,000 m steeplechase (SC), 5,000 m, 10,000 m and/or marathon. A total of 37 participants were included in the analysis (male = 21 and female = 16). Personal best times were within 2-12 % and 1-14 % of the British record for males and females, respectively. Data was pooled from 800 m and 1,500 m to form a middle-distance group (MD; n = 18) and from 3,000 m SC, 5,000 m and 10,000 m in to a long-distance group (LD; n = 9). **Results** Duration of the TP was (mean  $\pm$  SD) 7  $\pm$  3 d, 6  $\pm$  1 d and 15  $\pm$  4 d for MD, LD and marathon, respectively. Continuous running volume was reduced by 29  $\pm$  11 % in MD, 30  $\pm$  13 % in LD and 48  $\pm$  12 % in marathon. Frequency of continuous running during TP ranged from 57-150 % in MD, 71-117 % in LD and 43-88 % in marathon when compared to RTP. A greater total weekly running volume during RTP was associated with a longer TP duration and a greater reduction in continuous running volume during TP ( $R^2 = 0.33$ ,  $P < 0.05$ ;  $R^2 = 0.46$ ,  $P < 0.05$ , respectively). The percentage of continuous and interval running frequencies during TP were related to frequency during RTP ( $R^2 = 0.43$ ,  $P < 0.05$ ;  $R^2 = 0.13$ ,  $P < 0.05$ ). The peak intensity interval training session of TP was not different to race speed in MD runners (102  $\pm$  2 %). Long-distance runners completed the peak intensity interval session significantly faster than race speed (111  $\pm$  13%,  $P < 0.05$ ), despite no difference to MD in proximity of the peak session to competition (3  $\pm$  1 d and 3  $\pm$  1 d, respectively). **Conclusion** In elite British endurance runners, tapering appears to be a fluid and dynamic process and the strategies employed are individualised and determined by previous training. It is clear that LD runners significantly increase interval training intensity above race speed in the final days of the taper, but the possibility of a late physiological and performance benefit from such an increase warrants further investigation.

**SUSPENSION TRAUMA AND TILT-TABLE TEST SYNCOPE: THE SAME AND THE DIFFERENT.**

Lanfranconi, F.1, Barbic, F.2, Pollastri, L.1, Bartesaghi, M.1, Corna, G.1, Furlan, R.2, Miserocchi, G.1

*1Department of Health Sciences, Laboratory of Clinical Physiology and Sport Medicine, University of Milano-Bicocca, via Cadore 48, Monza, Italy. 2Medicina Generale Clinica Medica, Humanitas Institute*

**Introduction** Following a fall, the subject hanging on the harness and waiting for rescue may incur into the risk of a lethal multivisceral hypoxia distress due to orthostatic stasis named "suspension trauma". To this condition are exposed all the workers involved in work at height. The purpose of this study was to evaluate by non-invasive methods the individual risk of developing suspension trauma. **Methods** Forty adults (mean  $\pm$  st.dev: age 39,1 $\pm$ 8,2; body mass index 24,2 $\pm$ 3,03; 85% males, 15% females) were enrolled: 16 were regular users of harness, 14 regularly involved in physical training but were not users of harness and 10 were controls. Each subject underwent: a) an incremental exercise test on treadmill until exhaustion; b) a motionless suspension test until medical signs of orthostatic intolerance appeared or extreme subject discomfort was reported (suspension time recorded); c) individuals with a positive motionless test for syncope underwent to a tilt-table test. Oxygen uptake, end tidal pressure of CO<sub>2</sub>, heart rate and blood pressure were measured, as well as brain oxygenation status by near-infrared spectroscopy. **Results** No difference in the mean suspension time was found in the 3 groups (average of all participants 28.7 $\pm$ 11.4 min (range 8-56), coefficient of variation 40%). No correlation was found between the level of aerobic fitness and suspension time. Four persons revealed a risk of syncope during suspension in harness: a decrease in brain oxygenation was evident before the development of signs of pre-syncope although no oscillatory pattern of cardiovascular response was noticed. In these 4 individuals only a partial hint of syncope's signs was noticed during the tilt table test. **Discussion** The experience in use of harness and the aerobic fitness do not correlate with the suspension time and thus the onset of developing suspension trauma. The cerebral hypoxia is a co-factor and not the main cause of syncope. The discomfort in harness and the loss of control of anti-gravity muscles are the main factors differentiating the suspension trauma from the tilt-table test syncope **References** Amphoux M. (1998). International Fall Protection Symposium, Germany, September 1998. Bariod, Thery B (1994). Spelunca, 55, 39-42 Seddon P (2002). Contract Reserch Report (for the Health and Safety Executive) Furlan R (1998). Circulation, 98, 1756-61.

**EFFECT OF GENDER AND SKIN PIGMENTATION ON SPRINT PERFORMANCE AND PLASMA VOLUME CHANGES**

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**Introduction** Concerning physical performances several differences were observed between black and white subjects in several sports. While data are available for anaerobic performances as sprinting (Fall and Pirnay, 1989) little is known concerning repeated sprint ability (RS), which represent an important fitness component for team-sports. Consequently, The aim of this study was to investigate the influence of skin color in both sexes in North-African subjects on sprint and repeated sprint performances and PV changes (PVV). In fact, PV is known to play an important role in the recovery capacity (Krip et al 1997). **Methods** Thirty-six North-Africans physical education students agreed to participate to this study. They were divided according to skin color and gender. They are as follow: Black men's group (BM, n=9), White men's group (WM, n=9), Black women's group (BW, n=9) and White women's group (WW, n=9). The participants performed the running anaerobic sprint test (RAST: 6 $\times$ 35m with 10s of recovery between sprints). The haematocrit (Hct) and haemoglobin (Hb) were measured at rest, after warming-up, immediately after the RAST and after 5, 15 and 30 minutes of recovery. The PVV was determined

from the Hct and Hb. Blood lactate concentrations were determined after 3 min of recovery ([La]peak). Results There were no significant differences in RAST's performances and PVV between BM and WM. However, [La]peak was significantly higher ( $p < 0.05$ ) in CM ( $11.8 \pm 2.3$  mmol.L<sup>-1</sup>) compared to BM ( $15.4 \pm 3.2$  mmol.L<sup>-1</sup>). Average power/body mass and average power/lean mass were significantly higher ( $p < 0.05$ ) in BW compared to WW. There was no significant difference in [La]peak between the latter groups. After 5 minutes of recovery PVV was significantly ( $p < 0.05$ ) higher in BW ( $-10.1 \pm 8.4\%$ ) compared to WW ( $+1.1 \pm 5.3\%$ ). Moreover, BM and WM were faster and developed peak power and average power significantly higher ( $p < 0.05$ ) than their women counterparts. PVV was significantly higher ( $p < 0.05$ ) only in WM compared to WW ( $-12.7 \pm 8.9\%$  vs.  $-3.8 \pm 7.0\%$  and  $-10.7 \pm 9.0\%$  vs.  $+1.1 \pm 5.3\%$ , respectively at the end of the RAST and after 5 min of recovery). Discussion The present study showed that skin color influenced neither RAST's performances nor PVV in men. However RAST's performances and PVV were influenced by skin color in women. To our knowledge, this is the first study to show such data. Differences between male and female are well established in the literature, mainly because of sex differences in body composition (Glenmark et al 1992). References Fall A., Pirnay F. (1989). *Médecine du Sport*. 63(5) 266-274 Glenmark B., Hedberg G., Jansson E. (1992). *Acta Physiol Scand*. 146 (2): 251-9. Krip B., Gledhill N., Jamnik V., Warburton D. (1997) *MSSE*, 29, 1469-1476.

## EFFECT OF CARBOHYDRATE SUPPLEMENTATION AT CONTINUOUS INTENSIVE EXERCISE

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Introduction Generally it is accepted that CHO supplementation during exercise may have an ergogenic effect on long activities of moderate intensity ( $>60'$ ,  $75\%VO_{2max}$ ). However, few studies have investigated the effects of CHO supplementation during continuous intensive exercise ( $30-40'$ ,  $80-90\%VO_{2max}$  or  $95-105\%AT$ ). Therefore, the aim of this study is to investigate the effects of CHO ingestion during continuous intensive exercise. Methods Six well-trained runners ( $30 \pm 6.4$  years;  $VO_{2max}$ :  $49 \pm 3.7$  ml.kg.min;  $AT$ :  $10.8 \pm 0.5$  km/h), performed incremental test to determinate lactate anaerobic threshold (AT) and maximal oxygen uptake ( $VO_{2max}$ ). Posteriorly, all subjects performed two experimental trials, which were conducted in a random order, 4 days apart, at the same time of day for each subject. Experimental trials consisted of exercise session (ES) organized in two stages: SII:  $30'$  in intensity of AT; and SIII: immediately after the SII, speed was increased by 30% and guided to perform evaluated more  $10'$  at higher speed possible with the freedom to change the speed when needed. One day of a trial, subjects received a CHO beverage (1g/kg body mass/hour of exercise at 6% dilution in water), or a coloured flavoured placebo (PLA). The CHO and PLA were ingested during the SII of ES every 5'. During the ES were controlled heart rate (HR) and average speed (AS) every minute. Results Significant differences were identified in AS across the trials (CHO:  $11.4 \pm 0.2$  km/h and PLA:  $11.1 \pm 0.3$  km/h). Specifically, in the SIII of the trials, the difference in the AS was even more relevant (CHO:  $11.70 \pm 0.1$  and PLA:  $11.07 \pm 0.2$  km/h). Both the average intensity during the complete trials (CHO:  $102.1 \pm 0.2\%AT$  and PLA:  $99.5 \pm 0.3\%AT$ ), as the average intensity of SIII (CHO:  $105.3 \pm 0.4\%AT$  and PLA:  $99.4 \pm 0.2\%AT$ ) demonstrated the positive effect of CHO supplementation. Discussion It is established in the literature that the use of CHO promotes positive effects on yield by endurance exercise from  $60'$ , since throughout history several studies were unable to identify the ergogenic effect of CHO supplementation in activity up to  $40'$  (Palmer et al. 1998; Jeukendrup et al. 2008). However, in the present study was identified significant differences with the use of CHO in the performance (AS;  $\%AT$ ) of the ES, and especially the SIII ( $10'$  end) probably because the supplementation with CHO supplied the muscle glycogen depletion promoted by SII. Thus, we conclude that carbohydrate supplementation can promote performance improvement in continuous intensive exercise. References Palmer, G. et al. (1998). *Int J Sports Med*, 19(6), 415-418. Jeukendrup, A. et al. (2008). *Eur J Appl Physiol*, 104(5), 831-837.

## THE CARDIAC AUTONOMIC MODULATION IS DETERMINED BY GENDER AND IS INDEPENDENT ON AEROBIC PHYSICAL CAPACITY

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Introduction: Aerobic physical capacity plays an important role in reducing morbidity and mortality rates in individuals with cardiovascular diseases. This action is often related to an improvement in the autonomic modulation of the heart rate variability (HRV). However, there are still controversy regarding the effects of physical training on cardiac autonomic control in healthy subjects. (Hautala et al, 2003; Genovesi et al, 2007; Gilder et al, 2008). Therefore, our objective was to investigate whether the aerobic capacity interferes with autonomic modulation of HRV and whether there are gender differences. Methods: Men (N=48) and women (N=48) underwent ergospirometry and divided into groups according maximal aerobic capacity: low (LAC=VO<sub>2</sub>: 22-38 ml kg<sup>-1</sup> min<sup>-1</sup>, medium (MAC=VO<sub>2</sub>: 38-48 ml kg<sup>-1</sup> min<sup>-1</sup>) and high (HAC=VO<sub>2</sub>: >48 ml kg<sup>-1</sup> min<sup>-1</sup>). Autonomic modulation of HRV was investigated by means of spectral analysis at supine position. Results: Both groups formed by men, the groups formed by women, showed no differences in HRV in relation to aerobic capacity. However, women showed a reduction in low frequency oscillations (LF=0.04-0.15Hz) and increase in high frequency oscillations (HF=0.15-0.5Hz) when compared to men, regardless of the aerobic physical capacity. Discussion: The results suggest that aerobic physical capacity does not interfere in the HRV modulation, however the cardiac modulatory balance was different between genders with greater influence of autonomic parasympathetic component in women and sympathetic component in men, respectively. References: Genovesi, S, Zaccaria, D, Rossi, E, Valsecchi, MG, Stella, A, Stramba-badiale, M. Effects of exercise training on heart rate and QT interval in healthy young individuals: are there gender differences? *Europace*. 9(1):55-60, 2007. Gilder, M, Ramsbottom, R. Measures of cardiac autonomic control in women with differing volumes of physical activity. *J Sports Sci*. 26(7):781-6, 2008. Hautala AJ, Mäkikallio TH, Kiviniemi A, Laukkanen RT, Nissilä S, Huikuri HV, Tulppo, MP. Cardiovascular autonomic function correlates with the response to aerobic training in healthy sedentary subjects. *Am J Physiol Heart Circ Physiol*. 285(4): H1747-H1752, 2003.

## TRAINING TRANSFERS FROM RUNNING TO CYCLING: A CASE STUDY OF IMPROVEMENTS IN CYCLING AND RUNNING VO<sub>2</sub>MAX AFTER A BLOCK OF HIGH-INTENSITY AEROBE INTERVAL TRAINING IN AN ELITE CYCLIST

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Introduction Maximal oxygen uptake ( $VO_{2max}$ ) enhancements depend upon exercise modality, although physiological training transfers have been found from running to cycling. The purpose of this study was therefore to examine changes in running and cycling  $VO_{2max}$  after a block of high-intensity aerobic interval training (HAIT) in an elite cyclist. Methods A Norwegian elite cyclist with a baseline  $VO_{2max}$  of  $64.7$  ml.kg<sup>-1</sup>.min<sup>-1</sup> ( $5.5$  l.min<sup>-1</sup>) was tested for  $VO_{2max}$  on both treadmill and ergometer cycle pre, and post a HAIT block (14 sessions of  $4 \times 4$  min running at  $90-95\%$  HRmax in 9 days). During the 9 days with HAIT, no cycling was performed. The post-test were performed 1

day, 7 days and 45 days after finishing the HAIT block. Between post-tests 2 (7 days) and 3 (45 days), the cyclist performed 3 HAIT sessions per week as cycling in addition to his traditional training. Results The HAIT block performed as running led to an immediate increase of 3.4% in running VO<sub>2</sub>max (from 64.3 to 66.5 ml·kg<sup>-1</sup>·min<sup>-1</sup>) and 8.2% (from 64.7 to 70.0 ml·kg<sup>-1</sup>·min<sup>-1</sup>) in cycling VO<sub>2</sub>max post-test (7 days). At post-test 3 (45 days), the improvement from pre-test was 7.0% (to 68.8 ml·kg<sup>-1</sup>·min<sup>-1</sup>) and 15.6% (to 74.8 ml·kg<sup>-1</sup>·min<sup>-1</sup>) in running and cycling VO<sub>2</sub>max respectively. Maximum speed at 5% treadmill inclination (running) increased by 11%, and maximum power (cycling) increased by 10% from pre-test to post-test (45 days). Discussion In this cyclist, a HAIT block performed as running resulted in greater improvement in cycling VO<sub>2</sub>max compared to running VO<sub>2</sub>max. These training transfers from running to cycling may have important practical implications for the preseason training among cyclists.

### BIOELECTRICAL IMPEDANCE VECTOR ANALYSIS AND ALTITUDE TRAINING IN ELITE SWIMMERS: PRELIMINARY RESULTS

Irurtia, A.1, Chaverri, D.1, Barrero, A.1, Carrasco, M.1,2, Zubero, J.3, Nebot, V.4, Štrumbel, B.5, Qiu, J.6, Iglesias, X.1, Rodríguez, F.A.1

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Introduction Bioelectrical impedance vector analysis (BIVA) is a relative novel methodology for assessing the hydration status (Lukaski & Piccoli, 2012) without algorithm-inherent errors or requiring assumptions such as constant tissue hydration (Norman et al., 2012). Altitude training (AT) may favor dehydration due to low ambient air humidity, hyperventilation and increased diuresis, particularly at the early phase of altitude acclimatization (Truijens & Rodríguez, 2011). This study aimed to examine the distribution of the bioelectrical impedance vector in male (M) and female (F) elite swimmers using two different AT strategies: live high-train high (LH-TH) and live high-train low (LH-TL). Method 48 elite M and F swimmers lived at altitude (2,320 m) and trained whether at that altitude only (LH-TH, M/F, n=14/20), or also at lower altitude (690 m) two days weekly (LH-TL, M/F, n=9/5). Anthropometric and bioelectrical variables (Z-Metrix®, BioparHom Co, France) were obtained before and during 3-weekly training microcycles (W1, W2, W3). 50 kHz whole-body bioimpedance vectors were analyzed by the resistance-reactance (R/Xc) graphic method and Z mean values plotted (Piccoli et al., 1994). Hotelling's T<sub>2</sub> test was used to determine the difference in the complex localized vector through the 95% confidence and tolerance intervals obtained by BIVA. Results Except for the LH-TL F group, body mass significantly decreased from W1, and further in W2 and W3. BIVA showed different migration patterns of the bioelectrical impedance vector according to the intervention; LH-TH group: R and Xc significantly increased in M and F; LH-TL group: R increased and Xc decreased in F, but there were not significant differences in R or Xc in M. Discussion LH-TH swimmers showed a migration of the vector characterized by a significant increase in length (R) and a decrease in dielectric mass of soft tissues (Xc), likely as a result of moderate dehydration. Contrarily, the vector of both LH-TL groups appeared to reflect the maintenance of an optimal homeostatic status, without any significant bioelectrical changes (M) or showing adequate hydration adaptation (F). Concluding, the LH-TL strategy seems to favor a better maintenance of the hydration status in elite swimmers during AT. References Lukaski HC, Piccoli A (2012). Handbook of Anthropometry. Springer, 287-305. Norman K, Stöbaus N, Pirlich M, Bösy-Westphal A (2012). Clin Nutr 31(6), 854-61. Piccoli A, Rossi B, Pillon L, Bucciantone G (1994). Kidney Int, 46, 534-539 Truijens MJ, Rodríguez FA (2011). World Book of Swimming: From Science to Performance. Nova Science, 393-408.

### IS BIOELECTRICAL IMPEDANCE ANALYSIS ACCURATE TO ESTIMATE FAT MASS IN FEMALES WITH 21-HYDROXYLASE DEFICIENCY?

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Introduction Congenital adrenal hyperplasia due to 21-hydroxylase deficiency (21OHD) is associated with increase of fat mass (BF). The use of bioelectrical impedance analysis (BIA) to estimate the FM is easy and inexpensive. However, the accuracy of these methods in patients with 21-hydroxylase deficiency (21OHD) has not been explored. The objective of this study was to evaluate the accuracy of BIA equations in assessing FM in individuals with 21OHD using dual-energy X-ray absorptiometry (DXA) as the reference method. Methods Forty-one females with 21OHD, aged six to 27 years, were assessed. Two BIA prediction equations were tested: Deurenberg et al. (1990) and Houtkooper et al. (1992). Results The equation of Deurenberg et al. overestimated significantly the values of fat mass (16.8±7.0 kg, t=3.88, p>0.001) and equation of Houtkooper et al. the values of fat mass were underestimated (14.3±7.3 kg, t=-5.54, p>0.001) compared with DXA (15.7±8.0). The regression analysis demonstrated that both equations had high explanatory power and low error (Deurenberg equation: R<sup>2</sup>=0.96 and standard error of estimation (SEE)=1.59 kg, and Houtkooper equation: R<sup>2</sup>=0.96 and SEE=1.62 kg). Limits of agreement ranged between -2.4 to 4.6 kg and -4.8 to 1.8 kg, for Deurenberg and Houtkooper equations, respectively. Significantly trends were found between the difference and the mean of both methods in both predictive BIA equations (r=-0.57 for Deurenberg equation and r=-0.41 for Houtkooper equation). Discussion In this sample of patients with CAH 21OHD, the BIA equations did not demonstrate accuracy in estimating FM, which may limit their application in clinical settings. Despite the two predictive BIA equations were highly associated. Both BIA equations differ significantly from FM measured by DXA and showed be dependent of adiposity level. These results seem to demonstrate the necessity of using specific models for this population to increase the capacity of bia predict fat mass in females with 21OHD. References Deurenberg P, Kusters CS, Smit HE.(1990). Eur J Clin Nutr, 44, 261-68. Houtkooper LB, Going SB, Lohman TG, Roche AF, Van Loan M.(1992). J Appl Physiol, 72, 366-73.

### WHOLE-BODY BIOELECTRICAL IMPEDANCE VECTOR MIGRATION FOR MONITORING HYDRATION STATUS AFTER AN ULTRA-ENDURANCE TRIATHLON

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Introduction Monitoring hydration status after an ultra-endurance triathlon (UET) emerges as a priority to safeguard both health and physical performance of the growing tri-athletic population (Knechtle et al., 2008). Bioelectrical impedance vector analysis (BIVA) is a relative novel methodology for assessing the hydration status (Lukaski & Piccoli, 2012). This study aimed to provide the first comprehensive characterization of the whole-body bioelectrical impedance vector migration induced by an UET. Method 11 well-trained non-professional ultra-endurance triathletes (age 37.2±4.6 years, body mass 74.3±6.7 kg, height 174.0±6.0 cm, VO<sub>2</sub>max 67.5±4.2 ml/kg·min) competed in an UET (Extreme Man Salou-Costa Daurada 2011). Body mass (BM) and bioelectrical variables (Z-Metrix®,

BioparHom Co, France) were obtained before, after, and 48 h post-race. 50 kHz whole-body bioimpedance vectors were analyzed by the resistance-reactance (R/Xc) graphic method and Z mean values plotted (Piccoli et al., 1994). Hotelling's T2 test was used to determine the difference in the complex localized vector through the 95% confidence and tolerance intervals obtained by BIVA. Results Changes in BM (74,0±6,8 kg) post-race (69,6±6,5 kg, -5,8±1,9% BM) and 48-h post-race (72,9±6,4 kg, -1,4±1,2%) were significant (ANOVA, p=0,001). BIVA showed Xc/h significant bioimpedance vector migration patterns from pre- (35,4±3,1 Ω/m) to post-race (38,6±4,2 Ω/m, p=0,05), from pre- to 48-h post-race (31,8±2,7 Ω/m; p=0,03), and from post-race to 48-h post-race (p=0,001). There were no significant differences in R/h. Discussion Body mass loss is consistent with previous UET studies (Sharwood et al., 2004). BIVA appears as a sensitive methodology for assessing changes in body water (R) and body soft tissues (Xc) after an ultra-endurance event. Knowing that Xc is inversely related to the dielectric membranes and body tissue interfaces, bioimpedance vector showed a migration characterized by a significant decrease of this dielectric mass after the race and returning to (and even exceeding) initial values thereafter. More research is needed to improve our understanding of bioimpedance vector migration patterns in ultra-endurance competitive events. References Knechtile B, Schwanke M, Knechtile P, Kohler G (2008). *Br J Sports Med* 42, 609-613. Lukaski HC, Piccoli A (2012). *Handbook of Anthropometry*. Springer, 287-305. Piccoli A, Rossi B, Pillon L, Bucciantie G (1994). *Kidney Int*, 46, 534-539. Sharwood KA, Collins M, Goedecke JH, et al. (2004). *Br J Sports Med*, 38, 718-724.

## THE EFFECTS OF FLUID DEPRIVATION ON UPPER AND LOWER BODY STRENGTH AND HYDRATION STATUS IN AMATEUR RUGBY PLAYERS

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Introduction Maximum strength has been shown to be negatively affected by hypohydration in studies that have used exercise heat stress or passive dehydration methods such as heat exposure to manipulate hydration status. However, these methods induce elevations in muscle temperature and impair the contractile properties of the muscle hence exacerbating the negative effects of dehydration on strength (Maughan, 2003). The aim of this study was to assess the effects of hypohydration on maximum strength following a period of fluid deprivation. Methods Ten amateur rugby players (mean ± SD; age: 22 ± 2.7 years, body mass: 91.4 ± 8.5 kg, stature: 182.5 ± 12.5 cm) performed two assessments of upper and lower body maximum strength (1RM barbell bench press and 1RM back squat) under two experimental conditions: a) without fluid restriction (EU) and b) after 6 hours of fluid restriction (DE). Subjects provided a urine sample immediately prior to each testing session from which urine osmolality was assessed using a Pocket Pal Osmo (Vitech Scientific Ltd.) and levels of dehydration were determined (hydrated 0-600 mOsmol/kgH<sub>2</sub>O; mild dehydration: 600-1000 mOsmol/kgH<sub>2</sub>O; severe dehydration: over 1000 mOsmol/kgH<sub>2</sub>O). Body mass (kg) was recorded prior to each testing session. Results Fluid deprivation decreased upper body maximum strength by 2.91% (EU: 107.5 ± 15.85 kg v DE: 104.25 ± 14.81 kg; P=0.00), lower body maximum strength by 3.34% (EU: 126.5 ± 19.05 kg v DE: 122.6 ± 18.05 kg; P=0.004) and body mass by 2.04% (EU: 91.4 ± 8.05 kg, DE: 89.6 ± 7.78 kg; P=0.17) while it increased urine osmolality by 40% (EU: 407 ± 155.4 mOsmol/kgH<sub>2</sub>O, DE: 684 ± 244.6 mOsmol/kgH<sub>2</sub>O; P=0.001). Discussion Six hours of fluid deprivation brought about mild dehydration that negatively affected upper and lower body maximum strength. These results are in agreement with those reported previously by Judelson et al. (2007) who stated that approximately 3-4% hypohydration induced by either exercise heat stress or passive dehydration reduces muscular strength by approximately 2%. The reduction in body mass in his study is similar to that reported by Schoffstall et al., (2001) even though they used passive dehydration. These results suggest that even a relatively short time period of six hours of fluid deprivation can impair maximum strength and cause mild dehydration. References Judelson D., Maresh C., Anderson J. et al. (2007). *Sports Med*, 37, 907-921 Schoffstall E., Branch J., Leuholz B., Swain D. (2001). *J Strength Cond Res*, 15, 102-108. Maughan R. (2003). *Eur J Clin Nutr*, 57, S19-S23.

## HYSTERESIS PHENOMENON IN THE RATE OF PERCEIVED EXERTION OF TRIATHLETES DURING CYCLING AND RUNNING

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Introduction The hysteresis phenomenon is a sign of nonlinearity in biological systems and it explains the co-existence of different states for the same parameter values. Although the rate of perceived exertion (RPE) is a common parameter for assessing and monitoring training intensity its hysteresis behavior has yet to be tested. The aim of this study was to reveal the existence of the hysteresis phenomenon in the evolution of RPE during progressive increasing/decreasing cycling and running tests. Methods Twenty trained triathletes, M=24,17, SD= 9,31 years old, previously familiarized with the experimental procedures performed in two different days 2 progressive increasing/decreasing tests (cycling and running, respectively) while reporting their RPE values (Borg's RPE 6-20 scale). In the loading phase they pedalled at 100W (with increments of 30W/min) and run at 8 Km/h (with increments of 1 Km/h), respectively, until they reached an RPE≥18. The load was then progressively decreased (30 W/min and 1 Km/h, respectively) like a mirror. The differences of the RPE median values for the same load intensities in the loading and unloading phases were compared using non-parametric Wilcoxon matched pairs test. Results For the cycling task the analysis showed a clear hysteresis phenomenon in the first and the second close to maximum pair of loads (p<0.001; p<0,007), between the loading and unloading phases, with unloading RPE values having larger medians than the loading ones. There were also significant differences between median RPE values in the pair of loads close to the minimum (p<0,05), but this time median RPEs had larger values for the loading phase. No significant differences were found for the rest of the RPE medians. In the running task only the RPE median values of the lowermost three loads showed a hysteresis, being the unloading RPE values lower than the uploading ones (p<0.01; p<0,02 and p<0,005). Discussion The results point to an existence of two types of hysteresis RPE effects in trained triathletes. The first takes a form of a memory of the previous states and the second has the inverse form of a forgetting of the previous states. We hypothesize that the first form is a consequence of a sensitization state, i.e. a state of amplified response to the same amount of load. On the contrary, the second form may be due to a habituation, i.e. the decrease of the response to the same value of input. These results point to the fact that RPE measures may be unreliable associates to the external load when changing load direction, especially close to maximal or minimal values.

**EFFECTS OF TWO DIFFERENT MUSCLE STRETCHING METHODS ON FRONT CRAWL SWIMMING PERFORMANCE**

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**EFFECTS OF TWO DIFFERENT MUSCLE STRETCHING METHODS ON FRONT CRAWL SWIMMING PERFORMANCE** Fernandes, R.1, Di Masi, F.1,2, Silva, G.3, Silveira, A.1 1: UFRRJ (Seropédica, Brazil), 2: UNIRIO (Rio de Janeiro, Brazil), 3: UFRJ (Rio De Janeiro, Brazil) Introduction Scientific research suggests that the flexibility training (muscle stretching) can be adverse to power and strength production, seem that valences are important to the sports performance. Thus, the aim of the present study was verify the acute effect of static stretching (SS) and proprioceptive neuromuscular facilitation (PNF) stretching on front crawl swimming performance. Methods Thirteen young males ( $22.7 \pm 1.42$  years;  $77.2 \pm 7.25$  Kg;  $172.5 \pm 1.33$  cm;  $25.9 \pm 4.09$  of BMI) was submitted to three randomized select experimental protocol situations, namely: a) 50 meters front crawl test without any stretch training; b) 50 meters front crawl test preceded by SS (2 sets of 30 seconds) for breast and thigh muscles (SS); and c) 50 meters crawl swimming test preceded by PNF (2 sets of 30 seconds by Scientific Stretching for Sports (3S) method) for breast and thigh muscles. Results The One-Way ANOVA with repeated measures was performed to identify differences between groups. When comparison were made between control and the stretching protocols, it was found a significant decrease on performance to time trial in front crawl 50 meters sprint test (CTRL:  $321,2 \pm 29,2$  vs. SS:  $329,2 \pm 25,1$  ms,  $p < 0,05$ ) e (CTRL:  $321,2 \pm 29,2$  ms vs. PNF:  $335,2 \pm 30,7$  ms,  $p < 0,0001$ ). However, when we performed comparisons between stretching protocols, we didn't find any difference on performance to the same dependent variable ( $p > 0,05$ ). Discussion The present study concludes that the SS and PNF, in acute mode, cause a deficit in the front crawl swimming performance. The present study is the first to demonstrate the loss in swimming performance after muscle stretching exercises. Therefore, there are no studies that allow a direct discussion of findings. When considering the stretching acute effects as prejudicial to the physical performance, the present results add up to literature (Nelson et al., 2005; Behm and Kibele, 2007; Rees et al., 2007; Mikolajec et al., 2012). Therefore, it's recommended that the muscle stretching should not be used before central activities, especially those where large strength production is involved, such as of 50 meters in swimming tests. For making definitive conclusions, new studies about the acute effect in flexibility training are suggested. References Behm, D. G. and A. Kibele (2007). European journal of applied physiology 101(5): 587-594. Mikolajec, K., Z. Waskiewicz, et al. (2012). Isokinetics and Exercise Science 20(1): 61-69. Nelson, A. G., N. M. Driscoll, et al. (2005). Journal of sports sciences 23(5): 449-454. Rees, S. S., A. J. Murphy, et al. (2007). The Journal of Strength & Conditioning Research 21(2): 572.

**EFFECT ON PERFORMANCE OF ENDURANCE TRAINING COMBINED WITH PIOGLITAZONE TREATMENT. STUDY OF THE SKELETAL MUSCLE ADAPTATIONS**

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**Introduction** The Peroxisome Proliferator Activated Receptor delta (PPAR-delta) agonist GW1516 and the PPAR delta-AMP-activated protein kinase activator (AICAR -5-aminoimidazole-4-carboxamide-1-beta-D-ribofuranoside) regulate the metabolic and contractile characteristics of myofibers, enhancing thus performance. Thiazolidinediones (TZDs) are PPAR gamma agonists that could induce similar biological changes than PPAR delta and PPAR delta-AMPK agonists. The most common TZDs are rosiglitazone and pioglitazone. The aim of this study was to determine the effect of a pioglitazone on performance and in skeletal muscle mitochondrial biogenesis. **Methods** Twenty male wistar rats were randomly divided into four experimental groups: rest group, treated group, trained group and trained-treated group. Pioglitazone was administered orally three times a week for 4 weeks at a dose of 15 mg/kg/day. Blood glucose levels, protein expression of intermediates involved in the mitochondrial biogenesis pathway and the citrate synthase activity were determined in both gastrocnemius and soleus muscles. We also determined the maximal aerobic velocity (MAV), endurance capacity, and grip strength before and after the training period. **Results** The trained animals (water and pioglitazone groups) significantly increased their maximal aerobic velocity, endurance capacity and grip strength. We found a significant increase in peroxisome proliferator-activated receptor coactivator-1 $\alpha$  (PGC-1 $\alpha$ ), and nuclear respiratory factor 1 (NRF1) protein content in the soleus muscle of the trained animals. Citrate synthase activity was also increased after training in soleus muscle. No changes were found in gastrocnemius muscle in any experimental group and in any protein involved in the mitochondrial biogenesis pathway. **Conclusions** In our study, pioglitazone administration did not increase performance and did not affect physiological adaptations. **Acknowledgments** The authors' work was supported by grant P2011/02 RM to GC.M. from the "Cátedra Real Madrid-UEM".

**15:00 - 16:00****Mini-Orals****PP-PM53 Misc. topics 4****VASCULAR FUNCTION, AEROBIC FITNESS AND PHYSICAL ACTIVITY IN MAINTENANCE HAEMODIALYSIS PATIENTS**

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**Introduction** Accelerated vascular aging occurs in people undergoing maintenance haemodialysis (HD) resulting in a high prevalence of atherosclerosis and left ventricular hypertrophy (London et al 2011). Low aerobic fitness and physical activity (PA) are highly prevalent and have been implicated in the shorter life expectancies of HD patients (Sietsema et al 2004, Matsuzawa et al 2012). This study explored the relationship between vascular function, aerobic fitness and physical activity (PA) in HD patients. **Methods** Cross sectional study of 19 male haemodialysis patients (6 diabetics): [data are mean (standard deviation); age  $52.9(17)$  years; BMI  $22.9(7.3)$ ; dialysis vintage  $26.4(20.9)$  months; FMD  $4.69\%(2.94)$ ; PWV  $7.9(2.0)$  m/s; VO<sub>2</sub>peak  $19.3$  ml/kg/min, daily steps  $2976(2214)$ ]. Endothelial function was determined by brachial artery flow mediated dilation (FMD) and aortic artery stiffness from carotid femoral pulse wave velocity (PWV). VO<sub>2</sub>peak was determined via cardiopulmonary exercise test and PA levels via triaxial accelerometry (Actigraph GT3X). **Results** PWV correlated with VO<sub>2</sub>peak ( $r = -0.44$ ,  $p = 0.039$ ) and age ( $r = 0.64$ ,  $p < 0.01$ ), with a trend seen for moderate PA ( $r = -0.45$ ,  $p = 0.05$ ). PWV was not correlated with

FMD or dialysis vintage. FMD was correlated with VO2 peak ( $r=0.66$ ,  $P<0.01$ ), age ( $r=0.57$ ,  $p=0.01$ ) and dialysis vintage ( $r=-0.52$ ,  $p=0.02$ ). FMD was positively correlated with PA ( $r=0.63$ ,  $p<0.01$ ) and negatively correlated with time spent sedentary ( $r=-0.60$ ,  $p<0.01$ ). After controlling for age the association between VO2peak and PWV was non-significant but the significant VO2-FMD relationship was retained. Discussion These data indicate that age, rather than VO2peak has a more influential association with PWV in male HD patients. In contrast, VO2peak appears to be strongly related to FMD, even after controlling for the influence of age; an observation also seen in healthy young men (Palmieri et al 2005). Crucially, time spent sedentary as well as time physically active may both influence VO2peak and FMD in HD patients. This is consistent with animal studies showing reduced endothelial function with enforced sedentary behaviour (Suvorava et al 2004). While FMD does not offer prognostic utility equivalent to PWV in HD patients the endothelium controls vascular homeostasis and dysfunction of this organ is the starting point for atherosclerosis. Identifying HD patients with low fitness and sedentary habits may assist nephrologists with management of vascular health. References London G. et al (2011) *Kidney Int Suppl.* 1, 10-12 Matsuzawa R. et al (2012) *Clin J Am Soc Nephrol.* Vol. 7 (12), 2010-6 Palmieri E. et al (2005) *Eur J Appl Physiol.* 94: 113-117 Sietsema K. et al (2004) *Kidney Int.* 65, 719-724 Suvorava T. et al (2004) *J Am Coll Cardiol.* 44, 1320-1327

### PHYSICAL FUNCTION OF UPPER-LIMB AFTER BREAST CANCER SURGERY VARY BY SURGERY TECHNIQUES -A PROSPECTIVE 2.5 YEARS FOLLOW UP STUDY-

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1: DCT, OUS (Oslo, Norway), 2: BC, OUS (Oslo, Norway), 3: EPI/BIO, OUS (Oslo, Norway) 4: NAR (Norway), 5: FHS (Tromsø, Norway) Introduction The introduction of Sentinel Node biopsy (SN) as a part of breast cancer treatment was assumed to minimize side effects compared to Axillary Dissection (AD). However, side effects and unanswered questions still exist in relation to assessment of upper limb function in breast cancer patients. Therefore, the aim of this study was to study upper limb side effects after breast cancer treatment by using validated measurements pre-operatively and after 2.5 years in two groups (SN and AD) of breast cancer patients stadium I to II. Methods One group of breast cancer patients went through surgery with SN only ( $n=187$ , mean age  $57 \pm 10$ ), and one group went through an additional AD ( $n=204$ , mean age  $55 \pm 10$ ). Outcomes were; Arm lymphedema ( $\geq 10\%$  increased arm volume relative to control arm volume), grip strength (kg), shoulder mobility and timed shoulder abduction endurance (sec), pain (VAS mm) and BMI ( $\text{kg}/\text{m}^2$ ). Parametric /non-parametric tests for hypothesized changes and differences and regression analysis for confounding factors were employed. Results We observed more adverse side effects in women treated by AD in comparison to women treated with SN after 2.5 years ( $P < .05$ ); Arm lymphedema (17% vs 3%), grip strength reduction (12% vs 2%) and pain (increase of 6% vs decrease of 50%). The side effects were similar for affected and control upper limb for all outcomes except for Arm lymphedema, occurring only in the affected side. Both groups increased their BMI ( $P < .05$ ), but with less than one unit. Discussion Side effects were observed after 2.5 years follow-up in both AD and SN groups, but a higher prevalence was observed in the AD group. The results were in accordance to other reports using validated pre-operative measurements (Sagen A. et al., 2009; McLaughlin SA. et al., 2008;). Thus, specially women who go through AD as part of breast cancer treatment may benefit from preoperative upper-limb assessments for both affected and control side and further post-operative physical therapy focusing on muscle strength exercises (McNeely ML., 2010, Cantarero-Villanueva I, 2012). Both groups may benefit from physical activity programs including information on a healthy lifestyle to avoid weight gain (Demark-Wahnefried W., 2012). References Sagen A, Kaarsen R, Risberg MA. *Acta Oncol* (2009), 48(8), 1102-1110. McLaughlin SA, Wright MJ, Morris KT, Giron GL, Sampson MR, Brockway JP et al. *J Clin Oncol* (2008) 26(32), 5213-5219. Cantarero-Villanueva I, Fernandez-Lao C, Arroyo-Morales M et al. *Am J Phys Med Rehabil* (2012) 91(9), 774-782. Demark-Wahnefried W, Campbell KL, Hayes SC. *Cancer* (2012) 118(8 Suppl), 2277-2287. McNeely ML, Campbell K, Ospina M, Rowe BH, Dabbs K, Klassen TP et al. *Cochrane Database Syst Rev* (2010) 6,CD005211.

### EFFECTS OF CONTRAST BATHING TREATED BY DIFFERENT ORDER OF COLD AND HOT WATER IMMERSION ON RECOVERY FROM MUSCLE FATIGUE AFTER STRENUOUS ACTIVITY

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Introduction In competitive sports, accumulated muscle fatigue caused by daily practice and games often lead to sports injuries. For the purpose of injury prevention, rapid recovery from muscle fatigue seems crucial. Recently, contrast bathing has been frequently used as one of the modality to recover from muscle fatigue. But, the standard protocol for contrast bathing has not been established yet. The appropriate water temperature, immersion duration, and the order of cold and hot water bathing remain unclear. The purpose of this study was to investigate whether the order of cold and hot water immersion in contrast bathing (where temperature and duration are preset) influences recovery from muscle fatigue after strenuous activity. Methods Six healthy college students (21.3yrs, 63.3kg) with no habit of resistance training were asked to apply two conditions of contrast water therapy; one finished with cold water (HC condition), the other finished with hot water (CH condition) in limb to limb comparison model. Before contrast bathing, each subject performed calf raise exercise until totally exhausted. Muscle stiffness, range of motion, circulatory conditions of popliteal artery, and visual analogue scale (VAS) were measured as indexes of muscle fatigue. Each measurement was performed before exercise (pre), right after exercise (post), immediately after contrast bathing (ACB), and at every 15 minutes after ACB over 75 minutes (15, 30, 45, 60, and 75minACB). Analyses A two way factorial analysis of variance was used to examine the difference between two conditions and time series variation of them. Then, comparison of the simple main effect by Bonferroni method was used to examine the difference between the two conditions on each measurement phase throughout the all data collection period, and between pre, post and the other measurement phases on each condition. Results No significant difference was found on interaction between the two conditions and time series variation of them. Muscle stiffness showed significant differences between post and 60minACB, 75minACB on HC condition, and between post and 75minACB on CH condition. Blood vessel diameter was significantly bigger only on 45minACB in HC condition than in CH condition. Discussion The physiological effect caused by contrast bathing in this study is assumed to be result of stimulation of superficial temperature receptor of skin. In this study, it was observed that decreasing of muscle stiffness was higher on HC condition than on CH condition. It is assumed that this result was brought because superficial temperature receptor is more sensitive to cold stimulation than to hot stimulation. Then, it is considered that pressure to vessel by muscle was lessened on HC condition and it led to greater vasoconstriction compared to CH condition. Conclusion Difference in order of cold and hot water immersion in bathing does not effect on recovery from muscle fatigue after strenuous activity.

## FACTORS RELATED TO KNEE ADDUCTION MOMENT DURING GAIT DIFFER WITH GAIT PATTERNS IN PATIENTS WITH KNEE OSTEOARTHRITIS

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**Introduction** Gait analysis in patients with knee osteoarthritis (OA) is frequently performed for assessment. Previous studies described knee adduction moment (KAM) as a factor closely related to the symptoms and severity (Kito N, et al. 2010) of knee OA. However, none of these studies investigated the differences in the factors related to KAM in patients with different gait patterns. The aim of this study was to classify gait patterns in patients with knee OA, and to investigate the factors related to KAM in each gait pattern. **Methods** Thirty women with knee OA were recruited. The participants' gait was analyzed at a self-selected speed by using a three-dimensional gait analysis system. Sagittal kinematic data of the affected knee were collected for gait classification. Simultaneously, gait speed and the impulse of KAM in the stance phase were calculated. In addition, the following parameters were measured as static factors: range of motion (ROM) of knee flexion/extension, isometric muscle strength of knee flexor/extensor, femorotibial angle (FTA), and the lumbar lordosis angle. Using kinematic data, hierarchical cluster analysis was applied to classify the gait patterns into groups. Then, partial correlation coefficients between KAM and static factors adjusted for gait speed were calculated for each group. **Results** Cluster analysis showed that gait patterns could be divided into 3 groups (G<sub>1</sub>~G<sub>3</sub>). The knee angle pattern observed in G<sub>1</sub> showed the greatest similarity to the pattern in healthy subjects. Patients in G<sub>2</sub> showed reduced knee excursion. In G<sub>3</sub>, greater knee flexion at foot strike and decreased knee extension at terminal stance were observed. In the partial correlation analysis the factors that correlated with KAM were, lumbar lordosis angle, FTA and knee extensor strength, FTA and knee extension ROM for G<sub>1</sub>, G<sub>2</sub> and G<sub>3</sub> respectively. **Discussion** Previous studies that attempted to reduce KAM during gait with exercise did not achieve the desired effect (Sled EA, et al. 2010, Lim BW, et al. 2008). The present study indicated that patients with varied gait patterns showed differences in the factors related to KAM. The failures in previous studies may be partially because they used the same recruitment and treatment approaches for patients with different gait patterns. The results of this study suggest that when clinicians attempt to reduce joint loading in knee OA patients, it can be more meaningful to categorize these patients into groups corresponding to homogeneous gait patterns. **References** Kito N, et al. (2010). *Clin Biomech* (Bristol, Avon). 25(9), 914-919. Sled EA, et al. (2010). *Phys Ther*. 90(6), 895-904. Lim BW, et al. (2008). *Arthritis Rheum*. 59(7), 943-951.

## THE SEVERITY OF ANEMIA IS ASSOCIATED WITH LOW EXERCISE CAPACITY IN PATIENTS UNDERWENT CARDIAC SURGERY

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**Introduction** Postoperative anemia is a common complication after the cardiovascular surgery. Low oxygen transport is suspected to affect oxygenation and function of tissues that may affect exercise capacity. Thus, the purpose of this study was to investigate the effect of severity of postoperative anemia on exercise capacity of patients after cardiac surgery. **Methods** This is a retrospective cohort study. We analyzed patients underwent cardiac surgery and completed cardiopulmonary test (CPX) in 2010 in a Heart Center in Taiwan. We included adult patients with postoperative anemia and excluded those with preoperative anemia. The concentration of hemoglobin (Hb) less than 12.5 g/dL was defined as anemia. The [Hb] was collected before discharge and the patients were classified into 3 groups: mild (11-12.5 g/dL), moderate (9-11 g/dL), and severe (<9 g/dL) anemia. Exercise capacity and responses were acquired from CPX, including peak oxygen consumption (VO<sub>2</sub>), heart rate (HR), blood pressure (BP), and oxygen pulse (O<sub>2</sub> pulse). One-way ANOVAs were used to compare the variables among different groups. The significant level was set at p<0.05. **Results** There were 202 patients (73.8% male, 61.30±12.62 year-old) being recruited. The rate of postoperative blood transfusion was 34.9%, and most patients did not recover at discharge. There were 37 (18.3%) patients with mild, 124 (61.4%) with moderate, and 41 (20.3%) with severe anemia. Older age tended to increase the severity of anemia (p=0.051). Patients in the severe group had significantly lower peak VO<sub>2</sub> than moderate and mild groups (15.08±4.81 vs. 17.94±6.02 and 18.71±4.97 ml/kg/min, p=0.010); lower peak HR (p=0.040), O<sub>2</sub> pulse (p=0.041) and higher resting systolic BP (p=0.040) were also found. **Discussion** Our findings highlight a high prevalence of postoperative anemia persisting with moderate-to-severe level at discharge, especially elders. Lower [Hb] was related to lower exercise capacity and worse cardiovascular responses to exercise. That may play a vital role of poor prognosis and quality of life in patients underwent cardiac surgery comorbid with postoperative anemia. Further study should follow up the recovery of the postoperative anemia and exercise capacity for a longer period; especially elders underwent cardiac surgery. **References** Westenbrink, B.D., et al., (2011). *Heart*, 97(19), 1590-1596. Salisbury, A.C., et al., (2010) *Circ Cardiovasc Qual Outcomes*, 3(4), 337-346. Brevig, J., et al., (2009). *Ann Thorac Surg*, 87(2), 532-9. Kuduvalli, M., et al., (2005) *Eur J Cardiothorac Surg*, 27(4), 592-598.

## A PROSPECTIVE STUDY ON FULL-BODY KINEMATIC RELATED RISK FACTORS IN THE DEVELOPMENT OF EXERTIONAL MEDIAL TIBIAL PAIN

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**ABSTRACT Objective:** To prospectively determine risk factors contributing to the development of exertional medial tibial pain (EMTP). **Methods:** Data were prospectively collected on healthy female students in physical education, who were freshmen in 2010-2011 and 2011-2012. Eighty-six female students aged 19.38±0.85 years, were tested at the beginning of their first academic year. Kinematic parameters in the frontal and transverse plane were measured during a single leg drop jump (SLDJ). For further analysis, the SLDJ task was divided in 2 phases: touchdown (TD) until maximal knee flexion (MKF) and then MKF until take-off (TO), representing landing and push-off phase, respectively. The injury follow-up of the subjects was assessed using a weekly online questionnaire and a three-monthly retrospective control questionnaire. EMTP was diagnosed by an experienced M.D. (Doctor of Medicine). Cox regression analysis was used to identify the potential risk factors for the development of EMTP. **Results:** During injury follow-up (1-2 years), 22 subjects were diagnosed with EMTP. The results of this study identified that increased range of motion (ROM) in the transverse plane of both hip and thorax during landing (P=0.010 and P=0.026 respectively) and during push-off (P=0.019 and P=0.045 respectively) are predictive parameters for the development of EMTP in females. **Conclusions:** Increased ROM values of hip and thorax in the transverse plane, which can be interpreted as impaired ability to maintain DJS, are significant contributors to the development of EMTP in females.

## THE RELATIONSHIP BETWEEN TOE EXERCISES AND THE MEDIAL LONGITUDINAL ARCH OF THE FOOT

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1: Gumma Paz College, 2: Waseda University

**Introduction** Although toes play an important role, toe flexor strength is poorly understood. We have previously published clinical (Shiroshita 2011) and electromyogram (EMG) studies (Shiroshita 2012) of the toe exercises developed by us. However, these studies did not involve measurement of morphologic variations; as a result, the morphologic relationship between these toe exercises and the medial longitudinal arch (MLA) remained unclear. The purpose of this study was to examine the relationship between the toe exercises and MLA. **Methods** The subjects were 28 participants (20 men, 8 women) with a mean age of  $21.0 \pm 0.7$  years. The participants were classified 3 groups, which were a great-toe-flexor exercise group (GTE), a lesser-toe-flexors exercise group (LTE) and a towel-gathering exercise group (TGE). The toe exercise groups performed isotonic contractions (10 times) of the greater toe flexor (IP extension) in the GTE or lesser toe flexors (DIP extension and PIP flexion) in the LTE. The TGE performed 3 minutes. The GTE and LTE performed the toe exercises seated; a 3-kg weight was placed on their distal thigh and they tilted their trunk forward. The subjects tried to raise their heel with their toes to perform the toe flexor exercises. We assessed the navicular drop test (NDT) (Body 1982) results obtained using a three dimensional foot form device (3DFOOT SCANNER standard type JMS2100CU, DreamGP company, Japan), before and after the exercises were performed. For statistical analysis, we performed Wilcoxon signed-rank tests using IBM SPSS Statistics 20. The results are presented as mean (SD) and were considered significant at p values less than 0.05. This study was performed with the consent of the Ethics Committees for Human Research of Waseda University and Gumma Paz College. **Results** The NDT results for the TGE and the GTE group changed from 4.2 (1.4) mm to 4.8 (1.3) mm ( $p = 0.138$ ) and 4.9 (1.7) mm to 5.2 (1.7) mm ( $p = 0.173$ ), respectively, with no difference before or after the exercises. On the other hand, the NDT results for the LTE significantly changed from 5.7 (0.9) mm to 3.6 (1.2) mm ( $p = 0.005$ ). **Discussion** The TGE and the GTE did not show a morphologic relationship with MLA. In fact, they showed a tendency to reduce the rigidity of MLA. On the other hand, the LTE increased the rigidity of MLA. We consider that it is necessary to study the toe exercises we have developed using a longitudinal research method. **Keywords:** toes, navicular drop test, the medial longitudinal arch **References** 1. Shiroshita T, Fukubayashi T. *J Phys Ther Sci.* 2011, 23(3): 455-458. 2. Shiroshita T, Fukubayashi T. *J Phys Ther Sci.* 2012, 24(1): 59-62. 3. Brody DM. *Orthop Clin North Am.* 1982, 13(3): 541-558.

## COMPARISON OF DUAL TASK PERFORMANCE ON OBSTACLE CROSSING AMONG NON-FALLERS, SINGLE AND MULTIPLE FALLERS

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**Introduction** Falls have been a major health problem in the elderly population. Previous studies indicated that older adults with only one fall experience were more similar to non-fallers when compared to multiple fallers (Lord et al., 1994). For elderly, tripping over or stepping on obstacles is a common reason of falling (Campbell et al., 1990). In real-life situation, people often perform two things simultaneously which is referred as dual task paradigm. Using dual task paradigms with a more challenge motor task may be an effective way to evaluate the ability of older adults with different fall experiences for fall prevention. Therefore, the purpose of this study were to investigate whether the dual task paradigm would influence the spatiotemporal parameters during obstacle crossing in older adults and to examine the effect of different fall experiences on obstacle crossing ability under dual task condition. **Methods** Community-dwelling older adults who aged 65 years old were recruited in this study. Individuals were divided into three groups based on their fall experiences over previous 12 months; older adults (OA, n=14), single fallers (SF, n=13) and multiple fallers (MF, n=5) group. The dual task paradigm was used in this study. The primary task was to cross an obstacle at the middle of walkway. The secondary task was to perform serial 7 subtractions. Six motion capture cameras were used to collect the three dimensional movement data of lower extremities. Two-way ANOVA with repeated measures was used to analyze the outcome measures. **Results** From single to dual task, participants significantly decreased their leading heel-obstacle distance, crossing length and velocity ( $p=0.006$ ;  $p=0.014$ ;  $p<0.001$ ). For trailing toe-obstacle distance (TTD), there was a main effect of group ( $p=0.041$ ). Post hoc analysis revealed that TTD of OA group was significantly greater than SF group ( $p=0.038$ ). **Discussion** The present study demonstrates that dual task significantly affected the obstacle crossing ability of the participants and the finding is similar to previous study (Kim and Brunt, 2007). The results suggest that older adults adopt a more cautious way when encounter a more challenge condition. In addition, older fallers performed shorter TTD indicated that they were much closer to the obstacle in order to accomplish the task. However, group effect is not remarkable in the current study. It may due to participants' number was not equivalent and we will recruit more multiple fallers in the future. **Reference** Campbell AJ, Borrie MJ, Spears GF, Jackson SL, Brown JS, Fitzgerald JL. (1990). *Age Ageing*, 19(2), 136-141. Kim HD, Brunt D. (2007). *Arch Phys Med Rehabil*, 88(10), 1309-1313. Lord SR, Ward JA, Williams P, Anstey KJ. (1994). *J Am Geriatr Soc*, 42(10), 1110-1117.

## POLYMORPHISMS IN BETA ADRENERGIC RECEPTOR GENES DIFFER BETWEEN ATHLETES AND NON-ATHLETIC CONTROLS

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**Introduction** Beta adrenergic receptor (ADRB) gene polymorphisms have been associated with elite endurance performance (Moore et al., 2001; Santiago et al., 2011; Sawczuk et al. 2012; Wolfarth et al., 2007). Up to now there is no study focussing on ADRB variants within strength and team sport athletes. Therefore, the aim of this study was to compare the allelic and genotype frequencies of ADRB genetic variants between athletes engaging in power-oriented sports, athletes engaging in team sports and non-athletic controls. **Methods** The study population consisted of 56 sprint/power athletes (SPA), 144 team sport athletes (TSA) like handball and soccer players, and 223 healthy controls (HC). Athletes were included in the study sample only if they had participated on the highest national or international level. The International Physical Activity Questionnaire was used to assess the physical activity level of the control group. Genotype and allelic frequencies were analysed for ADRB1 Ser49Gly (rs1801252), ADRB2 Arg16Gly (rs1042713), ADRB2 Gln27Glu (rs1042714) and ADRB3 Trp64Arg (rs4994) polymorphisms by Real-time PCR using TaqMan® SNP genotyping assays (Life Technologies, Carlsbad, California). The Chi-square test was used for statistical comparisons between the groups and a  $p<0.05$  was considered as being statistically significant. **Results** We observed significant differences in genotype frequencies for the ADRB1 Ser49Gly ( $p = 0.013$ ) and the ADRB2 Gln27Glu ( $p = 0.044$ ) polymorphisms between HC and SPA with higher frequencies of the ADRB1 Gly49Gly and ADRB2 Gln27Glu genotypes in SPA. Furthermore, we found a significant difference in the genotype distribution for the ADRB3 Trp64Arg polymorphism ( $p = 0.079$ ) between

TSA and HC with a higher frequency of the 64Trp allele in TSA. Discussion The main findings of our study were that the ADRB1 Gly49Gly and the ADRB2 Gln27Glu genotypes seem to be favourable for power-oriented sport performance. Interestingly, there is no significant difference between TSA and SPA which could be due to the fact that strength is an important skill for professional handball and soccer players. This would be in accordance with the findings of Santiago et al. (2008) showing that soccer players have a higher frequency of the sprint/power-associated variant of ACTN3 (R allele). As this is the first report revealing a positive association between team sport performance and the ADRB3 Trp64Arg polymorphism the results need to be replicated in similar populations. References Moore, GE, et al. (2001). *Metabolism*, 50(12), 1391-1392. Santiago, C, et al. (2008). *Br J Sports Med*, 42(1), 71-73. Santiago, C, et al. (2011). *Br J Sports Med*, 45 (2), 147-149. Sawczuk, M, et al. (2012). *Cent Eur J Biol*, 7(5), 794-800. Wolfarth, B, et al. (2007). *Metabolism*, 56(12), 1649-1651.

### THE INFLUENCE OF ACETAMINOPHEN ON REPEATED SPRINT CYCLING PERFORMANCE

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Introduction During exercise, increases in intramuscular metabolic by-products (bradykinin, prostaglandins, potassium, hydrogen ions) correlate with increases in work rate during repeated sprint activity. Consequently, type III and type IV afferent fibres send nociceptive signals to the central nervous system (CNS) regarding actual or potential tissue damage (O'Connor et al., 1999), where these signals are interpreted as pain. It is speculated that high nociceptive activity elicits reductions in work rate during intense physical exercise (Mauger et al., 2010). Whilst this has been demonstrated in moderate duration cycling exercise, there are no studies where this hypothesis has been tested in repeated sprint activity. Therefore the aim of this study was to investigate the efficacy of acetaminophen (an analgesic) on improving overall work rate during an all-out repeated sprint protocol. Methods Nine recreationally active male subjects (age:  $21 \pm 2$  yrs, height:  $175 \pm 7$  cm, weight  $75 \pm 14$  kg,  $VO_{2max}$ :  $47 \pm 6$  mL/kg/min) completed a graded exercise test, a familiarisation set of wingate anaerobic tests (WAnT) and two experimental sets of WAnT's (8 x 30 s sprints, 2 min rest intervals). In the experimental WAnT's, subjects ingested either 1.5g acetaminophen or a placebo in a double blind, randomised, cross-over design. During the WAnT trials, subjects provided ratings of perceived pain 20 s into each sprint. Average power output (APO), fatigue index and heart rate (HR) were measured following each sprint. Results Subjects cycled at a significantly greater APO ( $p < 0.05$ ) following the ingestion of acetaminophen ( $397W \pm 32$ ) when compared with the placebo trial ( $367W \pm 55$ ). This was due to a significantly greater APO during sprints 6, 7, and 8 ( $p < 0.05$ ). Fatigue index was significantly reduced ( $t_8 = 5.79$ ,  $p < 0.05$ ) following acetaminophen ingestion ( $22\% \pm 11$ ) when compared with the placebo trial ( $31\% \pm 7$ ). No significant differences in perceived pain or HR were observed between conditions ( $p > 0.05$ ). Discussion This study provides evidence that repeated sprint ability can be improved following the ingestion of acetaminophen. Acetaminophen may have induced an ergogenic effect through the reduction of pain for a given work rate, thereby enabling subjects to exercise closer to a true physiological limit (Mauger et al., 2010). This suggests that individuals may regulate their work rate according to a fixed level of pain or discomfort, which may constrain performance below that which is physiologically achievable. References Mauger, A.R., Jones, A., Williams. (2010) *J Appl Physiol*, 108, 98-104 O'Connor, P.J., Cook, D.B. (1999). *Exerc Sport Sci Rev*, 27, 119-166

### THE INFLUENCE OF VIBRATION FREQUENCY AND AMPLITUDE ON THE CO-ACTIVATION DURING A DYNAMIC EXERCISE UPON AN UNSTABLE VIBRATORY PLATFORM

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Introduction The co-activation increase during whole body vibration (WBV) is considered to have a positive effect on joint stabilization associated with postural control strategies (Berschin and Sommer, 2004; Pollock et al., 2010; Roelands et al., 2004). The most well investigated indirect method, a subject stand on a stable vibration platform. On the other hand, an increasingly popular exercise modality involves the use of labile surfaces (Hupperets et al., 2009). Both methods have shown to induce increases on co-activation separately. However, the effects on co-activation combining vibration and a labile surface has not been investigated. The aim of this study was to analyze the influence of vibration frequency and amplitude on the co-activation during a dynamic movement on a unstable vibratory platform. Methods Thirty male physical education students volunteered to participate in this study. Subjects were asked to move the unstable vibratory platform oscillating uniformly to the left and right side of the fulcrum following a metronome programmed at 60 cycles min<sup>-1</sup> at four different vibration frequencies (0, 25, 35 and 45 Hz), and two peak-to-peak displacements (low; 1.2 mm and high; 2.2 mm). Surface electromyography (EMG) of gastrocnemius lateralis (GL), anterior tibialis (AT), biceps femoris (BF) and rectus femoris (RF) were recorded. Co-activation ratios were calculated as GL/AT and BF/RF. Two-ways analysis of variance for repeated measures were used to assess the effect of frequencies and displacement. Results Increasing vibration frequency (from 0 to 45Hz) resulted in a progressive increase in GL/AT ratio. The analysis revealed a significant frequency main effect ( $p < 0.001$ ) only for GL/AT ratio. Post hoc tests showed a significant higher GL/AT at 25, 35 and 45Hz vibration frequencies compared with 0Hz. Discussion The present findings are unique because co-activation was assessed during a dynamic oscillating movement upon an unstable vibration platform. Our results are in line with previous WBV studies including static and dynamic exercises demonstrating an increase in co-activation of lower extremity extensor and flexor muscles in response to an increase in vibration frequency (Roelands, 2004; Pollock et al., 2010). However the effect of vibration frequency was only evident at the GL/AT ratio. This could be explained firstly, because GL and AT are most proximal to the generation of the WBV stimulus and secondly, because GL presumably plays a more important stabilizing role of the ankle to maintain the body balance. References Berschin, G., Sommer, H-M. (2004). *Deutsche Zeitschrift für Sportmedizin*, 152-156. Hupperets MD., Verhagen EA., Van Mechelen W. (2009). *Sports Med*. 39, 591-605. Pollock, RD., Woledge, RC., Mills, KR., Martin, FC., Newham, DJ. (2010). *Clin Biomech (Bristol, Avon)*, 25, 840-846. Roelants, M., Delecluse, C., Verschueren, SM. (2004). *J Am Geriatr Soc*, 52, 901-908.

### EFFECTS OF A CIRCUIT FOR SENSORY STIMULATION ON ISOKINETIC PEAK TORQUE AND DYNAMIC BALANCE IN OLDER WOMEN

Avelar, B., Costa, J., Oliveira, P., Dutra, M., Safons, M., Lima, R.

*University of Brasilia*

Introduction Age related changes in postural control contribute to instability and increased risk of falls in older adults. Muscle peak power and dynamic balance are critical components of functional performance and should be included in exercise strategies to improve postural control. The potential positive effect of a sensory stimulation circuit (SSC) on muscle power and dynamic balance is unknown. The purpose of this quasi-experimental trial was to assess the effects of a SSC on muscle power and dynamic balance in elderly women.

**Methods** The sample consisted of 23 sedentary elderly women divided into sensory stimulation group (SSG) N=10 (70.10± 6.64 years) and control group (CG) N=13 (66.92±4.50 years). The SSG performed a protocol designed by Costa et al. (2010) that emphasized static and dynamic balance exercises with opened and closed eyes, addition of obstacles and unstable surfaces during 1 hour, twice a week, over 13 weeks. The CG was instructed to maintain their habitual activities. Measurements of isokinetic knee extensors peak torque (180°/s) and Timed Up & Go test (TUG) were obtained before and after the intervention period. ANOVA with group (SSG vs. CG) and time (baseline vs. post) as factors was performed with Bonferroni adjustments. Statistical significance was set at p=.05. Results At baseline, groups did not differ in terms of age, height, weight and outcome measures (p>.05). Exercise compliance was 91%. Peak torque at 180°/s showed a significant between groups interaction (p=.041) but not the TUG test (p=.159). Post hoc analyses revealed significant effects of time within SSG for peak torque (p=.021) and TUG (p=.032) on average by 10,7% and 6,4%, respectively. No significant changes were noted in the CG. **Discussion** Although the primary goal of the SSC protocol proposed by Costa et al. (2010) was to promote improvements in dynamic balance, the current study provided further important information regarding skeletal muscle power gains in older women. Importantly, available studies suggest that muscle power is a better predictor of functional performance than muscle strength in the elderly (Correa et al. 2012; Pereira et al. 2012). These findings suggest that 13 weeks of the studied SSC induce increases on muscle power and dynamic balance in older women and constitute a low cost and efficient option for this population. References Costa JNA et al.(2012). Motric, 8,(Supl.2),485-492. Correa CS et al.(2012). Int J Sports Med, 33(12),962-969. Pereira A et al.(2012). Exp Gerontol,47,250-255.

## 15:00 - 16:00

### Mini-Orals

#### PP-PM62 Sports Medicine [SM] 6

##### ASSOCIATION OF PERSISTENT STAPHYLOCOCCUS AUREUS NASAL CARRIER WITH HIGH FREQUENCY SKIN ABSCESS IN AMERICAN FOOTBALL PLAYERS

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1 : Institute of Health and Sports Sciences, University of Tsukuba 2 : Health and Sports Sciences major, Department of Education, Faculty of Education, Hakuoh University Introduction Staphylococcus aureus (SA) is an emerging cause of infection in players of physical contact sports (Nguyen et al. 2005). Nasal colonization by SA is a well-established risk factor of acute cutaneous infection (Kluytmans et al. 1997). To understand the basis of the SA infection of physical contact athlete, we compared the SA infection among three distinct carriers based on nasal carriage and skin lesions in University American football team. **Methods** University American football players who took part in this study were 36 male members. Nasal samples were collected by the same person over a 9-month interval from January 2012 to November 2012. Swab samples were obtained from the right or left anterior nares by using a sterile swab. The samples were impregnated with 100µl of PBS. After 10µl of PBS samples were inoculated and incubated at 37C for 24±2 h on the compact Dry X-SA media (CD-XSA; Nissui Pharmaceutical Co., Ltd., Tokyo, Japan) (Teramura, et al. 2010). The specific SA colonies were counted. A questionnaire that captured basic demographic and clinical data was administered to all the players concerning their date of abscess, player position and skin lesions. **Results** 1) According to our definition, there were 6 (16.7%) persistent, 3 (8.3%) intermittent, 17 (47.2%) occasional, and 10 (27.8 %) non carriers in this team. 2) By comparing their colony number of three distinct carrier groups, the persistent carrier (117.7 CFU/ml) showed a significantly larger count than a mean count of the intermittent carrier and occasional carrier (65.4 CFU/ml) (P<0.05). 3) Skin abscess was more frequently identified in the persistent carrier (P<0.05). **Discussion** Major findings are that persistent SA nasal carrier was 16.7%, and coincident with high frequency skin abscess. Additionally, number of SA colonies in the nose was significantly higher in persistent carrier than others. Thus, persistent carrier may act as a 'SA reservoir' that facilitates transmission to the uninfected players. References Kluytmans, J., A. van Belkum and H. Verbrugh (1997). Clin Microbiol Rev 10(3): 505-520. Nguyen, D. M., L. Mascola, E. Brancoff (2005). Emerg Infect Dis 11(4): 526-532. Teramura, H., S. Mizuochi and H. Kodaka (2010). Biocontrol Sci 15(4): 149-154.

##### COGNITIVE DIETARY RESTRAINT: PREVALENCE AND ASSOCIATION WITH MENSTRUAL DYSFUNCTION IN FEMALE RUNNERS

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**Introduction** Female athletes are particularly vulnerable to certain undesirable health outcomes, the most well known is the Female Athlete Triad, incorporating the combination of: menstrual dysfunction, disordered eating and compromised bone health. Some evidence exists that cognitive dietary restraint (CDR) may lead to disordered eating, low energy availability and also possibly menstrual dysfunction (Pollock et al. 2010). Limited research has been conducted on the Australian population, more specifically on how CDR impacts on menstrual function. Therefore, the aim of this study was to assess the prevalence and degree of CDR and menstrual dysfunction among sub-elite female runners. Furthermore to establish if CDR is a contributing predictor for those females experiencing menstrual dysfunction. **Methods** Adult female members of Athletics Victoria (Australia) were invited to complete an online questionnaire that included previously validated, standardized scales designed to assess eating behaviours and cognitive dietary restraint (Three-Factor Eating Questionnaire) (de Lauzon et al. 2004) and further internally designed questions investigating physical activity and menstrual patterns. Athletes with diagnosed eating disorders were excluded from the study. Analysis of the data was carried out using SPSS version 16.0 (SPSS, Inc., Chicago, IL, USA). **Results** Female runners (n=104) completed the online questionnaire. There was a high prevalence of CDR of varying degrees and menstrual dysfunction amongst the cohort, with 71% of the cohort reporting medium to high CDR restraint scores with a linear trend of higher weekly kilometres (-12.67km/week (p=0.007)). 25% of the participants reported currently experiencing menstrual dysfunction and 51% of the participants reported having been amenorrhoeic (loss of menses for >3months) in the past. CDR did not appear to be a predictor of menstrual dysfunction in this cohort r = 0.0107 (p=0.1092) **Discussion** The high levels of CDR and menstrual dysfunction observed in this cohort are a concern for female runners, placing this population at a high risk for fertility problems, poor bone health and serious injuries such as stress fractures. More longitudinal investigations, with larger cohorts are required along with better identification

and management systems and processes for females who at risk or presently suffering from one or more elements of the female athlete triad. References de Lauzon, B, Romon, M, Deschamps, Vr, Lafay, L, Borys, J-M, Karlsson, J, Ducimetire, P & Charles, MA 2004, 'The Three-Factor Eating Questionnaire-R18 is able to distinguish among different eating patterns in a general population', *The Journal Of Nutrition*, vol. 134, no. 9, pp. 2372-80. Pollock, N, Grogan, C, Perry, M, Pedlar, C, Cooke, K, Morrissey, D & Dimitriou, L 2010, 'Bone-mineral density and other features of the female athlete triad in elite endurance runners: a longitudinal and cross-sectional observational study', *International Journal Of Sport Nutrition And Exercise Metabolism*, vol. 20, no. 5, pp. 418-26.

### THERAPEUTICAL USE EXEMPTIONS OF ELITE ATHLETES - GLUCOCORTICOID USE AND ABUSE

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**Introduction** Athletes may have illnesses or conditions that require to take particular medications. Use of substances from Prohibited List for medical reasons requires an approved Therapeutic Use Exemption (TUE). To gain approval, an athlete must submit the appropriate application form along with substantial medical justification at least 30 days in advance of intended use. Athletes have obligation to get approval before using any medication that can cause doping positive result. One of criteria for granting a TUE points that there is no reasonable therapeutic alternative for prohibited substance or prohibited method. Methods In this cross sectional study, 150 TUE applications from elite Serbian athletes were analyzed, in period of 2007. to 2012. by using official data of Anti-doping agency of Serbia (ADAS). These applications had been processed by TUE Committee of International sports federations or ADAS. Results TUE was requested from 116 athletes with average age  $29.6 \pm 7.6$  and men to women ratio 70:30%. More than once 16.4% athletes applied for TUE with maximum of 5 TUE/athlete. The highest prevalence of TUE requests came from athletics (20.1%), basketball (19.5), football (12.1), archery (6%) and tennis (4.7%). The musculoskeletal disorders (80%) and asthma (14.8%) were dominant pathological conditions among Serbian athletes. Enthesiitis, lumbar syndrom and lumbar disc herniation had highest prevalence among musculoskeletal disorders. Only 8% applications were related to chronic diseases (diabetes, colitis ulcerosa, infertility, chronic renal insufficiency, hypertension and neoplasma). Most commonly used medicines were glucocorticosteroides (GCS) represented by 72% and salbutamol with 9.8%. Betamethasone (27.3%), dexamethasone (16.8%) and triamcinolon (14.7%) were the most frequent administrated GCS. Intramuscular (32.9%), inhalation (15.4%) and intraarticular (12.8) routes of drug administration were mostly represented in treatment of athletes. Discussion This study can be useful for perceiving medical conditions of elite athletes which require TUE. Low number of TUE in Serbia implies that the education of athletes and sports federations should be on a higher level. Frequent use of GCS, without valid medical indication and thinking about alternative drugs and methods that could be equally effective, can cause severe side effects leading to decreased sports performance. Since illegitimate consumption of these medicines can cause doping positive result, the importance of reporting TUE should be stressed out. References Dvorak, J., N.Feddermann and K.Grimm. 2006. *Br J Sports Med* 2006; 40:i48-i54

### AEROBIC EXERCISE RECOVERS DOPAMINERGIC AND SEROTONERGIC DYSFUNCTION IN METHAMPHETAMINE-INTOXICATED MICE

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**Introduction** Methamphetamine is an illicit psychostimulant drug widely abused in the world that leads to long-lasting neurodegenerative changes in monoaminergic brain regions. Exercise has stood out because of its rehabilitation properties in drug addiction settings. In this study, we sought to investigate whether physical exercise can repair injured dopamine (DA) and serotonin (5-HT) terminals in the frontal cortex and striatum from methamphetamine (METH)-exposed mice. **Methods** A total of 24 C57BL/6 mice (12-week-old; 23-26 g) were divided into four groups: the exercise groups were submitted to a seven-week treadmill exercise regimen post-METH injection (30 mg/kg METH, i.p.). The sedentary groups were exposed to the treadmill as well. The animals were sacrificed 48 hours following the exercise protocol. Frontal cortical and striatal DA, its metabolites (DOPAC+HVA) and 5-HT total levels (HPLC-ECD) as well as tyrosine hydroxylase (TH; Western Blotting) were determined as monoaminergic terminal markers. Glial fibrillary acidic protein (GFAP; Western Blotting) levels were also measured as an astrogliosis marker. All values were expressed as means  $\pm$  SEM and statistical significance was evaluated by ANOVA followed by Bonferroni's multiple comparison test or by Student's two-tailed t test (GraphPad Prism 5.00.288). The significance level was set at a p value less than 0.05. **Results** Neurodegeneration of both frontal cortical and striatal dopaminergic terminals was still in place 7 weeks following METH single injection, as evidenced by the decreased values of dopamine/metabolites and TH levels ( $p < 0.05$ ). On the contrary, GFAP levels were normal in both regions. Although METH had depleted 5-HT in frontal cortex ( $p < 0.05$ ), it failed to impact striatal 5-HT levels. Exercise not only restored striatal dopaminergic markers levels (METH-exercise vs. METH-sedentary,  $p < 0.05$ ) but also increased total striatal 5-HT contents (Saline-exercise vs. Saline-sedentary,  $p < 0.05$ ). Although exercise fostered 5-HT cortical recovery (METH-exercise vs. METH-sedentary,  $p < 0.05$ ), it failed to restore cortical dopaminergic markers. **Discussion** This study is highly suggestive of exercise being endowed with repairing/trophic properties towards DA/5-HT striatal and frontal cortical terminals. The mechanism underlying this positive effect warrants further scrutiny. One can suggest that treadmill exercise has potential to be a non-pharmacological strategy of neuronal repair in METH addicts. Supported by Strategy Project PEst-C/SAU/UI3282/2011-COMPETE

### PLATELET-RICH PLASMA TO TREAT CHRONIC UPPER PATELLAR TENDINOPATHIES

Kaux, J.F., Croisier, J.L., Bruyère, O., Rodriguez, C., Daniel, C., Godon, B., Simoni, P., Alvarez, V., Brabant, G., Lapraille, S., Lonneux, V., Noël, D., Collette, J., Le Goff, C., Gothot, A.

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**Background:** Upper patellar tendinopathies remain often chronic and rebel to a thorough conservative treatment. Moreover, the option of a surgical treatment could be disappointing. New treatments are being developed. Injection of PRP is one of these. Platelets contain lot of growth factors which would have the potentiality to enhance the healing process of tendons. Even if in vitro and animal experiments have demonstrated this stimulation of tendon healing process, clinical series are subject to controversy. **Methods:** Twenty patients with chronic upper patellar tendinopathy were enrolled. Assessments [VAS, clinical examination with an algometer, algofunctional scores (IKDC and VISA-P), functional assessments (isokinetic and Optojump) and imagery (ultrasounds and MRI)] were made before infiltration of PRP, and 6 weeks and 3 months after. The PRP was obtained by an apheresis system (COM.TEC, Fresenius). Six millilitres of PRP were injected without local anaesthetic. One week after infiltration, patients started a 6-week standardised sub-maximal eccentric reeducation. **Results:** We observed a very significant improvement of the algofunctional status as soon as 6 weeks after the infiltration of PRP, and

continued to a lesser extent up to 3 months. During functional evaluation, pain decreased as well, but without significant improvement of performances. No significant improvements in the imagery were observed. Interestingly, patients who had a VAS equal or below 1 after 3 months post-infiltration were younger (24.7 vs 32.2 y.o.). Moreover, these younger patients had a significant increase of the IKDC score ( $p=0.003$ ), a significant improvement of pain during isokinetic evaluations ( $p<0.05$ ), and during Optojump assessments ( $p=0.01$ ). Seventy-five percent of subjects were able to return to sport, even if only half of these patients recovered the same level than before the tendinopathy. Discussion / Conclusions: This study demonstrates that a local infiltration of PRP associated with a submaximal eccentric protocol is efficient to improve symptoms of chronic upper patellar tendinopathies, non-responsive to classical conservative treatments. However, up to now, there is no consensus on the method to prepare the PRP. Indeed, each technique could provide a very different PRP (variations in the platelet concentrations and of the amount of red and white cells). References: 1. Effects of platelet-rich plasma (PRP) on the healing of Achilles tendons of rats. *Wound Repair Regen* 2012; 20:748-56. 2. Platelet-rich plasma application in the management of chronic tendinopathies. *Acta Orthop Belg* 2013; 79: in press

### THE INFLUENCE OF HORMONAL AND BIOCHEMICAL PARAMETERS ON THE CHANGES OF VO<sub>2</sub>MAX IN PROFESSIONAL FOOTBALL PLAYERS

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The aim of this study was to evaluate the influence of some hormonal and biochemical parameters on changes of VO<sub>2</sub> max in professional football players during a training and competition football process. This study included 30 professional football players from one of the teams of the first football league. The investigations were made at three points: in the beginning of the preparation period, after the preparation period, and after competition period. Each of the investigations was performed in three phases. The following parameters had been determined: VO<sub>2</sub> max (ml/kg/min), heart rates (b/min), blood lactates (mmol/l), serum levels of testosterone (nmol), plasma levels of cortisol (mmol/l) and ACTH (pg/ml) by RIA method and plasma levels of creatine kinase (CK U/l) by DEROM method during a maximal treadmill test in the first phase; AnT (km/h and beat/min) with Conconi method in the second phase; blood lactates during a specific designed high intensity football training session on the field in the third phase. There were significant changes of VO<sub>2</sub> max ( $48,31\pm 4.08$ ;  $51,31\pm 4.16$ ;  $49,5\pm 4.81$ ) during the season, with insignificant changes of AnT ( $12,7\pm 0,80$ ;  $12,73\pm 1,71$ ;  $12,2\pm 1,47$ ). CK plasma levels changed significantly during the season (decreasing at the end of the season). There were significant changes of testosterone serum levels (decreasing at the end of the season) and cortisol and ACTH plasma levels (increasing at the end of the season) during the season. The blood lactates levels during maximal treadmill test changed insignificantly and on the field changed significantly (increasing at the end of the season) at the end of the season. The changes of VO<sub>2</sub> max were significantly influenced by hormonal and biochemical parameters in each period of training and competition period. The significant changes of some parameters and their correlations indicate disadaptation and depletion of the adaptation mechanisms at the end of season. The significant increasing of VO<sub>2</sub>max, decreasing of CK exercise induced answer and the lower levels of blood lactates after preparation period indicate a beginning of adaptation of some systems, although there is no increase of AnT and cortisol exercise induced answer as signs for an improvement of sport performance. Some biochemical and hormonal changes during the football training and competition period could be the markers of VO<sub>2</sub>max changes.

### DIFFERENT TYPES OF EXERCISE AND LIBERATION OF CIRCULATING PROGENITOR CELLS IN PATIENTS WHO SUFFERED A TRAUMATIC BRAIN INJURY. A PILOT STUDY

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Introduction: physical exercise may improve cognitive function and attention, and decrease cognitive deterioration and depression. The mechanisms involved are not clear. The objective of this study is to improve physical or psychological sequelae of patients who suffered a Traumatic Brain Injury (TBI) with a program of physical exercise and muscle electrical stimulation, and measure circulating progenitor cells (CPC) in peripheral blood. Methods: a pilot study was carried out with five patients, but only two of them ended a nine week exercise program with aerobic endurance, resistance and proprioception exercises (five sessions per week: three in the Exercise Physiology Unit and two at home). During these sessions two electrical muscle stimulation series of 20 minutes were applied (Electro-stimulation group, EG). Another group of five patients followed a twelve weeks program (Cycling group, CG). Inclusion criteria: 1) Patients who suffered a TBI more than one year ago with physical or psychological sequelae, 2) No epilepsy 3) Males 20-60 years old. Psychological tests and physical stress tests were done before and after the program. CPC (CD34+) were measured in peripheral blood several times along the protocol. Results: In EG, the results of psychological tests did not change, aerobic capacity improved according physical tests data, increasing VO<sub>2</sub> uptake, and CPC levels increased in the last three weeks. In CG the psychological tests failed to show any change, aerobic capacity improved in physical test increasing VO<sub>2</sub> uptake, but CPC in peripheral blood did not increase. Discussion: In our study all patients improved aerobic capacity, but only two patients increased CPC in blood. One reason may be that the two subjects carried out a higher workload although we could not be able to measure it, and another reason could be that the two patients did a localized effect with electrical muscle stimulation (and probably much higher muscle micro-injuries) while the other group followed a generalized exercise with bicycle activity. Psychological tests did not detect any change, but patients reported subjective improvement, so that we could search for different tests in order to detect these changes in TBI patients. References: Sullivan et al. *Brain Inj* 1990; 4 :407-414. Gordon et al. *J head Trauma Rehabil* 1998;13 :58-67. Mossberg et al. *Arch Phys Med Rehabil* 2007;88 :315-320. Itoh T, et al. (2011). *J Neural Transm* 2011; 118: 193-202. Koutroumpi Met al. (2012). *World J Cardiol* 2012; 4: 312-326.

### THE EFFECT OF ACUTE AEROBIC EXERCISE ON SERUM CORTISOL AND COGNITIVE FUNCTION IN YOUNG ADULTS WITH DIFFERENT CARDIORESPIRATORY FITNESS LEVELS

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Tsai, C. L.1, Chen, T. C.1, Chou, F. Y.1,2, Chen, F. C.3 1: National Cheng Kung University (Tainan, Taiwan), 2: Chi Mei Medical Center (Tainan, Taiwan), 3: National Pingtung University of Science and Technology (Pingtung, Taiwan) Introduction Although numerous studies have

demonstrated that physical fitness and acute aerobic exercise are positively related to the cognitive functions. To our knowledge, none of studies addressed the neuroelectric and biochemical mechanisms that may underlie the positive effects on cognition associated with acute aerobic exercise and with physical fitness. Therefore, the present study was aimed to examine possible biochemical effectors involved in the impact that moderately intense aerobic exercise has on cognitive functions in young adults with different cardiorespiratory fitness levels. Additionally, the relationship between changes in cortisol levels and cognitive performance was examined. Methods On the first visit thirty-eight young adults were separated into higher- and lower-fit groups according to their maximal oxygen consumption after performing a graded exercise test. On the second visit in the same week, cognitive performance (behavioral and electrophysiological indices) via an endogenous visuospatial attention task test and biochemical index were measured before and after an acute bout of 30-minute moderate intensity aerobic exercise on a motor-driven treadmill. All independent variables (e.g., reaction time, P3 amplitude, and cortisol level) from the acute bout of moderate aerobic exercise were separately analyzed with a repeated-measures ANOVA. Results Higher-fit group exhibited shorter RTs compared to lower-fit one as well as larger P3 amplitudes before acute exercise. Shorter RTs and reduced cortisol levels were shown following acute exercise for both groups. However, only higher-fit group exhibited greater P3 amplitudes after the acute exercise. In addition, only reduced cortisol levels and increased P3 amplitude were significantly correlated in the higher-fit group. Discussion The findings that young adults with higher cardiorespiratory fitness exhibited better behavioral and electrophysiological performance before acute exercise support the cardiovascular fitness hypothesis that greater fitness benefits various aspects of cognitive functioning. However, cardiorespiratory fitness positively modulates the relation between acute exercise and electrophysiological performance in younger adults with higher cardiorespiratory fitness when performing the cognitive task, suggesting higher-fit individuals showed particular efficiency with regard to attentional resource allocation after acute exercise, which means that the mechanisms underlying the effects of such exercise on cognitive functioning may be fitness dependent. The cortisol reactivity before and after acute aerobic exercise could be one of the underlying mechanisms for the beneficial effects of aerobic fitness.

## SECONDARY HYPOGONADISM IN MALE ATHLETES USING ANABOLIC-ANDROGENIC STEROIDS

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Introduction Illicit use of AAS is widespread in many parts of the world. Eg. in Sweden the number of users is estimated to be between 10 000 - 100 000 a year (Lood et al., 2012). AAS suppress the hypothalamo-pituitary-gonadal (HPG) axis leading to decreased production of testosterone (T) and spermatozoa. Although the gonadal function usually recovers after the withdrawal of AAS, in a growing number of cases AAS induced hypogonadism (ASIH) of unknown pathophysiology is observed (Tan and Scally, 2009). Our aim was to assess the HPG axis in adult men with a history of long-term exposure to AAS. Methods The study was performed in 13 men (aged 25±4) who were referred to an andrological clinic because of hypogonadism (T <3 ng/ml, symptoms of T deficiency). They received AAS in a similar manner (3-4 cycles of eg. Deca Durabolin 4000 mg, Omnadren 7000 mg, Metanabol 1200 mg and/or Oxandrolone 5000 mg during a year) for 3.9±1.6 years. The drug-free interval was 2.1±1.0 years. Each studied man underwent an andrological examination with basal evaluation of: LH, FSH, T, E2, SHBG, PRL. Then a clomiphene stimulation test (CST) was performed (50 mg of clomiphene/daily for 7 days). We compared concentrations of LH, FSH and T. Results Mean concentrations of LH, FSH and T before and after clomiphene were respectively (mean±SD): 3±1,2 and 8,3±2 mIU/ml; 3±1,1 and 10±14,6 mIU/ml; 2,3±0,6 and 7,2±1,7 mmol/l (p<0.001). It was equal to an increase by respectively: 3,4±2,2; 3,2±4,1 and 3,3±0,9 times. Discussion ASIH is usually temporal. In most cases the androgenic milieu restores within a year after cessation of AAS, though in some athletes hypogonadism and sperm production disturbances may persist suggesting a failure of the HPG (van Breda et al., 2003). In our investigation clomiphene stimulation demonstrated a proper function of the HPG in hypogonadal athletes. It induced the same increases of gonadotropins and T concentrations as observed in healthy subjects. The reaction to an antiestrogen appeared to be intact even in long-term doping users. The results of CST indicate that application of clomiphene can be considered as a therapeutic option in such cases. Whether it also translates into sperm count changes remains to be established. References Lood Y, Eklund A, Garle M, Ahlner J (2012). *Forensic Sci Int*, 219(1-3), 199-204. Tan RS, Scally MC (2009). *Med Hypotheses*, 72(6), 723-8. van Breda E, Keizer HA, Kuipers H, Wolffenbuttel BH (2003). *Int J Sports Med*, 24(3), 195-6.

## AWARENESS SURVEY CONCERNING ANTI-DOPING ON TOP-LEVEL HANDBALL PLAYERS OF SEVERAL GENERATIONS IN JAPAN.

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Introduction For athletes, awareness of anti-doping is indispensable. In 2012, in two players belonging to our association, results of doping tests to them were positive, and they were imposed penalties. It was considered that they performed violations even though inadvertent, and were suspended qualification for three months. Therefore, we carried out the survey of current awareness to anti-doping in top-level players. Subjects and Methods We administered a questionnaire survey regarding anti-doping knowledge to 2250 top-level players of each generation. The contents of the questionnaire include the awareness, the way to deal with illness or injury, medicine (prescription and over-the-counter), some energy drinks, supplements, Chinese herbal medicine and anti-doping education. Result Overall, 1624/2050(79.2%) questionnaires (922 male and 702 female) were returned and available for analysis. And 263 of all (16.2%) had been selected as the member of national team once or more over. National players had a significantly higher level of awareness for anti-doping than non-national players. Especially, it was remarkable to check whether it is possible to take medicines, supplements, and drinks or to do self-learning for anti-doping by using JADA web site and so on. Compared male with female, female had a significantly higher awareness than male. Conclusion Previously, doping test was performed only for elite-level players. But in recent, in addition to them, even under category players have been often the target for the purpose of enlightenment. The recent situation has occurred because inadvertent violations were increasing. Of course, elite-level players have more opportunities to obtain some information about anti-doping. But non-national players have no opportunities except for self-learning. By a violation, the player may be disqualified forever. So we have to structure systematic anti-doping education, and make more opportunities to educate every player, especially junior generation.

**SALIVARY BETA-DEFENSIN 2 INCREASES AFTER YOGA EXERCISE**

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**Introduction** Yoga stretching can be done comfortably and easily by beginners and the elderly to compensate for lack of exercise or poor health maintenance. The aim of this study was to determine the effect of yoga stretching on mucosal immune functions, primarily human  $\beta$ -defensin 2 (HBD-2) in saliva. **Methods** 15 healthy adults ( $60.4 \pm 8.0$  yr) participated in this study. Each of them was at rest for 90 min on the first day, and performed yoga exercise for 90 min on the second day. During yoga exercise, they first massaged their legs and pressed acupressure points for 20 min. Then, they held yoga poses (Warrior Pose, Extended Triangle Pose, Downward-Facing Dog etc.) for 65 min, and finally lay supine (Corpse Pose) for 5 min. Saliva samples stimulated by chewing a sterile cotton at a frequency of 60/60s were collected. HBD-2 concentration was measured using enzyme-linked immunosorbent assay (ELISA), and HBD-2 expression rate was calculated by multiplying HBD-2 concentration by saliva flow rate. **Results** Saliva flow rate showed no significant change by rest and yoga exercise. HBD-2 concentration after yoga stretching ( $165.4 \pm 127.1$  pg  $\cdot$  mL<sup>-1</sup>) was significantly higher than that before yoga stretching ( $84.1 \pm 63.4$  pg  $\cdot$  mL<sup>-1</sup>;  $p < 0.01$ ). HBD-2 expression rate after yoga stretching ( $232.8 \pm 192.9$  pg  $\cdot$  min<sup>-1</sup>) was significantly higher than that before yoga stretching ( $110.7 \pm 96.8$  pg  $\cdot$  min<sup>-1</sup>;  $p < 0.01$ ). HBD-2 concentration ( $p < 0.05$ ) and HBD-2 expression rate ( $p < 0.01$ ) at post on the second day (Yoga) was significantly higher than that on the first day (Rest). **Discussion** In this study, salivary HBD-2 concentration and HBD-2 expression rate significantly increased after yoga exercise. Recent studies have reported that yoga has a relaxation effect (Hartfiel et al., 2011; Telles et al., 2009). Additionally, several studies investigated the suppressive effect of mental stress on the expression of HBD-2 (Tomita et al., 2002; McDermott et al., 2003). Taken together, the relaxation effect of yoga stretching likely decreases mental stress, which in turn increases salivary HBD-2 expression. We conclude that yoga exercise aimed at relaxation might enhance mucosal immune function and be useful for the elderly and athletes to maintain their health. **References** Hartfiel N, Havenhand J, Khalsa SB, Clarke G, Krayer A. (2011). *Scand J Work Environ Health*, 37(1), 70-76. Telles S, Gaur V, Balkrishna A. (2009). *Percept Mot Skills*, 109(3), 924-930. Tomita T, Nagase T, Ohga E, Yamaguchi Y, Yoshizumi M, Ouchi Y. (2002). *Respirology*, 7(4), 305-310. McDermott AM, Redfern RL, Zhang B, Pei Y, Huang L, Prose RJ. (2003). *Invest Ophthalmol Vis Sci*, 44(5), 1859-1865.

**CONTRIBUTING FACTORS OF THE MOTIVATION FOR RECEIVING THERAPY ABOUT ACUPUNCTURE IN ATHLETES**

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**Introduction** Acupuncture is a traditional therapy that is used widely around the world (Mao et al., 2010), and can control muscle pain and prevent the decline in physical performance. Therefore, acupuncture has been recently applied as an enhancer of sports performance (Ahmedov, 2010; Lin et al., 1999; Terada et al., 2001). The purpose of this study was to examine factors of the motivation for receiving therapy about acupuncture in athletes. **Methods** Three-hundreds-twenty-eight university students (210 men and 118 women; mean age,  $20.2 \pm 1.1$  years) majored in physical education provided consent to participate in survey that using questionnaire quantifiable fears and knowledge of the acupuncture therapy and attitudes about receiving acupuncture treatment. **Results** Two-hundred and seventy-six of 328 people (84.1%) had the experience of the sport-related injuries, and 191 of 328 people (69.2%) had experience of the acupuncture treatments. We divided them in two ways; one whose members play whether team (team group,  $n = 169$ ) or individual (individual group,  $n = 159$ ) sports, and one whose members play interpersonal (interpersonal group,  $n = 251$ ) sports or competitive athletics (competitive group,  $n = 77$ ). Analysis of covariance (ANCOVA) was used for comparisons of the data between the groups, it showed that between-group significant differences, when compared interpersonal group and competitive group ( $p=0.03$ ). In stepwise multiple regression analysis, fear of the acupuncture therapy, knowledge of the acupuncture therapy, family members with experience of the acupuncture therapy and interpersonal sports or competitive athletics were independently and significantly associated with the motivation for receiving therapy. **Conclusion** It was shown that athlete's personality including the sport event type characteristic influenced the attitude about the acupuncture treatment. **References** Ahmedov S. (2010). Ergogenic effect of acupuncture in sport and exercise: a brief review. *Journal of Strength and Conditioning Research*, 24(5), 1421-1427. Lin JG, Yang SH. (1999). Effect of acupuncture on exercise-induced muscle soreness and serum creatine kinase activity. *American Journal of Chinese Medicine*, 27, 299-305. Mao JJ, Kapur R. (2010). Acupuncture in primary care. *Primary Care*, 37(1), 105-117. Terada K, Mukai N, Miyamoto T, Miyanaga Y. (2001). Effect of acupuncture stimulation on delayed onset muscle soreness produced by eccentric exercise. *Japanese Journal of Physical Fitness and Sports Medicine*, 50(5), 583-591. [Article in Japanese]

**15:00 - 16:00****Mini-Orals****PP-PM15 Health and Fitness [HF] 9****OLDER ADULT'S QUADRICEPS STRENGTH IN DEEP WATER RUNNING PROGRAM**

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**Introduction** Strength impairments in elderly have been fairly studied once it's related to functional capacity limitations. Especially attention has been given to quadriceps strength since it's one of the muscle groups with higher decline in older people. After that, loss of quadriceps strength has been related to decrease of balance and increase of falls. Therefore, the aim of this study was to verify knee muscles force production in older adults after an aqua fitness program. **Methods** 7 older adults (4 women and 3 men), mean age  $62 (\pm 3)$  years old, participated to a 12 weeks (2 hours per week) deep water fitness program. Exercises were basically shifts, similar to deep water running, associated with upper and lower limb movements. Right knee torque production was evaluated in an isokinetic dynamometer at sit position during 0, 60 and 180 degrees per second before and after the training program. After 5 minutes warming up in a cycle ergometer participants were positioned on the dynamometer and prepared according to manufacturer instructions. The test consisted in

3 maximal voluntary isometric contractions (5 seconds) at 70° of knee flexion; 5 maximal voluntary concentric flexion and extensions at 60 and 180 degrees per second. The interval between repetitions was 120 seconds. Before each velocity test one bout was performed to familiarization. Participants were informed of the study protocol and all risks and possible harms as described in the consent form. Knee extensors peak torque (PT) during isometric and concentric torque-angle curve was analyzed by means of Student's *t* test for paired samples. Results Isometric extensor PT was higher after training (180,4 ±64,7 Nm) than before (163,2 ±51,4 Nm). PT at highest isokinetic speed was higher after training (90,6 ±35,6 Nm) than before (80,5 ±30,6 Nm) as well. But no difference was observed between pre (116,5 ±40,2 Nm) and post training (115,3 ±39,5 Nm). Discussion After 12 weeks of deep water exercises extensors strength increases were observed at isometric and 180 degrees per second isokinetic test. Specific speed muscle adaptations has been reported (Frasson et al. 2007) and can be an explanation to the strength gain observed at isokinetic results since its considered a medium speed (Terrerri et al. 2001), similar to movements speed usually performed during aqua fitness sessions. Those findings are important considering elderly quadriceps strength impairments (Samuel et al. 2009) and possibility of health promotion. References Frasson VB, Rossier DE, Herzog W, Vaz MA (2007). *Brazilian Journal of Biomechanics*, 8(14), 31-37. Terreri ASAP, Greve JMD, Amatuzzi MM (2001). *Rev Bras Med Esporte*, 7(5), 170-174. Samuel D, Wilson K, Martin H, Allen R, Aihie Sayer A, Stokes M (2009). *King's College London. Proc Physiol Soc* 14, PC9.

## EFFECTS OF COMBINED STRENGTH AND ENDURANCE TRAINING ON PHYSICAL PERFORMANCE AND HEALTH IN YOUNG WOMEN

Kyröläinen, H., Salminen, R., Repola, J., Häkkinen, K., Haimi, J.

*University of Jyväskylä*

Introduction Cardiovascular fitness has decreased (e.g. Santtila et al., 2006) and obesity (e.g. Ekelund et al., 2007) increased in youth during the last ten years especially in Western countries. Regular physical activity can have beneficial effects on physical performance, body composition and health (e.g. Blair and Church, 2004). Therefore there is an urgent need to find out optimal training program for improving physical performance and health outcomes. We tried to clarify effects of combined strength and endurance training on physical performance, hormonal responses and some health markers. Methods Subjects were 25-30-year-old females with very low physical activity, and 65 % of them were overweight (BMI >25). They performed strength and endurance training three times a week during nine weeks. Independent strength training was performed at the gym and instructed endurance training by indoor cycling. Several experimental measurements were assessed before, in the middle and after the training period. No nutritional guidelines were given to the subjects. Results The 9-week training period led to 8.5 % increase in maximal oxygen uptake. Resting heart rate and heart rate variability (HRV) remained unchanged with the exception of a decrease of 48.2 % in high-frequency power (HF). Isometric maximal strength of the leg and arm extensors increased by 28.9 % and 7.8 %, respectively. No changes in rate of force development were noticed. Maximal isometric trunk flexion and extension increased by 27.2 % and 16.1 %, respectively. Total cholesterol values lowered by 7.6 %, while HDL (high density lipoprotein) increased by 8.8 %. LDL (low density lipoprotein), hemoglobin, fasting plasma glucose and triglyceride remained unchanged. Plasma cortisol increased by 22.7 % but no changes in plasma testosterone, estradiol or sex hormone binding globulin (SHBG) were observed. The skeletal muscle mass increased by 0.8 %, but there were no changes in body weight, fat mass, or fat percentage. Discussion Our results indicate that the 9-week strength and endurance training period, including three training sessions in a week, improve maximal endurance and strength capacity as well as some health outcomes. Thus, combined strength and endurance training itself can induce significant health benefits without any changes in dietary habits. References Blair SN, Church TS. (2004) *JAMA* 8, 292: 1232-4. Ekelund U, Särnblad S, Brage S, et al. (2007) *Int J Obes* 31, 65-71. Santtila M, Kyröläinen H, Vasankari T, et al. (2006) *Med Sci Sports and Exerc* 38, 1990-4.

## EFFECTS OF CONCURRENT TRAINING ON CAROTID INTIMA-MEDIA THICKNESS OF MIDDLE-AGE OBESE MEN

Cavaglieri, C., Oliveira-Silva, M.V., Gáspari, A.F., Rossi, G., Nadruz, W.J., Brunelli, D.T., Bonganha, V., Libardi, C.A., Chacon-Mikahil, M.P.T.

*State University of Campinas*

Introduction Atherosclerosis is an inflammatory chronic disease and one of the major causes of death in the world. Atherogenesis is the development of atheromatus plaques in inner lining of the arteries, specifically in the intima-media wall. This process is related to hemodynamic changes, inflammatory mediators increase and deterioration in the lipid profile, which in turn are common elements in obesity. Large part of the medicine drugs have failed in treating this disease (1), however, long time intervention (more than one year) whit aerobic training have been shown to decrease intima-media thickness. But Tanaka (2002) did not find decreased IMT whit aerobic training intervention of 6 months, and nowadays the recommendation for this age group are Concurrent Training, because it can interlock the benefits of both trainings. Thus, the aim of this study was to analyze the effect of Concurrent Training on carotid IMT of middle-age obese men. Methods Eight men (48.03 ±5.15 years and 31.61 ±2.37 km/m<sup>2</sup>) were analyzed. The carotid IMT measures were made by ultrasonography with the equipment Vivid 3 Pro, the carotid artery images were obtained by linear transducer whit frequency of 10MHz. There were Six months of Concurrent Training, comprised by Resistance and Aerobic training in the same training session. The comparison between pre- and post-training for maximal upper and lower body strength (One Repetition maximum test), oxygen peak consumption (Cardio-pulmonary test) and IMT were made by paired T-test. Results After the training period were observed significant increase in upper body strength (74.6 ±9.7 to 87.5 ±16.4 kg, p=0.01) and lower body strength (323.8 ±49.8 to 375.6 ±37.0 kg, p=0.002) were observed. However, no training effects occurred on oxygen peak consumption (28.03 ±4.07 to 28.12 ±2.87 ml/kg/min, p= 0.32) and IMT (0.6 ±0.1 to 0.6 ±0.1 mm, p=0.68). Discussion Different authors showed the effects of exercise training on the IMT of various arteries, however positive effects on Carotid IMT have been reported only in long time studies (3). Studies with short time intervention, lower than one year, have showed similar results to our research, even with aerobic training (2) considered more effective (4). Conclusion The training protocol proposed wasn't effective to decrease the IMT after 6 months, probably a larger intervention time is necessary to promote changes in this variable of middle-aged obese. References 1- Libby P, Ridker PM, Hansson, GK. (2011). *Nature*, 473. 2- Tanaka et al. *J Appl Physiol*. 92, 1458–64, 2002. 3- Rauramaa et al. *Ann Intern Med*. 140, 1007–14, 2004. 4- Thijssen et al. *Clinical Science*. 122, 311–22, 2012.

## LOWER EXTREMITY AND CORE MUSCLES ACTIVATION DURING AN AQUATIC RESISTANCE EXERCISE PERFORMED WITH DIFFERENT DEVICES

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Water environment is an effective tool to improve the strength and may increase the muscle mass both in older and younger physically active people. Many different devices are used in aquatic resistance training. There are two kinds of devices: floating and drag, which may be of different sizes. However, little research has been reported regarding the effects of using different devices during the performance of resistance exercises in a water environment. PURPOSE: To compare lower extremity and core muscles activation during leg adduction performed at maximum velocity with 4 different aquatic devices. METHODS: 24 physically fit and healthy subjects (23.2 ± 1.18 years) took part in a randomized, within-subject design assessment. The maximum isometric voluntary contraction (MIVC) was evaluated for the normalization of the electromyographic measures. Latissimus dorsi (LD), Rectus Abdominis (RA), External Oblique (EO) and Erector Spinae (ES) muscular activity were recorded and the maximum root mean square values were calculated for each condition. Surface electromyography was isolated and the activity was analyzed during 3 repetitions of leg adduction performed with 4 aquatic devices: Drag Hydroboot (DH), Drag Aquafins (DA), Floating Boot (FB), and Floating Support (FS). All values were expressed as the %EMG and compared using Analysis of Variance with repeated measures. Significance level was set at  $p < 0.05$ . RESULTS: For all muscles analyzed in the present study, no significant differences were found [AL:  $F(1,73,27.70) = 1.322$ ,  $p = 0.280$ ; RA:  $F(3,30) = 1.138$ ,  $p = 0.124$ ; EO:  $F(3,39) = 0.680$ ,  $p = 0.570$ ; ES:  $F(3,30) = 1.138$ ,  $p = 0.350$ ] between performance of the aquatic exercise under the four conditions (DH, DA, FB and FS). CONCLUSION: When training in a water environment, different sizes and kinds (drag and floating) of devices can lead to similar muscle activation when the movement is performed at maximum velocity. Therefore, if maximum muscle activation of the extremities and core muscles is required the kind of device is not relevant.

## EFFECTS OF STRENGTH TRAINING ON OBJECTIVELY RECORDED PHYSICAL ACTIVITY IN ELDERLY MEN

Berntsen, S., Stea, T.H., Bjørnsen, T., Salvesen, S., Lohne-Seiler, H., Hellelid, K.J., Paulsen, G.

University of Agder

Introduction It is unclear whether participation in strength training programs specifically developed for elderly translates into a more physically active lifestyle. In addition, in few studies physical activity (PA) is objectively recorded and conclusions are typically based on PA self-reports. The aim of the present study is to determine whether changes in muscle strength and mass during a 12 weeks strength training period are associated with changes in the PA-level, in elderly men. Methods Fifty elderly males (60 – 81 years old) participated in a double blinded randomized placebo controlled trial (SARA-elderly). The main aim was to investigate the effect of supplementation of antioxidants (C and E vitamin) and a multivitamin (i.e., omega-3 and whey protein) on muscle mass and maximal strength during 12 weeks (3 times/week) of strength training (2/wk 8-10RM, 1/wk between 3-5RM or 13-15RM). The load was weekly adjusted, and the volume increased progressively throughout the 12 weeks. Muscle mass was assessed as changes in lean mass with Dual Energy X-ray absorptiometry (DXA) and thickness of rectus femoris and vastus lateralis with ultrasound imaging. Strength was measured as 1 Repetition Maximum (1RM) in leg press and knee extension. PA was recorded by the activity monitor SenseWear™ Pro3 (BodyMedia inc, US) for four consecutive days (2 weekdays and 2 weekend days). Results are presented as median. Results There were significantly ( $p < 0.001$  for all changes) increases in lean mass in the legs (3.3%), muscle strength (18.5% in leg press and 16.0% in knee extension) and muscle thickness (13.1% for rectus femoris and 7.4% for vastus lateralis). There was a significant ( $p < 0.001$ ) reduction in moderate- to- vigorous-intensity PA (MVPA) from Autumn to Winter (from 5.7 to 1.7 hours/day); however, percentage change in lean mass in the legs was significantly and negatively ( $r = -0.32$ ;  $p = 0.03$ ) associated with change in MVPA. Changes in neither muscle strength nor muscle thickness were associated with changes in MVPA. Discussion As known, season (e.g. Winter with snow) appears to have large influence on the physical activity level in Norway. However, participation in a strength training program accompanied by an increase in lean mass in the legs, seems to influence MVPA. Our findings have to be confirmed in a randomized controlled setting with a control group not participating in strength training.

## INFLUENCE OF PILATES TRAINING ON CHRONIC NON-SPECIFIC LOW BACK PAIN

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Introduction Most conventional intervention have modest efficacy for the management of low back pain. On the other hand, regular therapeutic exercise seem to have significant benefits in patients with chronic low back pain (CLBP). Hayden et al. (2000) concluded therapeutic exercise has a significant impact on pain and function in this population. More recently, Sorosky et al. (2008) focused on the scientific and theoretical basis of using yoga and Pilates in the management of CLBP. They proposed some intervention principles that may be applied for managing patients with CLBP. The aim of this work was to evaluate the effects of five weeks Pilates training on pain intensity and force in women presenting CLBP. Methods Two groups of 10 women volunteered to participate in this study (mean age 51 years). All the subjects presented CLBP symptoms for at least 2 years. Control group (CG) performed initial and final evaluations and followed medical treatment in between. Pilates Group (PG) followed two Pilates training sessions (1 hour) per week during five weeks. Initial (T0) and final (T1) evaluations contained pain intensity evaluation (Dallas questionnaire), erector spinae and abdominal muscles endurance (Sorensen and Shirado tests). Comparisons were performed using a one way analysis of variance (group) for repeated measures (T0 and T1). Linear regressions were calculated between force improvement and pain decrease. The level of significance was set at  $p < 0.05$ . Results No differences have been observed in pain intensity, erector spinae and abdominal muscles endurance in CG between T0 and T1. On the contrary, PG demonstrated a significant decrease in pain intensity (5.8 vs 3.4,  $p < 0.01$ ) and a significant increase in erector spinae and abdominal muscles endurance (+100% and +60% respectively,  $p < 0.01$ ). No relationship was obtained between muscles endurance improvements (express in percentage of initial values) and pain intensity decrease. Discussion This study confirmed the analgesic effect of Pilates training on CLBP. Specific active exercises reduced significantly pain intensity and increased trunk muscles endurance whereas control group didn't observe any changes. Despite the fact that no relationship was obtained between muscle force improvement and pain intensity decrease, these results confirm the clinical relevance of Pilates as an appropriate treatment for CLBP. Neurophysiologic and mechanical mechanisms should be investigated more thoroughly to determine the optimal training dose and the most appropriate exercises. References Hayden JA, van Tulder MW, Malmivaara A, Koes BW. (2000). Cochrane Database Syst Rev. Sorosky S, Stipl S and Akuthota V, (2008). Curr Rev Musculoskelet Med. 1:39–47

### BONE DENSITY AND STRENGTH INDEXES IN ADOLESCENT SWIMMERS

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1. Genud Research Group, Universidad de Zaragoza, Spain 2. Universidad de Zaragoza, Spain 3. Aberystwyth University, UK

**Introduction:** It is generally accepted that sport is beneficial to bone mass[1]. However, not all sports have the same effect. In fact, non-weight bearing sports such as swimming have been shown to have no, or even negative effect on bone mineral density (BMD). **Aim:** To evaluate bone mass and structure in order to view BMD and bone strength indexes of adolescent swimmers and compare them to sex- and age-matched controls. **Material and methods:** A total of 66 male and female adolescent swimmers (38 males)(14.6±1.5 y) were compared to 23 controls (12 males) (15.4±1.8 y) who practiced less than 3 hours of physical activity per week. Subtotal whole body, upper and lower limbs BMD was measured with dual energy X-ray (DXA). Peripheral Quantitative Computerized Tomography (pQCT) was used to evaluate volumetric BMD (vBMD), cortical thickness and to calculate several strength indexes at radius and tibia. ANCOVA analyses were performed in order to view differences between groups for BMD adjusted by age, height and subtotal whole body lean; and for stress indexes adjusted by age. **Results:** Swimmers presented lower BMD at the lower limbs (1.04±0.08 vs 1.09±0.08 g/cm<sup>2</sup>, p<0.05) and higher at the upper limbs (0.70±0.03 vs 0.68±0.03 g/cm<sup>2</sup>, p<0.05) compared to controls when evaluated with DXA. Swimmers also presented lower tibia vBMD and lower tibia cortical thickness than controls (all p<0.05). However, at the radius, swimmers presented higher stress strain index (136.26±32.26 vs 117.77±34.29 N, p<0.05) and resistance to fracture load for the X axis (490.55±116.09 vs 423.99±123.09 N, p<0.05). The measured stress strength indexes were similar between groups at tibia. **Conclusion:** From these findings, it seems that the radii of the swimmers might be stronger than those of controls. No differences were found for tibia regarding strength indexes suggesting that although swimmers present lower BMD at this area, bone structure makes this bone as strong as that of the controls. The higher stress strength indexes of the radius in swimmers could be due to the constant effort that the forearm muscles perform during the practice of swimming. The higher stress strain index and fracture load values presented by the swimmers are of special interest due to the fact that swimmers that are only evaluated by DXA may be thought to have a higher risk of suffering osteoporotic fractures later in life. However, if bone structure is taken into account, swimmers seem to have stronger or similar bones and therefore may have a lower risk of suffering this kind of fractures. 1. Vicente-Rodríguez G. How does exercise affect bone development during growth? *Sports Med.* 2006;36(7):561-9.

### AEROBIC EXERCISE TRAINING LOWERS CEREBRAL PULSATILITY INDEX AFTER ACUTE AEROBIC EXERCISE IN MIDDLE-AGED AND OLDER WOMEN

Nobuhiko, A., Ra, S.G., Matsubara, T., Choi, Y., Tanahashi, K., Miyaki, A., Higashino, R., Kumagai, H., Oikawa, S., Ajsaka, R., Maeda, S.

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**Background:** A pulsatility index (PI) reflects vascular resistance of peripheral small vessel. The vascular resistance in cerebral circulation is low, providing a robust blood flow to the brain throughout systole and diastole. Increase in PI of cerebral artery contributes to the progression of cerebrovascular disease and has been identified as a risk factor for cerebrovascular disease. Although aerobic exercise affects vascular function, little is known to the effect of acute exercise on cerebral pulsatility index. We investigated whether cerebral artery pulsatility changes after acute aerobic exercise, and whether this change in pulsatility is enhanced by aerobic exercise training. **Methods:** Six healthy middle-aged and older women participated in 12 weeks exercise training intervention study. We measured PI of middle cerebral artery by means of transcranial Doppler method before and after a cycling aerobic exercise bout at their individual oxygen uptake at ventilatory threshold for 30 min, before and after 12 weeks of aerobic exercise training intervention. **Results:** After the aerobic exercise training, oxygen uptake at ventilatory threshold significantly increased (P < 0.05). Before exercise training, there was no significant change in the PI of middle cerebral artery between before and after acute aerobic exercise, however, after the exercise training intervention, the PI of middle cerebral artery significantly decreased 30 min after exercise (P < 0.05). **Conclusion:** The present study demonstrated that aerobic exercise training lowers cerebral pulsatility after acute aerobic exercise. This result suggests that aerobic exercise may reduce cerebrovascular resistance, thereby contributing to improvement of cerebral perfusion.

### THE EFFECTS OF ACCELERATION TRAINING ON KNEE FUNCTION AND PHYSICAL PERFORMANCE OF MIDDLE-AGED AND ELDERLY WOMEN WITH CHRONIC KNEE PAIN: ONE YEAR INTERVENTION WITH ACCELERATION TRAINING

Yoon, J., Tsuji, T., Aiba, T., Tsunoda, K., Kanamori, A., Okura, T., Tanaka, K.

*University of Tsukuba*

**Introduction:** Acceleration Training (AT) is a type of whole body vibration (WBV) training where participants maintain a variety of positions or perform specific activities on a 3 dimensional platform. With AT one can expect the same beneficial effects of resistance training without imposing heavy weight or executing dynamic actions. There is considerable research that supports the correlation between AT and improvements in lower limb muscle strength. Hence, AT can be an effective training method for people who have difficulty practicing dynamic training methods due to osteoarthritis, especially in the knees. In this intervention study, we evaluated the effect of AT on knee function in middle-age and elderly women with osteoarthritis and chronic knee pain. **Methods:** We observed 21 women (62.0 ± 5.6 yr) with chronic knee pain for one year. We held 45 minute AT sessions using the Power Plate Pro5, 3 times per week for 8 weeks followed by once weekly training. The women were evaluated 3 times: the beginning of week 1, the beginning of week 9 and at the end of the one year intervention. We used Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) to evaluate knee joint function, and we measured timed-up-and-go (TUG), 5-m habitual walk (5-m HW) and sit-and-reach (SR) to evaluate physical performance. We compared measurements from the 3 evaluations using an ANOVA. **Results:** Over the one-year period, the average total WOMAC score went from 12.6 ± 12.2 points to 9.4 ± 10.9 points to 34.3 ± 14.7 points (P < 0.01). The average SR score went from 36.3 ± 8.05 s. to 46.55 ± 9.71 s. to 44.8 ± 9.1 s. (P < 0.01), TUG went from 5.86 ± 0.71 s. to 5.17 ± 0.71 s. to 5.41 ± 0.81 s. (P < 0.01) and 5-m HW went from 3.78 ± 0.47 s. to 3.65 ± 0.59 s. to 3.29 ± 0.39 s. (P < 0.01). We found significant improvements between weeks 1 and 9, but not between week 1 and the end of the year-long intervention. The multilayered comparison indicated significant differences for the following time periods: between week 1 and end of one-year for WOMAC score (P < 0.01); between week 1 and week 9 and between week 1 and end of one-year for SR; between week 1 and week 9 for TUG; and between week 1 and end of one-year for 5-m HW. **Conclusion:** These results suggest that AT helps improve or maintain physical abilities of middle-aged and elderly women with knee pain. As for the frequency of the exercise, 3 times a week proved to be more effective than once a week. There was no objective evidence showing significant improvement in knee

function. The measurements from week 9, however, indicated improvement compared to week 1, implying that 3 times per week training is effective.

### ACCELERATION TRAINING FOR IMPROVING PHYSICAL FITNESS AND WEIGHT LOSS IN OBESE WOMEN

So, R., Eto, M., Tsujimoto, T., Tanaka, K.

*University of Tsukuba*

**Introduction** Acceleration training (AT) was initially used by elite athletes to improve speed-strength performance. Although AT is now becoming a popular alternative training method, it is unclear whether combining AT with a diet provides sufficient physical stimulation for improving muscle strength and physical fitness in obese individuals. The present study aimed to determine the synergistic effects of AT on body composition and physical fitness with our weight-loss program in obese women. **Methods** Twenty-eight obese, middle-aged women were divided into two groups as follows: dietary plus aerobic exercise group (DA; BMI: 29.3±3.0 kg/m<sup>2</sup>); and dietary plus aerobic exercise and acceleration training group (DAA; BMI: 31.2±4.0 kg/m<sup>2</sup>). Both groups included a 12-week weight-loss program. Body composition, visceral adipose tissue (VAT) area, physical fitness elements (hand grip strength, side-to-side steps, single-leg balance with eyes closed, sit-and-reach, and VO<sub>2</sub>max) were measured before and after the program. **Results** Anthropometric measures, abdominal adipose tissue and body composition had decreased significantly by the 12-week program in both groups. While BMI, VAT and total fat mass showed a significantly greater reduction in the DAA group. The program induced a significant increase in VO<sub>2</sub>max in both groups. Hand-grip strength (+2.1±3.0 kg), single-leg balance (+11.0±15.4 s) and the sit-and-reach test (+6.5±4.8 cm) improved significantly only in the DAA group after the program. However, no significant difference existed between the groups in the training effect on physical fitness variables. **Discussion** Although the reasons for AT's beneficial effect on VAT remain unclear, one possible factor is the activation of the central sympathetic nervous system (SNS). A major effect of SNS innervations on white adipose tissue is the triggering of lipolysis, a previous study (1) reported that acute exposure to AT activated the SNS. Also, the other reason why the AT improves muscle strength and muscular performance may be the influence of acceleration created by the minute vibration of the platform (2). AT can modulate force by changing acceleration through a change in frequency (Hz) and amplitude (mm) of vibration and it mechanically produces fast and short changes in the length of the muscle-tendon complex. **Conclusion** AT may be effective in weight-loss intervention for reducing VAT and enhancing muscle strength and performance in obese women. **References** 1. Ando H et al. (2003). *Scand J Work Environ Health*. 2003; 29 (3):216-9. 2. Van der Meer G et al. (2007). *Handbook of Acceleration Training Science, Principles and Benefits*.

### STRENGTH TRAINING IMPROVES FATNESS, FITNESS AND GLYCEMIA IN APPARENTLY HEALTHY OLDER ADULTS

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*Faculdade Estácio FAL; Centro Universitário CESMAC; Research Center in Physical Activity, Health and Leisure*

**Introduction:** Impaired glycemic control, dyslipidemia, proinflammatory markers and obesity are related abnormalities implicated in the early stages of cardiovascular disease. All of them have high prevalence with increased age. Since a demographic trend to the increasing in the number of older adult population has been observed, there is an enormous public health interest in identifying factors that promote an independent and healthy state. Although strength training is well known to improve functionality there is scarce evidence concerning its effects on cardio metabolic profile in apparently healthy older adults. **Purpose:** To investigate the effects of a 4-month strength training program on body composition, fitness, fasting glycemia, lipid profile, and C-reactive protein of older adults with no diagnosis of chronic conditions. **Methods:** twenty community-dwelling old age individuals (seven men; 66.5 ± 4.3 years; BMI=27.4 ± 3.9 kg/m<sup>2</sup>) were randomized into two groups: 1) strength training (ST; n=10, nine exercises, 1-2 sets, 8-12 repetitions, 3 days/wk) or 2) control (CG; n=10, no exercise). Weight, height, body composition (lean mass, trunk fat and %body fat - %BF, assessed by DXA), fitness (assessed by 6-minute walk test - 6MWT, sit-to-stand five-times, and hand-grip strength), fasting glycemia, lipid profile (total, LDL and HDL cholesterol), and high sensitive C-reactive protein were evaluated at baseline (M1) and after the four months (M2). To assess mean changes between the two moments the t test to repeated measures was used (p<0.05). **Results:** After 4 months of strength training, older adults presented: reduced %BF (M1=33.5 ± 7.4 vs. M2=31.6 ± 7.3; p<0.01) and trunk fat (11.9 ± 4.5kg vs. M2=10.5 ± 3.9kg; p<0.01), better performance on 6MWT (M1=641.9 ± 62.7m vs. M2=693.1 ± 76.3; p<0.01) and sit-to-stand five-times (M1=8"10 ± 1"35 vs. M2=7"32 ± 2"29; p=0.04) as well as a reduced fasting glycemia (M1=85.4 ± 6.8 vs. M2=73.3 ± 7.1; p<0.01). Surprisingly, CG presented lower levels of total cholesterol at M2 (M1=240.2 ± 31.7 vs. M2=211.2 ± 44.8; p=0.02) but this result seems to be due a significant reduction on HDL cholesterol (M1=63.3 ± 18.8 vs. M2=48.8 ± 11.1; p=0.02). **Conclusions:** Strength training reduced fat but did not improved lean mass in healthy older individuals. However, even with no significant gain in lean mass, strength training improved fitness and glycemic control of older adults. Supported by FCT (PTDC/DES/108780/2008; SFRH/BD/33124/2007; PEst-OE/SAU/UI0617/2011)

### EFFECT OF RECREATIONAL SWIMMING IN PERFORMANCE OF 200M FREESTYLE

Lampadari, V.1, Thanopoulos, V.1, Dopsaj, M.2, Rozi, G.1, Ktena, S.1, Geru, E.3

*1: National & Kapodistrian University of Athens, 2: Faculty of Sport and Physical Education, University of Belgrade 3: Swimming Coach, Panellinos Club of Athens*

**Introduction** Swimming as a physical activity enables the proper functioning of all body systems. Exercise in the water helps maintaining and improving aerobic capacity (Tanaka et al., 1997). The measurement of heart rate is an indicator of exercise intensity (Klisouras, 2007). The aim of this study was to improve the performance in 200m freestyle swimming of men and women, through a recreational swimming program of 8 weeks, one hour per day and at least three times a week. **Methods** The sample consisted of 30 sedentary subjects aged 45.2±4.0 years. Of these (n= 15) were men aged 46.07±4.43 years, height 177.33±4.13cm and weighing 86.6±8.23kg and (n= 15) women aged 44.33±3.46 years, height 165.2±3.67cm, weight 66.89±8.48kg. At the beginning, all participants swam 200m freestyle swimming with maximum intensity. Afterwards they followed a systematic swimming program in order to improve their performance in the distance of 200 meters. The intensity ranged from 60-90% of maximum heart rate. At the end of 8 weeks, the participants repeated the same test. Immediately after the end of both tests total performance time and heart rate were recorded. **Results** The results showed that total performance time of the sample was significantly lower in the final in comparison to initial measurement (347.8±68.6 initial, 332.4±66.3 final) which was the objective of the study. In heart rate difference was not observed for the whole sample. In relation to gender, men had better performance times and higher heart rate in both measurements in comparison to women. At individual level, men showed significantly improved performance time (296.5±33.7 initial, 283.5±31.9 final) while heart rate showed no significant differences (144.8±9.31 initial, 143.6±9.74 final). Statistical significant difference was also observed in performance time of women (399.2±54.4

initial,  $381.4 \pm 54.3$  final) as well as in heart rate ( $125.6 \pm 12.3$  initial,  $130.4 \pm 9.4$  final). Discussion For the participants of our research, systematic recreational swimming program resulted in statistically significant improvement in swimming performance of the 200m freestyle. Heart rate showed no statistically significant improvement. From the results of this research we can conclude that even if the recreational swimming program was oriented to improving the performance of 200m freestyle, can lead to positive changes. References Klisouras V. (2007). Ergophysiology. Pascalidis Editions. 232-238. Tanaka H, Desouza CA, Jones PP, Stevenson ET, Davy KP and Seals DR. (1997). Greater rate of decline in maximal aerobic capacity with age in physically active vs. sedentary women. Journal of Applied Physiology 83:1947.

### HYPOXIC ENDURANCE TRAINING CAN REDUCE INSULIN RESISTANCE IN OBESE RATS

Zhang, L., Lu, Y.L., Xu, J.F., Feng, L.S.

*China Institute of Sport Science*

Abstract: Insulin resistance and high blood glucose level are common in obese people. We have found that hypoxic endurance training can help to reduce body fat and increase the catabolism of body fat. In this research we want to investigate further if it also can help to remedy glucose metabolic disturbance. 260 SD rats of 3 weeks age were fed by high fat diet, which contains 18-20% fat, for 12 weeks. 160 fatter rats, which were 20.7% heavier than the rest, were picked out and then underwent 2 weeks of adaptive training. 130 rats of similar performance were picked out with mean FBG  $8.68 \text{ mmol/L}$ , indicated obvious glucose metabolic disorder. The rats were divided into 13 groups, 1 is original status group, and the other 12 groups underwent normoxic training (NT) or simple hypoxia exposure (HE) or hypoxic training (HT) for 1, 2, 3 and 4 weeks, and all still fed by high fat diet. Treadmill were used to train the rats with speed of 26 m/min under normoxia and 21 m/min under hypoxia, which was 13.6%  $\text{O}_2$ , which simulated 3500m altitude. The training time was 1 hour/day and 6 days/week. Serum fasting blood glucose (FBG), insulin, glucagon, growth hormone, cortisone, adrenaline, free fat acid (FFA), leptin, adiponectin and GLUT4 gene mRNA in gastrocnemius muscle were tested. Main Results: After 4 weeks of training, (1) Body weight reduction: the Lee's Index declined significantly from 325.9 to 308.3(NT), 312.2(HE) and 302.7(HT). (2) FBG (mmol/L) reduction: the FBG declined significantly from 8.684 to 6.889(NT), 5.398(HE) and 6.513(HT). (3) Blood Insulin (mIU/L) reduction: the Insulin declined significantly from 4.117 to 2.798(NT), 3.109(HE) and 1.926(HT). At the same time, the other hormones like glucagon, growth hormone and adrenaline significantly increased significantly from 35%-200%. (4) Blood FFA ( $\mu\text{Ep/L}$ ) reduction: the FFA declined significantly from 476.9 to 404.0(NT), 432.8(HE) and 366.2(HT). (5) Blood Leptin (pg/ml) increase: the leptin increased significantly from 632.8 to 672.0(NT), 691.2(HE) and 729.4(HT). (6) Blood Adiponectin (ng/ml) increase: the adiponectin increased significantly from 0.441 to 0.643(NT), 0.594(HE) and 0.670(HT). (7) Muscle GLUT4 mRNA level reduction: the GLUT4 mRNA level declined significantly by 21.1%(NT), 21.2%(HE) and 34.2%(HT). Conclusion: Simple hypoxic exposure can reduce body weight, FBG and memory insulin resistance significantly. If add aerobic training to hypoxic exposure, the results will be better. The mechanisms may include the better effects in reducing blood FFA, and raising blood leptin and adiponectin, which were benefit for improving the insulin sensitivity.

**15:00 - 16:00**

### Mini-Orals

#### PP-PM06 Biochemistry [BC] 2

### EFFECT OF L-ARGININE SUPPLEMENTATION ON NITRIC OXIDE SYNTHESIS, INSULIN AND GROWTH HORMONE RELEASE DURING HIGH-INTENSITY EXERCISE

Alvares, T., Marques, A., Conte-Junior, C., Silva, J., Paschoalin, V.

*Federal University of Rio de Janeiro*

Introduction L-arginine has been hypothesized to improve exercise performance by increasing nitric oxide synthesis and levels of insulin and growth hormone (GH). Changes of these parameters in response to L-arginine supplementation may clarify the mechanisms underlying its putative physiological effects on physical performance. Therefore, the aim of this study was to analyze changes on plasma nitrate plus nitrite ( $\text{NO}_x$ ), and serum insulin and GH levels in response to exercise after L-arginine supplementation. Methods 15 highly trained runners (4 females) were randomly divided in ARG (6 g of L-arginine) and PLA (6 g of corn starch) groups. At the first, the runners took the supplementation and rested for 20 min. Afterwards, the subjects performed two bouts of a 5 km time-trial running test with a 10-min rest period. Blood samples were drawn before supplementation (PRE), immediately after the first 5 km time-trial running test (IP-1), immediately after the second 5 km time-trial running test (IP-2) and after 20 min of rest (+20). Plasma  $\text{NO}_x$ , serum insulin and GH, and total running time (TRT) were evaluated. Results Significant increases in plasma  $\text{NO}_x$  from PRE ( $61.0 \pm 22.8$  vs.  $59.9 \pm 15.4 \mu\text{mol/L}$ ) to IP-2 ( $103.3 \pm 46.0$  vs.  $94.0 \pm 32.8 \mu\text{mol/L}$ ) and +20 ( $102.9 \pm 51.6$  vs.  $99.8 \pm 29.6 \mu\text{mol/L}$ ) and serum GH levels from PRE ( $3.28 \pm 0.95$  vs.  $3.21 \pm 0.5 \text{ ng/mL}$ ) to IP-1 ( $4.35 \pm 0.23$  vs.  $4.17 \pm 0.13 \text{ ng/mL}$ ), IP-2 ( $4.22 \pm 0.25$  vs.  $4.17 \pm 0.09 \text{ ng/mL}$ ) and +20 ( $4.14 \pm 0.28$  vs.  $4.13 \pm 0.18 \text{ ng/mL}$ ) were observed in both ARG and PLA with no significant differences between the groups. There were no significant differences in serum insulin at any sample times in both ARG and PLA groups. Furthermore, no significant difference between ARG and PLA was observed on TRT on the both running tests. Discussion In both ARG and PLA groups,  $\text{NO}_x$  and GH increased significantly in response to exercise. Furthermore, no significant difference in serum insulin and exercise performance was observed between the groups. Since we did not observe any significant effect L-arginine supplementation on increases on  $\text{NO}$ , insulin or GH concentrations, there was no expectation of improvement in exercise performance. Previous evidence (Alvares et al., 2012) has also shown no positive effect of L-arginine on  $\text{NO}$  synthesis and exercise performance as compared to placebo. L-arginine-based nutritional supplements may not be effective as a potential ergogenic aid to promote metabolic and hormonal changes in healthy and physically active individuals. References Alvares TS, Conte CA, Paschoalin VM, Silva JT, Meirelles CM, Bhambhani YN, Gomes PS. Appl Physiol Nutr Metab. 2012;37(1):115-26.

## VOLUNTARY RUNNING EXERCISE WITH NEW SUPPLEMENT INCREASE MUSCLE MASS VIA FOLLISTATIN ACTIVATION

Oishi, Y., Hashimoto, T.

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**Introduction:** Satellite cells are important for myofibers repair, maintenance, and growth (Grand et al., 2007). The number of satellite cells increases by exercise (Charifi et al., 2003, Verdijk et al., 2009). In addition, the number of satellite cells was increased by creatine or estrogen administration (Deborah et al., 2007, Olsen et al., 2010). However, yet remarkably little is known about molecular mechanisms underlying augmented number of satellite cells induced by exercise training and supplements. We herein posit that follistatin is a potential mechanism as the important factor to regulate muscle mass by inhibiting myostatin (Gilson et al., 2009), which negatively regulating muscle mass (McCroskery et al., 2003). We found previously that an exercise-inducible metabolite increased mRNA levels of myogenin, which is a muscle-specific transcription factor involved in the skeletal muscle development and repair (Hashimoto et al., 2007). Therefore, in this study, we attempted to examine whether exercise training with new supplement, developed based on exercise-inducible metabolites, could increase muscle mass via increased expression of myogenin and/or follistatin. **Method:** Male Fisher 344 rats were divided into three groups: control group (CON) (n=6), exercise group (EX) (n=9), and exercise with the supplement group (SP) (n=9). The SP group undertook new supplement 3 times per week by oral administration. The SP and EX exercised voluntarily wheel running 3 times per week. After 5 weeks exercise and supplement administration, muscles (tibialis anterior (TA), extensor digitorum longus (EDL), soleus (SOL) and plantaris (PLA)) were removed and immunostained with total paired box homeotic gene 7 (Pax7), activated myogenic differentiation factor D (MyoD), and myonuclei. We also assessed Pax7, MyoD, myogenin and follistatin by western blotting. We also histochemically analyzed muscle cross sectional area (CSA). **Result:** TA, EDL and PLA weights per body weights in the SP and EX groups were significantly higher than those in the CON (P<0.01). SOL weights per body weights, however, were significantly higher only in the SP group than in the CON (P<0.01). Protein expressions of Pax7, MyoD, and myogenin did not change. The total number of Pax7, MyoD, and myonucleus did not change. The slow fiber and fast fiber CSA did not change. Follistatin level in SP were significantly higher than those in the CON (P<0.05) by western blotting. **Discussion:** In this study, the number of satellite cells did not increase in the EX and SP groups, probably due to the low intensity of voluntary running exercise. Actually in the previous study, the number of satellite cells was increased by high intensity (85-95% Vo2 peak) endurance training (Charifi et al., 2003). However, in the SP group, rats showed significant increase or tendency of increase in muscle weights per body weights, as compared to CON or EX, respectively. The result suggests that voluntary running exercise with new supplement might increase muscle weights through the increased expression of follistatin.

## IS SALIVARY TESTOSTERONE A VALID MARKER OF MATURATION IN ELITE YOUTH MALE ATHLETES?

Nikolovski, Z., Elgingo, M.I., Voss, S.C., Douglas, A.R., Cable, N.T., Johnson, A.

*ASPIRE Academy*

**Introduction** The assessment of biological maturity in elite youth athletes is important to establish, since there is large variability in somatic and biological growth between individuals of the same chronological age (CA), and quantification of maturational status is needed in order to apply correct training loads and reduce the risk of injury. At present markers of maturity include peak height velocity (PHV), skeletal age (X-ray) and assessment of secondary sexual characteristics (SSC). X-ray is costly and invasive, whilst SSC is not tolerated by adolescent boys, in Arabic cultures. This study investigated whether salivary testosterone can be used as a reliable and non-invasive assessment of biological age by correlating with established markers of maturation. **Methods** 140 elite male youth athletes (age 12 to 18) were consented and assessed as a part of their annual medical screening. After an overnight fast, anthropometric measures were taken for the determination of peak height velocity (Mirwald et al., (2002) and X-ray images were taken of the left and right wrist for the determination of skeletal age according to the methods of (Fels and TW3) as described in Malina (2001). A saliva sample was collected using oral swabs and testosterone determined with ELISA kit from Salimetrics LLC (State College, PA, USA). Differences in testosterone concentrations were examined using IBM SPSS 20.0 (Armonk, NY, USA). **Results** Mean peak height velocity for all subjects was 14.1 + 2.0 years CA. Mean skeletal age was greater than CA for both methods (14.26 + 3.7 years TW3 vs. 15.23 + 2.3 Fels). When mean salivary testosterone concentrations are expressed as relative to PHV (i.e. 1 year or more before PHV, around PHV, or more than 1 year after PHV) mean concentration (SD) of testosterone were 51.4 (17) pg/ml, 109.1 (46) pg/ml and 179.2 (62) pg/ml, respectively. These concentrations are significantly different (p<0.001). Furthermore, 60% of the variance in testosterone concentration is explained by CA (R<sup>2</sup> = 0.6026). **Discussion** These data suggest that there are differences in the quantification of maturation using PHV and skeletal age. The addition of salivary testosterone concentration allows the differentiation of maturation, since there are marked increases from before to after PHV. Such a non-invasive test may therefore be helpful in application of the correct training loads in these populations. **References:** Mirwald, R.L, et al. (2002), *Med Sci Sports Exerc.* 34(4): 689-94. Malina, R.M (2011) *Sports Med.* 41 (11); 925-947

## OXIDATIVE STRESS STATUS AFTER THE SOCCER GAME IN ELITE MALE PLAYERS

Djordjevic, B.1, Baralic, I.2, Andjelkovic, M.2, Dikic, N.2, Antic, T.2, Vukasinovic-Vesic, M.2, Kotur-Stevuljivic, J.1, Radojevic-Skodric, S.3

*1: Faculty of Pharmacy, University of Belgrade, 2: Sports Medicine Association of Serbia, 3: School of Medicine, University of Belgrade*

**Introduction** Exercise is a prone condition to enhanced oxidative stress and damage and the specific activity pattern of a soccer game may favor additional pro-oxidant redox alterations. The present investigation attempted to determine the responses of muscle damage markers, circulating levels of oxidative stress and antioxidant status markers after training game. **Methods** Forty soccer players, members of the young selection of soccer club "Partizan", were assigned to 4 different teams that competed against each other in 2 simultaneous training games. Plasma creatine kinase (CK), lactate dehydrogenase (LDH), malondialdehyde (MDA), advanced oxidation protein products (AOPP), superoxide anion (O<sub>2</sub><sup>•-</sup>), superoxide-dismutase (SOD), total antioxidant status (TAS), sulfhydryl (-SH) groups, total oxidant status (TOS) and redox balance were measured before and immediately after the training game. In addition, soccer players recorded their dietary intake during 3 consecutive days in order to estimate average energy and nutritional intake. **Results** A training game significantly elevated CK and LDH levels (p<0.05). The levels of oxidative stress markers (MDA, AOPP and O<sub>2</sub><sup>•-</sup>) remained unchanged. Soccer game induced an acute decrease (p< 0.05) in SOD and TAS. In parallel, the SH groups content and redox balance remained unchanged. TOS significantly decreased after the game (p<0.05). Multiple regression analysis revealed that O<sub>2</sub><sup>•-</sup>, TOS and AOPP are significant predictors of TAS both before and after the game. Also, SOD and SH were significantly correlated to O<sub>2</sub><sup>•-</sup> and TOS. Average dietary vitamin A and E intakes were below the recommended dietary allowances (RDA): 68% of the RDA for vitamin A and 42% of the RDA for vitamin E. **Discussion** The present data suggest that soccer training game increases the levels of muscle damage markers. Oxidative stress status

did not change immediately after the game, probably due to recruitment of endogenous antioxidants. Established connection between TAS and oxidative stress markers might indicate that plasma antioxidants are instantly utilized to eliminate free radicals. Our findings suggest that plasma antioxidant response following training game is modified by inadequate intake of antioxidants. Ascensão A, Rebelo A, Oliveira E, Marques F, Pereira L, Magalhães J. (2008). *Clin Biochem*, 41, 841-851.

### **SALIVARY SEX HORMONES RESPONSE IN RUGBY PLAYERS AFTER WHOLE BODY CRYOSTIMULATION**

Grasso, D.1, Lanteri, P.1, Di Bernardo, C.1, Mauri, C.1, Porcelli, S.2, Colombini, A.1, Zani, V.3, Bonomi, F.G.3,4, Melegati, G.1, Banfi, G.1,5, Lombardi, G.1

*I.R.C.C.S. Istituto Ortopedico Galeazzi*

1:IRCCS Istituto Ortopedico Galeazzi (Milano, Italy), 2:CNR (Segrate, Italy), 3:Polisambulatorio Bongi (Orzinuovi, Italy), 4:Humanitas Gavazzeni (Bergamo, Italy), 5:University of Milano (Milano, Italy) Introduction Saliva represents a low stress, noninvasive collection methodology that allows steroid hormone monitoring in athletes, reflecting type, duration and intensity of exercise (Papacosta et al., 2011; Crewther et al., 2013; Gatti and De Palo, 2011). Whole body cryotherapy (WBC) consists of short whole-body exposures to extremely cold air (-110° to -140°C): initially used to treat inflammatory diseases, is currently acquiring increasing popularity in sports medicine. Cryostimulation practice is widely accepted as an effective treatment to accelerate muscle recovery in rugby players (Banfi et al., 2010). Aim of this study was to investigate the changes in salivary levels of steroid hormones after 2 and 14 WBC sessions in rugby players, in order to investigate the effects of the treatment on the salivary hormonal status of these athletes. Methods Twenty five professional rugby players, belonging to the Italian National Team, underwent to a 7 days-long cryotherapy protocol consisting of 2 daily sessions. Saliva was sampled: the morning prior to the start of the WBC, after end of the second WBC, in the evening, and the morning of the day after the last WBC session. Saliva was analyzed for cortisol, DHEA, testosterone and estradiol using a competitive enzyme-linked immunosorbent assay. Results Cortisol and estradiol showed a reduction already after the 2 WBC sessions of the first day, often exceeding critical (CD) difference and circadian variations. After 14 consecutive WBC sessions cortisol, DHEA and estradiol levels decreased, testosterone increased as well as the testosterone to cortisol ratio. Even in this case, the majority of subjects showed variations exceeding the CD. Discussion Rugby training is known to induce cortisol increase and testosterone decrease (Elloumi et al., 2003), while no data about DHEA and estradiol exist. In the present study, WBC had acute effects on salivary steroid hormones profile already after a single twice-daily session; but the most significant variations were observed, in all the evaluated hormones, after one-week consecutive twice-daily sessions. Saliva represents a useful tool to monitor athlete's hormonal asset even concomitantly with WBC treatment. References Papacosta E, Nassis GP (2011). *J Sci Med Sport*, 14, 424-434 Crewther BT, Sanctuary CE, Kilduff LP, et al. (2013). *J Strength Cond Res*, 27, 471-6 Gatti R, De Palo EF (2011). *Scand J Med Sci Sports*, 21, 157-69. Banfi G, Lombardi G, Colombini A, Melegati G (2010). *Sports Med*, 40, 509-17 Elloumi M, Maso F, Michaux O, et al. (2003). *Eur J Appl Physiol*, 90, 23-8

### **THE EFFECTS OF IRON SUPPLEMENTATION ON COMPLETE BLOOD COUNT FOLLOWING AN ACUTE ECCENTRIC EXERCISE BOUT**

Deli, C.K., Paschalis, V., Georgakouli, K., Zalavras, A., Fatouros, I.G., Koutedakis, Y., Jamurtas, A.Z.

*University of Thessaly*

Purpose: the purpose of this study was to investigate the effect of iron supplementation on complete blood count after eccentric exercise in adults compared to children. Methodology: sixteen male adults (18 – 50 years old) and eleven boys (10 – 12 years old) participated in the study, which was conducted in two cycles in a double blind mode. At each cycle the participants were consumed either the iron supplement (37mg of elemental iron per day for three weeks before and one week after the eccentric exercise) or the placebo (flour) in a random order. After a 4 weeks period of wash out following the first cycle, the participants repeated the procedure at the second cycle. Results: Significant interaction between time (baseline, 24 and 72 hours post exercise) and condition (iron supplement or placebo), as well as main effect of age came up for Hb. Before exercise ( $M = 14.068$ ,  $SE = 0.28$ ), Hb was greater than 72 hours after exercise ( $M = 13.513$ ,  $SE = 0.23$ ), but only for the iron group, and adults ( $M = 14.687$ ,  $SE = 0.2$ ) had greater hemoglobin than children ( $M = 12.873$ ,  $SE = 0.237$ ) in all time points regardless of condition. Significant time-by-age interaction came up for Hct, and adults had greater levels than children at baseline, before and 72 hours after exercise. Main effect of time came up for red blood cells (RBC), with values at 72 hours being lower compared to baseline, while main effect of age existed on white blood cells (WBC) with adults showing greater values compared to children. Conclusion: Four weeks of iron supplementation affects in the same way most of the hematological parameters after eccentric exercise in both adults and children, without any significant changes except for Hb, Hct, RBC and WBC. Additionally, iron supplementation can lead to lower levels of Hb after eccentric exercise in both adults and children, and this needs special attention.

**15:00 - 16:00**

## **Mini-Orals**

### **PP-PM12 Health and Fitness [HF] 6**

#### **PAST SPORTS ACTIVITIES DURING GROWTH INDUCES BONE MINERAL CONTENTS AND CHANGES IN BONE GEOMETRY IN YOUNG MEN AND WOMEN**

Kato, T., Yamashita, T., Matumoto, M., Takami, K., Honda, A., Umemura, Y.

*Suzuka University of Medical Science*

Introduction High-impact jump training not only increases bone mineral content (BMC), but also improves bone structure and strength in early-pubertal girls. Dual energy X-ray absorptiometry (DXA) measured BMC, areal bone mineral density (aBMD) and MRI determined bone geometric characteristics of the mid-femur in young men and women were analysed, and the effect of past sporting activity on each was determined. We also looked at whether the effect of estrogen function on bone geometry was affected by childhood exercise. Methods Sixty-three premenopausal young women ( $21.4 \pm 0.6$  years) and 79 young men ( $21.2 \pm 0.8$  years) were analysed. The average

age of menarche of the female subjects was  $12.7 \pm 1.5$  years old. Osteogenic index (OI) of previous sporting activity was calculated as follows; (times/week)  $\times$  years  $\times$  strain score of previous sports activity (Nilsson et al 2009). Subjects were classified into three groups, the first two based on age of commencement of sport participation, elementary school group (6-12 years), junior high school to college group (13-22 years) and a third group for those who only participated in low-impact non-weight-bearing sports such as swimming or had no sport participation (no-sport). Main outcome measures DXA was used to measure BMC and aBMD in the lumbar spine and proximal femur. MRI was used to determine bone geometric characteristics in the mid-femur such as femoral mid-diaphyseal cross-sectional area (CSA), periosteal perimeter, and maximum and minimum second moment of area. Results In women, OI was significantly correlated with all the MRI determined bone geometric parameters and DXA measured BMC and aBMD at the femoral neck. However, there was no significant correlation of OI with BMC and aBMD at the lumbar spine and total proximal femur. In men, OI was significantly correlated with all DXA and MRI determined bone parameters, except for the perimeter. In women, analysis of covariance revealed that the elementary school group showed significantly greater femoral mid-diaphyseal perimeter (vs no sport group), bone CSA (vs junior and no-sport) and max and min second moment of area (vs no-sport). However, no significant difference was found in muscle CSA among 3 groups of women. Conclusions During growth, past sporting activity has different effects on bone strength parameters under the effects of sexual dimorphism. Estrogen inhibits periosteal expansion, thus the effects of sporting activity before and in early puberty appears to have a positive effect on bone shape and geometry. References Nilsson M, Ohlsson C, Mellstrom D, Lorentzon M. (2009) *J Bone Miner Res*, 24:125-133.

### **LIFESTYLE MODIFICATION OF EXERCISE AND DIET IMPROVES SERUM TESTOSTERONE LEVEL AND AORTIC STIFFNESS IN OVERWEIGHT AND OBESE MEN**

Hiroshi, K., Miyaki, A., Higashino, R., Akazawa, N., Choi, Y., Ra, S.G., Matsubara, T., Tanahashi, K., Eto, M., Tanaka, K., Ajisaka, R., Maeda, S.

*University of Tsukuba*

Background: Serum Testosterone level is associated with arterial stiffness. In obese individuals, arterial stiffness is high and serum testosterone level is low as compared with age-matched normal weight counterparts. Several studies have shown that lifestyle modification (aerobic exercise or dietary modification) decreases arterial stiffness in obese individuals. However, it is unclear about the effect of such lifestyle modification on serum testosterone level in obese men. The purpose of this study was to examine whether a lifestyle modification of exercise and diet increases serum testosterone level in overweight and obese men, and if so, whether the increase in serum testosterone level correlates with the decrease in arterial stiffness. Methods: Eleven overweight and obese men (age:  $53 \pm 3$  yrs, BMI:  $30 \pm 1$  kg/m<sup>2</sup>) completed a 12-week lifestyle modification program (well-balanced 1680 kcal/day diet and brisk walking for 40-60 min/day, 3 days/week). Before and after the program, we measured aortic pulse-wave velocity (PWV), an index of aortic stiffness, and serum total testosterone level in the participants. To analyze the statistical differences between before and after the program, the students' t test for paired values was used. Relationship between the change in aortic PWV and that in serum testosterone level was analyzed using Pearson's correlation. Results: After the 12-week lifestyle modification program, a significant weight loss in the overweight and obese men ( $-11.9 \pm 1.3$  kg,  $P < 0.05$ ) was observed. After the program, aortic PWV decreased significantly and serum testosterone level increased significantly ( $P < 0.05$ ,  $P < 0.05$ , respectively). Moreover, there was a significant relationship between the change in aortic PWV and that in serum testosterone level ( $r = -0.67$ ,  $P < 0.05$ ). Conclusions: After the 12-week lifestyle modification, aortic PWV decreased significantly and serum testosterone level increased significantly in the overweight and obese men. We also demonstrated that there was a negative relationship between the change in aortic PWV and the change in serum testosterone level. These findings suggest that lifestyle modification of exercise and diet increases serum testosterone level and the increase in serum testosterone level may contribute to a decrease in arterial stiffness in overweight and obese men.

### **MINIMALLY INVASIVE MICROPERFUSION NEEDLE FOR CONTINUOUS LACTATE MONITORING DURING EXERCISE**

Tsuruoka, N., Ishii, K., Matsunaga, T., Nagatomi, R., Haga, Y.

*Tohoku University*

Introduction Lactate concentration during exercise is usually measured by hand-held blood lactate analysers (Tanner RK et al., 2010). However, it is difficult to collect blood continuously in the field exercise. Recently, we developed microperfusion needle and collected subepidermal tissue lactate (Tsuruoka et al., 2012). Lactate is collected and carried out of the body by perfusion fluid. The diameter of the needle is 250  $\mu$ m and the length of inserting area is about 1 mm. A thin needle around 250  $\mu$ m in diameter can be inserted in subepidermal tissue without pain. The purpose of this study was to confirm whether there is a correlation between collected lactate concentration and blood one during exercise. Methods Five male C57BL/6 mice were used in this experiment. After the mice were anesthetized with Sevoflurane, the needle was inserted into the skin of mice's back and fixed. Each mouse was run in a separate lane on the treadmill at 10 m/min initially. Running speed was gradually increased 5 m for every 5 min until the target speed and then fixed at target speed. Target speeds were 15, 20, and 25 m/min. Dialysate (saline) perfusion was started before running to prevent a plugging or a clotting. Two minutes after fixing a target running speed, perfused saline was collected into the syringe for 10 minutes. After the exercise, blood samples were collected and measured lactate concentration using simplified blood lactate test meter. Lactate concentration of perfused solutions was measured using fluorescent stain kit (L-Lactate Assay Kit, Cayman Chemical Company, USA). Person's correlation test was performed between lactate concentration of perfused solution and blood. Results Lactate concentration of perfused solution was significantly correlated with lactate concentration of blood ( $P < 0.01$ ). The recovery rate of lactate was about 0.57 %. There was no damage in fabricated needles after used for animal experiment. There were no bleed and infection on mice's back after the experiment. Discussion This result shows that bloodless lactate measurement is possible using this microperfusion needle. In addition, since this device use microperfusion, continuous monitoring of lactate is possible in combination with on-line sensor. There was no damage in microperfusion needle and mouse's back. This shows our device can be used in safety even under heavy exercise. This needle has a possibility of measuring regional lactate concentration since this needle is very thin and can collect lactate from subepidermal tissue around needle. References Tanner RK, Fuller KL, Ross ML. (2010). *Eur J Appl Physiol.*, 551-559. Tsuruoka N, Ishii K, Matsunaga T, Nagatomi R, Haga Y. (2012). *Proc. MEMS*, 941-944.

## EFFECTS OF YOGA BREATHING ON HEART RATE AND THE CARDIAC PARASYMPATHETIC NERVE SYSTEM

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**Introduction:** Yoga breathing is comprised of diaphragmatic breathing and thoracic breathing. The purpose of this study was to compare the heart rate and parasympathetic nerve system on Yoga breathing with a spontaneous breathing trial. **Methods:** Twelve healthy Japanese males participated in this study (age  $26 \pm 1$  year, height  $175.0 \pm 4.9$  cm, weight  $70.5 \pm 0.4$  kg). All subjects were fully informed about the details of the study and provided written informed consent. The measurement conditions were the spontaneous breathing condition and the yoga breathing condition. Before breath control, all subjects kept resting in a supine posture for 10-min (baseline). Then, each subject did controlled breathing (spontaneous breathing or yoga breathing) while sitting for 10-min. After breath control, all subjects continued to rest in a supine posture for 25-min as recovery period. The breathing during baseline and recovery period was unified into spontaneous breathing. Heart rate and the cardiac parasympathetic nerve system were measured from baseline to the end of the recovery period. In order to except the influence of breathing-rate change at the time of baseline and recovery period, breathing rate was adjusted so that it became one time to every 4 seconds (2 second inhalation and 2 second expiration). The variation of HF to baseline was calculated. **Results and discussion:** The heart rate of both conditions in recovery period was significantly lower than that of controlled breathing ( $P < 0.05$ ). The heart rate in yoga breathing ( $70 \pm 11$  bpm) was significantly higher than baseline ( $62 \pm 7$  bpm) ( $P < 0.05$ ). The cardiac parasympathetic nervous system (HF) in yoga breathing was significantly lower than baseline ( $P < 0.05$ ). The cardiac parasympathetic nervous system (HF) during yoga breathing in recovery period ( $113.5 \pm 30.7$ ) was significantly higher than immediately after the end of controlled breathing ( $99.5 \pm 9.9$ ) ( $P < 0.05$ ). Yoga breathing needs assistance of the abdominal muscles, intercostal muscle and diaphragm activity. It is considered that heart rate was raised by yoga breathing, and the cardiac parasympathetic nervous system (HF) was suppressed by yoga breathing. However, it is considered that the yoga breathing exasperated the cardiac parasympathetic nervous system (HF) in the recovery period.

## ARE OPTIMISTIC PERCEPTIONS OF PERSONAL PHYSICAL ACTIVITY BEHAVIOUR A PROBLEM IN PHYSICAL ACTIVITY PROMOTION? RESULTS FROM A NATIONAL SURVEY.

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The 2007 and 2008 wave of the Health Survey for England (HSE) included questions surrounding perceptions of personal physical activity (PA) behaviour (i.e. do I feel that my PA level is good?). Such questions have been used in previous research to assess perceptions of personal PA behaviour and awareness of PA (Vandelanotte et al, 2011). This research suggests that individuals who do not meet PA guidelines, need to perceive themselves as inactive, and be aware that their behaviour is inadequate, before they will be motivated to change (van Sluijs et al, 2007). Method Data from the 2007 and 2008 waves of the HSE were examined. Mann-Whitney U-tests were used to investigate demographic differences between the two waves of the survey, and between self-reported PA and awareness of PA in HSE 2007. Correlational analysis was conducted to examine whether an individual's perception of engaging in sufficient PA is related to their intention to engage in more PA. Results The samples answering: 'Do you think you do enough PA to keep fit?' ( $N=4,471$ ); 'How active do you think you are relative to others?' ( $N=2,510$ ); and those with self-reported PA ( $N=3,666$ ) had homogenous demographic distributions (e.g. ethnic group [ $p=.2$ ], geographic location [ $p=.21$ ], socio-economic group [ $p=.81$ ], household income [ $p=.97$ ] and social class [ $p=.72$ ]). There was no significant difference in household income [ $p=.29$ ], employment status [ $p=.1$ ], marital status [ $p=.63$ ], BMI [ $p=.29$ ] and age [ $p=.9$ ] between HSE 2007 ( $N=14,385$ ) and HSE 2008 ( $N=22,623$ ). Perceptions of personal PA were optimistic relative to actual measurements of PA. 35% believed they did enough PA to achieve fitness and 87.3% stated they were very or quite active relative to others. In contrast, self-reported PA suggested that only 29% achieved PA guidelines (150 minutes/week moderate-vigorous PA). The perception that one already does enough PA for fitness was negatively correlated with the intention to do more PA ( $r=-.38$ ;  $p<.001$ ). Correlations remained significant after controlling for demographic factors. The data suggests a discrepancy between personal perceptions of PA behaviour and actual PA behaviour. In addition, when accelerometers were introduced to HSE 2008, only ~5% met PA guidelines (NHS, 2009). Although PA levels are low, these individuals did not judge themselves as having inadequate PA levels. This is likely to be motivationally maladaptive as such misperceptions prevent intentions to improve behaviour from being formed. Appropriate educational interventions are needed. References NHS: The Information Centre. Health Survey for England 2008, 2009. Van Sluijs et al. A cross-sectional study of awareness of physical activity: Associations with personal, behavioral and psychosocial factors. *IJBNPA*, 2007; 4, 53-61 Vandelanotte et al. Identifying population subgroups at risk for underestimating weight health risks and overestimating physical activity health benefits. *J Health Psych*, 2011; 16, 760-769.

## ASSESSING CARDIORESPIRATORY FITNESS WITHOUT PERFORMING EXERCISE TESTING IN KOREAN ADULT MEN.

Jeon, Y.J.1, Im, J.H.1, Lee, B.K.2, Kim, C.H.3, Kim, B.W.3

1) KAIST(Daejeon, S Korea) 2) SangMyung University(Cheonan, S Korea) 3) Daejeon University(Daejeon, S Korea)

**Introduction** The purpose of this study is to assess cardiorespiratory fitness with non-exercise variables such as body index and resting heart rate. The prediction of  $VO_{2max}$  using non-exercise data is necessary when measurement equipment cannot be prepared. In addition, safe and low-cost measurement is possible without active motivation by subjects, complex test devices, or a skilled examiner. **Method** The subjects are consisted of 533 male aging from 17 to 65 and we separated them into two groups randomly; 385 for a sample, 148 for a cross-validation group. They went through maximal exercise testing with Bruce protocol, and we measured the metabolic responses in the end of the first(3 minute) and second stage(6 minute). To predict  $VO_{2max}$ , we applied multiple regression analysis to the sample with stepwise method. **Results** Model 1's variables are weight, height, resting heart rate, age( $R=0.46$ ,  $SEE=6.07$ ,  $SEE\%=15.21$ ,  $p<.01$ ), and the equation is  $VO_{2max}=2.401-0.311(\text{Weight})+0.254(\text{Height})-0.130(\text{HRrest})-0.095(\text{Age})$ . Model 2's variables are weight, height, resting heart rate( $R=0.43$ ,  $SEE=6.16$ ,  $SEE\%=15.44$ ,  $p<.01$ ), and the equation is  $VO_{2max}=10.173-0.357(\text{Weight})+0.374(\text{Height})-0.111(\text{HRrest})$ . Model 3's variables are weight, height( $R=0.39$ ,  $SEE=6.16$ ,  $SEE\%=15.44$ ,  $p<.01$ ), and the equation is  $VO_{2max}=9.981-0.327(\text{Weight})+0.305(\text{Height})$ . Model 4's variables are weight( $R=0.31$ ,  $SEE=6.48$ ,  $SEE\%=16.24$ ,  $p<.01$ ), and the equation is  $VO_{2max}=56.334-0.240(\text{Weight})$ . The result showed that moderate  $R^2$  and low SEE value and all the prediction variables did not show multi-collinearity. When we conducted cross-validation of these models with 385 men, measured  $VO_{2max}$  and estimated  $VO_{2max}$  had statistical significance with correlation  $r=0.34 \sim 0.52$ ,  $P<.01$ . **Discussion & Conclusion** The prediction equations developed in this study were founded to predict  $VO_{2max}$  of health Korean men in a very accurate manner( $R=0.31 \sim 0.46$ ,  $SEE=6.07 \sim 6.48$ ,  $SEE\%=15.21 \sim 16.24$ ). The

models suggested in this study used the prediction variables that can be measured easily and showed the accuracy that is similar to or higher than those of other studies. Bland-Altman plotting confirmed that the estimation models are reliable and have low systematic error. Although all models are functional with validity considering their simplicity and utility, Model 1 has the best accuracy. Reference Nes, B. M., Janszky, I., Vatten, L. J., Nilsen, T. I. L., Aspenes, S. T., & Wisloff, U.(2011). Estimating VO<sub>2</sub>peak from a nonexercise prediction model: The HUNT study, Norway. *Med. Sci. Sports Exerc.*, 43(11). 2024~2030. Sanada, K, Midorikawa, T., Yasuda, T., Kearns, C. F., & Abe, T.(2007). Development of nonexercise prediction models of maximal oxygen uptake in healthy Japanese young men. *European Journal of Applied Physiology*, 99(2). 143-148. Jackson AS, Blair SN, Mahar MT, Wier LT, Ross RM, and Stuteville JE(1990). 'Prediction of functional aerobic capacity without exercise testing'. *Med Sci Sports Exerc*, 22(6). 863-870.

### PREDICTION OF MAXIMAL OXYGEN UPTAKE USING METABOLICAL VARIABLES IN SUB-MAXIMAL EXERCISE.

Im, J.H.1, Jeon, Y.J.1, Lee, B.K.2, Kim, C.H.3, Kim, B.W.3

1) KAIST(Daejeon, S Korea) 2) SangMyung University(Cheonan, S Korea) 3) DaeJeon University(Daejeon, S Korea)

**Introduction** The purpose of this study is to develop and validate statistical models for predicting VO<sub>2</sub>max using body index and sub-maximal metabolic variables. The indirect prediction of VO<sub>2</sub>max using together body index, respiratory variables, and heart rate during sub-maximal exercise identified at the time of maximal exercise stress testing offers many advantages un many aspects such as accuracy and on-site utilization. **Method** The subjects are consisted of 714 people aging from 18 to 63, and we separated them into two groups randomly; prediction group(n=474) and cross-validation group(n=220). They went through maximal exercise testing with Bruce protocol, and we measured the metabolic responses in the end of the first(3 minute) and second stage(6 minute). To predict VO<sub>2</sub>max, we applied multiple regression analysis to the prediction group with stepwise method. **Results** Prediction variables for model 1~4 are gender, weight, age, height, time to reach 150 HR, 6 minute HR, 6 minute VO<sub>2</sub>, and VCO<sub>2</sub>. The result showed that R is 0.73~0.76(p<.01), R<sup>2</sup> is 0.54~0.58, SEE=4.75~4.96, and SEE% is 12.87%~13.51% with high R<sup>2</sup> and low SEE value. Based on cross-validation results, the measured VO<sub>2</sub>max and estimated VO<sub>2</sub>max had large correlation with statistical significance(r=0.524~0.783, P<.01). Model 1's equation is VO<sub>2</sub>max(ml/kg/min)= 56.638-5.863(Gender)-0.261(Weight)-0.079(Age)+0.099(Height)-0.122(6minHR)+0.013(6minVO<sub>2</sub>)-0.008(6minVCO<sub>2</sub>). Model 2's equation is VO<sub>2</sub>max(ml/kg/min)=74.020-6.711(Gender)-0.235(Weight)-0.097(Age)-0.125(6minHR)+0.013(6minVO<sub>2</sub>)-0.008(6minVCO<sub>2</sub>). **Discussion & Conclusion** This study developed prediction equations, targeting a relatively large number of healthy Korean males and females. According to a survey of previous studies by Malek et(2004), Cooper and Storer(2001) developed a prediction equation, targeting a prediction group of 522 subjects(male 328, female 194). Furthermore, the models having low prediction error were identified(%TE=4.67~6.36). Bland-Altman plotting confirmed that the estimation models are reliable and have low systematic error. Therefore, predicting VO<sub>2</sub>max using body index and submaximal metabolic variables has high accuracy and will be useful in fields. Reference Malek, M. H., Housh, T. J., Berger, D. E., Coburn, J. W., & Beck, T. W(2004). A new nonexercise-based VO<sub>2</sub>max equation for aerobically trained females. *Med. Sci. Sports Exerc.*, 36(10). 1804~1810. Sanada, K, Midorikawa, T., Yasuda, T., Kearns, C. F., & Abe, T.(2007). Development of nonexercise prediction models of maximal oxygen uptake in healthy Japanese young men. *European Journal of Applied Physiology*, 99(2). 143-148. Jackson AS, Blair SN, Mahar MT, Wier LT, Ross RM, and Stuteville JE(1990). 'Prediction of functional aerobic capacity without exercise testing'. *Med Sci Sports Exerc*, 22(6). 863-870.

### WHEELCHAIR DANCE "SKILL" AND EXERCISE INTENSITY DURING DANCE IN BEDRIDDEN INDIVIDUALS WITH SEVERE CEREBRAL PALSY

Terada, K.1, Satonaka, A.2,3, Terada, Y.4, Suzuki, N.2,3

1: Nagoya College (Toyoake), 2: Nagoya U. (Nagoya), 3: IDR (Kasugai), 4: NKU- JC (Inuyama)

**Introduction** It is extremely difficult for the bedridden individuals to participate in physical activity. We had wheelchair dance custom-made for the bedridden individuals with severe cerebral palsy in this study. The aim of this study was to examine the relationship between wheelchair dance "skill" and the exercise intensity during the waltz and the jive performance. **Methods** We recruited 6 individuals with severe athetospastic cerebral palsy (50.7±8.9 years) from a welfare facility. Their intelligence was not impaired. They were instructed to dance with an instructor as a standing partner. As no participants could manipulate their wheelchair by themselves and deformities of limbs and trunks differed among them, we had the waltz and the jive custom-made for each participant. We measured oxygen uptake (VO<sub>2</sub>) and heart rate during the waltz and the jive. Each participant's skill of the waltz and the jive was also evaluated. The evaluation consisted of 10 items, with each rated on a 3 step scale as either 0 (can't do it at all), 1 (can do it a little bit), or 2 (can do it without problems). A perfect score was 20 points. **Results** (A) 2 participants experienced greater VO<sub>2</sub> and heart rate increase during the waltz session than during the jive, (B) 2 participants experienced roughly equivalent increases in VO<sub>2</sub> and a slight heart rate increase during both types of sessions, and (C) 2 participants showed very little change in either VO<sub>2</sub> or heart rate. The (A) group participants had especially high scores in the waltz performance evaluation, 19 points and 18 points, whereas the (B) and (C) group participants had low scores in both the waltz and the jive (an average 12 of and 8 points, respectively). **Discussion** The jive, a dance performed to more of an up tempo rhythm, is considered one of the more challenging within the difficult Latin style. In the participants with a significantly higher performance score on the waltz than the jive, linking arms with their standing partners enabled greater control of the related exercise, and preservation of a stable posture. Accordingly, even for these individuals with severe cerebral palsy, if dancing posture can be maintained, exercise intensity improves, and patients' fitness levels can be expected to as well (Terada, et al., 2011). Exercise programs can therefore be prescribed by using severe cerebral palsy patients' ability to hold the posture necessary for the waltz as one standard, and then determining whether or not dances which make maximal use of these postures can be performed. **References** Terada K, Satonaka A, Terada Y, Suzuki N. (2011). VISTA 2011 Booklet, International Paralympics Committee, 103.

### PSYCHO-PHYSIOLOGICAL RESPONSES TO A STANDARDIZED EXERCISE PROGRAM INDOORS VS. NATURAL ENVIRONMENT: PRELIMINARY RESULTS FROM A PILOT STUDY. PART III: CARDIOVASCULAR MODULATION.

Mikkila, S.1, Calogiuri, G.2, Patil, G.2, Weydahl, A.1

1: Finnmark University College, Alta, Norway, 2: Norwegian University of Life Science, Aas, Norway

**Introduction** It has been suggested that exercising in contact with nature may provide health benefits beyond exercising elsewhere, but evidence of the effects of 'green exercise' on physical health is still scarce (Thompson Coon et al., 2011). Recent studies indicate possible effects of viewing images of nature on heart rate variability (HRV) (Gladwell et al., 2012). HRV reflects the status in the autonomic nervous system and is related to cardiovascular health. As a pilot study, we have investigated HRV and blood pressure (BP) after a standardized

exercise program in two different environmental settings: indoors (gym hall) vs. outdoors in a natural setting. Methods Healthy adults, 7 males and 7 females (age 48.5 $\pm$ 7.3 yr; BMI 25.4 $\pm$ 2.45; VO<sub>2</sub>max 39.8 $\pm$ 7.7 ml/min/kg), undertook two exercise sessions within 1-week, each consisting in 25-min biking (60.1 $\pm$ 7.9 %HRR) followed by 20-min circuit strength training with rubber bands (49.7 $\pm$ 9.6 %HRR). The subjects exercised at 15:30, randomized to the indoor or the outdoor group. After both sessions, beat-to-beat intervals were recorded overnight with HR-monitor belt and BP was measured the following morning. A 5-minute sequence during the first slow wave sleep (Brandenberger et al. 2005) was isolated for the HRV frequency analyses. Outputs were analyzed using a linear mixed model, with individuals' value collected in baseline conditions (no exercise for 48-hours) set as a covariate. Results Diastolic BP was significantly lower ( $p=0.018$ ) the morning following the outdoor exercise sessions. A tendency to lower values was observed also for the systolic BP, although significance was not achieved. A poor quality of the overnight beat-to-beat monitoring did not allow including all the subjects in the analysis: only 8 subjects had a complete set of monitoring (baseline and post exercise). No significant differences across groups were found in HRV parameters. Discussion The data suggest that green exercise may positively impact the cardiovascular modulation, with possible health benefits in the long term, such as lower BP values. Though, studies on larger samples and longer interventions are recommended. References Gladwell, V. F., Brown, D. K., Barton, J. L., Tarvainen, M. P., Kuoppa, P., Pretty, J., et al. (2012). *Eur j appl physiol*, 112(9), 3379-3386. Thompson Coon, J., Boddy, K., Stein, K., Whear, R., Barton, J., & Depledge, M. H. (2011). *Environ sci technol*, 45(5), 1761-1772. Brandenberger, G.; Buchheit, M.; Ehrhart, J.; Simon, C.; & Piquard, F. (2005) *Autonomic Neuroscience: Basic and Clinical*, 121: 81-86.

### REGULAR MOIST SNUFF DIPPING DOES NOT AFFECT ENDURANCE EXERCISE PERFORMANCE.

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Physiological and medical effects of snuff have previously been obtained either in cross-sectional studies or after snuff administration to non-tobacco users, but the effects of snuff cessation (SC) after several years of daily use on individual level are unknown. 24 participants with >2 years of daily snuff-use were tested before and after >6 weeks SC (SCG), together with a control group (CO) of 11 snuff users who kept their normal habits. Resting heart rate (HR) was significantly lower in SCG after SC. Body mass in SCG group increased by 1.4  $\pm$  1.7 kg and blood pressure (BP) were reduced, but without significant differences between groups. Total cholesterol increased from 4.12  $\pm$  0.54 (95% CI 3.89–4.35) to 4.46  $\pm$  0.70 (95% CI 4.16–4.75) mM/L in SCG, due to increased LDL, and this change was significantly different from CO. Resting values of HDL, C-reactive protein, and free fatty acids (FFA) remained unchanged in both groups. During a four-stage incremental (from 50 to 80% of VO<sub>2</sub>max) and a prolonged (60 min at 50% of VO<sub>2</sub>max) cycling test HR and BP were reduced in SCG, while oxygen uptake (VO<sub>2</sub>), respiratory exchange ratio, blood lactate (bLa) and blood glucose (bGlu) concentration, and rate of perceived exertion were unchanged. All measurements were unchanged in CO. During the prolonged exercise FFA was reduced but there was no significant difference between groups. During the maximal treadmill running test peak values of VO<sub>2</sub>, pulmonary ventilation (VE), time to exhaustion and bLa were unchanged in both groups. In conclusion, endurance exercise performance (VO<sub>2</sub>max and maximal endurance time) does not seem to be affected by prolonged snuff use, while effects on cardiovascular risk factors are contradictory.

### 10 YEAR CARDIOVASCULAR RISK ASSESSMENT IN UNIVERSITY STUDENTS

Uvacsek, M.1, Kneffel, Z.1, Tóth, M.1, Johnson, A.W.2, Vehrs, P.2

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Introduction Cardiovascular disease (CVD) causes more than half of all deaths in the European region, and according to WHO, 80% of premature heart disease and stroke is preventable. Healthy lifestyles, such as eating a healthy diet, regular physical activity, and not smoking are the most important preventive measures. Use of CVD risk assessment tools in a young population provides necessary information about risk for CVD which can be used to develop health promotion initiatives for youth. Methods The aim of the study was to compare, BMI, percent body fat (%BF), blood pressure, total cholesterol (TC) and high density lipoprotein cholesterol (HDL C), family history, activity behaviors, and the 10 year risk of having a heart attack between 166 students (21.62 $\pm$ 2.59 yrs.) from Utah, USA and 198 students (22.11 $\pm$ 2.51 yrs.) from Hungary. The body dimensions were measured according to ISAC methods (Norton et al.1996) the %BF was measured with Omron BF 306 and the 10 year CVD risk was calculated online (<http://hp2010.nhlbihin.net/atpiiii/calculator>). Results According to the results, 92% of the Hungarian students and 100% of the Utah students had an estimated 10 year risk of 1% or less, however 8% of the Hungarians had moderate risk. The high prevalence of low risk was due to the young age of subjects, healthy body composition and non smoking behavior. The Hungarians who had higher risk of heart attack had significantly higher waist hip ratio (WHR), TC, diastolic blood pressure (DBP) and were smokers compared to the Hungarians with low risk. Four percent of the Utah students and 3% of the Hungarian students had positive cardiovascular family history. Based on self-reported levels of physical activity, 19% of Utah women and 14% of Utah men were sedentary compared to 50% of Hungarian women and 46% of Hungarian men. Conclusion Age is one of the primary risk factors for CVD. Young men and women who participated in this study were, for the most part healthy and had a low risk for CVD. Nevertheless, our data shows that even young men and women who are sedentary, smoke, and have high WHR, TC, and DBP have increased risk of CVD. Although, symptoms of CVD may not be manifest until later in life, health promotion efforts should also be targeted to young men and women. References Norton K., Whittingham N., Carter L., Kerr D., Gore C., Merfell-Jones M. (1996): Measurement techniques in anthropometry. In: K Norton & T Olds (Eds.). *Anthropometrica*, Sydney UNSW Press, 25-75. World Health Organization (2011): Global status report on noncommunicable diseases 2010. Geneva, ([http://www.euro.who.int/en/what-we-do/health-topics/noncommunicable-diseases/cardiovascular-diseases/facts-and-figures](http://whqlibdoc.who.int/publications/2011/9789240686458_eng.pdf))

### NATIONAL PHYSICAL FITNESS TESTS DATA IN GREEK CHILDREN AGED 7 TO 10-Y-OLD AND THE IMPORTANCE OF THEIR INTER-RELATIONSHIP.

Tambalis, K., Papoutsakis, S., Sidossis, L.

*Harokopio University*

Introduction: Physical fitness of children is connected to a clustering of risk factors such as hypertension, hyperlipidemia, and obesity (Anderssen et al., 2007, Tambalis et al., 2011). In order to create preventive strategies, it is important to incorporate national physical fitness levels in children. Therefore, the purpose of the current study was to evaluate the distribution of age- and gender- specific physical fitness tests measurements in 7- to 10-year-old Greek children and to determine their relation to body mass index. Methods: Population-based data derived from a health survey in approximately 85% of all Greek schools. Anthropometric measurements (i.e., height and weight) and physical fitness tests (i.e., multi-stage shuttle run, vertical jump, standing long jump, small ball throw and 30-meter sprint)

from 141,169 children (boys: 51 %) were evaluated. The results of each fitness test performance with quartiles by age and sex were also calculated. Children were classified as having a score in the lower-poor (1st), middle-good (2nd-3rd), and upper-excellent (4th) quartiles of the distribution. Results: This study provides age- and gender-specific normative values for physical fitness tests in Greek children aged 7 to 10 years old, using the LMS statistical method. The correlation coefficients between BMI and performances in speed, explosive power and aerobic fitness tests were negative and significant (all  $P$ -values $<0.01$ ), for both genders. Among physical fitness tests, the strongest correlations were observed between anaerobic speed (30m sprint) and all the other tests, for both genders ( $r$  varied 0.42 - 0.46, all  $P$ 's $<0.001$ ). Moreover, approximately 3.5% of children pass the upper quartile in all tests. Discussion: The presented population-based data for physical fitness tests in almost all Greek children aged 7 to 10 years old revealed that only a small percentile of children pass the upper quartile in all tests. Moreover, there is a clear interaction between children's performance and BMI, also confirmed by other relative studies (Nevill et al., 2009). We provide evidence that the 30 meter sprint test is a physical test easy to use in all school contexts in order to measure physical performance and also an effortless way to monitor possible modifications towards the promotion of physical activity and healthy lifestyle. References Anderssen SA, Cooper AR, Riddoch C, Sardinha LB, Harro M, Brage S, Andersen LB. (2007). *Eur J Cardiovasc Prev Rehabil*, 14, 526-31. Tambalis KD, Panagiotakos DB, Psarra G, Sidossis LS. (2011). *Obes Facts*, 4(2), 165-74. Nevill A.M., Tsiotra G., Tsimeas P., Koutedakis Y. (2009). *Pediatric Exercise Science*, 21, 220-232.

15:00 - 16:00

## Mini-Orals

### PP-PM22 Molecular Biology [MB] 2

#### ALTERED GLYCOGEN METABOLISM IN ALPHA-ACTININ-3 DEFICIENT INDIVIDUALS

Norman, B., Esbjörnsson, A., Glenmark, B., Lindholm, M., Jansson, E.

*Laboratory Medicin*

Introduction Alpha-actinin-3 deficiency is caused by a stop codon polymorphism in the ACTN3 gene (R577X), and homozygotes for the mutation (XX-genotype) lack  $\alpha$ -actinin-3 in their type II fibers where the protein is normally expressed. The deficiency has been shown to be associated with athletic performance and athletes with XX-genotype have in numerous studies been shown to have inferior sprint and power performance compared to RR/RX. Recent findings in ACTN3 knock-out mice have shown that several enzymes in glycolytic metabolism are upregulated, glycogen phosphorylase (GPh) activity is markedly reduced and muscle glycogen content is increased in association with  $\alpha$ -actinin-3 deficiency (1). These findings suggest that alteration in glycogen metabolism may provide a mechanistic link for the observed differences between the ACTN3-genotypes. Methods In the present investigation glycogen content at rest, glycogen utilization during sprint exercise in separate pools of type I and type II fibers and effects of three months of endurance training on resting glycogen levels were measured in skeletal muscle biopsies from human subjects with different ACTN3 genotypes. Results At rest no differences in glycogen content between the three ACTN3 genotypes were found. However, the decrease in glycogen content during sprint exercise was significantly lower in XX than in RR/RX but only in the type II fibers. In addition the increase in resting glycogen levels with endurance training was significantly larger in XX. Discussion These results are in line with the findings in knock-out mice and endorse the proposal that  $\alpha$ -actinin-3 may be involved in the regulation of glycogen metabolism. References 1. Quinlan, K. G., J. T. Seto, et al. 2010 *Hum Mol Genet* 19(7): 1335-1346

#### COLOCALISATION OF PAXILLIN WITH FOCAL ADHESION KINASE IN HUMAN SKELETAL MUSCLE AND ITS ASSOCIATED MICROVASCULATURE

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Introduction Focal adhesion complexes regulate the conversion of mechanical stimuli into intracellular signalling. Within these sites are growth factor- and mechano-sensitive signalling proteins such as focal adhesion kinase (FAK) and paxillin, and their activation is associated with angiogenesis and skeletal muscle hypertrophy. We have previously visualised FAK in human skeletal muscle tissue (Wilson et al. 2012), but little is known about paxillin's localisation and spatial correlation with FAK. This study aimed to generate the first microscopic images of paxillin and its colocalisation with FAK to test the hypothesis that these two proteins closely interact in human skeletal muscle and its associated microvasculature, and to confirm previous observations in cell lines. Methods Percutaneous muscle biopsies were collected from the resting m. vastus lateralis of 7 healthy fasted males (mean $\pm$ SD; age 22 $\pm$ 4 y; BMI 23.6 $\pm$ 0.9 kg/m<sup>2</sup>). Cryosections (5 $\mu$ m) were stained with antibodies against paxillin and coincubated with anti-dystrophin to identify the sarcolemma, anti-myosin heavy chain type I for fibre-type differentiation, lectin UEA-I to identify the endothelium of capillaries and anti-alpha-smooth muscle actin to identify larger blood vessels. Colocalisation analysis was performed using confocal microscopy. Fluorescence intensity and colocalisation (Pearson's correlation coefficient) was determined using Image Pro 5.1. Results Paxillin was primarily localised to sarcolemmal regions in transversely orientated muscle fibres, forming a continuous distribution along the sarcolemma with partial colocalisation with dystrophin ( $r=0.414\pm0.026$ ). Paxillin immunoreactivity was ~2.4 fold higher at the sarcolemma compared with sarcoplasmic regions ( $P<0.001$ ) and sarcoplasmic paxillin immunoreactivity was slightly higher (~10%) in type I than type II fibres ( $P<0.01$ ). Colocalisation analysis suggests FAK and paxillin partially colocalised at sarcolemmal and microvascular regions ( $r=0.367\pm0.036$ ). Within the endothelium and smooth muscle, paxillin was distributed heterogeneously. Conclusion Paxillin is primarily localised to sarcolemmal and microvascular regions in human skeletal muscle and mirrors the localisation and distribution of FAK. Their spatial correlation in these distinct regions confirms our hypothesis that these proteins closely interact and supports their suggested role in the regulation and coordination of growth factor- and mechano-sensitive signalling. Wilson, O.J., Shaw, C.S., Sherlock, M., Stewart, P.M., and Wagenmakers, A.J. (2012). Immunofluorescent visualisation of focal adhesion kinase in human skeletal muscle and its associated microvasculature. *Histochemistry and cell biology* 138, 617-626

**ANGIOTENSIN CONVERTING ENZYME EXERTS SYSTEM CONTROL OVER FUEL HANDLING IN SKELETAL MUSCLE**

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1 Institute for Biomedical Research into Human Movement and Health, Manchester Metropolitan University, Manchester, United Kingdom  
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 3 Race Director, Chester Marathon Introduction: A silencer region (I-allele) within intron 16 of the gene for the major regulator of vascular perfusion, angiotensin converting enzyme (ACE), is implicated in phenotypic variation of aerobic fitness in humans. Using a genetical metabolomics approach we set out to expose whether metabolic processes in locomotor muscle at rest and during exercise underlie the reported differences in aerobic performance between genotypes with the ACE I-allele versus those without the I-allele, i.e. ACE-II / ACE-ID vs. ACE-DD. Methods: Not-specifically trained white British men (n=51) were recruited from the Northwest of England. Anthropometry, maximal oxygen uptake (VO<sub>2</sub>max), respiration exchange ratio (RER) and serum metabolites were assessed at rest and during a lab-based test which consisted of 30 minutes exhaustive, single-leg aerobic bicycle exercise at 60% of single leg aerobic power output (n=29). Another subset of subjects completed a field test consisting of the Chester Marathon (n=23). Muscle biopsies were collected at rest and 30 minutes after the lab-based test; and used to assess muscle capillarity and muscle metabolites using mass spectrometry. Differences between subjects with and without the ACE I-allele were assessed with a two-tailed T-test. Pre vs. post differences were assessed using an ANOVA with post hoc test of Fisher. Statistical significance was called at p<0.05. Results: Subjects without the silencer region demonstrated a reduced RER and showed elevated serum glucose concentration during the single-leg exercise. Elevated serum glucose in the subjects without compared to those with the ACE I-allele was confirmed by measures immediately after the Marathon (7.7 vs. 4.3 mM) which only subjects with the ACE I-allele did complete under 3 hours. Subjects lacking the ACE I-allele demonstrated a lower capillary-to-fibre ratio in vastus lateralis muscle (-24%) and showed a selective depletion of metabolites in the non-polar phase after the single leg exercise (p = 0.01). Conclusions: The observations imply a genetically modulated role for angiotensin converting enzyme in control of glucose import and substrate combustion in working human skeletal muscle.

**AICAR STIMULATION INCREASED MITOCHONDRIAL CD36 PRESENCE IN C2C12 CELLS**

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Introduction In skeletal muscles, the fatty acid (FA) transport protein CD36 facilitates the cellular uptake of long-chain FA on the plasma membrane. The transporter is also suggested to localize on the mitochondrial outer membrane, where its quantity correlates with FA oxidation rate. Therefore, mitochondrial CD36 could regulate FA oxidation capacity and may play an important role in fatty acid metabolism. Previous study reported that exercise-training increase not only the total CD36 content, but also its content on plasma membrane and in mitochondria. Moreover, acute or repeated adenosine monophosphate- (AMP) activated protein kinase (AMPK) activation also increases CD36 content in rat cardiac myocytes and rat skeletal muscle cell line L6. However, factors for translocation/expression CD36 to/on the mitochondria remains unknown. The purpose of the present study was to determine whether the mitochondrial CD36 protein content was increased or not. We performed the repeated treatment with 5-aminoimidazole-4-carboxamide-1-β-D-ribofuranoside (AICAR) or caffeine on the mouse skeletal muscle cell to activate AMPK and Ca<sup>2+</sup> signaling pathway. Methods Mouse skeletal muscle cells (C2C12) were cultured in 10% fetal bovine serum (FBS) and subsequently differentiated in 2% donor bovine serum (DBS). After differentiation, cells were incubated (5 h; 5 consecutive days) with or without 1 mM AICAR or 3 mM caffeine, containing 10% FBS and 1% penicillin-streptomycin. Nineteen hours after the last day of treatment, the cells were harvested. Then the cells were homogenized and centrifuged to obtain a mitochondrial and cytosolic fraction. The two fractions and whole cell preparation were compared for CD36, phospho-AMPK and voltage dependent anion channel (VDAC) protein levels using immunoblotting. Results The AICAR treatment induced an increase in CD36 protein content in the mitochondrial fraction (p < 0.05), without affecting cytosolic or whole cell contents. In contrast, caffeine treatment did not upregulate the CD36 protein content in the mitochondrial and cytosolic fractions, or on the whole cell preparation. The VDAC content was not changed in whole preparation by AICAR and caffeine treatment. AICAR and caffeine caused an acute increase in the phospho-AMPK within 1 h (p < 0.05). But AMPK phosphorylation was not stimulated when the cells were harvested (19h after the last AICAR treatment). Conclusion Repeated and long-term treatment (5 h x 5 consecutive days) with AICAR and caffeine will cause a temporal but repeated increase in AMPK phosphorylation. The repeated exposure to AICAR, but not caffeine, selectively raised the mitochondrial CD36 protein content in C2C12 cells, without affecting total content of CD36 within the myocyte.

**ASSESSMENT OF S6K1 ACTIVITY IN HUMAN SKELETAL MUSCLE USING THE QUANTITATIVE RADIOLABELED TECHNIQUE**

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Introduction Skeletal muscle growth is to a large extent regulated by the mechanistic target of rapamycin complex 1 (mTORC1) pathway (Goodman et al., 2011). It has been well demonstrated that the activity of this complex is enhanced by mechanical load as well as amino acids. The ribosomal protein S6 kinase 1 (S6K1) is one of the most well characterized substrates of mTORC1 and upon phosphorylation of S6K1 at Thr389 by this complex, the activity of S6K1 increases. As such, the phosphorylation status of S6K1 at this site has been used as functional readout of mTORC1 activity in human and animal tissue (Baar & Esser, 1999; Terzis et al., 2008). However, the western blot method generally used to measure S6K1 phosphorylation is only semi-quantitative which may provide less accurate results. In this study, we have assessed S6K1 activity using the quantitative radiolabeled technique. Methods Resistance trained men performed heavy resistance exercise and were supplemented with essential amino acids before, during and after exercise. Biopsies were taken in the vastus lateralis muscle before and 1 h after exercise. Muscle samples were homogenized in ice cold Chaps buffer and S6K1 was immunoprecipitated (IP) using a total S6K1 antibody and Protein G coated magnetic beads. Following IP, the beads with the protein-antibody complex were washed in appropriate buffers after which each sample was divided into triplicates and washed once with kinase buffer. The kinase reaction was run in the appropriate kinase buffer with radiolabeled ATP for 45 min at 30 °C with constant shaking. Two of the triplicates contained S6K substrate and the last triplicate served as a blank without substrate. The reaction was terminated by spotting the reaction mixture on phosphocellulose paper that was immersed in phosphoric acid. Radioactivity was then measured in a scintillation counter. Results The exercise and amino acid intervention resulted in an approximately eight fold increase in S6K1 activity.

Discussion In this study we show that it is possible to measure S6K1 kinase activity in human skeletal muscle following an intervention that is known to increase skeletal muscle protein synthesis and mTORC1 signalling. The use of a quantitative kinase assay will allow for more accurate study of the this signalling pathway in human muscle. References Baar K & Esser K. (1999). Phosphorylation of p70(S6k) correlates with increased skeletal muscle mass following resistance exercise. *The American journal of physiology* 276, C120-127. Goodman CA, Mayhew DL & Hornberger TA. (2011). Recent progress toward understanding the molecular mechanisms that regulate skeletal muscle mass. *Cellular signalling* 23, 1896-1906. Terzis G, Georgiadis G, Stratakos G, Vogiatzis I, Kavouras S, Manta P, Mascher H & Blomstrand E. (2008). Resistance exercise-induced increase in muscle mass correlates with p70S6 kinase phosphorylation in human subjects. *European journal of applied physiology* 102, 145-152.

## MARKERS OF MITOCHONDRIAL BIOGENESIS ARE AFFECTED BY AGING AND EXERCISE TRAINING IN RAT SKELETAL MUSCLE

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Introduction Impairments of the mitochondrial reticulum or network, and its function have often been associated with aging. A decline in mitochondrial biogenesis and mitochondrial protein quality control in skeletal muscle, directly contributes to this problem, but exercise training has been suggested as a possible cure. PURPOSE: In this report, we tested the effects of moderate intensity exercise training on young and old rats, and assessed mitochondrial biogenesis and mitochondrial protein quality control. Methods Twelve young (three mo) and twelve old (26 mo) male Wistar rats were used in the study and grouped into young control (YC), young exercised (YE), old control (OC) and old exercised (OE). The investigation was carried out according to the requirements of The Guiding Principles for Care and Use of Animals, EU. Exercised rats were trained on treadmill for 6 weeks, 5 times per week, where the running speed and duration of the exercise were gradually increased. We examined in this study the gastrocnemius muscle by Western blot and fluorometric assays. Statistical significance was assessed by one-way ANOVA, followed by Tukey's post hoc test. Results Exercise training prevented or attenuated significant age-associated (detrimental) declines in SIRT1 activity ( $437 \pm 174$  v.  $1166 \pm 109$  rel. act.  $p < 0.05$ ), AMPK ( $0.21 \pm 0.11$  v.  $1.05 \pm 0.29$  rel.dens.  $p < 0.01$ ), peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC-1 $\alpha$ ) ( $0.35 \pm 0.04$  v.  $0.87 \pm 0.08$  rel.dens.  $p < 0.01$ ) and the Lon protease, in the gastrocnemius muscle of rats. Exercise training also prevented the age-related (detrimental) increases in NRF1 ( $1.11 \pm 0.17$  v.  $0.67 \pm 0.1$  rel.dens.  $p < 0.01$ ), TFAM, Mfn1 ( $0.98 \pm 0.31$  v.  $0.48 \pm 0.16$  rel.dens.  $p < 0.01$ ), Fis1 and polynucleotide phosphorylase (PNPase) ( $1.52 \pm 0.42$  v.  $1.05 \pm 0.25$  rel.dens.  $p < 0.01$ ) levels. Conclusion Our data suggest that regular exercise training can help minimize detrimental skeletal muscle aging deficits stimulating mitochondrial biogenesis through the PGC-1 $\alpha$  system, a rejuvenating the mitochondrial network via fission and fusion, and improving quality control of mitochondrial proteins by the Lon protease. All of these properties, working in conjunction with one another, would improve the overall functionality of mitochondria in aged cells. The present work was supported by Hungarian grants from ETT 38388, Tét JAPI3/02, JSPS (L-10566), OTKA (K75702) awarded to Z. Radák. K.J.A.D. and J.N. were supported by grant #RO1-ES003598, and by ARRA Supplement 3RO1-ES 003598-22S2, both from the NIH/NIEHS to KJAD.

## ASSOCIATION OF TYPE XI COLLAGEN GENES WITH CHRONIC ACHILLES TENDINOPATHY IN TWO INDEPENDENT POPULATIONS.

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Introduction Injury to the mid-substance of the Achilles tendon is multifactorial, resulting from interactions of extrinsic and intrinsic factors. Several genes, including COL5A1, have recently been identified as important intrinsic risk factors. COL5A1 encodes the  $\alpha 1$  chain of type V collagen, which plays an important role in collagen fibril assembly. Type XI collagen, which is also expressed in tendons, shares structural and functional homology with type V collagen. Type XI collagen is encoded by the COL11A1, COL11A2 and COL2A1 genes. Mutations in these genes cause severe disorders, while polymorphisms, such as COL11A1 rs3753841 (T/C), COL11A1 rs1676486 (C/T) and COL11A2 rs1799907 (A/T), have been associated with connective tissue disorders. The aim was to investigate the association of these three SNPs with Achilles tendinopathy (AT) in South African (SA) and Australian (AUS) cohorts and whether these SNPs interact with COL5A1 to modulate the risk of AT. Methods A total of 182 participants diagnosed with chronic Achilles tendinopathy (AT, 104 SA, 78 AUS) and 336 appropriately matched asymptomatic controls (CON, 160 SA, 176 AUS) and were genotyped for the three SNPs. Results Although there were no independent associations with any of the COL11A1 (rs3753841 and rs1676486) and COL11A2 (rs1799907) SNPs with AT, gene-gene interactions between the COL11A1 and COL11A2 genes were associated with AT. Specifically, the T and C alleles of the COL11A1 rs3753841 and rs1676486 SNPs, respectively, as well as the T allele of the COL11A2 rs1799907 SNP, were associated with increased risk of AT. The functional AGGG allele (rs17146744) within the COL5A1 3'-UTR also interacted with these type XI collagen SNPs to increase the risk of AT. Due to the allele interactions between COL11A1, COL11A2 and COL5A1, a genotype risk score was calculated for the AT and CON participants. The "at risk" genotypes for AT at each variant contributed 2 points (COL5A1 AGGG/AGGG; COL11A1 rs3753841 TT; COL11A1 rs1676486 CC and COL11A2 TT) towards the genotype risk scores while the low-risk genotypes contributed 0 points. When the scores for rs1676486, rs1799907 and rs17146744 were calculated, the minimum risk score of 0 was significantly under-represented in the AT group ( $p = 0.015$ , OR = 5.4, 95% CI = 1.2-23.8), while the maximum score of 6 was significantly over-represented in the AT group ( $p = 0.022$ , OR = 2.4, 95% CI = 1.2 to 5.0). Discussion In summary, this study provides evidence that genes that encode for the structurally and functionally related type XI (COL11A1 and COL11A2) and type V (COL5A1) collagen interact with one another to modulate the risk for Achilles tendinopathy.

## MOLECULAR BIOGESESIS IN RATS SELECTED BY RUNNING CAPACITY

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Introduction Recently the positive physiological effect of the daily sport activity is quite well known. Studies observing different genetical groups are limited. Wisloff et al.\* showed that disadvantageous genetical background not only effect the running distance but the circulatory-, endothel functions, and blood sugar homeostasis so. Methods We worked with rats selected by their running capacity (26th generation). The first genetical unit represents the "high running capacity" (HRC) rats the other the "low running capacity" (LRC) ones. Three groups were formed in each genetical unit one were trained five days per week (at 70% VO<sub>2</sub>max), another exposed to calorie restriction. Physiological parameters were measure like maximal relative oxygen uptake, body weight, and some cognitive tests were preformed. As

a marker of performance we register the running distance during the oxygen uptake measurement. For the molecular background we used western blot diagnostic method. Our interest was dedicated to examine the parts of mitochondrial biogenesis therefore biochemical markers from gastrocnemius muscles were measured. We were curious about the PGC-1, Sirt1 and the MFN-1 pathways. Results We observed improved running distance in both genetic groups in the case of training. The LRC trained group distance data was similar to the HRC untrained groups. Some other remarkable physiological changes were evincible in both treated group. In the field of biochemistry similar adaptational pattern can be seen in the PGC-1 and the Sirt-1 levels in the treated groups. The Mfn-1 results can be explained by the better mitochondrial functions of trained animals. Discussion Our recent finding suggests that the physical activity reduce physiological problems connected to the genetic disadvantages due to the better functional status of the mitochondria. This results can help to draw attention to the importance of regular physical activity especially in less favored population. References \* Wisløff U, Najjar SM, Ellingsen O, Haram PM, Swoap S, Al-Share Q, Fernström M, Rezaei K, Lee SJ, Koch LG, Britton SL. Science. 2005 Jan 21;307(5708):418-20.

### GENOMIC COPY NUMBER VARIATION WITHIN THE TNC AND ADAM8 GENES AS POSSIBLE PREDISPOSING RISK FACTORS FOR ACHILLES TENDON PATHOLOGY

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**INTRODUCTION** Achilles tendon pathology (ATP) is a multifactorial disorder which predominantly affects athletic populations. A variety of risk factors are known to predispose to ATP and recent work has identified that genetics has a prominent role. However, to date, studies into the genetic basis of ATP have largely focused on small scale DNA variants such as SNPs. The influence of larger scale (>1kb) copy number variation (CNV) on the risk of ATP has not been addressed. **METHODS** We decided to investigate whether genomic CNV within two genes that might have important roles in the pathogenesis of ATP, through diverse mechanisms, were additional risk factors in a South African case (N=103)-control (N=89) Caucasian cohort. It has previously been shown that a GT repeat variant within the tenascin C (TNC) gene is associated with ATP and ADAM8 expression levels have been shown to be high in ruptured Achilles tendon compared to controls. For our analysis of TNC we used a Taqman CNV probe (Hs06903309) to determine the CN status for a region of the TNC gene located within intron 15. For ADAM8 we used the Hs02429708 probe that detects CNV variation within exon 23 of the gene. CN status at each candidate locus was determined using a multiplex PCR reaction on a StepOne Plus (Applied Biosystems) real time instrument running CopyCaller (version 2.0) software. CN signals were normalised against a reference probe for RNase P. A t-test was used to detect significant (P<0.05) differences between ATP cases and controls. **RESULTS AND DISCUSSION** For the TNC Hs06903309 probe we found no significant difference (P=0.953) between mean CN in ATP cases and controls. Likewise, for the ADAM8 Hs02429708 probe we found no evidence of mean CN difference (P=0.346) between ATP cases and controls. In summary, our preliminary findings suggest that CNV at the two loci investigated do not predispose individuals to Achilles tendon pathology. Our work is now extending to investigate the role of CNVs as risk factors for ATP in additional candidate genes in larger population cohorts.

### MONITORING ADAPTATION TO HEAT STRESS: CAN HSP72 EXPRESSION IN LEUKOCYTES BE A SURROGATE MEASURE FOR CHANGES IN SKELETAL MUSCLE?

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**Introduction** HSP 72 is a protein known to be upregulated when the human body is exposed to external stressors particularly excessive heat. The protein acts to prevent other proteins from denaturing under external stressors and so has a major role in human adaptation to activity in extreme environments. Measurement of the transcriptional levels of HSP72 (Hsp72) could therefore, act as an effective monitor for successful adaptation to such environments, however, it is levels in skeletal muscle that are seen as most relevant. Clearly, constant muscle biopsies are not viable for monitoring levels therefore this study was designed to investigate whether Hsp72 levels in leukocytes (much more easily obtained) can act as a "surrogate" for the changes occurring in skeletal muscle. **Methods** Our group have previously defined an exercise protocol (30 min downhill run (-10% gradient; 30°C, 50% RH) at LT) that maximises Hsp72 expression in leukocytes. 5 additional participants were enrolled onto the protocol with a muscle biopsy step (Vastus lateralis; VL) added to the blood-harvesting step. Hsp72 expression was determined in both leukocytes and skeletal muscle by quantitative PCR and compared. Relevant physiological measures (Rectal temperature (Tre) measured continuously during exercise, quadriceps tenderness (QT) and visual analog scale of pain (VAS) measured before exercise, and immediately, 3 hrs, 24 hrs and 48 hrs post) were made to confirm and quantify the physiological strain caused by the protocol. Results VL Hsp72 increased immediately post exercise (95% CI = 1.3 ± 0.5 to 5.8 ± 2.5 fold, p < 0.001) but leukocyte Hsp72 (95% CI = 0.7 ± 0.3 to 2.3 ± 0.6 fold, p = 0.105) did not. Additionally, the changes seen in VL were of a greater magnitude than those seen in leukocytes (F = 24.0, p < 0.001). Tre increased at 30 min (95% CI 37.3 ± 0.3 to 39.3 ± 0.4 p < 0.001) compared to 0 min while VAS was increased at 24 hrs post exercise (95% CI 0.0 ± 0.0 to 3.8 ± 3.8 p = 0.001) compared to basal. QT did not change from basal. **Conclusion** Increases in Hsp72 demonstrated in VL are not mirrored in leukocytes. This suggests that leukocyte Hsp72 may not be a reasonable surrogate tissue. Further work utilising increased participant numbers and HSP72 protein expression are required to fully elucidate whether leukocytes can be utilised as a surrogate tissue.

### THE AGTR2 GENE POLYMORPHISM IS ASSOCIATED WITH MUSCLE FIBRE COMPOSITION AND ENDURANCE ATHLETE STATUS

Mustafina, L.J.1,2, Mustafina, M.M.2, Lyubaeva, E.V.3, Nasibulina, E.S.2, Glotov, A.S.4, Vinogradova, O.L.3, Ahmetov, I.I.1,2  
1; Volga Region State Academy of Physical Culture, Sport and Tourism; 2; Kazan State Medical University; 3; Institute for Biomedical Problems; 4; St Petersburg State University

**Introduction** The ability to perform aerobic or anaerobic exercise widely varies among individuals, partially depending on their muscle fibre composition. The renin-angiotensin system is supposed to be one of the regulators of skeletal muscle growth and differentiation (Zhang et al. 2003; Johnston et al. 2011; Ahmetov et al. 2012). The angiotensin II type 2 receptor (encoded by AGTR2 gene in the X chromosome) by mediating the effect of the angiotensin II play an important role in developmental biology and pathophysiology. The C3123A (rs11091046) polymorphism of the AGTR2 gene located within the 3'-untranslated region of exon 3 have been reported to be associated with several cardiovascular phenotypes. In the present study, we examined the impact of the C3123A polymorphism of the AGTR2 gene on muscle fibre type composition and elite athlete status. **Methods** One hundred and fifteen Russian athletes (34 females and 81 males)

from different sporting disciplines (duration of event: 45 s – 2 hrs) were involved in the study. AGTR2 genotype and allele frequencies were compared to 148 controls (84 females and 74 males). To examine the association between AGTR2 gene variant and fibre type composition, muscle biopsies from m. vastus lateralis were obtained and analyzed in 55 young healthy men. Results Muscle fiber typing showed significant correlation between AGTR2 polymorphism and muscle fiber specification. The AGTR2 C allele carriers had significantly ( $P=0.003$ ) higher percentages of slow-twitch fibers ( $54.2 \pm 11.1$  vs  $45.2 \pm 10.2\%$ ) than A allele carriers. Furthermore, we found that the frequency of the AGTR2 C allele was significantly higher in endurance-oriented male athletes compared to controls ( $61.7$  vs  $43.2\%$ ;  $P=0.0014$ ). When considering individual sporting disciplines, the frequency of AGTR2 C allele was significantly higher in male 800 m - 10 km runners ( $P=0.027$ ) and kettlebell lifters ( $P=0.001$ ) compared to controls. Similarly, the frequency of the AGTR2 C allele was significantly higher in female cross-country skiers compared to female controls ( $83.3$  vs  $50.6\%$ ;  $P = 0.036$ ). Conclusion In conclusion, we have shown for the first time that variation in the AGTR2 gene is associated with muscle fibre type composition and elite endurance athlete status. References Zhang B. et al. Clin Genet. 2003;63:139-144. Johnston AP. et al. J Renin Angiotensin Aldosterone Syst. 2011;12(2):75-84. Ahmetov II. et al. Int J Sport Nutr Exerc Metab. 2012;22(4):292-303.

## 15:00 - 16:00

### Mini-Orals

#### PP-PM67 Training and Testing [TT] 2

##### VALIDATION OF A GAME BASED PERFORMANCE TEST IN TEAM HANDBALL

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Team-handball is a fast pace game of defensive and offensive actions that includes specific movements consisting of passing and catching a ball, throwing, jumping, screening, blocking, fast accelerations including stops, direction changes and frequent changes with low intensity movements as in standing, walking and jogging. The aim of the study was to develop and validate a game based performance test in team-handball. 20 experienced team-handball players performed two game based tests with one-week separation between each test, an incremental treadmill-running test, and a team-handball test game. The game based test consisted of 8 heats (separated by 40-60s rest between every heat) including team-handball specific actions and intensities similar to those observed in game analyses (Michalsik et al., 2012). We measured peak oxygen uptake ( $VO_{2peak}$ ), utilizing portable metabolic system (Cosmed K4B2), blood lactate concentration (LA) (EKF, Biosen C), heart rate (HR) (Polar, Kempele, Finland), sprinting time, and offensive and defensive time actions as well as running intensities (Inmotion LPM-system, Abatec, Austria), ball velocity and jump height (PeakMotus, Vicon Peak, UK). Reliability and validity of the tests were calculated utilizing ICCs, PM-correlations and independent t-tests. For the test-retest reliability, we found an ICC of  $>.80$  for the maximal LA and HR and the mean offense and defense time, ball velocity and jump height that yielded an ICC of  $>.90$  for the  $VO_{2peak}$  in the game based test. Significant differences between experienced and elite players (construct validity) were found for the HR, defensive time and ball velocity as well as a high correlation ( $r = .88$ ) between the game based test and the test game that resulted in the maximal LA and low correlation of ( $r = .58$ ) between the game based test and the incremental treadmill-running test for  $VO_{2peak}$ . We found also similar percentage for walking and standing (73%), low (18%) and high (9%) intensity running in the game based performance test compared to those found in game analyses by Michalsik et al. (2012). In conclusion, we found that the game based performance test is a valid test to assess performance in team-handball that is similar to those used in actual game. However, a high cardiorespiratory fitness measured during the incremental treadmill-running test is not an essential component to play team-handball on a high level during the entire game (team-handball specific endurance). References Michalsik LB, Aagard P, Madsen K. (2012). Int J Sports Med (published online)

##### ACUTE WBV DOES NOT AFFECT THE TORQUE-LENGTH PROFILE OF THE QUADRICEPS MUSCLE-TENDON UNIT.

Rieder, F.1, Kösters, A.1, Müller, E.1, Seynnes, O.R.2

*1: PLUS (Salzburg, Austria), 2: NIH (Oslo, Norway)*

Introduction Besides possible increases in force and power output after one bout of whole body vibration (WBV), recent publications indicated acute changes in the length-tension relationship of the plantarflexor muscle-tendon unit (MTU). In addition, shifts of peak torque towards longer muscle lengths were attributed to an increased compliance of the MTU (Kemertis et al., 2008; Pelligrini et al., 2010). This hypothesis is consistent with similar changes in the force-length relationship of the medial gastrocnemius MTU when a stretched-induced-decrease in tendon stiffness occurs (Kubo et al, 2001). Hence, the aim of this study was to investigate acute effects of WBV on the quadriceps torque-angle relationship and on the patellar tendon stiffness. Methods 24 subjects were randomly assigned to a WBV or to a control group. The WBV group did 7 x 1-minute bouts static squatting on a NEMES BOSCO vibration plate (frequency=20Hz, amplitude=2mm) whereas the control group performed the same squats without vibration. Patellar tendon stiffness and isometric knee extension torque-angle relationship were measured 24 hours before, immediately after and 24 hours after the intervention. Outcomes were assessed with a two way ANOVA for repeated measures. Results The optimal angle of torque production did not shift and maximal torque remained unchanged in all tested angles after vibration. There was no significant change in patellar tendon stiffness immediately after ( $+10.9\% \pm 16.5\%$ ) or 24 hours after ( $-3.5\% \pm 10.5\%$ ) vibration. No significant change was observed in any variables measured in the control group. Discussion Using the present protocol, WBV has no acute effects on quadriceps maximal torque production. Unlike previous report on the plantarflexors, the knee extensors torque-length profile was unaffected by vibration. In line with these results, the unchanged tendon stiffness suggests that this configuration of WBV does not affect the mechanical properties of tendinous tissue acutely. Differences in passive tensile loading, inherent to the squatting position of the WBV plate, may explain the discrepancy between the present findings and results obtained on the plantarflexors (Kemertis et al., 2008; Pelligrini et al., 2010). Literature Kemertis, M., Lythgo, N., Morgan, D. & Galea, M. (2008). Ankle Flexors Produce Peak Torque at Longer Muscle Lengths after Whole-Body Vibration. Med Sci Sports Exerc, 40 (11), 1977-1983. Kubo, K, Kanehisha, H., Kawakami, Y & Fukunaga, T. (2001). Influence of static stretching on viscoelastic properties of human tendon structures in vivo. J Appl Physiol, 90 (2), 520-527. Pelligrini, M., Lythgo, N., Morgan, D. & Galea, M. (2010). Voluntary activation of the ankle plantar flexors following whole-body vibration. Eur J Appl Physiol, 108, 927-934.

## ACTIVITY PROFILES OF FOUR DIFFERENT FOOTBALL SMALL-SIDED GAMES

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**Introduction** Small-sided games are widely used by football coaches at all levels of the game to develop technical, tactical abilities and physical conditioning of players. Research suggests that physiological, perceptual and technical responses can be modified during small-sided games in football by modifying game constraints such as the number of players, the size of the pitch, the rules of the game, or coach encouragement (Hill-Haas et al., 2008). The aim of this study was to identify the physiological and activity profiles of 4 football small-sided games formats. **Methods** 10 professional football players participated in 4 variations of small-sided games (2-, 3-, 4- and 5-a-side) with an intermittent regime involving 3×6 min bouts with 1 min of passive planned rest. Relative pitch size per player remained constant across the 4 small-sided games at around 150m<sup>2</sup>. Player's activity, rating of perceived exertion and heart rate profiles during the small-sided games was measured using portable GPS units at 5 Hz. ANOVA was used to compare the variables across the small-sided games format, Bonferroni Post hoc test was used to identify pairwise comparisons. Results Statistically significant differences among small-sided games format in the %HRmax ( $p=0.001$ ) were found, as well as, between small-sided games format in all times spent in heart rate zones, exception made in time spent at 75-84 %HRmax. Moreover, statistically significant differences ( $p<0.001$ ) between rating of perceived exertion values in the small-sided games format were found. Statistically significant differences among small-sided games format to total distance performed ( $p<0.001$ ) and between the number of sprints performed in each small-sided game ( $p<0.001$ ) were found. Statistically significant differences were found across small-sided games in the total body load. The 4-a-side presented the highest and the 5-a-side the lowest values ( $95.18 \pm 17.54$  and  $86.43 \pm 14.47$ , respectively). The body load per minute declined each 2 minutes of play. **Discussion** The results showed that smaller game formats elicit higher mean heart rate, rating of perceived exertion, and that players spent more time in higher %HR zones. By this, smaller formats are more appropriate to increase physiological stress, while larger formats can be used to improve match-specific demands. The body load results may suggest that small-sided games duration can be programmed in 2 min blocks interspersed with very short periods of rest, in order to allow for a quick recovery and maintenance of the workload characteristics. These concerns are particularly important when using 5-a-side games because at the end of the game period the body load has substantially decreased. **References** Hill-Haas S, Coutts A, Rowsell G, Dawson B (2008). *J Sci Med Sport*, 11, 487-490.

## ANALYSIS OF TRACK RUNNING PERFORMANCE USING GLOBAL POSITIONING SYSTEMS AND ACCELEROMETER BASED DATA

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**Introduction** The continuous tracking of speed (vrun) and position during running events is often limited by the characteristics of study locations, including the complexity of the terrain and other conditions that influence the accuracy, continuity and availability of captured information. Nowadays light weight portable global positioning systems (GPS) with embedded tri-axial accelerometers (ACC) have been developed to obtain time spent moving, record distance covered, monitor vrun and measure ACC forces. Aim is to focus on pros and cons of GPS and ACC as well as their reliability and validity under track running conditions. **Methods** Within the present study the physical performance during altered track running (20-400 m; range vrun: 2.2-9.3 m/s) of a group of competitive athletes ( $n=10$  men (S1):  $25 \pm 3$  yrs,  $182 \pm 6$  cm,  $81 \pm 6$  kg;  $n=10$  women (S2):  $20 \pm 5$  yrs,  $162 \pm 5$  cm,  $59 \pm 6$  kg) was captured and analysed. A vest containing the GPS and ACC sensor was tightly fitted and placed between the scapulae to ensure a non-restricted range of movement. The ACC operated with 100 Hz, the GPS collected the position data with 5 Hz, reaching  $9.0 \pm 1.1$  satellites concurrent. Additionally a single light beam system (SLB) and a digital measuring wheel were used as gold standard for completed distance and time. Descriptive and group-specific parametric statistics were applied. Validity and reliability were assessed using 95% limits of agreement and coefficient of variation (CV) for all variables. Results Mean GPS results in S1 showed distance deviances for short sprint runs (<50 m, vrun:  $7.5 \pm 0.6$  m/s) of  $-0.7 \pm 2.2\%$  ( $n=20$ ), for sprints 50-100 m (vrun:  $8.4 \pm 0.4$  m/s) of  $-0.2 \pm 1.0\%$  ( $n=19$ ) and for runs  $\geq 100$  m until 300 m (vrun:  $8.3 \pm 0.5$  m/s) of  $-0.1 \pm 0.6\%$  ( $n=23$ ). The mean running distance divergence in S2 against the reference constant value of e.g. 70 m was  $67.8 \pm 2.1$  m ( $-3.1\%$ ;  $p \leq 0.001$ ), the reliability was good (CV: 3.1%;  $p \leq 0.483$ ). Over splits and 400 m in S2 the underestimation of GPS grows up to 3.5 % ( $-14.8$  m). Peak total ACC, defined as largest positive sum of the dynamic acceleration in the three directions, showed a range of 7.7-12.2g and individual profiles. **Discussion/Conclusion** The GPS and ACC sensors are a valid and reliable method of measuring distance and simultaneous movement in the three perpendicular axes at various running intensities. In accordance with previous studies, the current results demonstrate the systematic underestimation of GPS measurements compared with measured distances and SLB-calculations of speed at all measured intervals. By coupling ACC with GPS, movements can be determined accurately, and position applied to track physical performance. Both can assist field research in exercise science more or less sensitive, even at higher movement intensities.

## EFFECT OF LOW-VOLUME HIGH-INTENSITY TRAINING ON PERFORMANCE IN MASTER SWIMMERS

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*National Research Council*

1IBFM, National Research Council, Italy. 2DSBT, University of Udine, Italy. 3DBS, University of Milan, Italy **INTRODUCTION** Training programs for swimmers are usually characterized by high-volume sessions, approximately 20–30 h/wk depending on the period of the season and the level of the athletes (Sharp, 2000). Moreover, a great part of the weekly training volume is usually performed at low intensity. Recently the benefits on performance and physiological responses of low-volume high-intensity training has been reported in several athletes (Laursen et al, 2002). As for high-intensity training in swimming, few studies mainly focused on young are available (Sperlich et al, 2010). The aim of the present study was to evaluate in high-level master swimmers the effect of low-volume high-intensity training on performance and physiological factors. **METHODS** Twelve male master swimmers ( $32 \pm 5$  yrs) performed two different 6-week training periods separated by 3 weeks of tapering. The first period of training (HV-LI) was characterized by high volume and low intensity sessions (swimming about 14 km/wk), whereas the other (LV-HI) by low volume and high intensity sessions (swimming about 7 km/wk). All swimmers were tested before (PRE) and after each training period. In laboratory, they performed an incremental arm exercise test until exhaustion in order to obtain peak cardiovascular and metabolic values. In 25-m swimming pool, the best performance time was assessed in 100m, 400m and 2000m swims. A 7 x 200m protocol was also performed for individual anaerobic threshold (Vant) assessment. **RESULTS** In relation to PRE, after HV-LI: 1)  $VO_{2peak}$  significantly increased (+9%); 2) performance time on 2000m and on 400m significantly

improved (+4.2 % and +4.0 % respectively). In relation to HV-LI, after LV-HI: 1) VO<sub>2</sub>peak did not change; 2) time performance on 2000m and on 400m did not change; 3) Vant improved, resulting significantly higher than PRE (1.07 ± 0.2 vs. 1.27 ± 0.1 m/s, respectively PRE and after LV-HI); 4) time performance on 100m significantly improved (+2%). DISCUSSION HV-LI training improved maximal aerobic power, time performance on 2000m and 400m. LV-HI did not negative influenced effect of HV-LI on maximal aerobic power, 2000m and 400m. Additionally, LV-HI training also improved 100m time performance and velocity at anaerobic threshold. Despite a consistent reduction (about 50%) of training volume, high-intensity training preserves the aerobic swimming performance improvements of traditional high-volume training and it is more effective on short-distances performance time. REFERENCES Sharp RL. Exercise and Sport Science, 2000: 895–904 Laursen PB, Jenkins DG. Sports Med, 2002: 53–73 Sperlich B, Zinner C, Heilemann C, et al. Eur J Appl Physiol, 2010:1029–1036

### EFFECT OF A SOCCER MATCH SIMULATION ON THE FUNCTIONAL HAMSTRING-TO-QUADRICEPS RATIO

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**Introduction** Functional hamstring-to-quadriceps ratio (H/Q: ratio between eccentric hamstring to concentric quadriceps torque) is gaining popularity in soccer as potential predictor of injury risk. It has been shown that after fatiguing exercise tasks, H/Q is reduced, and this may increase the injury risk(Rahnama,2003). The aim of this study was to examine the effect of fatigue on H/Q ratio after a soccer match simulation and to examine whether it is influenced by sport-specific experience (i.e. sport-specific adaptations). **Methods** For this cross-sectional study, 22 amateur soccer players and 18 control (sport science students practicing different sports like swimming, running, etc.) completed the Loughborough Intermittent Shuttle Test (LIST). During fatiguing exercise, RPE and heart rate was monitored. Pre and post LIST, participants performed 1) isokinetic strength test at 60°/s, 180°/s and 300°/s on dominant (D) and non dominant (ND) limb, 2) Squat Jump (SJ) and Counter Movement Jump (CMJ). Dependent variables were analysed using a mixed 3-way ANOVA. Results No three-way interaction we found. After LIST, D showed a significant reduction in H/Q at 180°/s (CI 95% -0.150 to -0.055) and 300°/s (-0.149 to -0.044), and there was a trend at 60°/s (-0.065 to 0.002, p=0.065). In ND limb, significant reduction in H/Q occurred only at 60°/s (-0.080 to -0.011). Eccentric peak torque flexion angle resulted significantly increased in D at 60°/s (7.3° to 14.2°), 180°/s (3.6° to 13.5°) and 300°/s (1.8° to 9.4°) and in ND at 60°/s (5.3° to 12.1°), 180°/s (8.5° to 19.1°) and 300°/s (2.4° to 9.8°). In both limbs concentric peak torque angle during extension did not change. Two way interaction was found for RPE (p<0,01) and heart rate were significantly lower in soccer players. Both SJ and CMJ showed decrement in all subjects, but it was significantly greater in control. **Discussion** Functional H/Q ratio was significantly altered by exercise-induced fatigue, especially in dominant limb, confirming A previous study(Delextrat,2010). A novel finding was that the peak angle during eccentric knee flexion was left shifted indicating an alteration of torque-length relationship. This latter result may be an additional factor influencing the injury risk that warrants further studies. However, it is not different between groups, suggesting that this mechanism is not influenced by sport background. Delextrat, A et al. (2010). The use of the functional H:Q ratio to assess fatigue in soccer. Int. J of sports med., 31(3), 192–7. Rahnama, N. et al. (2003). Muscle fatigue induced by exercise simulating the work rate of competitive soccer. J sports sci., 21(11), 933–42.

### AN IDEAL WAITING TIME FOR VERTICAL JUMPING PERFORMANCE AFTER THE WARM UP PROGRAMME CONSIST OF STATIC STRETCHING

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*1:KOU(Kocaeli, Turkey), 2:HU (Istanbul, Turkey)*

**Introduction:** Football is one of the most popular team sports in the world. During the match and training, there is a lot of movement spent for running, jumping etc. A good warm up session cannot only improve performance but also prevent injuries due to strenuous moves during training and/or tournaments (Bishop, 2003; Holcomb, 2000; Gelen et al, 2012). According to the literature, dynamic stretching exercises increase strength performance during warm up session (Chattang et al 2010; Perrier et al 2011), and static stretching exercises decrease strength performance (Nelson et al 2005; Kistler et al 2010). It is recommended to give some waiting time for eliminate to this negative effect after the static stretching exercises (Torres, 2008). The aim of this study was to determine an ideal waiting time for vertical jump performance after the warm up exercises which was consisted of static stretching. **Methods:** 24 football players from Kocaelispor A2 Team in Turkey participated to this study. All subjects had previous competitive match experience at national tournaments. They have also training experience. Five different warm-up protocols were applied to players in each of 48 hours randomly. First protocol was 5 minute jogging, second protocols 5 minute jogging with static stretching. The other protocols 5 minute jogging with static stretching+ 5 minutes, 10 minutes and 15 minutes interval time respectively. In static stretching protocol, 4 different movements were worked out with two sets in 30 seconds for each muscle group. Following each warm-up session, subjects were tested vertical jump. Descriptive statistics (mean ± SD) formulated for the variables age, height, body weight data were analysed. Repeated measures of variance in SPSS program were used to compare the data obtained from 5 protocols. **Results:** As a result of this study, the warming up session that was consisted of static stretching exercises had effected negatively on vertical jumping performance. However, this negative effect was disappeared after the five minutes waiting time (p<0.05). **Discussion:** In previous studies showed that the negative and the positive effects of static stretching and the other stretching types. Chaouachi et al. (2010) studied the effect of warm-ups involving static or dynamic stretching on agility, sprinting, and jumping performance in trained individuals. They applied static stretching, an adequate warm-up and dynamic sport-specific activities to trained individuals with at least 5 or more minutes of recovery before their sport activity. Also, Torres et al. (2008) indicated that negative effects of static stretching leave the body after 5 minutes or longer period. This study and the literature showed that some relationships among warm-up, performance and interval time exist. It is recommended not to choose static stretching exercises in performances that requires explosive power such as vertical jump. If it is to be preferred, it should be given at least 5 minutes waiting time before performance to loose its negative effects.

### EFFECT OF FITNESS LEVEL ON TRAINING LOAD DURING SMALL-SIDED GAMES IN SOCCER PLAYERS

Al Haddad, H., Simpson, B., Buchheit, M., Gregson, W., Di Salvo, V., Mendez-Villanueva, A.

*Aspire, Doha*

**Introduction** Small-sided games (SSG) are very popular training drills in soccer. SSG appear to replicate to a certain extent the physical intensity, movement patterns and the technical requirements of competitive match play (Hill-Haas et al., 2011). Therefore, from an integrated and soccer-specific physical training perspective, SSG are commonly used to develop physiological adaptations to the game. However, whether players' fitness levels can impact the acute training load responses during SSG and therefore the development of a

certain physical quality remains unknown (Mendez-Villanueva et al., 2013). Therefore, in this study we investigated whether the training load arising from SSG would differ between players with substantially different levels of aerobic fitness. Methods Fifteen professional soccer players first performed an incremental running test to estimate their maximal aerobic speed. Players were then divided in two groups: high aerobic speed (HAS) and low aerobic speed (LAS), based on a moderate effect size (ES) difference (i.e., 0.5 x between-group SD) from the group average. Finally, eight players were eligible and were included in this study (i.e., 4 in HAS and 4 in LAS). During 3 different training sessions a 5-a-side SSG was performed and a total of 35 data sets of 7-min 5-a-side SSG (50x40m) (17 for HAS and 15 for LAS) were compared. Total distance covered, high-speed running distance >14.4 km.h<sup>-1</sup> and the number of accelerations >3 m.s<sup>-2</sup> were measured with GPS (GPSports, 15Hz). Heart rate (HR) related-indices were also collected (mean HR as % of HRmax, time spent at >90% of HRmax expressed as % of total playing time). Results Average estimated maximal aerobic speed was 18.4±0.7 km.h<sup>-1</sup> for HAS and 15.4±0.3 km.h<sup>-1</sup> for LAS. No clear differences between HAS and LAS for total distance covered (679±238 vs. 634±221m, ES=0.20, 90% confident limits [-0.19;0.59]), high speed running distance (103±42 vs. 90±60 m, 0.25 [-0.14;0.64]) were observed. LAS players presented greater number of accelerations (4.5±3.9 vs. 2.2±1.7, 0.85 [0.46;1.24]) compared with HAS. Average HR (86±2% vs. 81±3%, 1.28 [0.89;1.67]) and total time spent >90% of HR max (43±24% vs. 14±18%, 1.36 [0.97;1.75]) were greater in LAS compared with HAS. Discussion Superior aerobic fitness was unlikely to affect the distance covered during a 5-a-side SSG but was associated with a reduced external (i.e., accelerations) and internal (i.e., HR) training load. These results may indicate the need for more individualized training prescription based on player's fitness level and/or game specific requirements. Hill-Haas, S. V., Dawson B., Impellizzeri F. M., Coutts A. J. (2011). *Sports Med*, 41, 199-220. Mendez-Villanueva, A., Buchheit M., Simpson B., Bourdon P. C. (2013). *Int J Sports Med*, 34, 101-110.

### EFFECTS OF DIFFERENT ISOKINETICS KNEE EXTENSION WARM-UP ON MUSCLE PERFORMANCE IN YOUNG SUBJECTS

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1:UnB (Brasília, Brazil), 2:UFG (Goiânia, Brazil), 3:IFTM (Paracatu, Brazil)

**Introduction** The assessment of muscular strength is essential for understanding the neuromuscular performance capacity of an individual or athlete. Thus, these subjects typically perform a warm-up to prepare to engage in neuromuscular tests. Studies utilizing isokinetic strength testing generally require subjects to perform different velocities warm-up protocols. Further examination of isokinetic testing protocols revealed that the warm-up velocities range from 30 to 300°s<sup>-1</sup>, and in many cases investigators fail to report warm-up protocols. Thus, the optimal warm-up protocol for isokinetic strength performance assessment enhancement remains unclear. Therefore, the purpose of this study was to analyze the effects of different warm-up routines on strength in young adults. **Methods** Fifteen healthy young men (24.8 ± 3.5 years) were exposed to five knee extensors warm-up randomized protocol before an isokinetic strength test (at 60°s<sup>-1</sup>). The warm-up protocols were: 1) submaximal (SUB), 10 submaximal consecutive repetitions (about 50% of maximum effort) at 60°s<sup>-1</sup>; 2) intermittent (INT), 10 maximal intermittent repetitions (30 seconds between reps) at 60°s<sup>-1</sup>; 3) 180, 10 maximal consecutive repetitions at 180°s<sup>-1</sup>; 4) 300, 10 maximal consecutive repetitions at 300°s<sup>-1</sup> and 5) control (CON) session (no warm-up). **Results** PT was significantly (p<0.05) higher after the INT (295.27±53.21 N.m) when compared to 300 (267.50±47.35 N.m) and 180 (275.21±48.61 N.m) warm-up protocols. Also, PT was significantly (p<0.05) higher in the no warm-up CON (285.41±48.70 N.m) protocol when compared to 300. **Discussion** One of the main findings of the present study was that the warm-ups protocols were not more efficient than no warm-up. These results are in agreement to Altamirano et al. (2012). They reported that warm-up did not affect PT. Another finding was that no warm-up and INT protocols were superior when compared to higher velocities warm-ups protocols (180 and 300). Some individuals reported mental and physiological benefits after a warm-up (Sweet; Hagerman, 2001). Thus, for those individuals the INT protocol could be an interesting warm-up strategy. Also, Batista et al. (2007) reported that the INT protocol seems to be an effective way to produce postactivation potentiation. Finally, according to our results subject should avoid warm-up using velocities higher than the testing velocity. **References** Altamirano KM, Coburn JW, Brown LE, Judelson DA. (2012). *J Strength Cond Res*, 26(5), 1296-1301. Batista MAB, Ugrinowitsch C, Roschel H, Lotufo R, Ricard MD, Tricoli VAA. (2007). *J Strength Cond Res*, 21(3), 837-840. Sweet S, Hagerman P. (2001). *Strength Cond J*, 23(6), 36.

### ACCELEROMETER MEASURED DAILY PHYSICAL ACTIVITY AND SEDENTARY PURSUITS - COMPARISON BETWEEN TWO MODELS OF THE ACTIGRAPH

Tanha, T., Tornberg, Å., Dencker, M., Wollmer, P.

*Clinical Sciences*

**Abstract Background:** Physical activity is and will continue to be a very important factor for cardiovascular health. There are numerous studies on physical activity and in recent years accelerometry is accepted as an objective measurement method. New generation accelerometers are on the market and are used frequently and data and cut-off points from the old generation accelerometers are often used interchangeably. However, there is very few validation studies performed between different generations of the commonly used Actigraph accelerometers. **Methods:** We compared daily physical activity data generated from the old generation Actigraph model 7164 with the new generation Actigraph GT1M accelerometer in 15 randomly selected young females for eight consecutive days. Minutes per day of light, moderate and vigorous physical activity (LMVPA), moderate and vigorous physical activity (MVPA), vigorous physical activity (VPA) and very vigorous physical activity (VVPA) were calculated. Moreover, minutes of sedentary pursuits per day was calculated. **Findings:** There were significant (P<0.05) differences between the Actigraph 7164 and the GT1M concerning LMVPA (237±49 vs. 225±37 min/day), MVPA (61±17 vs. 56±14 min/day), VPA (15±7 vs. 9±4 min/day) and VVPA (4±3 vs. 1±1 min/day). No significance was observed in data from mean minutes of sedentary pursuits between the two different models. **Conclusions:** Data from the old generation Actigraph 7164 and the new generation Actigraph GT1M accelerometers differ, where the Actigraph GT1M generates lower values for free living physical activity. Mean minutes sedentary time per day is not dependent accelerometer model. These results need to be taken into consideration when using these devices.

15:00 - 16:00

## Mini-Orals

## PP-PM72 Training and Testing [TT] 7

**KINEMATIC MEASURES OF TRAMPOLINE ATHLETES WITH RESPECT TO DOWNWARD TRAMPOLINE BED DEFLECTION: A PILOT STUDY**

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Introduction Jump height is an important scoring criterion in the sport of trampoline. The mechanisms that contribute to jump height in this sport however, are not well understood. Measuring the downward deflection (DD) may provide more insight into some variables such as vertical stiffness, which may aid jump height on elastic surfaces (Moritz, 2004). The purpose of this pilot study is to measure joint kinematics of trampoline athletes during the DD of the bed throughout the jump cycle. Methods A vision based system with a camera along the length and width of the trampoline bed were set to monitor DD. Goniometers (Mega Electronics) were placed at the hip (H) and knee (K) with information fed into the ME6000 data logger. Athletes (N=4) performed a straight bounce jump routine with the 3-6 consecutive jumps taken for data analysis when they reached their maximum height. Joint angle data for the hip (H) and knee (K) were synchronized with DD over the jump cycle, and average values were obtained. Correlates for jump height were determined and stepwise linear regression was performed to investigate potential factors for jump height. Significance was set to  $p < 0.05$ . Results Average time of flight for national and recreational athletes was 1.3 s (0.3), with an average jumping frequency of 0.6 Hz (0.1). Two major inflection points were observed in both H and K which occurred at 35.0% and 70.4% of the jump cycle at the H and 41.1% and 74.8% of the cycle for the K. In relation to the DD an inflection point occurred on the way down, and the other on the way up for both H and K (80.1% and 80.7% on way down respectively and 64.8% and 63.4% on way up respectively). No differences were seen between the H and K deflection points for both time and DD. Early stepwise models show that minimizing the entry and exit knee angle during the jump cycle time and the timing of the first knee extension in relation to the bottom of the bed may be important predictors for jump height ( $r^2 = 0.945$ ). Discussion Looking at the DD deflection of the bed in combination with the jump cycle time, would suggest that there are three distinct phases in the trampoline bed; one for landing, one for pushing off, and one during the take-off. Pushing off closer to the maximum DD of the bed may result in greater trampoline jump height. Greater leg extension is seen from all athletes; however, less leg extension may have positive contributions to jump height. The results of this study suggest that stiffness may be an important muscular criterion to jump height in trampoline athletes. References Moritz C, Farley T. (2004). *Jrnl Exp Bio* 208, 939-949.

**DOES THE RECENT INTERNAL LOAD ON PLAYERS AFFECT MATCH OUTCOMES IN ELITE AUSTRALIAN FOOTBALL?**

Aughey, R.1,2, Flyger, N.1, Sweeting, A.J.1, Inness, M.W.H.1,2, Elias, G.P.1, Gallaher, E.L.1, Walker, E.1,2

*Victoria University / Western Bulldogs FC*

Introduction Elite football clubs allocate significant resources to monitoring the internal load on athletes during a competitive season (Borrenson & Lambert, 2009). Despite this investment, little is known on the effect of team internal load on match outcomes in elite football. Methods Internal load was quantified from the session RPE method (Foster et al 2001) for elite individual players from one team in 141 professional Australian football matches over 6 seasons, then averaged for players that competed for the team each week. Average weekly internal load (WL) and strain (load x monotony or sameness of load; WS) was compared to Average monthly load (ML) and strain (four-week rolling average; MS) for each player against the match outcome, with covariates for relative position of teams in the competition and days between matches. Differences were assessed with effect size (ES) and magnitude based inferences. Results Average weekly load on players was likely 10% higher for match wins ( $ES\ 0.38 \pm 0.28$ ), but when days between matches was used as a covariate this was reversed and was very likely 17% lower for wins ( $-0.82 \pm 0.56$ ). When relative ladder position was considered, there was no clear difference in total load between wins and losses ( $-0.31 \pm 0.56$ ). There was no clear effect in the percentage difference between WL and ML for wins ( $-0.32 \pm 0.40$ ). Weekly strain was not clearly different for wins ( $0.10 \pm 0.31$ ), but a likely 76% higher in WS vs. MS ( $0.59 \pm 0.44$ ) that was possibly reversed when days between matches was used as a covariate ( $-34\%$ ,  $-0.44 \pm 0.90$ ), with no clear difference when relative ladder position was a covariate ( $0.26 \pm 1.42$ ). Discussion The interactions between weekly individual athlete load and strain, recent load and strain and wins and losses of teams are complex. In order to best prepare teams for competition the difference between weekly and recent strain seems the most important variable to consider, with a larger deficit between weekly strain and 4-wk average strain more conducive for success. Understandably, the importance of this manipulation of strain is ablated when the relative technical proficiency of teams is considered. References Borresen, J and Lambert, M. (2009). *Sports Med*, 39, 779-795. Foster, C. et al. *J Strength Cond Res*, 2001. 15(1): p. 109-15.

**THE INFLUENCE OF ADDITIONAL SODIUM IN A BEVERAGE ON REPEATED SPRINT ABILITY IN PROFESSIONAL SOCCER PLAYERS**

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Introduction In soccer, players lose variable amounts of electrolytes, of which sodium ( $Na^+$ ) is the most important (Shirreffs et al., 1997). Sprinting is of great importance for performance in elite soccer, as it clearly distinguishes between top-class and high-level elite players (Mohr et al., 2008). Field-based repeated sprint tests have been significantly correlated with both running and sprinting distance during actual match play (Rampinini et al., 2007). Therefore, it was the aim of this study to examine whether the addition of  $Na^+$  to a beverage is related to the ability to perform repeated sprints. Methods 15 healthy, male professional soccer players from the Hong Kong football league (mean  $\pm$  SD: age  $24.1 \pm 3.5$  years, height  $1.78 \pm 0.07$  m, body mass (BM)  $72.6 \pm 12.1$  kg) took part in two soccer-specific, in-season training sessions of similar intensity (T1 & T2), while drinking either a beverage with 22 mmol/L  $Na^+$  (S) or 0 mmol/L  $Na^+$  (NS). Environmental conditions (Temp: 35 °C, RH: 90%, Wind speed: 1.03 - 1.20 m/sec) were similar on both occasions. Players commenced exercise in a euhydrated condition. Players were randomly assigned either S or NS beverage in T1 and consumed the other beverage in T2. Ad libitum

drinking was permitted in T1 and drinking in T2 was pre-determined to match consumption volume in T1. Each participant was assessed to establish their pre- and post-training hydration status by urine specific gravity (USG). A repeated sprint ability (RSA) test (Rampinini et al., 2007) was conducted immediately after both training sessions. Results RSA time was significantly decreased in the S trial (S vs NS:  $7.07 \pm 0.28$  s vs  $7.20 \pm 0.28$  s,  $p < 0.05$ ). Mean percentage BM losses were within recommended ranges (i.e.  $< 2\%$ ) on both days. There were no significant differences observed in USG between training sessions ( $p < 0.05$ ). Discussion The consumption of a beverage containing Na<sup>+</sup> had a positive effect on the sprint performance of soccer players, when compared to the ingestion of a sodium-free beverage. Similar to previous research, our study highlighted mild dehydration amongst the players (Owen et al., 2013), which was most likely due to the ad libitum fluid consumption. However, individual data showed that many players were dehydrated to a level where performance decrements can be expected (i.e.  $> 2\%$  BM). Furthermore, the inclusion of Na<sup>+</sup> in the beverage did not significantly alter USG in the professional soccer players. Mohr M, Krstrup P, Andersson H, Kirkendall D and Bangsbo J. (2008). J Strength Cond Res, 22(2), 341-349. Owen JA, Kehoe SJ and Oliver SJ. (2013). J Sports Sci, 31(1), 1-10. Rampinini E, Bishop D, Marcora SM, Ferrari Bravo D, Sassi R and Impellizzeri FM. (2007). Int J Sports Med, 28(3), 228-235. Shirreffs SM and Maughan RJ. (1997). J Appl Physiol, 82(1), 336-341.

## HEART RATE DURING A BRAZILIAN JIU-JITSU TRAINING SESSION

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INTRODUCTION Physiological responses to Brazilian Jiu-Jitsu (BJJ) practice have been investigated during simulated combats (ANDREATO et al, 2012; BORGES et al, 2012), but limited information exists regarding common used training sessions (SILVA et al, 2011). Therefore, the aim of this study was to analyze heart rate (HR) behavior during an ordinary BJJ training session involving both technical and combat exercises. METHODS Twelve male BJJ athletes ( $23.0 \pm 4.1$  yrs;  $75.7 \pm 11.0$  kg and  $176 \pm 4$  cm) volunteered to this study and carried out a training session of ~ 1 h. A general warm-up (WUP) was followed by technical exercises (TEC) involving guard pass and sweeps, and combats (COM) consisting in BJJ simulated matches. HR was continuously monitored during the session (POLAR® S810, Finland), being expressed in both absolute (bpm) and relative (% HRmax) values. Comparisons between specific phases regarding average and peak HR were performed by one-way ANOVA for repeated measures followed by Tukey's post hoc test with  $P < 0.05$ . RESULTS Session duration was  $62.2 \pm 2.5$  min, with average HR of  $134 \pm 12$  bpm or  $68.7 \pm 6.8\%$  HRmax. WUP, TEC and COM lasted  $11.8 \pm 1.2$ ,  $21.4 \pm 1.6$  and  $28.7 \pm 0.8$  min. Average HR in WUP and TEC were  $119 \pm 17$  and  $119 \pm 14$  bpm, corresponding to  $63 \pm 8$  and  $63 \pm 5\%$  HRmax. These values were significantly lower ( $P < 0.05$ ) than those observed in COM ( $151 \pm 12$  bpm or  $81 \pm 3\%$  HRmax). Peak HR in WUP and TEC were  $156.7 \pm 16$  and  $149.4 \pm 14.4$  bpm, or  $79.6 \pm 8.4$  and  $75.8 \pm 7.0\%$  HRmax. Peak HR values in COM ( $189 \pm 9$  bpm or  $95.9 \pm 5.1\%$  HRmax) were also significantly different from those in other phases ( $P < 0.05$ ). DISCUSSION From average HR values the BJJ training session could be considered moderate for the studied subjects. Peak HR in COM was similar those reported by Borges et al. (2012) and Andreato et al. (2012) in BJJ simulations combats. This phase demanded the highest effort of the athletes during the training session, leading to peak values that indicate high intensity exertion. REFERENCES Borges CC, De Oliveira RA, De Oliveira RA, Silva RFS, Perfeito PJC. (2012). Physiological responses in acute jiu-jitsu and correlation with the aerobic capacity. Fiep Bulletin, 82, 2. Andreato LV, Moraes SMF, Del Conti Esteves JV, Pereira RRA, Gomes TLM, Andreato TV et al. (2012) Physiological responses and rate of perceived exertion in Brazilian jiu-jitsu athletes. Kinesiology, 44(2), 173-181. Silva LH, Marshal R, Ribeiro LFP, Mauríno Júnior D, Drigo AJ. (2011). Correlation between methods of quantifying of training load in a session of combats of jiu-jitsu. Fiep Bulletin, 81, 2.

## FINGER FLEXOR STRENGTH MEASUREMENT WITH DIFFERENT ARM POSITIONS IN SPORT CLIMBERS

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Introduction Different arm positions have been used to assess specific finger flexor strength in sport climbers (Grant, Hynes, Whittaker, & Aitchison, 1996; Watts, Martin, & Durtschi, 1993). The aim of the study was to evaluate the validity and reliability of 4 different arm positions for finger flexor strength measurement in sport climbers. Methods Twenty two male climbers of various climbing abilities volunteered to the study. All measurements were undertaken in a sitting position with the same position of finger on the measurement device in a randomly assigned order. Three attempts for left and right hand for each arm position were performed with a 2 minute rest: 1) grip strength with the thumb in opposition, arm extended near the body; 2) arm on a table in the horizontal position (90 degrees between trunk and arm) flexed in elbow (90 degrees); 3) arm partially extended (120 degrees between trunk and arm); 4) arm fully extended (180 degrees between trunk and arm). The measured strength was related to body mass. The intra-class correlation coefficient ICC 2,1 (Shrout & Fleiss, 1979) was used to assess the intra-session reliability of the measurements. The criterion validity was expressed by the relationship between the test results and the climbing ability. Results A high ICC 2,1 was found for all tests 1) 0.90 2) 0.85 3) 0.94 4) 0.86. The highest relationship to the climbing ability was found for the test with fully extended arms ( $r = 0.77$ ). The grip strength, the test with 90 degrees and 120 degrees arm flexion correlated moderately with the climbing ability (0.55, 0.52, and 0.55). Discussion All finger flexor tests demonstrated a high reliability similar to the handgrip dynamometry. Watts et al. (1993) and Macleod et al. (2007) found the grip strength related to body mass as a good indicator of climbing ability although the test lacks specificity with most hand positions required during sport climbing. According to our results, the test with flexed arms proposed by Grant et al. (1996) provided similar results as hand dynamometry. The test with fully extended arms appeared most suitable to assess finger flexor strength in climbers. References Grant, S., Hynes, V., Whittaker, A., & Aitchison, T. (1996). J Sports Sci, 14(4), 301-309. Macleod, D., Sutherland, D. L., Buntin, L., Whitaker, A., Aitchison, T., Watt, I., et al. (2007). J Sports Sci, 25(12), 1433-1443. Shrout, P. E., & Fleiss, J. L. (1979). Psych Bulletin, 86(2), 420-428. Watts, P. B., Martin, D. T., & Durtschi, S. (1993). J Sports Sci, 11, 113-117.

## THE TEST-RETEST RELIABILITY AND MINIMAL DETECTABLE CHANGE OF THE BALANCE ERROR SCORING SYSTEM

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Introduction Balance is an important aspect of sports performance, which can be impaired following minor head injury (MHI; Vieira et al., 2009). The balance error scoring system (BESS) is a clinical tool commonly used for assessment of post-MHI recovery (Riemann & Guskiewicz, 2000). In order for a clinical tool to be accepted in practice, it must be robust from a psychometric perspective, in terms of reliability and sensitivity. This study aimed to ascertain test-retest reliability and, the previously unknown, minimal detectable change (MDC) of the BESS in order to ensure it was appropriate for use in the clinical setting. Methodology N = 36 (25 female; 11 male) academy-

level athletes (19 trampolinists, 11 soccer players, 6 dancers) were assessed using the BESS on two separate testing sessions, 1 week apart. The BESS comprises 6 testing conditions based on modified rhomburg stances and is scored according to "error points" (Valovich McLeod et al., 2006). Results Strong test-retest reliability of the total BESS score was identified (ICC = 0.784) with a MDC of 6-10 error points, dependent on confidence interval used. Discussion and clinical implications The strong reliability score and the relatively low MDC when using conservative measures would recommend the use of BESS in post-MHI assessment of young academy-level athletes. The results from this investigation favour comparably to previous literature (Broglia et al., 2009; Valovich et al., 2006) and further advocate the need to ascertain a mean total error score as a basis for assessment (Bell et al., 2011). However, more is required to further determine BESS MDC in this and other subject groups and whether the use of post-hoc video analysis would enhance reliability of the tool (Padua et al., 2011). Key References Bell DR, Guskiewicz KM, Clark MA et al. Systematic Review of the Balance Error Scoring System. *Sports Health*. 2011;3(3):287-295. Broglia SP, Puetz TW. The effect of sport concussion on neurocognitive function, self-report symptoms, and postural control: a meta-analysis. *Sports Med*. 2008;38(1):53-67. Broglia SP, Zhu W, Sopiarsz K et al. Generalizability theory analysis of Balance Error Scoring System reliability in health young adults. *J Athl Train*. 2009;44(5):497-502. Padua DA, Bolin MC, DiStefano LJ et al. Reliability of the Landing Error Scoring System – real time, a clinical assessment of jump-landing biomechanics. *J Sport Rehabil*. 2011;20(2):145-408. Riemann BL, Guskiewicz KM. Effects of mild head injury on postural stability as measured through clinical balance testing. *J Athl Train*. 2000;35(1):19-25. Valovich McLeod TC, Barr WB, McCrea M et al. Psychometric and measurement properties of concussion assessment tools in youth sports. *J Athl Train*. 2006;41(4):399-408. Vieira TM, de Oliveira LF, Nadal J. An overview of age-related changes in postural control during quiet standing tasks using classical and modern stabilometric descriptors. *J Electromyogr Kinesiol*. 2009;19(6):513-519.

### **BIODENSITY STRENGTH TRAINING: HIGH-INTENSITY LOW-VOLUME TRAINING IN 550 YOUNG AND OLDER MALES AND FEMALES**

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Introduction bioDensity strength training is a high-intensity (maximal-voluntary contraction) and low volume approach to resistance training (RT) that has been commercially available since 2009 (Jaquish, J. et al. 2012). Four multi-joint and multi-muscle group maximal-voluntary contractions are performed for 5 seconds once per week. To date, the strength gains associated with this limited-range static mode of RT have not been reported. This retrospective study reports strength changes in young to older males and females across 24-weeks of training. Methods 550 males and females completed 24 weekly bioDensity RT sessions. Changes in Chest Press (CP), Leg Press (LP), Core Pull (Core) and Vertical Lift (VL) strength were determined (RMANOVA) at 8, 12, and 24 weeks. The effect of age on strength gains was determined by a median-age split in males (> or < 57.0 years; N=174) and females (> or < 60.5 years; N=376). Results bioDensity RT resulted in significant strength gains for CP, LP, Core, and VL at 8-weeks in men and women. Age-specific results show similar strength increases at 8-weeks with the exception of CP in younger men and Core in older men, although significant increases were observed for Core in older men at 12-weeks (12.7%; P<0.05). For all but Core strength gains at 12-weeks in older men, there were no additional increases in strength between 12- and 24-weeks for any of the exercises in males or females in any age group. Discussion These findings demonstrate significant and functional increases in strength across a wide age range of males and females with 1 session per week of high-intensity bioDensity RT. However, the 5-second maximal-voluntary contraction 1-time per week was not a sufficient intensity and volume combination to elicit further strength gains at 24-weeks. These findings are aligned with those of others demonstrating the efficacy (de Vos et al. 2008), feasibility, and safety (Littbrand et al. 2011) of high-intensity strength training even in older adults. References Jaquish J, Singh R, Hynote E, and Conviser J. Osteogenic Loading: A new modality to facilitate bone density development. Nevada City, CA: Performance Health Systems, 2012. Littbrand H, Carlsson M, Lundin-Olsson L, Lindelöf N, Häglin L, Gustafson Y, Rosendahl E. Effect of a high-intensity functional exercise program on functional balance: preplanned subgroup analyses of a randomized controlled trial in residential care facilities. *J Am Geriatr Soc*. 2011 Jul;59(7):1274-82. de Vos NJ, Singh NA, Ross DA, Stavrinou TM, Orr R, Fatarone Singh MA. Effect of power-training intensity on the contribution of force and velocity to peak power in older adults. *J Aging Phys Act*. 2008 Oct;16(4):393-407.

### **PHYSIOLOGICAL RESPONSES AND ENERGY COST DURING A SIMULATION OF FENCING**

Roberto, S., Omeri, M.3, Di Ciolo, E.3, Sanna, I.1, Palazzolo, G.1, Piredda, S.1, Sainas, G.1, Marcelli, M.1, Migliaccio, G.M.2, Pinna, M.1, Crisafulli, A.1, Milia, R.1

*1Sports Physiology Lab., University of Cagliari(Italy); 2Regional School of Sport of Sardinia, Italian Olympic Committee; 3F.I.S. Federazione Italiana Scherma.*

Introduction. Fencing is an Olympic combat sport during which athletes perform a one to one action using bladed weapons. The combat consists in 3 x 3 minutes fighting, with 1 minute rest between each combat. There are few studies investigating on oxygen uptake and energetic demand during Fencing competition, thus the energetic expenditure (EE) and requests in this sport remain speculative. This study was performed to obtain an understanding of the physiological capacities underlying fencing performance. Methods. The aerobic energy expenditure and the recruitment of lactic anaerobic metabolism were determined in 15 athletes (2 females and 13 males) during a simulation of fencing by using a portable gas analyser (MedGraphics VO2000), able to provide data of oxygen uptake (V'O<sub>2</sub>), carbon dioxide production (V'CO<sub>2</sub>) and heart rate (HR). The excess of CO<sub>2</sub> production (CO<sub>2</sub>excess) was also measured in order to obtain an index of anaerobic glycolysis. Blood lactate (Bla) was assessed by means of a portable lactate analyzer (Lactate Pro, Arkray Inc., Kyoto, Japan). Results. During the match group EE was on average (mean ± standard deviation) 10.5±2.8 kcalxmin<sup>-1</sup>, corresponding to 9.1±2.3 metabolic equivalents. V'O<sub>2</sub> and HR were always above the level of the anaerobic threshold previously assessed in a preliminary incremental test. CO<sub>2</sub>excess showed an abrupt increase in the first recovery after the first fight and reached a value of 339.1±240.1 mLxmin<sup>-1</sup>. Blood lactate concentration at peak was 6.8±2.4 mmolxL<sup>-1</sup>. Discussion. These data suggest that Fencing is a physically demanding sport activity with great involvement of both the aerobic metabolism and anaerobic glycolysis. Coaches should consider these facts when building training programs able to improve the specific adaptations required by Fencing. References. Crisafulli A et al. (2009) *Appl Physiol Nutr Metab*, 34(2):143-50. Roi G. S. et al (2008) *Sports Med*, 38(6):465-481. Weichenberger M. et al (2012) *Int. J. Sports Med*, 33(1):48-52. Tsolakis C. et al. (2010) *Percept Mot Skills*, 110(3 Pt 2):1015-28.

## THE RELATIONSHIP BETWEEN BODY COMPOSITION AND THE AEROBIC CAPACITY OF AMPUTEE SOCCER PLAYERS

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**Introduction** Soccer which includes various explosive movements like jumping, shooting, forward and backward shuffles, challenges, turns, dribbles, sprints, controlling the ball under pressure, running at different intensities, speeds, and sliding tackles, is an aerobic-based anaerobic sport (Köklü et al. 2011). In amputee soccer, short bursts of high intensity power production and aerobic capacity play a major role in performance (Özkan et al., 2012; Yazıcıoğlu K., 2007). The physiological demands of soccer require players to be competent in several aspects of fitness (Reilly & Doran, 2003). Moreover, body structure has generally been found to have a significant relationship to physical and aerobic performance (Docherty & Gaul, 1991). Therefore, the purpose of the present study was to investigate the relationship between body composition and aerobic capacity of amputee soccer players. **Methods** Thirteen amputee soccer players participated in this study voluntarily. Subjects' height, body weight, body mass index, skinfold thicknesses and body fat percentage (Jackson and Pollock formula) were determined. Aerobic capacities of 13 players were evaluated by the 1-Mile Run Test (1-MRT) and the Cooper Test (CT). The subjects' VO<sub>2</sub>max was estimated by the prediction equations developed Cureton et al. (1995) for the 1-MRT and Cooper et al. (1968) for the CT. **Results** The results of the Pearson Product Moment correlation analysis indicated that estimated aerobic capacity by 1-MRT was significantly correlated with body weight, body mass index and biceps, triceps, pectoral, midaxillar, suprailiac, subscapula, abdominal, thigh skinfold thicknesses ( $r = -0.588$  to  $-0.759$ ,  $p < 0.05$ ). Significant correlations were found between estimated aerobic capacity by 1-CT and body weight ( $r = -0.766$ ,  $p < 0.05$ ), body mass index ( $r = -0.801$ ,  $p < 0.05$ ) biceps, pectoral, midaxillar, suprailiac, subscapula, abdominal and calf skinfold thicknesses ( $p < 0.05$ ); whereas, in contrast, there is no significant correlations between 1-CTVO<sub>2</sub>Max and thigh, triceps skinfold thicknesses ( $p > 0.05$ ). **Discussion** In adults, body size, as reflected by height and weight, is significantly related to aerobic performance or physical working capacity (Docherty & Gaul, 1991). Similarly, in conclusion, the findings of the present study indicated that body composition was described as an essential factor in aerobic performance in amputee football players. **References** Cooper K. H. (1968). JAMA, 203(3), 201-204. Cureton K, Sloniger M. A., O'Bannon JP. et al. (1995). Medicine & science in sports & exercise, 27(3), 445-451. Docherty, D, Gaul, C. (1991). International journal of sports medicine, 12(06), 525-532. Köklü Y., Asçı A., Kaçak F, Alemdaroglu U, Dündar U. (2011). The Journal of Strength & Conditioning Research, 25(6), 1522. Özkan A., Kayihan G., Köklü Y., Ergun N., Koz M., Ersöz G., & Dellal A. (2012). Journal of Human Kinetics, (35),141-146 Reilly T., Doran D. (2003). Science and soccer, 21. Yazıcıoğlu K., (2007). Amputee Sports for Victims of Terrorism (Vol. 31)

## THE EFFECTS OF CAFFEINATED CHEWING GUM ON SIMULATED RACE PERFORMANCE IN COMPETITIVE FEMALE CYCLISTS

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**Introduction** Numerous studies have investigated the effects of caffeine supplementation on endurance and sprint performance with both trained and untrained subjects (Doherty, et al. 2004; Astorino & Robertson, 2010). Therefore, the aim of this study was to determine the effects of caffeine on simulated race performance in competitive female cyclists. **Methodology** Ten well-trained female cyclists ( $25 \pm 7$  yrs;  $58.3 \pm 5.4$  ml.kg<sup>-1</sup>.min<sup>-1</sup>; PPO =  $334 \pm 46$  W) completed a series of three test over ~21 days. The cyclists completed an incremental ramp test followed by a maximal effort performance test on the first day. The performance test consisted of three laps of a 10km race circuit (30km total); in the final 200 meters of each lap subjects were required to complete a maximal sprint. Following the familiarization the cyclists completed two further performance trails with either caffeine (200mg) or a matched placebo chewing gum in a randomised counter balanced design. The cyclists chewed the gum for a set period after completing the first 10km circuit. Physiological and perceptual measures were taken at set intervals in both trials. Differences between trials were determined using magnitude based inferential statistics and are reported as mean differences with 90% confidence intervals. **Results** Mean power outputs over the first and second 10km laps of the trial were not substantially different between caffeine and placebo ( $1.1 \pm 4.0\%$ ;  $0.0 \pm 2.0\%$  respectively). However mean power output over the final 10-km was substantially higher ( $4.1 \pm 4.1\%$ ) with caffeine. Differences in mean power in the three 200 meter sprints were trivial but trended to a small increase in power following caffeine consumption ( $-1.7 \pm 3.5\%$ ,  $1.4 \pm 4.5\%$  and  $1.9 \pm 5.3\%$  for each respective sprint). There were no substantial differences in VO<sub>2</sub>, RPE, [La] or HR between trials over the first 20km, however there were small increases in VO<sub>2</sub>, [La] and HR but not RPE during the final 10km. **Discussion/Conclusion** The acute ingestion of caffeine via chewing gum provides a small but potentially worthwhile increase in performance during the final 10km of a 30km performance trial in female cyclists. In addition while caffeine did not lead to any clear enhancement in sprint performance there was a trend for an enhancement during the latter sprint trials. The improvements in performance were associated with small changes in measured physiological responses and no substantial changes in RPE. **References** Astorino TA, Roberson DW. Efficacy of acute caffeine ingestion for short-term high intensity exercise performance: a systematic review. J Strength Cond Res 24:257–265, 2010. Doherty M, et al. Caffeine lowers perceptual response and increases power output during high-intensity cycling. J Sports Sci 22:637-643, 2004.

## AN EVALUATION OF METABOLIC RESPONSES BY TIME CONSTANT VALUE OF REGRESSION ANALYSIS

Sasaki, T., Tsunoda, K., Hoshino, H., Takeda, H.

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**Introduction** The oxygen consumption returns to resting level earlier than the change of HR after exercise. VO<sub>2</sub> and HR can be described by respective exponential curve fitting. Exponential equations had shown different time constants after the exercise. Those functions represent different physiological responses in the individual athlete. The purpose of this study is to clarify physiological characteristics by using the time constants after the exercise test. **Methodology** Twenty three volunteer athletes cooperated to perform incremental metabolic test in this study. The test is made up following conditions: 3 min sitting rest, step load tread mill running and at least 5 min sitting rest after exercise. Exercise tests are started at 3 km/h and increased by 0.5km/h every minute until exhaustion. The function for the VO<sub>2</sub> estimation can be described as the function of HR. **Result** All the metabolic data are standardized for comparing each metabolic parameter. The relationship between measured value and regression data shows significant similarity for the 23 athletes ( $r$  : over 0.8) . Therefore, this regression analysis can be used in order to represent individual athlete metabolic response after exercise. Mean values of time constants in each parameters after the exercise are make up following: VO<sub>2</sub> = 65.1sec, VCO<sub>2</sub> = 101.9sec, VE = 109.7sec, and HR = 102.3sec. Time constant of the HR has low correlation to the time constant of the VE ( $r=0.31$ ), the VO<sub>2</sub> ( $r=0.4$ ), and the VCO<sub>2</sub> ( $r=0.47$ ). These parameters show low correlation coefficient below the 0.5. On the other hand, time constant of the VO<sub>2</sub> has high correlation to the

time constant of the VE ( $r=0.84$ ) and the VCO<sub>2</sub> ( $r=0.77$ ). These parameters show high correlation coefficient over the 0.7. Discussion There is the difference of time constant for each metabolic parameter in exponential regression. It is necessary to solve for energy calculation and to describe the VO<sub>2</sub> and the HR after the exercise. However, it could not be estimating energy expenditure during human activities until some years ago. Now, energy estimation is possible by use the method (Sasaki and Tsunoda (2006)). Thus, it has become important for precise calculation that the metabolic parameter after the exercise is obtained. In this study, it can be considered that the difference in time constants of the VO<sub>2</sub> and the HR depend on individual metabolic capacity. In fact, SD is indicated large value in both parameters in VO<sub>2</sub> (20sec) and in HR (30sec). Therefore, large difference of the time constants reflects individual metabolic characteristic. References Sasaki, T. and Tsunoda, K. (2006), The estimation of oxygen consumption from heart rate using an exponential equation, *Hokkaido J. Phys. Educ, Hlth, Sport Sci.* 41 :27-35.

## 15:00 - 16:00

### Mini-Orals

#### PP-PM78 Training and Testing [TT] 13

##### CASE-STUDY: CURVILINEAR RELATIONSHIP BETWEEN SALIVARY TESTOSTERONE AND TRAINING LOAD IN A FEMALE OLYMPIC HAMMER THROWER.

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Testosterone might have a role in the adaptive response to training by regulating long-term muscle performance and/or short-term expression of neuromuscular performance; potentially a result of a dose-response relationship with training load, particularly in elite athletes (Crewther et al., *Sports Med*: 41, 2011). PURPOSE: To investigate a possible dose-response relationship between salivary testosterone of an elite power athlete relative to training load in a period leading up to major competition. METHODS: A female hammer thrower (personal best: 71.98 m; age: 21 y; body mass: 72.4 kg; height 1.71 m) agreed to participate in the present case-study that tracked training load and salivary testosterone during an 83-day period leading up to the London Olympic Games, 2012. Saliva collection was completed in accordance with recognized procedures for sample handling and storage (Dabbs, *Physiol Behavior*: 1, 1991) on 39 occasions during the 83 day-period and subsequently analyzed using a Salimetrics® high sensitivity salivary testosterone enzyme immunoassay kit. Training load was calculated as a moving exponential average using the number of throws completed each day with a decay constant of 42-days (Busso et al., *Eur J Appl Physiol Occup Physiol*: 69, 1994). Investigation of the relationship between salivary testosterone and training load was completed using a hierarchical regression approach. RESULTS: There is an observable relationship between training load (range: 11.0-15.6 average throws/day) and salivary testosterone (range: 34.0-255.9 pmol/L) that has a greater ( $p = 0.036$ ) predictive power when described by a curvilinear (inverted U-shaped) model ( $r = 0.470$ ,  $r^2 = 0.220$ ,  $F(2,38) = 5.091$ ,  $p = 0.011$ ) compared to a linear model ( $r = 0.343$ ,  $r^2 = 0.118$ ,  $F(1,38) = 4.945$ ,  $p = 0.032$ ). CONCLUSIONS: The relationship between training load and salivary testosterone appears to follow a dose-response pattern in an elite female hammer thrower. Although yet to be tested in an athlete support setting, the construction of an individual athlete's dose-response relationship between testosterone and training load could potentially allow optimisation of hormonal response that might underpin muscle and neuromuscular performance in the long and short term, respectively.

##### SOCIAL MEDIA SERVICE PROMOTES PHYSICAL ACTIVITY IN YOUNG RECRUITS

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Introduction It is generally well known that the physical fitness of army recruits has decreased and body weight has increased during the last decades (e.g. Dyrstad et. 2005, Santtila et al. 2006). The negative phenomena have partly been explained by increased physical inactivity among children and adolescents. Therefore, the purpose of present study was to investigate how promotion service of physical activity in social media (MarsMars.fi, HeiaHeia.com, Helsinki, Finland) affects physical activity and physical fitness in the Finnish call-up aged male recruits. Methods Subject group consisted of 802 voluntary male recruits (19.3±1.2 yrs, 1.80±0.07m, 75.5±13.9 kg). The promotion information and password of social media service were sent by mail to subjects three months before the compulsory military service. Body mass, aerobic capacity and physical activity information were self-reported by a structured questionnaire, which was replied during the first military service week. During the second week of military service, body mass was measured and maximal aerobic capacity was evaluated by 12 min running tests (Cooper 1968). Thereafter, the self-reported data were compared to the measured outcomes. Results 112 of 802 persons utilized the service. Aerobic capacity of the service utilizers ( $n=112$ ) did not change significantly (2353±397 vs. 2409±351 m,  $p=0.082$ ). Neither change was recorded in body weight. 60.4% of the service utilizers reported that their physical activity increased. The whole subject group ( $n=802$ ) reported that the best way to promote physical activity before the military service was exercises and training programmes offered by local civilian sport clubs (38.5%). A main reason for not using the present service was lack of need for the offered service (37.0%). Discussion Only 14.0 % of the study group took social media physical activity service in use. Physical activity of those subjects increased significantly due to the social media service. However, it did not lead to changes in body mass or aerobic capacity. According to present results, the promotion of physical activity in social media is very challenging. In conclusion, it will be very important to have a proper marketing campaign to get more adolescents interested in this kind of services, and there is still a need for development of new and more attractive physical activity services even outside of the internet. References Cooper KH (1968). *JAMA*. 203:201-4. Dyrstad SM, Aandstad A and Hallén J (2005). *Scand J Med Sci Sports*. 15:298-303. Santtila M, Kyröläinen H, Vasankari T, Tainen S, Palvalin K, Häkkinen A, Häkkinen K (2006). *Med Sci Sports Exerc*. 38:1990-94.

## RELATIONSHIP OF BODY COMPOSITION ON PERFORMANCE IN ADOLESCENT SWIMMERS

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**Introduction:** Body composition, particularly lean mass, is associated to performance in many adult elite sports. Adolescence is an optimal period to detect talent; we aimed therefore to elucidate the role of lean and fat mass in swimming performance during adolescence. **Methods:** A total of 82 adolescent swimmers (47 males) with a mean age of  $14.5 \pm 2.1$  years participated in this study. Participants were divided into two age-groups: younger (YG) and older (OG) than 14.5 years. Mean values of upper limbs and mean values of lower limbs lean and fat masses were evaluated using 2 methods: dual-energy X-ray absorptiometry (DXA) and bioimpedance. Two methods were used in order to view differences between method results and Personal best times (PBT) correlations. PBT were obtained from a freestyle 50 m maximum course registered in a 25 m swimming pool by a trained rater. Tanner-controlled partial correlations between body composition parameters and PBT were conducted. **Results:** In the male group, lean mass of both limbs was negatively correlated to PBT (the higher lean the better time), while in the female group arm fat mass was positively correlated to PBT (the higher fat the worse time), independently of the method of evaluation (all  $p \leq 0.05$ ). However, separately by age-groups, male YG showed no correlations for any variable, while female YG showed positive correlations between all fat measurements and PBT ( $r$ =from 0.56 to 0.803, all  $p \leq 0.05$ ). Male OG swimmers showed negative correlations for most lean mass measurements and positive correlations for fat mass evaluated by DXA, while female OG showed positive correlations between PBT and fat evaluated with DXA and bioimpedance (all  $p \leq 0.05$ ). Upper limbs fat was the body composition parameter that correlated most often and with higher correlation values ( $r=0.8$ ) with PBT independently of the method used in both groups. DXA and bioimpedance showed similar correlations independently of sex and age. **Conclusion:** It seems that performance is related to body composition in different ways depending on gender and age. Lean mass seems to be crucial for PBT in older adolescent males. However, no correlations were found in females for lean mass, while fat mass positively correlated with PBT independently of the age group. This could be due to the fact that females present lower values of lean mass, which is key to propulsion and higher values of fat mass than boys that may act as ballast and therefore be the most determinant body composition variable for this group regarding PBT.

## INTENSITY PARAMETERS CORRESPONDING TO FIXED LACTATE CONCENTRATIONS DETERMINED BY PERCEIVED EXERCITION.

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Blood lactate concentration (LAC) and rating of perceived exertion (RPE) have been shown as good markers of metabolic demand and LAC is widely used to determine intensity parameters (e.g., heart rate (HR) or speed) for runners in order to prescribe and to control training workload. If RPE is strongly correlated with LAC, the former could predict intensity parameters as well as LAC. Thus, the aim of this study was to determine the agreement between intensity parameters predicted by LAC and RPE in amateur runners. **Methods** Ninety-five amateur runners performed a test on a treadmill (Technogym RunRace, Italy) to determine intensity parameters at 2 mmol (LAC2) and 4 mmol (LAC4) as tested levels (stages duration= 4 min; pauses=1 min to measure LAC; speed increment=1.5 km.h<sup>-1</sup>/stage). The test started with an initial speed corresponding to the 70% of the average speed attained during the last competition, while criterion to stop was the achievement of a LAC  $\geq 4$  mmol. LAC, HR, speed and RPE were recorded in every stage. Individual RPE (RPEI) corresponding to LAC2 (RPEI2) and LAC4 (RPEI4) were predicted for each volunteers through the equation obtained from linear regression between LAC (independent) and RPE (dependent) values. Subsequently, HR (bpm) and speed (km.h<sup>-1</sup>) were predicted through the equation obtained from linear regression using fixed LAC and RPEI values as independent variables. Coefficient of determination (R<sup>2</sup>) was used to verify the fit of regressions. Bland & Altman plot was used to verify the agreement of the predicted values. Data are showed as mean  $\pm$ SD. **Results** The individual regressions between LAC and RPE showed high R<sup>2</sup> ( $0.94 \pm 0.065$ ). Thus, RPEI2 ( $4.2 \pm 1.0$  a.u.) and RPEI4 ( $6.8 \pm 1.1$  a.u.) could be adequate predicted by the linear regression. The Bland & Altman showed that HR predicted by LAC2 and RPEI2 (bias=  $-0.07 \pm 0.34$  bpm; CL 95%=  $\pm 0.7$  bpm), as well as by LAC4 and RPEI4 (bias=  $-0.5 \pm 2.0$  bpm; CL 95%=  $\pm 3.9$  bpm) showed excellent agreement. In the same way, speed predicted by LAC2 and RPEI2 (bias=  $-0.01 \pm 0.04$  km.h<sup>-1</sup>; CL 95%=  $\pm 0.08$  km.h<sup>-1</sup>), as well as by LAC4 and RPEI4 (bias=  $-0.05 \pm 0.35$  km.h<sup>-1</sup>; CL 95%=  $\pm 0.69$  km.h<sup>-1</sup>) also showed excellent agreement. **Conclusion** RPEI showed equal accuracy in relation to its correspondent LAC to predict intensity parameters (HR and speed). This is significant evidence since RPE correspondent to fixed LAC do not change after training period. Reference 1. Boutcher SH, et al. The effects of specificity of training on rating of perceived exertion at the lactate threshold. *Eur J Appl Physiol Occup Physiol.* 1989;59(5):365-9. ere

## EXPERT YOUTH COACHES' VIEW ON LONG TERM TECHNIQUE TRAINING

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**Introduction** Previous research on long term performance development highlighted the significance of technical training at a younger age (Hohmann et al., in press). However, most research in this area focused on explaining general motor skill acquisition and on the conditions that athletes practice under. What appears to remain unaddressed from a practical point of view is the question of how to correctly design the process of technique training in youth sports on the long run. The purpose of this paper was to analyse expert youth sports coaches' understanding of their training practice and to identify basic principles for long term technique development. **Methods** 68 expert youth-coaches (age:  $48.7 \pm 7.4$  years; coaching experience:  $23.7 \pm 7.1$  years) from different sports were selected purposefully to fit a number of similar criteria. The coaches were classified as expert coaches based on specified criteria related to multiple success in coaching. Specifically, expert coaches were defined by the number of successfully coached athletes who reached international competitions in the sport-specific high performance age. Following a qualitative research methodology, data were collected from qualitative, semi-structured interviews. An interview guide was developed to allow for the optimal comparability of the data and to ensure that each interview addressed the required topics. Data were analyzed by using coding procedures and inductive categorization methods inspired by grounded theory principles (Glaser and Strauss, 1967) in order to identify core categories and themes. **Results and Discussion** The evaluation of the data focused on reconstructing an general strategy for a long term design of technique training. Analysis of the transcribed interviews led to a chronological sequence of four main categories: (1) "feeling for technique", (2) "technique-inventory", (3) "technique-precision" and (4) "technique-stability". The findings suggest that successful youth coaches use these categories as an explanatory

framework to structure their knowledge on long term technique training. From a practical point of view it can be assumed that this framework relates the underlying theories and required methods of technique training to the specific stages of youth training. Further research is needed to test this framework against existing principles of technique training (e.g. Williams & Hodges, 2006) and whether it works to explain the process of technique training in other contexts and sports. References Hohmann, A, Singh, A, Voigt, L (in press). Konzepte erfolgreichen Nachwuchstrainings. Glaser, BG, Strauss, AL (1967). Discovery of the grounded theory: Strategies for qualitative research. Chicago, IL: Aldine Williams, AM, Hodges, NJ (2006). Skill acquisition in sport. New York: Routledge. Do not insert authors here

### EXERCISE TOLERANCE ABOVE CRITICAL POWER DOES DEPEND ON THE RATE OF UTILISATION OF $W'$ WHEN MANIPULATED TO THE EXTREMES WITHIN THE SEVERE INTENSITY DOMAIN

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**Introduction** Critical Power (CP) can be derived from the modelling of the power-time relationship and has been shown to be sustainable for 20-40 minutes. Any constant or slightly varied power output above CP can be maintained as long as  $W'$  (i.e., the curvature of the power-time relationship) is not fully depleted. Indeed,  $W'$  determines exercise tolerance when exercising above CP. Therefore, the purpose of this study was to determine the effect of high vs. low rate of utilization of  $W'$  on exercise tolerance within the severe intensity domain. **Methods** Eight active participants (age =  $25.4 \pm 3.5$  yr; body mass =  $75.2 \pm 9.9$  kg;  $VO_{2max}$  =  $57.5 \pm 10.4$  ml/kg/min) performed an incremental test for lactate threshold and  $VO_{2max}$  determinations, four maximal constant-workload tests to estimate CP and  $W'$ , and finally two varied-workload tests performed in randomized order (depletion of 70% of  $W'$  in either 3 or 10 minutes followed by a time to exhaustion at CP + 10W, respectively tlim3 and tlim10). All tests were performed to exhaustion. The three equivalents of the 2-parameter model ( $P=(W'/tlim)+CP$ ;  $tlim = W'/(P-CP)$ ;  $W=CP \cdot tlim + W'$ ) were used to fit the data and estimate CP and  $W'$ . The CP and  $W'$  estimates from the 3 equations were compared to select the best fit using the model associated with the lowest standard error for CP (SEE). **Results** CP and  $W'$  were  $231.9 \pm 61.1$  W (SEE =  $2.9 \pm 1.1$  W) and  $22.0 \pm 6.2$  kJ (SEE =  $1.0 \pm 0.2$  kJ), respectively. The tlim3 ( $15.8 \pm 6.5$  min) was significantly ( $p = 0.03$ ) longer than tlim10 ( $11.8 \pm 8.3$  min). **Discussion** The main finding of this study was that the tolerance to severe intensity exercise was increased when 70% of  $W'$  was depleted at a faster rate, early in the test. The severe intensity domain encompasses work rates above CP in which  $VO_{2max}$  can be elicited. While the same value of  $VO_2$  (i.e.,  $VO_{2max}$ ) is achieved regardless of exercise intensity within this domain, the time to achieve  $VO_{2max}$  is inversely related to exercise intensity (Caputo and Denadai, 2008). The increased rate of oxidative energy turnover (tlim3 condition) within the first part of the exercise is likely to reduce the depletion of the finite anaerobic energy reserves (i.e.,  $W'$ ), thus improving exercise tolerance. In conclusion, faster rate of utilization of the  $W'$  can improve the tolerance during exercise at severe intensity domain. This has previously been demonstrated when exercising maximally for 3-4 minutes (Bailey et al., 2011). **References** Caputo F, Denadai BS. (2008). Eur J Appl Physiol, 103, 47-57. Bailey SJ, Vanhatalo A, DiMenna FJ, Wilkerson DP, Jones AM. (2011). Med Sci Sports Exerc, 43, 457-467.

### EFFECTS OF HIGH AND MODERATE INTENSITY SEMI-SUPERVISED AEROBIC TRAINING PROGRAM IN ELDERLY

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**Introduction** High intensity supervised aerobic training is recommended to improve cardiovascular fitness in elderly. However, restricted social mobility limits the engagement in supervised training, and musculoskeletal abnormalities may difficult the prescription of high intensity exercise, enhancing the semi-supervised moderate exercise as an alternative option. This study was designed to test the hypothesis that moderate and high intensity semi-supervised aerobic training produces significant and similar benefits in elderly. **Methods** Forty seven sedentary subjects (>60 years) performed a maximal cardiopulmonary exercise test before and after 6 months of training. Forty subjects were eligible to start the program, and were randomly divided into 2 groups: high intensity aerobic training (HIT) or moderate intensity aerobic training (MIT). Each training program was composed by 3 sessions/week (2 home-based + 1 clinic-based). In each session, subjects walked or run during 40 min at a pre-determinate heart rate (HR) which was self-monitored. HR was established at the anaerobic threshold (AT) for the first 3 months for both groups and, afterwards, intensity was increased to the respiratory compensation point (RCP) only in the HIT. Twenty-four subjects completed the 6-month program (13 HIT/ 11 MIT). **Results** were compared by 2-way ANOVA (Newman-Keuls post-hoc test,  $P < 0.05$ ). **Results**  $VO_{2max}$  did not change after training in either of the groups, but total time of exercise and maximal work rate increased similarly in MIT and HIT (20 vs. 25 and 29 vs. 35%, respectively).  $VO_2$ , HR and ventilation at AT also increased similarly in both groups (7 vs. 24%, 8 vs. 3 and 12 vs. 32%, respectively). Moreover, HR and ventilation in RCP increased similarly too (3 vs. 1 and 13 vs. 18%, respectively). However,  $VO_2$  at RCP increased (14%) and resting HR decreased (9%) only in the HIT. Additionally, all the groups presented similar reductions in systolic and diastolic resting blood pressures (3 vs. 6 and 7 vs. 9%, respectively). **Discussion** Six months of moderate and high intensity semi-supervised aerobic training similarly improved exercise capacity, cardiovascular health and respiratory efficiency, while only HIT increased high intensity exercise tolerance and improved resting autonomic balance.

### EFFECTS OF DIFFERENT MOTIONS ON TIMING ERROR IN A COINCIDENT TIMING TASK

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**Introduction** Improvement in timing skills is an important factor in improving performance. Therefore, many studies have been carried out to measure and estimate timing skills. The standard method used to measure timing skill is the button-press method. However, in sports, there are few simple motions similar to the button-press task. Therefore, the purpose of this study is to examine the influences of different motions on timing error in a coincident timing task. **Methods** Twenty-four healthy young men ( $20.6 \pm 2.0$  yrs,  $171.0 \pm 6.6$  cm,  $67.1 \pm 11.3$  kg) and fourteen healthy young women ( $18.7 \pm 1.2$  yrs,  $160.3 \pm 6.8$  cm,  $50.6 \pm 6.8$  kg) volunteered for this study. Questionnaire surveys were carried out to investigate past sports experience. The results of the questionnaire were used to categorize subjects into 3 groups: open-skill sports group (O-group), closed-skill sports group (C-group), and the no sports group (N-Group). Timing skills were measured using 2 motion conditions that coincided with the arrival of a moving target running on a circular trackway on display. The 2 motion conditions evaluated were the button and landing conditions. In the button condition, the task was to manually press a button coinciding with the arrival of a moving target. In the landing condition, the task was to landing from a 35-cm high table coinciding with the arrival of a moving target. The timing error of each task was calculated. **Results and Discussion** In the button condition, the timing error was  $0.025 \pm$

0.015 sec in the N-group,  $0.019 \pm 0.005$  sec in the C-group, and  $0.030 \pm 0.022$  sec in the O-group. No significant differences were observed in the timing error in the button condition between the 3 groups. The timing error in the case of the landing condition was  $0.108 \pm 0.039$  sec in the N-group,  $0.071 \pm 0.025$  sec in the C-group, and  $0.077 \pm 0.016$  sec in the O-group. The timing error in the C-group and O-group was significantly lesser than that in the N-group ( $P < 0.05$ ). In addition, the timing error of the button condition was not correlated with that of the landing condition. This result showed that an increase in the motion time influences timing error. Furthermore, simple motion in a coincident timing task, such as a button-press task, cannot be used to evaluate timing skill. Therefore, we concluded that a task with a slightly greater motion time, such as a landing condition, is required to measure timing skill. (The Ministry of Education, Culture, Sports, Science and Technology, Grant-in-Aid for Young Scientists (B))

### RELIABILITY OF ISOMETRIC PEAK TORQUE AND RATE OF TORQUE DEVELOPMENT OF INTERNAL SHOULDERS ROTATORS MUSCLES IN SWIMMERS

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Introduction Peak torque (PT) and the rate of torque development (RTD) have been considered important neuromuscular parameters for the evaluation of athletes. In swimming, the internal rotators of the shoulders (ISR) have been considered important during the propulsive phase in front crawl (Pink et al., 1991). However, the information regarding the reliability of these parameters (i.e., PT and RTD) in the literature is lacking. The reliability is essential for experimental conditions such as training and rehabilitation programs. Therefore, the objective of this study was to analyze the reliability of the isometric and isokinetic PT and the RTD of ISR in swimmers. Methods Eight short- and middle-distance swimmers performed the following procedures, in different days, in a dynamometer: 1) Familiarization session; 2) Two identical experimental sessions consisting of two 5-s maximal isometric contractions to determine isometric peak torque (PTI), five maximal concentric contractions at  $60^\circ/\text{s}$  (PTC60) and five maximal concentric contractions at  $180^\circ/\text{s}$  (PTC180) to determine peak isokinetic torque. The RTD was determined during isometric contractions. The reliability of data was analyzed using Student *t* test, intraclass correlation coefficient (ICC) and typical error (TE). The reliability was classified in accordance with ICC values, as poor ( $<0.4$ ), moderate (0.4-0.75) or excellent ( $>0.75$ ) (Fleiss et al., 2003). Results PT values were similar between trials (PTI =  $48.9 \pm 11.0$  Nm and  $47.8 \pm 9.5$  Nm; PTC60 =  $55.5 \pm 10.1$  Nm and  $51.9 \pm 11.3$  Nm; PTC180 =  $55.1 \pm 7.1$  Nm and  $55.7 \pm 10.3$  Nm) ( $p > 0.05$ ). Moderate reliability was found for PT (PTI = 0.71; PTC60 = 0.62 and PTC180 = 0.71), and the TE for PTI, PTC60 and PTC180 ranged between 10.4-14.5%. RTD values were similar between trials ( $177.2 \pm 67.6$  Nm.s<sup>-1</sup> and  $186.1 \pm 85.4$  Nm.s<sup>-1</sup>) ( $p > 0.05$ ). Excellent reliability was found for the RTD (0.94) and the TE was 12.4%. Discussion The main finding of this study was that the isometric and isokinetic PT and RTD of the ISR presented moderate to excellent reliability in trained swimmers. Low to high reliability was reported for concentric PT of ISR (ICC = 0.53-0.98), due to factors such as the degrees of freedom, the subject's position and posture (Edouard et al., 2011). Therefore, caution might be necessary when using PT of ISR data as the basis for individual athlete-related decisions. References Edouard P, Samozino P, Julia M, Cervera SG, Vanbiervliet W, Calmels P, Gremeaux V. (2011) *J Sport Rehab*, 20, 367-383. Fleiss, JL, Levin, B, and Paik, M. (2003) *Statistical methods for rates and proportions*. John Wiley and Sons, New Jersey. Pink M, Perry J, Browne A, Scovazzo ML, Kerrigan J. (1991) *Am J Sports Med*, 19, 569-576.

### CORRELATES OF WHOLE BODY AND MUSCLE OXYGEN ON KINETICS, PHYSIOLOGICAL VARIABLES AND PERFORMANCE IN SPRINT KAYAK

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Introduction The purposes of the present investigation were to determine the relationships between whole body and muscle oxygen kinetics, physiological variables and performance in 200-m and 1000-m and whether well trained junior sprint kayak athletes with higher maximum aerobic power (MAP) were superior than their lower counterparts ( $n=20$ ,  $17 \pm 1.2$  y). Methods The National Sprint Kayak Incremental step test was performed on a kayak ergometer in the laboratory to determine  $\text{VO}_2\text{max}$ , MAP, power:weight ratio and  $\text{VO}_2\text{peak}$  at lactate threshold ( $\text{VO}_2\text{LT}$ ). A series of square wave tests determined whole body and muscle on kinetics. On-water time trials were completed over 200-m and 1000-m. MAP scores from the laboratory test were used to separate the highest eight (HG) and lowest eight (LG) scores. Results There were large to nearly perfect correlations between performance over 200-m and 1000-m and MAP,  $\text{VO}_2\text{max}$  power:weight and  $\text{VO}_2\text{LT}$ . Moderate correlations were found between the muscle O<sub>2</sub> kinetics at the heavy domain ( $\Delta 50\%$ ) and performance over 200-m and 1000-m. All physiological and performance variables were superior for the HG (100%, certain chance) compared to LG. The O<sub>2</sub> uptake kinetics in the moderate domain (77%, likely) and the muscle O<sub>2</sub> kinetics in the heavy domain (97%, very likely) presented to be superior for the HG. Discussion Our findings demonstrate the importance of the aerobic fitness to sprint kayak performance in both 200-m and 1000-m events. Specifically, the power:weight ratio, MAP and muscle O<sub>2</sub> kinetics in the heavy domain underlie sprint kayak performance in well trained paddlers. The strongest relationship observed with MAP compared all other physiological and performance variables, suggests these characteristics should be developed through specific training. Moreover, the faster muscle O<sub>2</sub> kinetics in the HG, and its moderate relationship with kayak performance in the whole group, suggest that interventions that speed muscle O<sub>2</sub> uptake kinetics are important for developing kayak athletes. Further studies are required to better explore optimal methods for speeding O<sub>2</sub> kinetics and performance in sprint kayak athletes.

### COMPARISON OF BIA AND SKINFOLD PREDICTION OF BODY FATNESS WITH UNDERWATER WEIGHING DENSITOMETRY IN A LONGITUDINAL STUDY ON ADOLESCENT SPRINT ATHLETES

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Introduction Estimation of body fatness is an important tool in athletic coaching. Sprint athletes are recognized as strength athletes who need to achieve a high power to weight ratio by maximizing muscle mass and maintaining low body fat. During adolescent growth, fat and fat free mass are known to evolve in a sex specific manner. The most accurate estimations of body fatness are achieved with laboratory techniques. However, less accurate but user friendly field methods offer a valuable alternative for follow-up of body fatness by athletics coaches (Norgan, 2005). It was the aim of this longitudinal study to compare field methods (BIA and skinfold based) with underwater densitometry in adolescent sprint athletes. Methods Adolescent sprint athletes (14 girls, 12 boys) were measured every 6 months during 3 years (age at start =  $15.0 \pm 1.1$  yrs in girls and  $15.1 \pm 1.3$  yrs in boys). On all 6 occasions, body fatness was estimated in 3 different ways. Anthropometric data were collected according ISAK guidelines (Marfell-Jones et al., 2006), used to estimate body fatness with the formu-

la of Slaughter et al. (1988). Secondly, BIA body fatness was estimated with the TANITA TBF 410. Finally, as the standard method, body density was measured through underwater weighing and body fatness was calculated with the formula of Siri (1956). Data were analysed with a Repeated Measures MANOVA. Pearson correlations were calculated between the different methods at each occasion. Significance level was set at 5%. Results No gender over time effect was observed during this study ( $P=0.181$ ). In both genders, mean values of body fatness according the skinfold formula and BIA evolved differently from the underwater weighing method ( $P=.012$  and  $P=.021$ , respectively). In girls, the skinfold formula and BIA correlated comparably with the underwater weighing method, with  $r$  ranging between .30 (non-significant) to .77 ( $P<.001$ ). In boys, the skinfold formula showed the strongest correlations with the underwater weighing method with  $r$  ranging between .32 (non-significant) to .64 ( $P<.001$ ). Discussion In both genders the field methods showed a different evolution of body fatness with the underwater weighing method which was considered as the standard. Moreover, low to moderately high correlations indicate important differences with the underwater weighing method at the individual level, especially in boys for the BIA method. Therefore, when using field methods to assess body fatness in adolescent sprint athletes, it is advised to additionally perform a laboratory measurement on a regular basis, which can be considered as a reference. References Marfell-Jones M, Olds T, Stewart A, Carter L (2006). International standards for anthropometric assessment. ISAK, Potchefstroom, South Africa. Norgan, NG (2005). Public Health Nutrition, 8(7A), 1108-1122. Siri WE (1961). Techniques for measuring body composition. National Academy Press, Washington, DC. Slaughter MH, Lohman TG, Boileau RA, Horswill CA, Stillman RJ, Van LM, Bembem DA (1988). Human Biology, 60, 709–723.

### EFFECT OF ISCHEMIC PRECONDITIONING ON LAND BASED SPRINTING IN TEAM SPORT ATHLETES.

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**Introduction** The study aimed to assess whether exposure to ischemic preconditioning (IPC) in a trained population would affect land based maximal sprinting performance over 30 m. **Methods** Twenty five well trained participants regularly involved in invasion type team sport events were recruited to take part in a randomised crossover study design. Participants underwent both an IPC and placebo treatment involving three periods of 5 min occlusion applied unilaterally (3 x 5min occlusion to each leg) at either 220 mmHg or 50 mmHg respectively. Each period of occlusion was followed by 5 min reperfusion. Following treatment three maximal sprints over a distance of 30 m were undertaken from a standing start interspersed with one minute recovery. Split times were recorded at 10, 20 and 30 m. Results No significant effects of the IPC treatment were observed on sprint speed ( $P<0.05$ ) at any of the split timings. Additional calculated effect sizes of the treatment were found to be small ( $ES<0.2$ ). **Discussion** Results from the present study suggest there to be no benefit to team sport players in utilising IPC as a means of enhancing sprint performance over a distance of 30 m. Whilst IPC has been shown to be beneficial to sprint activities in other sports such as swimming, further research is required to elucidate whether this is the case over distances associated with land based events in track and field and/or in events reliant on repeated sprint ability.

### SPORTS-SPECIFIC FEATURES OF SOCCER PLAYERS' HEART

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**Introduction** Physical training induces adaptations which affect all of the heart. Sports-specific adaptive cardiac structural changes are still under debate. The aim of this study is to determine the effect of intermittent high intensity exercise of moderate duration on the heart. **Methods** The subjects were 209 professional soccer players. In the first group ( $n=127$ ) the average age was  $19.2\pm 1.2$  and in the second group ( $n=82$ )  $24.6\pm 2.9$  years. As a part of the routine testing the echocardiography was performed using GE Vivid E/9. The t-test and correlation coefficients were calculated. Results Only 3 averages in the two groups – age, body mass and training age – differ with statistical significance. However, we can observe some tendencies of differences. All mean indices in the older group were greater: AO by 2.8%, LA size by 2.1%, LVIDd by 3.8%, IVSd by 3.4%, LVPW by 3.0% and SV by 8.3%. Older athletes had more measures similar to or higher than the substandards: LA $\geq 3.6$  cm (in 7.3% of the members of the group); LVIDd $\geq 6.0$  cm (6.1%; vs. 3.2% of the younger players); IVSd $\geq 1.5$  cm (4.9%; vs 3.9%); LVPW $\geq 1.5$  cm (3.7%; vs. 1.6%). **Discussion** Comparing the echocardiographic means of the two groups we confirmed that AO and LA were greater in the adult group. High endurance sports requiring rapid accelerations, such as soccer, result in increases in LA dimension. But considerable LA enlargement ( $>4.5$  cm) was rare ( $<2\%$ ). Our athletes' largest LA size was 3.8 cm. The most frequent cause of the exercise-related cardiac arrest in young athletes is HCM. Large-sample studies have shown that a significant proportion of endurance athletes exceed the 'normal upper limit' (5.5 cm) for LV. Among high level athletes from different sports, the LV diameter was measured to be 6.0 to 7.0 cm. This kind of eccentric hypertrophy exists in 6% of endurance athletes (Whyte et al., 2004). We have the same percentage in the older group but the greatest measure was 6.1 cm. Concentric type myocardial hypertrophy, common to strength/power sports, is characterized as an increase in LV mass with an augmented relative wall thickness ( $RWT>0.42$ ). Our biggest RWT value in the younger group was 0.40. SV was significantly greater in older athletes, as a testimony of a better functional state. **Conclusion** We can conclude that soccer's sports-specific influence on the heart produces 'symmetric remodelling', an adaptation where both the dilatation and the wall thickening of the chamber occur moderately. Rapid heart development ends by 21 years, the most changeable part of the heart in older soccer players is the left ventricle. References Whyte, G.P., George, K., Sharma, S., Firoozi, S., Stephens, N., Senior, R. and McKenna, W.J. (2004) The upper limit of physiological cardiac hypertrophy in elite male and female athletes: the British experience. European Journal of Applied Physiology 92, 592-597.

15:00 - 16:00

## Mini-Orals

## PP-PM84 Training and Testing [TT] 19

**REPEATED SPRINT ABILITY AND STRIDE KINEMATICS ARE ALTERED FOLLOWING AN OFFICIAL MATCH IN NATIONAL-LEVEL BASKETBALL PLAYERS**

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Recent studies have shown evidence that fatigue may occur during basketball match-play. It is well documented in other sports that fatigue alters biomechanical parameters and stride kinematics during sprinting, which could negatively affect performance and possibly predispose the athlete to injury in the latter stages of a competition. Therefore, the purpose of the present study is to investigate the effects of fatigue induced by playing an official national-level basketball match on repeated sprint ability (RSA) and stride kinematics. Nine male starting basketball players (22.8±2.2 years old, 191.3±5.8 cm, 88.0±10.3 kg, 12.3±4.6% of body fat) volunteered to take part. Six repetitions of maximal 4-s sprints were performed on a non-motorised treadmill, separated by 21-s of passive recovery, before and immediately after playing an official match. Fluid loss, playing time, and the frequencies of the main match activities were recorded. The peak, mean, and performance decrement for average and maximal speed, acceleration, power, vertical and horizontal forces, and stride parameters were calculated over the six sprints. Differences between pre- and post-match were assessed by student t-tests. Significant differences between pre- and post-tests were observed in mean speed (-3.3%), peak and mean horizontal forces (-4.3% and -17.4%), peak and mean vertical forces (-3.4% and -3.7%), contact time (+7.3%), stride duration (+4.6%) and stride frequency (-4.0%), ( $P < 0.05$ ). In addition, the variation in several RSA parameters, such as peak and mean speed, peak and mean acceleration, mean power, and peak and mean vertical force were significantly correlated to fluid loss and sprint, jump and shuffle frequencies ( $P < 0.05$ ). These results highlight that the impairment in repeated sprint ability depends on the specific activities performed, and that replacing fluid loss through sweating during a match is crucial. REFERENCES 1. Ben Abdelkrim N, Castagna C, El Fazaa S, El Ati J. The effect of players' standard and tactical strategy on game demands in men's basketball. *J Strength Cond Res* 2010; 24: 2652-62. 2. Christina KA, White SC, Gilchrist LA. Effect of localized muscle fatigue on vertical ground reaction forces and ankle joint motion during running. *Hum Mov Sci* 2001; 20: 257-76. 3. Hausswirth C, Bigard AX, Guezennec CY. Relationships between running mechanics and energy cost of running at the end of a triathlon and a marathon. *Int J Sports Med* 1997; 18: 330-9.

**ECCENTRIC OVERLOAD BY INERTIAL RESISTANCE TRAINING: EFFECTS ON PATELLAR TENDINOPATHY AND MUSCLE POWER IN JUMPING SPORTS**

Gual, G., Fort-Vanmeerhaeghe, A., Romero-Rodriguez, D., Tesch, P., Costa, L.

*Universitat de les Illes Balears*

Introduction Patellar tendinopathy has an elevated prevalence in jumping sports such as volleyball and basketball (Lian et al, 2005; Swerver et al, 2011). Given the scientific evidence provided during the last decades concerning the therapeutic benefits of eccentric training (Larsson et al, 2012) and the scarcity of research focused on the prevention of this injury, we aimed to investigate the effects of a weekly eccentric training program by inertial resistance in the prevention of patellar tendinopathy and lower limbs muscle power. Methods Four male and four female basketball and volleyball teams participated in this study, and were randomly assigned to either the intervention group (IG) or the control group (CG). IG and CG performed during the whole session their planned sport program, while we added a weekly session of eccentric overload by inertial resistance to the IG. Data from patellar tendinopathy questionnaire (VISA-p), vertical counter-movement jump (CMJ) test and squat power test were recorded during three assessment times (T1, T2 and T3). Results Results showed no differences between groups neither in terms of patellar tendinopathy injury incidence nor VISA-p questionnaire. Female IG improved both the CMJ test (T1 vs T2 and T1 vs T3,  $p < 0.05$ ) and the squat power test (T1 vs T3,  $p < 0.05$ ). Male IG improved the squat power test either in T1 vs T2 and T1 vs T3 ( $p < 0.05$ ), while male CG improved the CMJ test only in the T2 vs T3 comparison ( $p < 0.05$ ). Discussion On the basis of this experimental study we conclude that a weekly eccentric overload squat training improves lower limbs muscle power in jumping sports. This training program does not worsen patellar tendon pain and/or function, but non-positive effects have been registered on injury prevention when comparing to a CG. Besides this, it is also important to mention that the improvements derived from this training program seem to be larger in women when comparing to men athletes. References Lian OB, Engebretsen L, & Bahr R (2005). Prevalence of jumper's knee among elite athletes from different sports: A cross-sectional study. *Am J Sports Med*, 33(4):561-7. Swerver J, Bredeweg S, & van den Akker-Scheek I (2011). Prevalence of jumper's knee among non-elite athletes from different sports: A cross-sectional survey. *Am J Sports Med*, 39(9):1984-8. Larsson ME, Käll I, Nilsson-Helander K (2012). Treatment of patellar tendinopathy - a systematic review of randomized controlled trials. *Knee Surg Sports Traumatol Arthrosc*, 20(8):1632-46.

**THE EFFECT OF HEAVY VS. MODERATE-LOAD TRAINING ON STRENGTH, JUMP HEIGHT AND ACCELERATION PERFORMANCE.**

Mora Custodio, R., Yáñez-García, J.M., Rodríguez-Rosell, D., Pareja-Blanco, F., González-Badillo, J.J.

*Universidad Pablo de Olavide*

Introduction From the various training variables, it appears that training intensity is the most important variable to consider when designing a resistance training (RT) program [1]. It is not clear which intensity produces greater neuromuscular performance improvement [2]. Therefore, the aim of this study was to analyze the effect of two type of RT with different intensities and equal volume on muscular strength, jump height and sprint performance. Methods Thirty-two physically active women (age: 21.3±1.7yr, height: 1.65±0.07m, body mass: 61.2±9.7kg) were randomly assigned in three experimental groups: high load group (HLG; n=10), moderate load group (MLG; n=14) and control group (CG; n=8). Training involved two sessions per week for 12wk in which subjects performed full squats (SQ) with 65-80%RM (HLG) or 40-60%RM (MLG) with 4-6rep/set. Both groups performed the same volume. The variables measured were counter-movement jump (CMJ), 1RM\_SQ and acceleration capacity in 10 and 20m (T10, T20, T10-20). A related-samples t-test was used to analyze

within-group pre-post changes. The differences between groups were assessed using an analysis of covariance (ANCOVA) with the contrast F of Bonferroni. Significance was accepted at  $P \leq 0.05$ . Effect sizes (ES) were calculated using Hedge's *g*. Results Significant improvements were found in all variables for MLG whereas HLG obtained significant enhancement only in T10 and RM\_SQ. Any variable showed changes for CG. Although only the RM\_SQ showed significant differences between training groups, ES indicates that the magnitude of change in each measured variable was higher for MLG than HLG. MLG showed significantly greater improvements than CG in T20, T10-20 and RM\_SQ, whereas HLG obtained higher increases than CG only in RM\_SQ. Discussion The main finding of this study was that MLG achieved higher improvements in performance than HLG. Other works have analyzed the effects of different intensities but they have used different volume [2] or exercise [3]. Therefore, in our study, when RT was performed with the same volume produces greater performance improvement with moderate intensities (40-60%RM) than high intensities (65-80%RM) in women physically active. References 1. Tan, B., Manipulating resistance training program variables to optimize maximum strength in men: A Review. *J Strength Cond Res*, 1999. 13(3): p. 289-304. 2. Hermassi, S., et al., The effect of heavy- vs. moderate-load training on the development of strength, power, and throwing ball velocity in male handball players. *J Strength Cond Res*, 2010. 24(9): p. 2408-18. 3. Wilson, G.J., et al., The optimal training load for the development of dynamic athletic performance. *Med Sci Sports Exerc*, 1993. 25(11): p. 1279-86. here

### ANTHROPOMETRIC PROFILE OF GERMAN ELITE ATHLETES

Araújo, M.C.1, Mießen, K.A.M.1, Baumgart, C.1, Freiwald, J.1

1: Research Center for Performance Diagnostics and Training Advice - FLT (University of Wuppertal, Germany)

**Introduction** An association between competitive success and physique attributes has been observed in many sports [1], further the anthropometric profile differs between athletes of different sports [2;3]. Reference data of elite athletes may contribute to a better understanding of the specific demands of a sport as well as to monitoring training regimens. Therefore, the aim of this study was to provide a comparative profile of German elite athletes of four distinct sports. **Methods** Seventy-five athletes participated in the study, composing the following groups: Soccer First League (A), Soccer Fourth League (B), Handball First League (C), German National Teams of Beach Soccer (D) and Roller Hockey - Quad (E). After measurement of stature (S) and total body mass (TBM), tetrapolar bioelectric impedance analysis (BIA) was performed (Bodystat QuadScan 4000, version 2/02, GB) in a supine position within 10 min rest. Body mass index (BMI), percent body fat (%F) and total body water (%TBW) as well as body cell mass (BCM) were then determined. Differences between groups were calculated using ANOVA, with Bonferroni post-hoc test. Statistical significance was set at  $p \leq 0.05$ . **Results** Results are presented as mean for each group. A:  $n=18$ ,  $S=1.82$  m,  $TBM=79.5$  kg,  $BMI=24.0$ ,  $\%F=10.3$ ,  $\%TBW=63.4$ ,  $BCM=40.4$  kg. B:  $n=22$ ,  $S=1.82$  m,  $TBM=76.8$  kg,  $BMI=23.1$ ,  $\%F=10.6$ ,  $\%TBW=62.7$ ,  $BCM=38.2$  kg. C:  $n=16$ ,  $S=1.90$  m,  $TBM=93.9$  kg,  $BMI=26.0$ ,  $\%F=13.1$ ,  $\%TBW=60.6$ ,  $BCM=46.3$  kg. D:  $n=7$ ,  $S=1.79$  m,  $TBM=76.2$  kg,  $BMI=23.7$ ,  $\%F=12.2$ ,  $\%TBW=61.3$ ,  $BCM=38.2$  kg. E:  $n=12$ ,  $S=1.79$  m,  $TBM=78.1$  kg,  $BMI=24.4$ ,  $\%F=12.2$ ,  $\%TBW=61.5$ ,  $BCM=39.3$  kg. Compared to all other groups C has significantly higher values for TBM ( $p<0.001$ ), S ( $p\leq 0.004$ ), BMI ( $p\leq 0.038$ ) and BCM ( $p\leq 0.001$ ), as well as for %F only in comparison to group A ( $p<0.045$ ). There are no significant differences between other groups. **Discussion** Although there seems to exist a determined profile for elite athletes, anthropometric and body composition characteristics may be more specific to certain sports such as handball in this case. Further research should investigate whether these differences are also reflected in distinct strength, power or endurance performances parameters. Moreover, the variables studied here were not able to differentiate competitive levels in German soccer, in contrast to results for Italian soccer players [2]. **References** [1] Tanner, R. K. & Gore, C. J. (2013). *Physiological tests for elite athletes*. (2nd ed.). Champaign: Human Kinetics. [2] Andreoli A, Melchiorri G, Brozzi M, Di Marco A, Volpe SL, Garofano P, Di Daniele N, De Lorenzo A. (2003). Effect of different sports on body cell mass in highly trained athletes. *Acta Diabetol*, 40, S122-5 [3] Svantesson U, Zander M, Klingberg S, Slinde, F. (2008). Body composition in male elite athletes, comparison of bioelectrical impedance spectroscopy with dual energy X-ray absorptiometry. *J Negat Results Biomed*, 7(1).

### POTENTIATION EFFECT OF VOLLEYBALL GAME AND PREPARATORY EXERCISES ON VERTICAL JUMP PERFORMANCE

Marocolo, M., Nazário-de-Rezende, F., Freitas, D.G.S., Silva, B.V.C., Evangelista, J.M., Souza, F.D., Mota, G.R.

Federal University of Triângulo Mineiro, President Antonio Carlos University, Estácio de Sá Faculty

**Introduction** The best-suited protocols for preparatory exercises aimed to improve performance in competitive situations are not well described in the literature. Thus, the aims of this study were: I) to evaluate the effect of 4 different preparatory exercises (PEs) on vertical countermovement jump (VCMJ) performance; and II) to verify the effect of participation in a volleyball game on the performance of 4 blocking-specific jumps. **Methods** The study was divided into two phases. The first phase included 9 female volleyball athletes ( $15.4 \pm 0.5$  yrs) and examined the effect of the athletes carrying out 4 PEs (stretching [ST] leg cycloergometer [Bike], leg-press resistance exercise [RE], and specific vertical jump [VJ]; in a random order) for 5 days on their subsequent VCMJ performance (contact carpet). The second phase included 12 female professional volleyball athletes ( $23.1 \pm 3.2$  yrs) who were tested before and after a friendly game to determine the effect of the game on their performance of 4 different blocking-specific jumps (stopped blocking [SB], cross-blocking [CB], last blocking without jump [LB], and last blocking with jump [LBJ]). **Results** Among the PEs assessed (first phase), VJ led to the best VCMJ performance. The second phase showed that, while SB and LB were not changed after the game, CB and LBJ performance was increased. The specific PE (VJ) led to better VCMJ performance than did the non-specific PEs. Volleyball game increased performance only for the blocks with stretch-shortening cycle [SSC] movements. **Discussion** Specific pre jumping exercises appear to be effective producing enhancement during training and games, but other methods of preparation may also be applied as a complementary manner. Using ST as a PE did not impair the height of VJ. The height of VJ was increased after athletes performed 3 sets of RE. In addition, after performing VJ, the VCMJ performance was improved. Strojnik and Komi (1998) reported potentiation effects after SCC jumps, showing increased explosive power. It may suggest that this type of PE is useful before competitions to improve the performance. We showed that among PE used, VJ is the best for improving VCMJ performance and, only block jumps with SSC are improved after the game. **References** Strojnik, V., Komi, P. V. (1998) Neuromuscular fatigue after maximal stretch-shortening cycle exercise. *Journal Appl Physiol* 84, 344-350.

### AGE-RELATED DIFFERENCES IN PHYSIOLOGICAL CHARACTERISTICS OF FEMALE GYMNASTS AGED 5-13 YEARS OLD.

Theos, A., Ioannidi, V., Giannopoulos, A., Moustogiannis, A., Savvadi, A., Maridaki, M.

University of Athens

**Introduction** Anthropometric and physiological characteristics influence sport performance especially in children (Focke et al. 2013, Nedeljkovic et al., 2007). The aim of the present study was to investigate differences in physiological characteristics of female gymnasts of a large age range. **Methods** One hundred sixty eight female gymnasts were separated in four groups according to their age. Group 1

(G1) consisted of 41 girls (age:  $6.7 \pm 0.4$  yrs, height:  $119.9 \pm 8.4$  cm, weight:  $24.6 \pm 5.9$  kg), group 2 (G2) of 43 girls (age:  $8.5 \pm 0.5$  yrs, height:  $125.8 \pm 18.8$  cm, weight:  $28.7 \pm 5.4$  kg), group 3 (G3) of 53 girls (age:  $10.5 \pm 0.5$  yrs, height:  $139.6 \pm 7.5$  cm, weight:  $35.4 \pm 6.4$  kg) and group 4 (G4) of 31 girls (age:  $12.2 \pm 0.4$  yrs, height:  $149.2 \pm 7.9$  cm, weight:  $44.2 \pm 9.5$  kg). Flexibility (sit & reach test), arm strength (handgrip) in the dominant hand, lower limb strength (squat jump) and agility (agility T-test) were measured. Data were analyzed using ANOVA and results are presented as mean  $\pm$  SD. Results Agility differed significantly among groups (G1:  $19.4 \pm 3.8$  sec, G2:  $15.9 \pm 1.7$  sec, G3:  $15.3 \pm 3.7$  sec, G4:  $13.7 \pm 1.7$  sec,  $p < 0.001$ ) and so did arm strength (G1:  $3.0 \pm 3.3$  kg, G2:  $6.1 \pm 3.5$  kg, G3:  $9.7 \pm 4.1$  kg, G4:  $13.9 \pm 5.7$  kg,  $p < 0.001$ ) and lower limb strength (G1:  $19.0 \pm 7.7$  cm, G2:  $25.2 \pm 6.8$  cm, G3:  $29.5 \pm 6.6$  cm, G4:  $34.1 \pm 8.9$  cm,  $p < 0.001$ ) On the other hand flexibility did not differ significantly among groups (G1:  $25.1 \pm 5.9$  cm, G2:  $25.2 \pm 6.0$  cm, G3:  $26.8 \pm 6.6$  cm, G4:  $27.1 \pm 7.7$  cm,  $p = 0.38$ ). Discussion The results of the present study indicate that age has a significant impact on agility and strength of female gymnasts, while it doesn't seem to impair flexibility. References Focke A., Strutzenberger G., Jekauc D., Worth A., Woll A., Schwameder H (2013) Eur. J. Sport Sci. DOI: 10.1080/17461391.2012.756069. Nedeljkovic A, Mirkov DM, Kukolj M, Ugarkovic D, Jaric S. (2007) J. Strength Cond. Res., 21(1), 245-250.

## COMPARISON OF PERCENTAGE OF MUSCLE MASS AND NEUROMUSCULAR PERFORMANCE BETWEEN U15 AND U17 SOCCER PLAYERS

Franciscon, C.A., Spigolon, L.M.P., Medeiros, E.M., Gongora, A., Rossini, F., Mathias, F.H., Borin, J.P.

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Introduction In forming young soccer player, periodic evaluations provide important information for monitoring their performances. This is with body composition, muscle mass percentage and neuromuscular performance, monitored to identify changes related to motor actions that are important in this sport. The present study aimed to evaluate and compare the percentage of muscle mass with the performance of the neuromuscular system of categories of soccer players U15 and U17. Methodology 30 athletes participated in the U15 category ( $14.79 \pm 0.48$  years,  $176.88 \pm 6.01$  cm,  $64.06 \pm 6.41$  kg) and 25 in the U17 category ( $16.76 \pm 0.59$  years,  $180, 19 \pm 6.96$  cm,  $71.86 \pm 5.99$  kg) with two years of training experience. Measurements were made of their percentage of muscle mass (% MMusc) (Martin et al, 1990), their neuromuscular performance, a sprint of 10m (T10M) (photocells Speed Test Fit - Cefise ©) (Svensson, Drust, 2005) and a counter-movement jump (CMJ) (Jump Test - Cefise ©) (Bosco, 1983). The Shapiro-Wilk verified the data normality and variance by ANOVA complemented by Tukey test with significance level of  $p < 0.01$ . Results For MMusc% (U15 =  $40.77 \pm 5.71\%$  and U17 =  $46.19 \pm 5.38\%$  -  $\Delta\% = 11.73\%$ ) and CMJ (U15 =  $45.30 \pm 4.78$  cm and U17 =  $49.97 \pm 5.94$  cm -  $\Delta\% = 9.35\%$ ), there were significant differences between the two categories. As for the T10M, no difference. Discussion The differences for MMusc% from the perspective of biological time (maturation index, U15 =  $1.47 \pm 0.60$  and U17 =  $2.83 \pm 0.56$ ) (Mirwald et al, 2002), favors the morphological changes that are positive in the U17, due to the same training of higher volume of activities that stimulated the increase of muscle mass. As for CMJ, coordinative changes linked to biological time, may explain part of the difference in performance of this variable, in addition to the content of the training U17 present similarity with the action performed on the test. No differences on the T10M. Some variables may not be explained only by biological questions, and body workout, but by motivational factors and interactions of biomechanics and kinematics, beyond the type of muscles fiber recruitment, frequency and speed of stimuli and fatigue level. References Bosco, C., Luhtanen, P, Komi, PV, (1983). Eur J Appl Physiol, v.50 n.2, p.273-282. Martin, AD, Spens, LF, Drinkwater, DT, Clarys, JP, (1990) Med Sci Sports Exercise, v.22, n.5, p. 729-733. Mirwald, RL, Baxter-Jones, AD, Bailey, DA, Beunen, GP, (2002) Med Sci Sports Exercise, v.34, n.4, p.689-694. Svensson, M, Drust, B, (2005) J Sport Sci, n.23, p.601-618.

## RELATIONSHIPS BETWEEN VO2MAX, MUSCULAR PERIPHERAL OXYGENATION AND FATIGUE INDEXES DURING A REPEATED-SPRINT EXERCISE

Ahmaidi, S., Jabbes, M.W.

*Picardie Jules Verne University*

This study aimed to examine the relationships between the main components of the aerobic fitness (i.e., VO<sub>2</sub>max, muscle deoxygenation level, muscle reoxygenation rate) and the main fatigue indexes (i.e., RSE% distance decrement, [La]-[blo], RPE) during a repeated sprint exercise (i.e., RSE). It was hypothesized that the peripheral aerobic fitness indexes will be the most correlated to the RSE fatigue indexes. Fourteen moderately trained males subjects ( $23.4 \pm 2.6$  years) took part to this study. All the participants performed, in a random order, a maximal progressive aerobic test VamEval to obtain their VO<sub>2</sub>max and a repeated sprint exercise (2 series 15-s all out 20 meters shuttle-sprints, interspersed with 15 sec of passive recovery). The total distance covered (TD), RSEdec%, [La]-[blo], and RPE were retained. Through the sprints, muscles deoxygenation levels and during the recovery, the reoxygenation rates were assessed with near-infrared spectroscopy on the Vastus Lateralis. Results showed the absence of relationships between VO<sub>2</sub>max and the RSE fatigue indexes. However, muscular deoxygenation levels and reoxygenation rates were highly correlated to the %RSEdec, [La]-[blo] and TD (%RSEdec :  $r = 0.86$  ; very large ;  $p < 0.01$  and  $r = 0.65$  ; Large ;  $p < 0.05$  respectively; for [La]-[blo] :  $r = 0.68$  ; large ;  $p < 0.05$  and  $r = 0.70$  ; very large ;  $p < 0.05$  respectively ; TD :  $r = 0.87$  ; very large ;  $p < 0.01$  and  $r = 0.62$  ; large ;  $p < 0.05$  respectively). It was concluded that the muscle oxygenation parameters as the reoxygenation rate and particularly the deoxygenation level, were the main aerobic fitness components which were related to the fatigue and therefore to the performance during a repeated sprint exercise

## THE FEASIBILITY OF USING PERCEIVED EXERTION TO ESTIMATE MAXIMAL HEART RATE

Mamen, A., Fredriksen, P.M.

*University College of Health Sciences-Campus Kristiania*

The linear relationship between work load, heart rate (HR) and Borg Rating of Perceived Exertion (RPE) may be used to estimate maximal heart rate from submaximal exertion. Johnson and Prins (1991), using multiple regression on data from one hundred persons exercising on a modified Balke protocol found that RPE estimated HR<sub>max</sub> was more accurate than the traditional 220-age formulae. To further investigate this, we had 41 subjects to perform a step protocol with five minutes step durations until a blood lactate concentration of 4 mmol/L was reached. RPE and HR were recorded at the end of each stage. After a short rest period, the subjects performed a maximal oxygen uptake test and the maximal HR was recorded at the end of the test. Using linear regression for each individual's submaximal HR and RPE data set, the RPE at the measured HR<sub>max</sub> was found by extrapolation. The mean (SD) RPE value at the measured HR<sub>max</sub> was 18.3 (0.8). Using this value on all subjects, the standard deviation of the estimated HR<sub>max</sub> was 6.8 beats pr. minute and the bias (difference between measured and estimated values) 1.1 beats pr. minute. Using the 220-age formulae, the standard deviation was 5.8 beats pr. minute, but the bias was -5.2 beats pr. minute. These results indicate that using submaximal RPE to predict individual maximal HR is

feasible, but do not offer any clear advantages over using 220- age. References: Johnson, J.H., and Prins. Prediction of maximal heart rate during a submaximal work test. *Journal of Sports Medicine & Physical Fitness*, 1991 (31) 1,44-47.

## 15:00 - 16:00

### Mini-Orals

#### PP-PM87 Misc. topics 3

#### O2 DESATURATION AT MODERATE ALTITUDE: COMPARAISON BETWEEN RUNNING AND ROLLER SKIING FIELD TEST

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Introduction Biathlon is an endurance sport whose the offseason training consists of running (R) and roller ski (RS) exercises at moderate altitude. Exercise induced hypoxemia (EIH) can develop in highly trained endurance athletes in terms of exercise mode, muscle mass involved in the exercise (Rasmussen et al., 1991) and the altitude (Powers, 1993). Yet EIH decreases performance, so the structures with competitive biathletes must master this phenomenon. That's why this study compares EIH development and cardio-respiratory responses, in younger highly trained biathletes, at moderate altitude, during running and roller ski field tests. Methods 9 younger highly trained biathletes (2 women and 7 men, 15.3±1.5 years) living and training at moderate altitude participated. They performed two incremental maximal field tests R and RS, at 1850 meters altitude. EIH (hemoglobin O2 saturation (SpO2) decreased ≥4% from baseline) was measured indirectly using an ear-lobe pulse oximeter included in the K4 (Cosmed) used for measured cardio-respiratory responses. Results During the R test, 8 athletes developed EIH whereas only 6 in RS test. Tests duration was the same furthermore at the end of tests, delta of SpO2 was significantly higher in R compared to RS (-9.11 ± 1.51 vs -5.89 ± 1.09; p<0.01). SpO2 was significantly lower in R compared to RS from 75% VO2max (p<0.05). VO2max was significantly higher in R than in RS (61.33 ± 6.36 vs 57 ± 6.60 ml.min-1.kg-1; p<0.001). No difference of maximal heart rate, global ventilation, tidal volume or respiratory frequency was present during and at the end of tests. Discussion The difference of VO2max main explains by a utilization of muscular fibers II more important during the RS exercise because of the upper body requested (Koppo et al., 2002). The mean transit time may be slightly longer during RS test than during R test because there is a linear relationship between the VO2 and the cardiac output (Qc) (Rasmussen et al., 1991). Furthermore if the Qc is higher during R test compared to RS test, lung blood pressures are more important causing higher pulmonary capillaries stretching or/and break (West et al., 1995). Better O2 pulmonary diffusion during RS test and gas exchange abnormality during R test could explain the difference of desaturation between these activities. The present study emphasizes the importance of the upper body training in biathletes for master EIH and the reduction of the performance associated. References Koppo K, Bouckaert J, Jones AM (2002). *Respiratory Physiology and neurobiology*, 133 241-250. Powers SK, Martin D, Dodd S (1993). *Sports Med*, 16(1):14-22. Rasmussen J, Hanel B, Diamant B, Secher NH (1991). *Med Sci Sports Exerc*, 23:1349-1352. West JB, Mathieu-Costello O (1995). *Eur J Appl Physiol Occup Physiol*, 70(2):99-108.

#### THE EFFECTS OF TWO WEEKS OF SEASON BREAK FOR GAME PERFORMANCE OF SOCCER

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Introduction: It is well known that the ability to perform in high-intensity activities throughout the soccer game is very important (Iaia et al, 2009), and this ability decreases during season break (Bangsbo, 2007). However it is not cleared how decrease the game performance after season break. The aim of this study was to examine the effects of two weeks of season break for game performance of soccer. Method: Subjects are 26 trained soccer players who belong to two university (age 21.8±0.7 years, height 175.4±3.4 cm, body mass 66.0±3.5 kg). They were analyzed by 2 competitive games, the last game of the season (GAME1), and after 2 weeks of GAME1 almost under the same condition. GAME1 and GAME2 were recorded by 3 cameras (2 fixed and 1 operated) so the whole soccer field is covered. We used the manual tracking system (Track Performance, sportstec). The following active categories were used: standing (0-2 km·h-1), walking (2-7 km·h-1), jogging (7-9 km·h-1), low-speed running (9-13 km·h-1), moderate-speed running (13-16 km·h-1), high-speed running (16-22 km·h-1), sprinting (>22 km·h-1), and high-intensity running, consisting of moderate-speed running, high-speed running, and sprinting (> 13 km·h-1) (Randers et al, 2010). Also, The Yo-Yo Intermittent Recovery test level 2 (Yo-Yo IR2) was tested after 3 days from GAME1 and 4 days from GAME2, respectively. Results: The total distance covered of GAME2 (9.7±0.18 km) was shorter than of GAME1 (10.4±1.14 km). The distance covered with sprinting was 22.9% less (P<0.01) in GAME2 than in GAME1 (0.89±0.25 km vs. 0.52±0.24 km). The distance covered by high-speed running of GAME2 (1.46±0.36 km) was lower than of GAME1 (1.85±0.47 km). The distance covered with high-intensity running of GAME2 (2.82±0.71 km) was shorter than of GAME1 (3.50±0.85 km). Yo-Yo IR2 performance was 18.2% less in GAME2 than GAME1 (850±108m vs. 695±77m). Discussion: The total distance covered during a game was 7% less in GAME2 than in GAME1, on the other hand, the distance covered with high-intensity exercise such as high-speed running, sprinting, high-intensity running was 19.9%, 22.9%, 17.6% less, respectively. Also the Yo-Yo IR2 performance remarkably decreased (18.2%) from GAME1 to GAME2. These data suggest that 2 weeks season break effects to physical performance during soccer game, especially in high-intensity exercise, which is a very important factor in a soccer game. References • F Iaia, E Rampinini, J Bangsbo, High-Intensity Training in Football; *Int J Sports Physiol Perform*, 4, 291-306, 2009. • J Bangsbo, Aerobic and Anaerobic Training in Soccer, 2007. • MB Randers, I Mujika, A Hewitt, J Santisteban, R Bischoff, R Solano, A Zubillaga, E Peltola, P Krstrup, M Mohr, Application of four different football match analysis systems, *J. Sports Sci*; 1-12, 2010.

#### A CROSS-SECTIONAL STUDY TO EVALUATE THE SPECIFIC STRENGTH IN WOMEN WATER POLO PLAYERS

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INEFC-UB (Barcelona, Spain) Introduction: The aim of the study was to evaluate the different manifestations of strength in water polo women players of several ages: throwing speed, swimming strength, defense strength, the maximum vertical jump height and the

maintained jump height. Method: Twenty-five women players of different categories and belonging to the Spanish Selection of Water polo took part in the study. The tests used were: the fight strength by means of backward pushing (center offensive), forward pushing (center defensive) and swimming strength. A rubber band connected to the strain gauge of the Musclab 4000e (ErgotestTM, Norway) was used for that purpose. The velocity of throwing was measured by means of the Radar Stalker Pro (Applied Concepts Inc., Flat Texas, TX, USA) in two different situations, that is, a throw without the goalkeeper and a throw demanding accuracy. In both situations two different throwing techniques were used. The height of vertical jump and that of the maintained jump were also measured with a camcorder (Casio ComputerCo., Ltd EXILIM High speed EXFC 100, Tokyo). Results: The results obtained in the test of fight strength are summed up next: backward pushing: 94,2, 134,4 and 8,7 N and forward pushing: 97,1, 116,7 and 133,7 N (14,15, 17 years old, respectively). The results of swimming strength: 97,2, 134,9 and 152,2 N (14,15, 17 years old, respectively). The values obtained in the jump tests are the following: maintained jump height: 0,19, 0,21, 0,22 m and vertical jump height: 0,59, 0,64 and 0,69 m (14,15, 17 years old, respectively). The results of throwing velocity without goalkeeper were: 50, 2, 53,5 and 55,9 km/h (technique 1) and 50,1, 53,3 and 56 km/h (technique 2) (14,15, 17 years old, respectively). Finally, the results of the throw demanding accuracy are: 45,7, 51,3 and 54,7 km/h (technique 1) and 46, 51 and 53,9 km/h (Technique 2). Discussion: The results of this study in throwing velocity go hand-in-hand with the ones obtained by Platanau (2011) (56 vs 59 km/h). The values obtained in the jump height are slightly higher than the ones presented by Platanau (2011) (0,61 vs 0,69 m). With regard to the swimming strength, our results are also higher than those obtained by Stain A. et al 2009 (117,8 vs 152,2). It is not possible to find any written data with which to compare the fight strength and maintained height values since these are new protocols of evaluation in water polo. We consider that they can complement and give a more accurate evaluation of the different manifestations of strength which are given in the game. Finally, we would like to stress that some of the subjects of this sample were medalists in the 2012 London Olympics. References: Platanou, T. (2011). *J S Med Phys F*, 51 (2), 185-93. Stain A. y col (2009). *J S Sc Med*, 8, 357-365.

### THE RELATIVE AGE EFFECT AMONG ELITE YOUTH MALE TENNIS PLAYERS

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Introduction Research in different sports has shown that athletes born early within the selection year are more likely to be part of elite teams and talent development programs. This overrepresentation of older athletes in youth sport has been labeled as the relative age effect (RAE). The purpose of this study was to identify the existence of RAE at youth level in tennis and to analyze if anthropometric and fitness characteristics vary according to birth date distribution. Methods Birth dates of all male players affiliated to the German Tennis Federation born from 1993 to 2000 (n = 120851), including players with official ranking in the under-18 ranking list (n = 7165) and a group defined as "regional selection" (n = 381) (i.e., comprised the most talented players), were analyzed. A third group, "national selection" (n = 57) (i.e., best of regional players selected by the national coaching staff), as well as the first 50 senior players of the national ranking were also analyzed. Moreover, 348 players of the regional selection participated in an anthropometrical (height, weight) and physical (grip strength, counter movement jump, 20m sprint, serve velocity and hit & turn test) testing. Results RAE was found across all age categories and selection levels. We found more players born in the first half of the year for senior (56%), ranked (54.4%); regional (65.1%) and national (70.2%) selection of players, and no bias towards the cut off day for all listed players (49%). Comparing fitness characteristics of players born across different quarters of the year, we were not able to find major differences in any of the characteristics analyzed. Discussion Results show that season of birth bias exists in the selection of youth tennis players in Germany, and suggest that selection level is an important factor regarding the strength of RAE. Present findings do not support the hypothesis that players who are born later in the selection year are likely to differ across a range of anthropometric and fitness attributes, and suggest that the relative age of the tennis player may not always be linked to a significant advantage in physical performance. The relative importance of physical qualities compared to technical and tactical skills in tennis may explain the present results. References Delorme N, & Raspaud M. *Scand J Med & Sci Sports*. (2009) 19: 235-242. Carling C, et al. *Scand J Med & Sci Sports*. (2009) 19: 3-9.

### FINE AND GROSS MOTOR SKILLS IN WATER POLO PLAYERS – JUNIORS AGED 14 TO 15 YEARS OLD

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Introduction The water polo game counts among the sports disciplines where acyclic movements are predominant. It doesn't simply mean swimming, but also a great number of other specific movements performed in horizontal and vertical positions, technical elements and procedures with and without the ball, with and without an opponent, all these indicating the game complexity. This complexity should be found in the specific training. Methods In the present study, we administered the Bruininks-Oseretsky Test Battery, second edition (BOT-2). This variant provides the psychomotor proficiency most objective evaluation. The tested subjects are members of two water polo teams – Juniors (14 to 15 years old). 24 players were tested. BOT-2 uses components that are organized around the two motricity types (fine motricity and gross motricity), as well as around the different coordination types. Results In subtest 3 (Manual Dexterity), the scale score shows that 80% out of the tested athletes fall within the investigated population mean and only 20% are above this mean. In subtest 7 (Upper Limb Coordination), the scale score frames 45% out of the tested athletes within the investigated population mean and 55% above this mean. On the opposite side, there are the results obtained in subtest 4 (Bilateral Coordination), where 75% out of the tested athletes fall under the investigated population mean and only 25% are at a mean level. In subtest 5 (Balance), 60% out of the tested athletes fall under the investigated population mean and 40% are at a mean level. Discussions This test evaluates athletes' psychomotor proficiency beyond the aquatic environment, in order to establish if there is a positive transfer/correlation in the expression of the psycho-motricity specific to the water polo game. The analysis and evaluation of the data obtained in the manual dexterity and the upper limb coordination subtests show a good expression of the arm-performed motor actions (specific to the water polo game). In the bilateral coordination and the balance subtests, the negative results confirm that these components should be equally exerted in the dry land physical training and in that specific to the water environment, both of them conditioning sports performance. References Bruininks, R.H., Bruininks, B.D. (2005). Bruininks-Oseretsky Test of Motor Proficiency. Second Edition Manual. Minneapolis: NCS Pearson, Inc., pp. 1-72. Marinescu, Gh., Bălan, V., Frățilă, C. (2004). Polo pe apă. București: BREN. Marinescu, Gh. (2003). Efort și antrenament. București: BREN. rt authors here

### CHANGES IN METABOLIC PARAMETERS DURING DIFFERENT PHASES OF AN AEROBIC TRAINING IN A TYPE 1 DIABETIC PATIENT.

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**INTRODUCTION** Regular physical activity has been showed to have a multiple health benefits for everyone, including those with T1D (Steppel and Horton, 2003). The hypothesis of this project is to verify the improvement on different metabolic parameters in a T1D patient using an insulin pump with a Continuous Glucose Monitoring System (CGMS) performing a specific aerobic training for a purpose of a 1 month walking (1000 km). **METHODS** A 40 years old T1D patient underwent to an incremental test until exhaustion on a motorized treadmill at the beginning of the training (TEST 1) and after 2 months (TEST 2), we evaluated also the resting energy expenditure by indirect calorimetry and estimated the body composition by bioelectrical impedance analysis. We continuously monitored the glycemic profile for 48 hours via CGMS, on the test-day and the day after. **RESULTS** We registered a small increase in the VO<sub>2</sub> max value (TEST 1= 4417 to TEST 2=4491 ml/min), and an increase in the resting energy expenditure (TEST 1=1680 to TEST 2= 1773 kcal/day). Total body weight decreased (TEST 1 = 86.6 to TEST 2= 85.2 kg) and so did Fat Mass (TEST 1= 9.2 to TEST 2 = 8.6 %). Fat Free Mass plus water remained unchanged (TEST 1= 78 to TEST 2 = 78 kg). CGMS data showed a similar average glucose level in the 2 days considered (TEST 1 = 123 to TEST 2 = 119 mg/dl), and showed a decrease average glucose level during the 2 hours in which the subject performed the test [10 AM – 12 PM] (TEST 1= 143 to TEST 2 = 129 mg/dl). The average daily insulin (U) was lower in the second test (TEST 1= 50.9 to TEST 2=46.2 U), resulted from the sum of average daily basal insulin (TEST 1= 25.9 to TEST 2=27.5 U) and average daily insulin bolus (TEST1 = 25 to TEST2= 18.7 U). The glucose level stayed on target longer in the TEST 2 vs TEST 1 (TEST 1= 58% to TEST 2 = 67%), whereas it remained for a shorter period below and above the target in TEST2 vs TEST1 (below: -3%; above: -6%, respectively). **DISCUSSION** These preliminary data show that an aerobic exercise performed for two months can improve the glycemic/insulin control values and the other metabolic parameters in a T1D patient (Yardley et al., 2012; Lehmann et al., 1997). A simple walking exercise without engaging in any risky high intensity physical activity can have overall beneficial effects on health in a T1D patient. **REFERENCES** Steppel JH and Horton ES (2003) *Rev Endocr Metab Disord.* 2003 Dec;4(4):355-60. Yardley JE, Kenny GP, Perkins BA, Riddell MC, Malcolm J, Boulay P, Khandwala F, Sigal RJ. (2012) *Diabetes Care* 35:669-675. Lehmann R, Kaplan V, Bingisser R, Bloch KE, Spinass GA. (1997) *Diabetes Care* 20(10):1603-11.

### RELATIONSHIPS BETWEEN RESPIRATORY MUSCLE ENDURANCE, EXERCISE PERFORMANCE AND THE METABOREFLEX ACTIVATION TIME

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**Purpose of study:** To assess respiratory muscle endurance by (i) measuring the maximum sustainable ventilation (MSV) and the time limit for constant-load exercise at 90% of maximum aerobic speed (MAS), and (ii) studying the relationships that might exist between these parameters and the time required to activate the metaboreflex TMA (through measurement of the oxygen tissue saturation with near-infrared spectrometry, (NIRS)). **Method:** 11 male, moderately trained adult volunteers participated in the study. All subjects underwent spirometry testing (to determine the vital capacity, forced vital capacity and maximum voluntary ventilation (MVV)) and a VamEval VO<sub>2</sub> max test to determine the MAS and the time limit for constant-load exercise at 90% of MAS, with assessment of gas exchanges (with a COSMED K4b2) and measurement of the oxygenation rate at the vastuslateralis (with NIRS). The kinetics of V'O<sub>2</sub> were modeled, in order to calculate the amplitude of the slow component of V'O<sub>2</sub>. Activation of the metaboreflex was identified as a sudden drop in the tissue O<sub>2</sub> saturation index (TSI). All subjects performed a respiratory muscle endurance test, which was initiated at 20% of the MVV. The ventilation rate was increased by 10% of the MVV every 3 minutes, until the subject could no longer maintain the target ventilation rate (fR) and/or tidal volume. **Results:** We observed a statistically significant correlation between respiratory muscle endurance (MSV/MVV%) and time limit during constant-load exercise at 90% of MAS ( $r = 0.95$ ;  $p < 0.001$ ). The mean amplitude of the slow component of V'O<sub>2</sub> was  $420 \pm 85$  ml/min. Recording the TSI at the vastuslateralis identified a sharp drop in the index of tissue saturation of  $6.69 \pm 5.84\%$ , following by termination of exercise  $130.17 \pm 62.77$  s later. There was also a significant correlation between respiratory muscle endurance and TMA ( $r = 0.83$ ;  $p < 0.05$ ). A relationship between respiratory muscle endurance and the amplitude of the slow component of V'O<sub>2</sub> (A2) was observed but was not statistically significant ( $r = -0.47$ ;  $p < 0.2$ ). **Conclusion:** Respiratory muscle endurance was correlated with TMA and the exercise time limit at 90% of MAS ( $r = 0.95$ ;  $p < 0.001$  and  $r = 0.83$ ;  $p < 0.05$ , respectively). In contrast, respiratory muscle endurance was not significantly correlated with the magnitude of the slow component of V'O<sub>2</sub>.

### RELATIONSHIPS BETWEEN SESSION-RPE, GPS MOVEMENT CHARACTERISTICS, AND HEART RATE DURING TRAINING AMONG ELITE YOUTH SOCCER PLAYERS

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**Introduction** Session-RPE has emerged in recent years as a useful subjective method of quantifying training intensity in elite team sports. When expressed as a product of training duration ('training load'), its validity against objective markers of volume and intensity in soccer has been advocated (e.g. Alexiou & Coultts, 2008; Impellizzeri et al., 2004), but to-date, no study has examined its validity against specific movement characteristics, including distance covered in high intensity activity, quantified via GPS technology. Therefore the aim of this study was to examine the relationships between session-RPE training load, GPS movement variables measures, and an objective heart rate load among elite youth soccer players. **Methods** Following ethical approval 13 elite soccer players, aged 16-18 years ( $182.5 \pm 4.9$  cm,  $77.2 \pm 5.9$  kg) were recruited from a youth soccer Academy in central England. All were monitored during training sessions (mean = 30, range = 23-36) over a two-month period in the 2012 season using 2 Hz Catapult GPS devices and heart rate (HR) telemetry. Following each session, a session-RPE score (Borg CR-10-scale) was obtained from each player and subsequently multiplied by the duration of the session to give a session-RPE training load (S-RPETL). Pearson correlations were computed between six locomotive variables and time spent above 85% HRmax and S-RPE TL for the group as a whole and by playing position (Defenders/Mid-fielders/Attackers). **Results** The GPS-derived variables and time spent above 85% HRmax were found to be significantly ( $P < 0.01$ ) correlated ( $r = 0.33-0.64$ ) with S-RPETL. Notably, following Fisher Z-transformations, four of the GPS variables were related more strongly with S-RPETL than 85% HRmax. Position-specific correlations were typically highest for the Midfielders ( $r = 0.33-0.75$ ) and lowest for the Attackers ( $r = 0.10-0.52$ ), and for all three positions stronger for the GPS variables than the HR variable. **Discussion** These findings provide further support towards the notion that session-RPE TL can be a valid indicator of training load during soccer training, and in the absence of expensive equipment (GPS and HR

monitoring) it could be a surrogate measure for monitoring global training load within elite youth soccer players. Whilst there was some position-related variability in the associations observed, the session-RPE TL method may be useful in the development of suitable training strategies for the whole squad, specific positions or even individuals. Moreover, it appears to provide a better representation of GPS movement characteristics than a relative HR measure. References Alexiou, H, Coutts, A (2008). *Int J Sports Physiol Perf*, 3, 320-30. Impellizzeri, F, Rampinini, E, Coutts, A, Sassi, A, Marcora, S (2004). *Med Sci Sports Exerc*, 36, 1042-7.

### **INFLUENCE OF EXERCISE ON P-WAVE DISPERSION FOR EVALUATING THE INDUCTION OF STRESS-INDUCED PAROXYSMAL ATRIAL FIBRILLATION ON HEALTHY MALES AND FEMALES.**

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**INTRODUCTION:** Exercise testing is a useful diagnostic tool for evaluating the induction of stress-induced paroxysmal atrial fibrillation. At rest the P-wave dispersion has been suggested to be greater in males than in females but if the P-wave dispersion is to be used in the clinical arena then any gender difference in response to exercise must be determined. **METHODS:** Sixteen healthy subjects (n=8 male, age: 21±0.3; n=8 female, age: 23±1.4) performed an incremental exercise test using the Bruce protocol. Electrocardiograms were recorded at rest, end exercise, 1, 3, and 5 mins recovery. P-waves were measured in each lead with the maximum (P-max) and minimum (P-min) P-wave durations recorded and P-wave dispersion calculated. ECG's were analysed using an established procedure. **RESULTS:** There was a significant decrease in P-max from rest to end exercise in males and females (males, 118.3±7.4 vs. 97.9±6.2 ms; females, 109.±44.5 vs. 94.3±4.6 ms; p=0.001). This response was seen for P-min (males, 65.6±3.3 vs. 50.8±2.7 ms; females, 58.4±3.3 vs. 45.6±2.7 ms; p=0.01). Irrespective of gender there was no significant change in P-wave dispersion in response to exercise. Males had a significantly longer P-max compared to females during the protocol (109.±62.3ms vs. 103.6±1.8ms; p=0.03) but this was not stage specific. There was no significant gender differences in either P-min (p=0.12) or P-wave dispersion (p=0.64) across the protocol or stage specific. **DISCUSSION:** The results from this study indicate that in contrast to P-max and P-min, the P-wave dispersion may not be significantly influenced by the sympathetic nervous system in males and females. Therefore, males and females should be evaluated in the same way when using the P-wave dispersion for predicting the development of stress-induced paroxysmal atrial fibrillation during clinical exercise testing.

### **ANALYSIS OF ACE, ACTN3, ENOS, PPARG, PPARA, HIF1A, PPARGC1B GENE POLYMORPHISMS FOR DETERMINATION OF A GENETIC PREDISPOSITION TO A VARIETY OF SPORTS**

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**Introduction** Effectiveness of athletic talent search is closely linked to the development of methods for determining genetic predisposition to high physical performance in specific sports. In world practice, several models to determine the genetic predisposition to sports which take into account the polymorphisms complex were created but the problem of selecting candidate genes and the number of SNPs still remains unsolved. Therefore, the aim of the study was to create models to determine genetic predisposition to the manifestation of a high physical performance in different sports based on complex analysis of gene polymorphisms. **Methods** In the course of the study a total of 332 persons DNA (110 athletes involved in speed-power sports, 85 – in endurance sports, 51 - in sports that require a combination of strength and endurance, 86 - sedentary control) were examined. Using the polymerase chain reaction method the I/D polymorphism of the ACE gene, R577X polymorphism of ACTN3, T-786 → C promoter polymorphism eNOS, Pro/Ala polymorphism PPARG, G/C polymorphism in intron 7 of the gene PPARA, Pro582 → Ser (C/T) polymorphism of HIF1A, Ala203Pro polymorphism of PPARGC1B were investigated. **Results** Using the method of multifactor dimensional reduction, models of intergenic interaction in assessing predisposition to speed-strength sports (predictive capacity- 65%) and sports with the requirements of the combined effects of strength and endurance (predictive capacity- 64%) were created. I/D polymorphism of ACE, T-786 → C polymorphism of eNOS, R577X polymorphism of ACTN3, G/C polymorphism of the 7th intron PPARA are important markers for determining the genetic predisposition to exercise in speed and power sports, and T-786 → C polymorphism of eNOS gene is a marker of predisposition to sports with the requirements of the combination of strength and endurance. **Discussion** We did not observe any statistic difference between genes distributions in a group of athletes specializing in endurance sports and sedentary control. That fact did not allow us to create an intergenic interaction model for this group. The obtained results match the previously established facts. It is known that such phenotypes as explosive power, high content fast-twitch muscle fibers which are necessary for the manifestation of high athletic performance, have a high degree of inheritance (Tainen et al, 2009) and are determined by a limited number of genes, whereas aerobic endurance is easily changed under the influence of external stimuli, has the lowest degree of inheritance, and is determined by the interaction of a large number of genes and their variations (Williams, 2008; Ahmetov, 2009). References Ahmetov I.I., Williams A.G., Popov D.V., Lyubaeva E.V., Hakimullina A.M. et al *Human Genetics* (2009). 126(6),751–761. Tainen K., Sipilä S, Kauppinen M, Kaprio J, Rantanen T. (2009). *J Appl Physiol*,106(5), 1604-10 Williams A., Folland J. (2008). *J Physiol* 586.1, 113-121.

### **EXPLOSIVE STRENGTH ASYMETRY OF THE LOWER LIMB IN VOLLEYBALL AND BASKETBALL PLAYERS**

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**Introduction** In order to determine the potential risk of injury, time to return to play after an injury and also optimize strength and conditioning training, the study of strength imbalance between limbs is essential. Taking this into consideration, the aim of this study was to investigate the differences in explosive strength between both legs in a group of male and female volleyball and basketball players. **Methods** Seventy-nine volleyball and basketball players (age: 23,7 ± 4,5 years, weight: 77,1 ± 9,1 kg, height: 182,3 ± 6,2 cm) performed three single-leg vertical countermovement jumps (SLVCJ) on a contact mat. Vertical jumping height and symmetry index (SI) between legs were analyzed. The SI was obtained by comparing both, dominant vs. non-dominant legs and stronger vs. weaker legs. **Results** When comparing leg dominance, significant differences were found in the whole group of players, while after making a comparison by sex, significant differences remained only in women. With regards to weaker vs. stronger legs, significant differences were noted in all the variables under study. SI average between legs ranged from 9.31% (males) to 12.4% (females) and from 10.49% (males) to 14.26% (females), when comparing dominant vs. non-dominant leg and stronger vs. weaker, respectively. **Discussion** This study shows significant differences in unilateral jump performance between legs in basketball and volleyball players. This concurs with previous studies, which

have shown the same significant imbalance between limbs. However, there are others which did not have similar findings (Hewitt, Cronin, & Hume, 2012; Stephens, Lawson, & Reiser, 2005). The results of our study and most of sport science researchers suggested a 10-15% threshold of asymmetry between legs to be considered as the usual physiological difference (Hewitt et al., 2012). The major SI average in females players is correlated with the findings of other authors relating neuromuscular deficits between legs as a risk factor which could address the major injury incidence in female athletes (Myer, Brent, Ford, & Hewett, 2011). References Hewitt, J. K., Cronin, J. B., & Hume, P. A. (2012). Asymmetry in multi-directional jumping tasks. *Physical therapy in sport*, 13(4), 238-42. Myer, G. D., Brent, J. L., Ford, K. R., & Hewett, T. E. (2011). Real-time assessment and neuromuscular training feedback techniques to prevent ACL injury in female athletes. *Strength and conditioning journal*, 33(3), 21-35. Stephens, T. M., Lawson, B. R., & Reiser, R. F. (2005). Bilateral asymmetries in max effort single-leg vertical jumps. *Biomedical sciences instrumentation*, 41, 317-22.

### PHYSICAL ACTIVITY REFERRAL: IMPACT ON PHYSICAL ACTIVITY ADHERENCE AND HEALTH-RELATED QUALITY OF LIFE.

Pardo, A., Garcia, J.A., Violan, M., Rubinat, M., Miñarro, C., Gonzalez, A., Roman, B.

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**Introduction** The Plan of Physical Activity, Sport and Health PAFES is a primary-care-based program implemented by the Health and the Sports Departments of the Government of Catalonia. It implanted Physical Activity (PA) prescription and physical activity referrals (PARs) to patients with cardiovascular risk factors (CVRF) in the Catalan primary care (PA) settings. PARs increase patients' PA level, but these increases may not be sustained over time (Morgan, 2005). This study has two aims: (i) to assess the effectiveness of PARs on the adherence to physical activity (PA) at medium- (6 months) and long-term (12 months); (ii) to assess the impact of PARs on health-related quality of life (HRQOL) among patients with CVRF: type II diabetes, hypertension, overweight (BMI  $\geq 25$  kg/m<sup>2</sup>) or dyslipidemia. **Methods** Within the framework of PAFES, a randomised controlled trial of 6-months exercise intervention with 6-months follow-up was conducted. 323 patients with  $\geq 2$  CVRF and contemplation stage of change (Prochaska & Marcus, 1994) were referred by PC to a supervised exercise program (3 sessions / week of 60 minutes of moderate-intensity PA) lead by a Physical education professional. Self-reported PA level and HRQOL were measured by the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003) and SF-12 (Alonso, 1996) respectively, at baseline, post-PARs and at 6-months follow-up. **Results** 75% (N=242; 75% women; 62.6 $\pm$ 8.5 years) of the sample finished the supervised exercise program, mean attendance of 84.1% (SD 18.5%). 16.5% dropped out due to health deterioration and 7.9% were missed during the follow-up. PAR produced significant improvement ( $p < 0.01$ ) of moderate intensity PA. Adherence to long term PA decreased, but the proportion of physically inactive remained lower than baseline. All domains of HRQL improved, maintaining the positive effects up to one year on physical functioning, mental health and social function ( $p < 0.01$ ). **Discussion** This study presents the first results of the PAFES supervised exercise program. The main results were (i) an increase in PA adherence at medium (6 months) but not long-term (12 months), (ii) a positive impact up to one year in HRQOL, mainly improving physical functioning, mental health and social function, and (iii) the need to study the mechanism to lengthen PA adherence. PARs helps to increase PA adherence at medium term and improve the HRQOL up to one year of patients with CVRF. **References** Morgan, O. (2005). *Public Health*, 119, 361 - 370. Prochaska JO & Marcus BH. Human Kinetics Publishers; 1994. p. 161-80. Craig, CL et al. (2003). *Med Sci Sports Exerc*, 35, 1381 - 1395. Alonso J & QualityMetric. (1996) *Med Care*.34:220-33.

### A PROFILE OF MASTERS ATHLETES: VARIOUS HEALTH AND PSYCHOLOGICAL INDICES

Heazlewood, I.T., Walsh, J., Climstein, M., DeBeliso, M., Kettunen, J., Sevene, T.G.6, Adams, K.

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**Do not insert authors here** **Introduction** An international team of researchers was formed to investigate the nexus between aging, physical activity, and the global obesity epidemic. **Methods** The team investigated over 10,000 masters athletes competing in international level competitions (2009 World Masters Games, 2010 Pan Pacific Masters Games, 2010 World Rugby Festival/Masters Rugby), presumably among the fittest of our aging population. Findings to date have furthered the understanding of the nexus between aging, physical activity, sports injuries, psychological factors associated with sports competition, health and obesity, providing an overview as to the profile of masters athletes over these various health related fitness and sports factors. **Results** Masters athletes demonstrated significant improvements in various health related indices over an age matched comparative Australian national population. Notable among these indices were body mass index for the majority, but not all participants. This was therefore not mitigated by the presumed propensity for increased muscularity in athletes over age matched national comparative population samples. As well as a number of positive health findings, for masters football athletes, the injury incidence during preparation for the tournament had similarities to, but was in fact significantly less than for other sporting populations. Some gender and sport based differences in injury location and classification type were identified. There were also no significant age related changes in injury nature (classification type, location, incidence, time off work or training). Whilst physical activity is well known to have many health benefits, paradoxically there had been concern for increased injury risk from highly competitive sport at older ages. Our findings do not support the premise of masters' football code athletes having higher incidence of injury as compared to younger athletes. With evidence of improved health indices associated with masters competition, it was logical to investigate factors connected with motivation to compete in masters sport. Socialization with other participants was the most important personal motivation for masters sport participation. Health and fitness were less important motivators than socializing to these masters level participants, but still stronger than competition. **Discussion** Our findings support the efficacy of masters' sport for overall improvement in health. To promote greater participation in this sport, strategies should best be focused on motivating factors such as socialisation with other participants.

### CARDIORESPIRATORY FITNESS AT COLLEGE-AGE AS A PREDICTIVE FACTOR FOR DEVELOPING DIABETES

Someya, Y.1, Kawai, S.1, Kohmura, Y.1, Aoki, K.1, Daida, H.2

*Juntendo University*

**Introduction** Reduced physical activity and low-level physical fitness in middle-aged individuals has been reported as a risk factor of diabetes. However, an association between physical fitness at college-age and diabetes has not been demonstrated in the Japanese population. In Japan, the National Physical Fitness Test is using the 1,500-meter endurance run as a measure of cardiorespiratory fitness from 1964. This test can perform easy and inexpensive compared with almost all cardiorespiratory fitness tests. We studied the relationship between cardiorespiratory fitness using the 1,500-meter endurance run at college-age, and the development of diabetes later in life in Japanese men. **Methods** Questionnaires were sent to 3,539 former students of Juntendo University regarding the occurrence of diabe-

tes and lifestyle between 2007 and 2009. The incidence rate of diabetes was compared with stored data on the 1,500-meter endurance test performed during college-age. Results A total of 639 male alumni had both data of the questionnaire and the 1,500-meter endurance test, and the studied follow-up period was from 17 to 34 years. An inverse association between the risk of diabetes and level of cardiorespiratory fitness was noted after adjustment for age, body mass index, smoking habits, and activity levels. Adjusted odds ratio of the incidence of diabetes according to the category (high, middle and low) was 1.00, 1.72 and 4.33 (for trend,  $p=0.02$ ). Discussion Men with low cardiorespiratory fitness during college-age might have low-level physical fitness in middle-age and had a high incidence of diabetes compared with men with high physical fitness (Okada et al., 2000; Sawada et al., 2003). Our data indicate that maintaining a high level of cardiorespiratory fitness from college-age aids in the prevention of diabetes. The 1,500-meter endurance run, as well as other cardiorespiratory fitness tests (Carnethon et al., 2003; Paffenbarger et al., 1973), could be a predictive factor for the development of diabetes. We propose that 1,500-meter endurance run tests could provide a way of predicting the development of diabetes later in life. These results indicate that a low cardiorespiratory fitness at college-age is an important risk factor for the development of diabetes later in life. References Carnethon MR, Gidding SS, Nehgme R, Sidney S, Jacobs DR Jr, Liu K. (2003). *JAMA*, 290(23), 3092-3100. Okada K, Hayashi T, Tsumura K, Suematsu C, Endo G, Fujii S. (2000). *Diabet Med.*, 17(1), 53-58. Paffenbarger RS Jr, Wing AL. (1973). *Am J Epidemiol.*, 97(5), 314-323. Sawada SS, Lee IM, Muto T, Matuszaki K, Blair SN. (2003). *Diabetes Care*, 26(10), 2918-2922.

**15:00 - 16:00**

## Mini-Orals

### PP-BN09 Biomechanics [BM] 9

#### DEVELOPING A SYSTEM TO MONITOR VERTICAL DEFLECTION IN A TRAMPOLINE BED

Chapman, C., Fischer, A., Rupf, R.

*Canadian Sport Institute Ontario*

**DEVELOPING A SYSTEM TO MONITOR VERTICAL DEFLECTION IN A TRAMPOLINE BED** Introduction The ability to jump high in an Olympic sized trampoline bed is not well understood due to the elastic surface involved. Understanding both the movement of the individual and the trampoline bed may provide more insight into jump height performance. To date, it appears as if no one has tracked the downward deflection (DD) of the elastic surface. The purpose is therefore to demonstrate new instrumentation that has been developed to assess DD of the trampoline bed and to provide general characteristics of the DD from athletes jumping on the bed. Methods Two cameras were positioned at the midline of the trampoline along the width and length of the trampoline bed at a depth around 60 cm below the bed. To find the position of the athlete and the DD, subtraction imaging was performed at 120Hz. An algorithm developed in Labview 7.1 determined the location of the subject on the bed, the DD and the flight time between jumps. These values were compared to visual checks to ensure system tolerances were met. Trampoline athletes (N=3) jumped on the trampoline bed with the three highest consecutive jumps processed for flight time, position and DD. Results Time of flight differed consistently from visual cues by less than 50ms. The ability of the system to determine landing location varied slightly based on landing position in the bed. However, differences could be reduced to less than 50mm. Performance for the DD metric was within system design tolerances, with variance no greater than 1cm. DD reached its maximum around 45.7% (+/-0.3) of the jump cycle. Coefficient of variation for DD between successive jumps is 4.2%. There is no correlation between DD and jump height. While not measured mass, may play a more prominent role. Discussion The outputs from the system aligned well with planned design tolerances. The information around the DD suggests athletes are compressing the bed sooner in the relative jump cycle. Previous work around elastic surfaces (Mortiz, 2004) may suggest that this early maximum DD may increase center of mass movement in athletes. The system provides the opportunity to measure vertical deflection of the bed, and allow for the trampoline bed and human to be modeled in spring mass systems. References Moritz C, Farley T. (2004). *Jrnl Exp Bio* 208, 939-949.

#### GOLF COACHING-BIOMECHANICS INTERFACE: STARTING WITH THE COACH

Morrison, A., Mcgrath, D., Wallace, E.S.

*University of Ulster*

**Introduction** There is a growing concern that the transfer of knowledge between sports science and coaching is unsatisfactory, and biomechanics is no exception (Knudson, 2007). While the integration of quantitative, qualitative and predictive approaches to technique analysis is supposedly imbedded in biomechanical practice, this does not seem to be evident (Lees, 2002), even in a highly technique based sports such as golf. The aim of this study was therefore to determine how elite coaches analyse the golf swing technique, to investigate elite golf coaches' opinions of biomechanics and to identify potential barriers to the integration of biomechanics into coaching practice. Methods Semi-structured interviews were used to record the views of 7 elite UK golf coaches. The transcripts were analysed inductively using a grounded theory approach. Results The process of golf swing technique analysis appeared to start in broadly the same area for all coaches: the curvature, direction and distance of the shots, which, interestingly, does not reflect the current state of the golf biomechanics literature. Coaches assume that these different aspects of the ball's trajectory are correlated to pre-impact conditions of the clubhead. The elements of technique that are thought to have a direct relationship to the pre-impact conditions of the clubhead (e.g. lateral body position in relation to the ball location and, therefore, where on the club's arc the ball is struck) are then adjusted. Subsequently, coaches suggest that there is no perfect swing, and effective swings incorporate movement "compensations" that effectively cancel each other out. The coaches' chief concern with biomechanics appears to be the use of "optimal" models of technique that do not take into account the individual characteristics of a player. Therefore, they struggle to see how they can apply the "optimal" data practically. Nevertheless, the coaches seem to appreciate that biomechanics research has had an influence on their coaching. Due to their different analysis methods, and a self-perceived lack of biomechanics knowledge, coaches suggest a closer relationship is needed between the two disciplines. Discussion This study helps to bring to light the issues that separate golf coaching from biomechanics. While some of the coaches freely admitted that their limited knowledge of biomechanics is a barrier to their use of it, the overriding factor was that it did not complement their existing methods of coaching. Although qualitative and quantitative analysis of technique have traditionally been segregated, considerations for a more circular exchange of information through the coaching-biomechanics interface may be beneficial

if future research is to have a real world application. References Knudson D (2007) Sports Biomech 6(1) 109-118 Lees A (2002) J Sports Sci 20(10) 813-828

### **EFFECT OF NEUROMUSCULAR TRAINING ON KNEE ROTATION IN YOUNG FEMALE: DESCRIPTION BY QUATERNIONS REPRESENTATION**

Santiago, P.R.P., Narayana, V.S., Cunha, S.A., Érica, E.V.

*University of Sao Paulo*

**Introduction:** The neuromuscular control is important for the execution of the movements in the sport, its modification or reduction can result in unnecessary and excessive movements of the joints of the lower limbs in many cases leading to injuries mainly ACL injuries. In order to improve the movement pattern several training protocols have been used as the intervention and the results were diverse. **Objective:** The aim of this study was to investigate the effect of neuromuscular training on knee rotation in young females by the method of quaternions. **Methods:** Five female participants were recruited to participate in the present study (age  $19.8 \pm 2.04$  years,  $65.6 \pm 6.8$  kg,  $1.66$  height  $\pm 0.04$  m, without injury and musculoskeletal pain in the lower limbs. They performed five single-leg drop landings from a platform with a height of  $0.4$  m, before (PRE) and after (POS) training. Six passive markers (three on the thigh and three on the shank) were used to obtain the 3D kinematics. The Matlab software were used to smooth the raw data with the 4th order Butterworth digital filter with  $10$  Hz of cut-off frequency, and to create coordinate systems of the thigh and shank to extract the unit quaternions from the knee joint observed in the task. Then the scalar portion of the unit quaternion was used to calculate the angular variation (AV) in degrees after initial contact with the ground until the time of peak angular rotation. The coefficient of variation in percent (CV) was used to verify the possible effect of neuromuscular training. **Results:** The mean, standard deviation and, CV of de AV were: PRE ( $56.7^\circ \pm 44.7^\circ$  and  $78.8\%$ ) and POS ( $43.4^\circ \pm 8.3^\circ$  and  $19.1\%$ ), that represents a  $59.7\%$  reduction in the CV. **Discussion:** The results of this study indicate that intervention during 7 weeks of neuromuscular training reduced of the knee rotation in young female during single-leg drop landing task. This can be considered as a factor beneficial for the prevention of injuries in this joint. **Acknowledgments:** FAPESP (process: 2010/20538-7 and 2011/14811-5)

### **DEFINING THE OPTIMAL LOAD FOR WEIGHTED STEP POWER TRAINING IN OLDER WOMEN**

Mair, J.L.1, Laudani, L.2, Vannozi, G.2, De Vito, G.1, Boreham, C.A.1, Macaluso, A.2

*1: University College Dublin (Ireland), 2: Università degli Studi di Roma*

**Introduction:** Weighted stepping is a dynamic multi-joint functional task that may enhance important aspects of functional fitness in older adults. However, the optimal load associated with peak power output during such a task is unknown. The aims of this study were three-fold: (1) to investigate the kinetic and neuromuscular responses to different loading patterns during step exercise in young and older sedentary women; (2) to determine the effect of ageing on these responses; (3) to determine the optimal external load associated with peak power output. **Methods:** Sixteen healthy females (8 young (mean, SD; aged  $24.6, 2.7$  years) and 8 older (aged  $69.8, 3.5$  years)) volunteered for this study, which was approved by the local University Ethics Committee. Ground reaction forces were measured during a step-test protocol requiring participants to step from one force platform (at ground level) onto a bench mounted onto a second force platform. Simultaneous measurements of vastus lateralis (VL) and biceps femoris (BF) muscle activation were recorded throughout using a portable bipolar sEMG system. Participants performed ten step-up repetitions as quickly as possible, leading with the dominant limb. Two bench heights ( $20$  &  $25$ cm) and five loads ( $0, 2.5, 5, 7.5$  &  $10\%$  body mass; BM), evenly distributed by means of a weighted vest, were investigated in a randomised order. Power output was calculated by multiplying the vertical force by vertical velocity of the body centre of mass during the ascent phase of stepping. **Results and Conclusion:** Increasing step height resulted in greater peak power ( $p < 0.01$ ) in the older women, while step height had no effect on kinetic responses in the young women. Increasing load had no significant effect in either group, although trends for peak power at  $10\%$  BM in the older and  $7.5\%$  BM loading in the younger group were evident. Peak power generating capacity was  $64\%$  lower in the older than that of the young ( $p < 0.001$ ). Alterations in stepping strategy were also apparent whereby the younger women performed a 'run' step, and older women performed a slower 'basic' step, highlighting an age-related reduction in ability to step at high speed. Normalised VL muscle activation was greater in the old compared with the young ( $p < 0.05$ ). However, peak force was significantly lower ( $p < 0.01$ ), suggesting that older women were operating closer to their threshold of maximum force in order to complete the stepping task. Optimal load at a step height of  $20$ cm was  $10\%$  BM in older and  $7.5\%$  BM in younger women, representing a  $6\%$  and  $11\%$  increase in peak power output over values obtained at  $0\%$  loading, respectively. These findings should be taken into account when designing weighted step power training programmes.

### **EFFICACY OF STRENGTH TRAINING ON MACHINE CONDITIONING ADJUSTMENT OF EXTERNAL LOAD TO MUSCLE WORK ABILITIES**

Karczewska, M., Madej, A., Iwańska, D., Urbanik, C., Staniszewski, M., Mastalerz, A., Gwarek, L.

*Jozef Pilsudski University of Physical Education in Warsaw*

**Introduction** Machines commonly used for strength training allow to control loads applied on muscles precisely. Since in human joints only rotatory movements are possible, the length of the muscle and its strength are dependent on joint angle (Biscarini 2003, Philippou 2003). In connection with the above some inconsistency may be noticed between the constant external load, obtained in training machines with discs, and muscle work. Therefore use of specific cam of various radius, which allows to adjust the external load to muscle work abilities in the function of joint angle, seems to be justified (Folland 2003). There was a test experiment taken of effectiveness of 8 weeks elbow flexors training on machine with disc and specially constructed cam. **Methods** Thirty untrained male students participated in the study. Subjects were divided into 2 groups of 15 each. Group A trained with variable-cam, group B with disc. Subjects from both training groups performed strength training in 8 series with 3 min rest intervals (I:  $4 \times 75\%$  max, II:  $2 \times 85\%$  max, III-VIII:  $1 \times 1RM$ ). Control measurements of muscle torques of elbow flexors under isokinetic conditions at 3 velocities of  $30^\circ \cdot s^{-1}$ ,  $60^\circ \cdot s^{-1}$  and  $180^\circ \cdot s^{-1}$  (Biodex System 3 Pro) took place before experiment, after 4 weeks, on the last day of experiment and 3 weeks after experiment (4 measurement sessions). Multi-Factor ANOVA for repeated measurements (Statistica 2000) was used to analyze differences in variables between groups. **Results** There were no significant interactions found between variables (training, load of cam and disc or velocity of measurements)  $F(6.261) = 0.43$ ;  $p = 0.858$ . The grade of muscle torques changes, at the velocity most adequate to the one of the movement while training, as a result of training was  $7.2\%$  in group A (variable-cam) vs.  $4.0\%$  in group B (disc). Significant interactions were related to influence of training and various isokinetic conditions ( $F(6.261) = 3.52$ ;  $p < 0.01$ ). The highest values of muscle torques in both groups sub-

jects achieved at the velocity of  $30^{\circ}\cdot s^{-1}$ , and the lowest at  $180^{\circ}\cdot s^{-1}$ . Discussion Results of many studies indicate the importance of training loads. It's being also pursued the loads would involve muscles to work in the highest degree (Oliveira 2009). Therefore various training machines are used in training. Nevertheless in the present study there was the same, significant progress in strength training with use of cam and disc. References Folland J, Morris B (2008). *J Sports Sci*, 26(2):163-169. Oliveira L, Matta T, Alves D, Garcia M, Vieira T (2009). *J Sports Sci and Med*, 8:24-29. Biscarini A (2003). *J App Biomech*, 19:223-238. Philippou A, Maridaki M, Bogdanis G (2003). *J Sports Sci*, 21:859-865.

### **DETERMINATION OF RESISTANCE TRAINING VARIABLES USING A SINGLE TRIAXIAL ACCELEROMETER**

Brown, N., Hellmann, N., Alt, W.

*University Stuttgart*

**Introduction** Objective measurement of resistance training parameters is a requirement to be able to quantify training strain in resistance training. At present, no valid methods are known to reduce the complexity of the high amount of relevant data (Toigo & Boutellier, 2006) and simplify the protocolling of training variables. Chang et al. (2007) used two accelerometers to identify a specific task and to determine the numbers of repetitions in resistance training using the main axis of the detected task. This method showed high reliability, but cannot be integrated into the training process due to complexity and limitation to one axis of movement. The following study uses only one accelerometer to determine the numbers of repetitions with a specific algorithm. **Methods** The validity of the algorithm was tested with 11 male subjects (age=  $24.8 \pm 0.6$  years, height=  $180.8 \pm 10$  cm, weight =  $75.3 \pm 7.1$  kg). The subjects executed 10 standard exercises with 8-12 repetition maximum. The acceleration data was collected using a 3-dimensional accelerometer (XSens Mtx) positioned on the right wrist. Video-analysis was used to control the validity of the algorithm. **Results** After a screening of the acceleration data by an expert, 90 of 110 exercises were integrated into the analysis. 20 exercises could not be analysed due to an error in data collection. 86.7% of the exercises were calculated correctly by the algorithm. The false calculations showed a mean deviance of  $35.3 \pm 31.1\%$  in counted repetitions. At most, too many repetitions were counted (91.7%). The bench press exercise showed the highest number of wrong calculations of repetitions (60.0%) **Discussion** This study shows, that a high amount of standard exercises can be quantified using only one accelerometer positioned on the subjects wrist. Wrong calculations of training variables was mainly found in specific exercises characterised by a high degree of freedom and therefore a high amount of oscillations in the movement, requiring for a modification of the algorithm. In further studies more training variables have to be examined to further optimise training quantification in resistance training and enhance the usability of the presented method. **References** Toigo, M., & Boutellier, U. (2006). New fundamental resistance exercise determinants of molecular and cellular muscle adaptations. *Eur J Appl Physiol*, 97, 643-663. Chang, K., Chen, M. Y., & Canny, J. (2007). Tracking Free-Weight Exercises. *Computer Science*, 4717, 19-37.

### **COMPARISON OF RELATIONSHIP BETWEEN ANTHROPOMETRIC MEASURES AND THE SHOULDER ROTATORS ISOKINETIC POWER**

Zapardiel Cortés, J.C., Rodríguez, M.L.

*Universidad de Alcalá*

**Introduction** The relationship between strength and anthropometric measures is an area of particular interest to a number of coaches. This relationship is especially important in sports where the powerful throwing can be the cause of success. Therefore, the aim of this study was to compare the relationship between several anthropometric measures and power generated in the rotational motion of the shoulder joint complex in three groups of athletes: multisport female athletes, multisport male athletes and handball male players. **Methods** Seventy multisport male athletes (5 left-handed, 65 right-handed), twenty-nine multisport female athletes (8 left-handed, 21 right-handed) and twenty-six handball male players (6 left-handed, 20 right-handed) participated in the study. Their ages ranged from 19 to 30 (mean 23.5). The anthropometric variables studied were the size, height, weight and body fat percent, and the isokinetic variable studied were the power. In order to measure the power, a System 3 Biodex isokinetic dynamometer is used. In order to measure the anthropometric parameters we followed the standardized techniques recommended by the International Society for the Advancement of Kinanthropometry. **Results** Statistically significant correlations were found between the strength and weight and percent body fat to angular velocities of 60 and  $180^{\circ}/s$  at the internal rotation, and also with the size in external rotation. The higher relationships were found in multisport female athletes, followed by multisport male athletes and lowest relationships were found in handball players. **Discussion** Handball players group results may indicate that the greater number of hours of training lowers correlation of anthropometric variables with the power. In this sense, Mayer et al (1994) supports this assertion. Similarly, strength training for the recruitment of large motor units, which made the handball players, could also be the cause of lowest relationships between the power and the anthropometric variables studied. Another reason that could make understand the lowest relationship observed in handball players is the type of training they did, combining strength training with technical and tactical training (Aguilar-Martínez et al, 2012). **References** Mayer F, Horstmann T, Roecker K, Heitkamp HC, Dickhuth HH. (1994). *Int J Sports Med* 1994;15(1):S19. Aguilar-Martínez D, Chiroso LJ, Marfín I, Chiroso LJ, CuadradoReyes J. (2012). *Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte*, 12 (48) 729-744.

### **JUMPING ONTO UNSTABLE SURFACES DOES NOT IMPAIR SUBSEQUENT STABLE JUMPING PERFORMANCE**

Pollitt, L., Bissas, A.

*Leeds Metropolitan University*

**Introduction** Although interest has grown over recent years in training using unstable surfaces, its acute and chronic performance effects are still not fully understood. Furthermore, this has excluded consideration of dynamic exercise where instability during landing may cause a heightened neuromuscular response to negotiate increased stability demands. An increased neural drive may then be directed towards the agonistic muscles when stability demands are reduced. This study was therefore designed to compare the effects of drop-jumps (DJ) onto unstable and stable surfaces on subsequent stable countermovement jump (CMJ) performance. **Methods** In a random crossover design 14 males ( $21.09 \pm 2.4$  yrs) completed 3 experimental conditions, with each condition consisting of an activation exercise (3 sets of 5 DJ from 0.4m) onto either unstable (BOSU, mini-trampoline (MT)) or stable (ground) surfaces, and a control condition. The experimental conditions represented a typical post-activation potentiation (PAP) protocol for an acute study (Saez Saez de Villareal et al., 2007). Testing consisted of 3 maximal CMJ on a force plate (1000Hz) before and after ( $t=5$ ,  $t=9$ min) each protocol and the best jump at each point was analysed. Four practice sessions were also conducted beforehand, with absolute and relative reliability statistics establishing the level of reproducibility for CMJ and DJ performance so the magnitude of any pre-post differences could be appreciated. Data

were analysed using Repeated Measures ANOVA. Results No differences were observed between conditions with respect to any kinetic, temporal or performance variables. With regards to the time factor each condition, including the control, followed a similar trend. No pre-post significant differences were observed for temporal variables (e.g. eccentric phase), while the reductions observed for key kinetic variables (e.g. peak power, take-off velocity) and specifically jump height (control (-5.5%), BOSU (-5.3%), MT (-2.6%), ground (-5.4%)) were within the reproducibility random error limits. Discussion The results across conditions with respect to time do not indicate that PAP was present, as no significant changes were observed during post-testing. This may arise from failure to employ the optimal protocol to evoke PAP, for which there is no uncontroversial standard. Nevertheless, these findings suggest that acute DJ sessions onto unstable surfaces yield similar effects to commonly performed DJ onto stable surfaces. Dynamic training onto unstable surfaces may therefore be beneficial during all stages of structured training, including rehabilitation, by reducing impact forces upon landing while maintaining performance and possibly conditioning the neural circuit. References Saez Saez de Villareal et al., (2007) *Eur J Appl Phys* 100(4): 393-401

## AN INERTIAL-SENSOR BASED METHOD TO QUANTIFY THE VERTICAL MOVEMENT OF RIDER AND HORSE IN DRESSAGE RIDING

Eckardt, F., Münz, A., Witte, K.

*Otto von Guericke University Magdeburg*

Introduction The rider should be sitting well-balanced, elastic, and smoothly absorbing the motion of the horse (FEI, 1994). So far, motion analyses of riders are limited to videometry and measurements on treadmills. However, today inertial sensors make it possible to quantify kinematic data with comparable accuracy to optical motion capture systems (Pfau et al., 2005). The purpose of this study is to quantify whether significant differences exist in the range of motion (ROM) and in the variability (CV) of vertical movement of the rider and the horse under field conditions. Materials and Methods Ten high level riders (age:  $23.4 \pm 5.25$ , riding experience:  $17.3 \pm 5.6$  years) participated in the study. They rode their own horses in walk (W), sitting trot (ST), rising trot (RT), right lead canter (CR), and left lead canter (CL) on a 30m track. Kinematic data from riders were collected using an inertial motion capture system (IMS, 120 Hz, Xsens). Further one inertial sensor (120 Hz, Xsens) was attached close to the sternum of the horse (saddle girth). One gait cycle was defined as the time between two successive ground contacts of the left front limb of the horse by using an acceleration sensor. We captured at least 28 strides for each rider and gait and normalized each stride in time. The vertical acceleration of the sensor on horse and segments from riders (head, trunk, pelvis) were integrated twice to obtain vertical displacement by using a method described by Pfau (2005). The ROM [cm] and the CV of vertical movement for rider and horse were calculated. We compared at a significance level of .05 mean values (ANOVA) of ROM and CV. Results ANOVA showed no differences in ROM of riders segments in each gait. Significant differences were found between ROM of rider segments and ROM of the horse. For all segments pairwise follow up-test showed no differences between ST (pelvis:  $15.98 \pm 0.89$ ) and RT (pelvis:  $16.94 \pm 3.0$ ) and between CR (pelvis:  $41.79 \pm 3.2$ ) and CL (pelvis:  $43.25 \pm 2.7$ ). Compared to all other gaits, CV in W was different. Discussion The IMS is suitable to quantify the vertical movement of rider and horse in different gaits under field conditions. Also, all calculated vertical displacement curves showed characteristic gait-dependent features. The CV in vertical movement for ST and RT are corresponding with the results of Peham et al. (2004). References Fédération Equestre Internationale (1994). Rules for dressage events. Lausanne, Switzerland. Peham, C., Licka, T., Schobesberger, H., & Meschan, E. (2004). Influence of the rider on the variability of the equine gait. *Human Movement Science*, 23, 663-671. Pfau, T. (2005). A method for deriving displacement data during cyclical movement using an inertial sensor. *Journal of Experimental Biology*, 208, 2503-2514.

## INFLUENCE OF RIDING SKILL ON COORDINATION DYNAMICS BETWEEN HORSE AND RIDER

Münz, A., Eckardt, F., Witte, K.

*Otto von Guericke University Magdeburg*

Introduction By connecting the body of the rider to the horse especially the rotation of the human pelvis is supposed to play a key role in horse riding (Pfanni & Tulli, 1994; Blokhuis et al., 2008). Regarding coordination between horse and rider, Lagarde et al. (2005) assume the exchange of information through the seat to be an important factor. We therefore suggest the coupling between the pelvis and the horse to be part of the skill of the rider to control the horse and to follow its movement. The aim of this study is to quantify the coordination between the pelvis and the horse. Materials and Methods Ten professional riders (age:  $23.4 \pm 5.25$ , BMI  $21.5 \pm 2.47$ , training hours/week:  $33.9 \pm 11.89$ ) and ten beginners (age:  $16.4 \pm 2.88$ , BMI  $20.2 \pm 2.32$ , training hours/week:  $2.6 \pm 1.36$ ) participated in the study, riding their own horses in walk (W), sitting trot (T) right lead canter (CR) and left lead canter (CL). One six degree of freedom inertial sensor (120 Hz, Co. Xsens) was mounted dorsally on the rider's pelvis. Another sensor was attached close to the sternum of the horse (saddle girth). For stride segmentation a third sensor was mounted laterally on the left cannon bone. A complete stride was defined as the time between two successive ground contacts of the left front limb of the horse. We captured 30 strides for each rider and gait. Strides were normalized to 101 samples (MATLAB, 2012b) and the continuous relative phase (CRP) between horse and rider was assessed. Based on rotations about the transversal axis of both, rider and horse, we tested mean CRP values for differences. Results Independent t-test showed significant ( $p < .05$ ) lower values for professional riders only in CL ( $-65.94 \pm 17.87$  vs.  $-86.61 \pm 9.54$ ) and CR ( $-72.99 \pm 18.73$  vs.  $-89.50 \pm 6.42$ ). Discussion Controlling the pelvis is a crucial skill in horse riding. Coordination in canter seems to be depending on the riding level. Professional riders showed smaller CRP values, indicating a slightly more in-phase behavior. However, this finding is not applicable to slower gaits (W and T). Wolfram et al. (2013) observed lower mean CRP values in CL and CR compared to W or T, which corresponds with our findings. References -Blokhuis, M., Arnosson, A., Hartmann, E., Van Reenan, G. (2008) Assessing the rider's seat and horse's behavior: difficulties and perspectives. *J. Appl. Anim. Welfare Sci.*, 11, 191-203. -Lagarde, J., Peham, C., Licka, A., & Kelso, J. A. (2005). Coordination dynamics of the Horse-Rider System. *J. Mot. Behav.*, 37 (6), 418-424. -Panni, A. S., & Tulli, A. (1994). Analysis of the movements involved in horse-riding. *J. Sport. Traumatol.*, 16 (4), 196-205. -Wolfram, I.A., Bosga, J., Meulenbroek, R.G.J. (2013). Coordination dynamics in horse-rider dyads. *Hum. Mov. Sci.*, <http://dx.doi.org/10.1016/j.humov.2012.11.002>.

## POST ACTIVATION POTENTIATION AND ACHILLES TENDON STIFFNESS IN ATHLETES

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Introduction The enhancement of muscle contractile properties caused by post activation potentiation can be related to improvements in excitation-contraction coupling, increased sensitivity to calcium and/or increased stiffness in the series of elastic components (I). This

study aimed to assess how Achilles tendon stiffness (ATS) was affected by a 6 s maximal voluntary contraction (MVC) and how any changes in stiffness were associated with changes in contractile properties. Methods Six power athletes participated. Initially supra maximal electric stimulation of the tibial nerve was used to evoke plantar flexor twitches before and up to 600 s after a 6 s MVC. In a second visit, ATS measurements were taken before and up to 600 s after a 6 s MVC. For ATS measurements, subjects performed standardized plantar flexor torques (0, 30 and 50% of MVC) while the insertion of the Achilles tendon was monitored by a real time ultrasound and a four-camera motion capture system. Torque was measured by an isokinetic dynamometer. From the twitches, Peak twitch (PT) and rate of torque development (RTD) were measured. ATS was calculated from plantar flexor torque and Achilles tendon length. Two-way ANOVAs and Tukey post-hoc tests were used to ascertain statistical significance ( $p < 0.05$ ). Results PT was significantly increased by  $39.5 \pm 15.5\%$ ;  $17.0 \pm 7.5\%$  and  $9.9 \pm 5.9\%$  at 30, 120 and 300 s after MVC. RTD was significantly increased by  $67.5 \pm 20.5\%$  and  $18.2 \pm 7.8\%$  at 30 and 120 s after MVC. At the same time points, no significant decreases or increases were found in ATS for any of the torque levels. Discussion While a decrease in ATS may lead to a decrease in performance an ATS increase might improve performance but also predispose to injury (2). Our data showed that in power athletes post activation potentiation of contractile properties can be induced without greatly affecting ATS. This conservation of ATS may make it possible for athletes to use conditioning MVCs to enhance muscular contractile properties without increasing the injury risk due to high stiffness. Acknowledgement: The authors wish to thank the Swedish Center for Sports Research (CIF) for financial support of this project and Paulo Gago wishes to thank Fundação para a Ciência e Tecnologia (FCT), Portugal for the Ph.D. Grant SFRH/BD/79184/2011. MacIntosh BR. Cellular and Whole Muscle Studies of Activity Dependent Potentiation Muscle Biophysics. In: Rassier DE, editor. *Advances in Experimental Medicine and Biology*. 682: Springer New York; 2010. p. 315-42. 2. Butler RJ, Crowell HP, Davis IM. Lower extremity stiffness: implications for performance and injury. *Clinical Biomechanics*. 2003

## EFFECTS OF RUNNING ON ACHILLES TENDON FATIGUE IN THE FREE AND GASTROCNEMIUS TENDON COMPONENTS

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**Introduction** The elastic properties of the human Achilles tendon are important for locomotion, however in vitro tests suggest that repeated cyclic strain leads to tendon fatigue represented by an increase in length in response to stress applied (Ker et al., 2000; Wren et al., 2003). In vivo experiments have yet to demonstrate mechanical fatigue in the human Achilles tendon. The aim of this study was to determine whether either the free Achilles tendon (calcaneus attachment to the soleus) or the gastrocnemius tendon (calcaneus attachment to the gastrocnemius) demonstrate tendon fatigue after running exercise. **Methods** Nine male participants (age = 22 (mean)  $\pm$  4 (SD) years, height =  $173. \pm 11$  cm, mass =  $74 \pm 9$  kg) volunteered to participate in this study. A test-retest protocol was used to examine the influence of running on tendon mechanical properties. Participants initially underwent a test to examine Achilles tendon strain during isometric contractions at four different torque levels (passive, 14, 42 and 70 N.m). They were then instructed to run continuously on a treadmill for 5km at a comfortable self-selected pace (10-14km.h<sup>-1</sup>). Immediately after the run, participants were re-tested to examine Achilles tendon strain in response to the same isometric contraction torque levels. Freehand three-dimensional ultrasound scans of the Achilles tendon were performed during all isometric contractions to accurately determine the free Achilles tendon and gastrocnemius tendon length and cross-sectional area (Farris et al., 2013). Results Prior to exercise, the free Achilles tendon underwent more strain than the gastrocnemius tendon across all torque levels ( $p < 0.001$ ). The length of the free Achilles tendon increased significantly across all torque levels after the run ( $p < 0.001$ ) indicating a small amount of tendon fatigue. In contrast there was no significant change in the length of the gastrocnemius tendon as a whole ( $p = 0.098$ ). A significant increase in the passive length of free Achilles tendon was found, however this effect was small (0.85%, effect size = 0.03) and did not correspond to any change in tendon volume. **Discussion** Our results have shown the first in vivo evidence of Achilles tendon fatigue after running exercise. This was, however, only evident in the free tendon and the effect was small and due primarily to a change in resting length and not tendon stiffness per se. These results may have implications for understanding Achilles tendon injury, because they suggest that some changes in material properties occur in the free tendon, which is commonly associated with tendinopathy. **References** Farris D, Trewartha G, McGuigan M, Lichtwark, G. (2013). *J Exp Biol*, 216, 594–600. Ker R, Wang T, Pike A. (2000). *J Exp Biol*, 203, 1317–1327. Wren T, Lindsey D, Beaupré G, Carter D. (2003). *Annals Biomed Eng*, 31, 710–717.

## CHANGES IN OPTIMAL CADENCE MINIMIZING MUSCULAR ACTIVATION WITH POWER OUTPUT AND MUSCLES INVESTIGATED.

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**CHANGES IN OPTIMAL CADENCE MINIMIZING MUSCULAR ACTIVATION WITH POWER OUTPUT AND MUSCLES INVESTIGATED.** **Introduction** Previous studies have reported inconsistent results, including linear, curvilinear, parabolic and steady muscular activity when cadence increased (Marsh and Martin 1995, McIntosh et al. 2000, Neptune et al. 1997). Two explanations can be proposed. Firstly, each muscle may be activated differently as cadence increased. Secondly, the differences observed for a same muscle between the studies are probably related to the methodology used as the power output or the range of cadences. Thus, the aim of this study was to investigate the influence of cadence on the muscular activity of various lower limb muscles at different power outputs. **Methods** Fourteen healthy noncyclists participated in this study. All subjects cycled on a friction-loaded ergometer during five 3-min periods of steady-state cycling with cadences ranging from 40 to 120 rpm, at five randomized power outputs (40 to 200 W). EMG activity of six major muscles of the lower limb (gluteus maximus GMx, biceps femoris BF, rectus femoris RF, vastus lateralis VL, gastrocnemius medialis GM, tibialis anterior TA) was continuously measured at 1000 Hz. The averaged root-mean-square value for each muscle was computed across 10 consecutive pedalling cycles. The individual EMG-cadence relationships were fitted by linear or parabolic regressions, which allowed the determination of optimal cadence minimizing EMG (Copt): at 40 rpm or at the minimum point of parabolic EMG-cadence curves, respectively. A two-ways analysis of variance for repeated measures (muscle x power) and a post-hoc LSD Fisher were used with a statistical significance limit defined as  $P < 0.05$ . Results The EMG-cadence relationships were mainly fitted by parabolic regressions, linear positive regressions being only observed in some subjects at low power outputs on GM, TA and VL muscles. Copt ranged from  $40 \text{ rpm} \pm 0.2$  for the GM muscle at 40 W to  $76.3 \text{ rpm} \pm 16.7$  for the GMx muscle at 200 W. ANOVA showed a significant muscle effect ( $P < 0.01$ ; VL and GM having the lowest Copt) and power output effect ( $P < 0.001$ ; 160 and 200 W allowing to obtain the highest Copt), without muscle-power interaction. **Discussion** Present results showed that each muscle responds differently to cadence increase at a given power output, what explained the unique Copt corresponding to each muscle. Moreover, the minimum muscular activity occurs at a progressively higher cadence as power output increases (excepted for the VL muscle), due to the force-velocity properties of muscles. This result was previously observed by McIntosh et al. (2000) with seven lower limb muscles averaged together. **References** Marsh AP, Martin PE (1995). *Med Sci*

Sports Exerc 27, 217-225. McIntosh BR, Neptune RR, Horton JF (2000). Med Sci Sports Exerc 32, 1281-1287. Neptune RR, Kautz SA, Hull ML (1997). J Biomech, 30, 1051-1058.

## 15:00 - 16:00

### Mini-Orals

#### PP-BN15 Motor Learning [ML] 2

##### EXPLORING S-SHAPE MOTOR LEARNING CURVES WITH PHASE TRANSITION

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**Introduction** Although many different shapes of motor learning curves have been suggested in textbooks, most of the motor learning curves observed in the literatures were based on tasks such as single limb positioning; the nature of learning those types of tasks is very different from learning the multi-segment coordination tasks. According to the frameworks of the dynamical systems theory, a new attractor emerges in the dynamic landscape during the coordination learning (phase transition), therefore a discontinuous jump (S-shape) on the learning curves may be observed (Newell et al., 2001). The purpose of the study was to examine the motor learning curve at the phase transition of acquiring the coordination pattern of the roller ball tasks based on the dynamical systems theory. **Methods** The roller-ball, a top encapsulated in a 7-cm diameter spherical shell, was prepared for the initial spinning speed of 20 rps and handed to the participants. The goal of the task was for the participants to produce the appropriate relative phase between the hand motion and the spinning ball in order to accelerate the ball to 50 rps by the end of each 10 s trial. All the participants practiced 50 trials a day for 10 days, and another 50 trials at 1 week retention test. In addition to plotting the average acceleration of each trial for 500 trials to observe qualitatively the S-shape learning curves for each participant, the One way ANOVA on the average acceleration of the trial was examined for the 1st, 10th, and the retention sessions, and the Level Crossing method (Wagenmakers et al., 2005) was used to test the phase transition during the learning process. **Results** The ANOVA result shows a significant effect on the performance segments, and the post hoc paired t-tests show the significant difference between the 1st and 10th practice sessions, and between the 1st and retention sessions; no difference between 10th and retention sessions was found. The results of the level crossing method performed on the individual 500 trials of performance measure show distinct bi-modal distributions indicating two stable equilibrium states over the 500 trials. **Discussion** The results provide preliminary evidence of a phase transition during the learning of a new coordination task and the related S-shape learning curve in the task outcome. Further experimental and modeling work will elaborate the generalization of these new findings on phase transitions and learning curves. **References** Newell K M, Liu Y-T, Mayer-Kress G. (2001). Psychol Rev, 108(1), 57-82. Wagenmakers E-J, Molenaar PCM, Grasman RPPP, Hartelman PAI, van der Maas HLJ. (2005). Physica D, 211, 263-276.

##### THE INFLUENCE OF DIFFERENT TEACHING METHODS ON MOTOR LEARNING IN SCHOOL CHILDREN

Braun, C., Focke, A., Stein, T., Seidel, I.

Karlsruher Institute of Technologies

**Introduction** Augmented feedback and observational learning are essential factors in motor skill learning (Magill, 2007). To our knowledge there is no study comparing the effectiveness of these two aspects in a school setting. Therefore, the aim of this study was to investigate different teaching methods (feedback, observational learning and their combination) for children in elementary school (2nd grade) and high school (5th grade) by learning the sport lacrosse. **Methods** Two hundred and eight subjects, 2nd grade (N=99) and 5th grade (N=109), performed lacrosse two times a week for 45 minutes in their sport class over five weeks. All subjects were divided into four different learning groups: feedback group (A), observational group (B), combination group (feedback and observation, C) and a control group (no lacrosse training, D). The feedback for group A and C was given as knowledge of performance, verbal, terminal, qualitative with a reduced frequency (systematical reduction) and as a combination of error and correction cues. For the observational learning groups B and C the model was always the same person. A pre-post-retention test design was used. After the pretest (T1) and a five week training program, the post test (T2) was conducted directly after the last training session. The retention test (T3) followed after another four weeks. The test battery includes throwing and catching of straight and variable balls in lacrosse. Physical activity and emotions were used as moderator variables. The experiment is not completed yet, so only the N=64 subjects (all 2nd grade, A=17, B=15, C=12, D=20) were analyzed so far. **Results** No significant interaction between test time and learning group was found for the straight catching task. All groups improved their performance from T1 to T3. In contrast for the tasks throwing and variable catching a significant interaction between test time and learning group was revealed ( $p = .014$ ,  $\eta^2 = .122$ ;  $p = .012$ ,  $\eta^2 = .125$ ). In the throwing task post hoc tests showed significant differences between T1 and T3 for all treatment groups (A, B, C) but not for the control group (D). For variable catching post hoc tests revealed significant differences between T1 and T3 only for the feedback (A) and the observation group (B) but not for the combination (C) and the control group (D). **Discussion** For 2nd graders both feedback and observational learning improved lacrosse performance after a five week training. Further analysis of the data could give information about differences between 2nd and 5th graders and might help to understand which teaching method is best for different school settings. **References** Magill, R.A. (2007). Motor Learning and Control. Concepts and Applications. (8th edition). Boston: McGraw-HillPark

##### THE DEVELOPMENTAL ACTIVITIES OF FEMALE PROFESSIONAL INTERNATIONAL SOCCER PLAYERS

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**Introduction** Expert male athletes engage in the developmental activities of practice, play and competition via somewhat predictable pathways. These are early specialisation, early diversification, and early engagement. Females engage in less physical activity during their youth compared to males (Troost et al., 2002), although whether this finding extends to the activities of expert female athletes has not been explored. The aim of this study was to examine the developmental activities of female professional international soccer players,

thereby providing information to aid the development of future players. It is expected that their activities will follow the early engagement pathway as per male players. Method Participants were adult female professional international soccer players from England (n=18) and Sweden (n=16). They completed the Participation History Questionnaire (PHQ) under supervision. The PHQ records milestones, such as start age, engagement in other sports, and hours in the soccer activities of practice, play and competition across childhood and adolescence. Preliminary between-group difference tests were used to compare groups on all dependant variables. Results Start age was earlier in Sweden (5 years of age) compared to England (6 years) ( $P < .05$ ). English players joined an elite academy (12 years), started as a senior professional (15 years), and started as an international (18 years) earlier compared to Swedish players (15, 17, and 21 years, respectively) (all  $P$ 's  $< .05$ ). During childhood, players engaged in more soccer play (233 hrs/yr) compared to practice (145 hrs/yr) and competition (33 hrs/yr), with English players (308 hrs/yr) engaging in more soccer play than Swedish (149 hrs/yr) (all  $P$ 's  $< .05$ ). Players engaged in 2 to 3 other sports during this period. During adolescence, they engaged in more soccer practice (344 hrs/yr) and competition (254 hrs/yr) compared to play (199 hrs/yr), although English players (317 hrs/yr) engaged in more soccer play than Swedish (66 hrs/yr) (all  $P$ 's  $< .05$ ). They engaged in 2 to 3 other sports during this period, although this reduced to 1 other sport at 18 years of age. Discussion This study is the first to examine the developmental activities of female professional international soccer players. Their developmental activities most closely followed the early engagement pathway, albeit with some variation from it. This pathway involves higher amounts of engagement in soccer play and lower amounts of engagement in other activities during childhood. It involves higher amounts of soccer practice during adolescence. Early engagement, as opposed to specialisation or diversification, may be a more optimal developmental pathway to expert performance. References Trost, S. G. et al. (2002). *Med Sci in Spo & Ex*, 34, 350-355.

## MOTOR SKILLS EVALUATION IN SCHOOL CHILDREN WITH DOWN'S SYNDROME: MABC TEST

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*Universidad de Alcalá*

Introduction In the present study it has been analyzed the applicability of different tasks, included in the motor test -Movement Assessment Battery for Children (MABC)-, which measures motor competence in children without disabilities, to children with Down's Syndrome (DS) aged nine to twelve years old. The aims of the study were to ascertain the applicability of this motor test in children with DS, and to evaluate the motor skills of these children with the above-mentioned test. Methods A total of 50 learners with DS participated in this study. We applied the MABC designed for the evaluation of motor skills in children from 4 to 12 years old. This battery is composed of 32 items divided in four sets of eight each and it was designed for its use in children of different groups of ages (Spanò et al, 1999). The selection of the different tasks of this battery was the band designed for 4 to 6 years old children made accordingly to the opinion of the professors. Results The degree of motor development in nine to twelve year old children with DS is lower than that of the four to six years old non-disabled children as measured with the MABC test. The motor test used has shown a level of difficulty and appropriate applications. In this study we can say that boys got better scores than girls in the static tasks and dynamic balance and visual-motor coordination. When we analyzed the motor competence of children with DS slightly lower to the chronological age from 9 to 10 years old, both sexes showed similar results (Rodríguez et al, 2002) and the differences began to accuse beyond 11 years old, present in the sample with DS, as the results of this study. Discussion In general population between 2 and 7-8 years of age the fundamental motor skills are consolidated (Ruiz et al, 1997). However, the results obtained in children with DS have not completed this process of consolidation of basic motor patterns. Despite being between 9 and 12 years old, this study show motor difficulties and more important than children without DS of 5 to keep balance and move according to different patterns of movement. The most serious DS disabilities in this study are related to balance, postural control and learning by cerebellum abnormalities (Pueschel, 1987). References Pueschel SM, Gallagher PL, Zartler AS, Pezzullo JC. (1987). *Research in Developmental Disabilities*, 8, 21-37. Rodríguez ML, Graupera, JL, Ruiz LM. (2002). *Rev.int.med.cienc.act.fis.deporte*, 7, 221-224. Ruiz LM, Graupera, JL, Gutiérrez M, Mayoral A. (1997). CIDE, Ministry of Education and Culture. Spanò M, Mercuri E, Rando T, Pantó T, Gagliano A, Henderson S, Guzzetta F. (1999). *European Journal of Paediatric Neurology*, 3,7-13.

## QUIET EYE TRAINING: WHAT INFLUENCE HAS QUIET EYE DURATION?

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Introduction: Recent research has identified that Quiet Eye Training (QET) is effective for both expediting novices' learning of golf putting, and making performance more resilient to the effects of pressure (e.g., Moore et al., 2012). However, while QET participants tend to have longer QE durations than control group counterparts, it is not clear that this extended duration of programming is responsible for the performance advantages found. We therefore compared two QET interventions, which differed only in terms of the duration of the final QE fixation in order to further our understanding of why QET 'works'. Methods: We randomly assigned 18 novice golfers into short (n = 8) and long (n = 10) QET groups. Both interventions followed a QET pre-shot routine (e.g., Moore et al., 2012) where the timing and duration of fixations on the hole and the ball were driven by an audio recording, which the participants followed. These recordings differed only in terms of the duration of the final fixation on the ball (800ms - short; 2500ms - long) before the initiation of the putting stroke. Participants made 40 putts from ten feet in a baseline (pre-training) condition before completing 320 putts under their specific QET protocol. Finally 20 putts were taken in both retention and pressure conditions (as Moore et al., 2012). 2 (Group) x 3 (Condition) ANOVA were performed on radial error (cm), QE duration (ms), and self-reported anxiety data (1-11). Results: A main effect for condition revealed that both groups significantly improved putting performance after training (Baseline = 47cm; Retention = 24cm;  $ps < .005$ ), however, there was no effect of pressure on performance (Pressure = 25cm), and no significant group or interaction effects ( $ps > .400$ ). Differences in QE durations were effectively manipulated by the training protocol as a significant interaction effect was found ( $p = .001$ ): 'Long': Baseline = 1520ms, Retention = 3177ms; 'Short': Baseline = 1202ms, Retention = 1003ms. No further changes occurred under pressure ('Long': Pressure = 2858ms; 'Short': Pressure = 996ms). The pressure manipulation was successful in significantly increasing anxiety (3.9) for both groups compared to baseline (2.2) and retention (2.0) conditions ( $ps < .001$ ). Conclusions: QET supported effective skill acquisition and performance under pressure, but surprisingly this was the case whether a long or short QE duration was trained. Previous research has suggested that such short QEs (~1000ms) leave performers susceptible to choking under pressure. We propose therefore that other elements of the QET routine warrant further research attention to further our understanding of why QET 'works'. References: Moore, L., Vine, S., Cooke, A., Ring, C., & Wilson, M.R. (2012). Quiet eye training expedites motor learning and aids performance under pressure: The roles of response programming and external attention. *Psychophysiology*, 49, 1005-1015.

### TMS OF HUMAN SMA LEADS TO SIMILAR MEP AS THOSE FOR M1 BUT WITH SMALLER SILENT PERIODS IN A PRECISE FORCE CONTROL TASK.

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**Introduction** The corticospinal (CS) system plays an important role in fine motor control, especially in precision grip tasks (Lemon et al., 1995). Most of the CS projections originate in the primary motor cortex (M1). However, in monkey, CS projections have also been found originating in Supplementary Motor Area (SMA) (He et al., 1995). We recently showed direct communication between human SMA and intrinsic hand muscles that seems to be related to the precision of force control (Chen et al, submitted). This suggests that CS projections from human SMA exist and become functional when manual force control needs high precision. In order to further study these CS projections from SMA, we compared the muscle responses to transcranial magnetic stimulation (TMS) of human M1 with that of SMA during a fine visuomotor force tracking task. **Methods** Eight right handed subjects maintained a cursor on a target profile, moving from right to left on a computer screen, by applying a force on a custom device with their right hand precision grip. The precision level of the control was imposed by two cursor sizes (smaller cursor = higher precision). Neuronavigated TMS was used to stimulate left M1 and SMA. We compare the motor evoked potentials (MEP) between SMA and M1 stimulation on an intrinsic right hand muscle. Results The MEPs for both stimulation sites were very stable across trials. SMA stimulation evoked MEPs on right FDI with similar latency, amplitude, and duration as M1 stimulation but with a significant shorter silent period (SP) ( $p < 0.0005$ ). Also, for M1 stimulation but not for SMA stimulation, SP was longer for the force control with high precision ( $p < 0.04$ ). **Discussion** The CS projections from SMA on hand muscle motoneurons seem to be as functional as those from M1 during precise force control tasks. However, the SP following TMS of SMA is shorter than that following TMS of M1, which suggests that the intracortical circuits are different for the two cortical sites. Moreover, the difference observed between SP for the high and low precision for M1 but not for SMA stimulation suggests that M1 and SMA are differently involved in the fine force control. **References** He SQ, Dum RP, Strick PL. (1995). *J Neurosci* 15: 3284-3306. Lemon RN, Johansson RS, Westling G. (1995). *J Neurosci* 15(9): 6145-6156. Chen S, Entakli J, Bonnard M, De-Graaf J. (submitted) Vaalto S, Säisänen L, Könönen M, Julkunen P, Hukkanen T, Määttä S, Karhu J. (2011). *Hum Brain Mapp* 32: 1692-1703.

### A DYNAMICAL SYSTEM APPROACH OF HORSE-RIDER COORDINATION DURING ENDURANCE RACE

Viry, S.1,2, Sleimen Malkoun, R.1, Temprado, J.J.1, Frances, J.P.3, Berton, E.1, Laurent, M.1, Nicol, C.1

1: ISM (Marseille, France), 2: BRD Concept (Anglet, France), 3: JPF Stables (Venelles, France)

**Introduction** In riding, most biomechanical studies have focused on the description of the horse locomotion and its variability in unriden condition. The coupling concept, inspired from the dynamic approach of complex systems, is particularly appropriate for the analysis of the horse-rider coordination (Lagarde et al. 2005, Wolfram et al. 2013). The recent development of mobile technologies allows combined horse and rider recordings during long lasting natural events. In the present study, we aimed to provide a method to characterize the dynamics of the horse-rider system using simple and unified representations of macroscopic variables capturing the horse-rider coupling in the various contextual situations of an endurance race. **Methods** An international horse-rider dyad was thus recorded during a 120 km race by using two tri-axial accelerometers (Equimetrix® and Locometrix®) placed as close as possible to their respective center of masse. Accelerometer data analysis concentrated on the relative horse and rider's vertical displacements to identify horse's gaits, riding techniques and horse-rider coupling patterns through Lissajous plots. Results The obtained shape and inclination of Lissajous plots allowed us to characterize four patterns of horse-rider coupling. These data revealed the use of two riding techniques per horse's gait (trot and canter) that could be quantified along the endurance race. The relative phase values between the respective horse and rider's vertical displacements at the lower reversal point of their mean cycle were found to be more dependent on the riding technique than on the horse's gait pattern. **Discussion** We showed that the concepts, methods and tools of self-organizing dynamic system approach offer new directions for understanding horse-rider coordination. The four specific patterns identified for the horse-rider coupling were found to depend more on the riding technique than on the horse's gait. The ridden horse model should therefore be differentiated from the unriden one. The identified horse-rider coordination patterns may thus be taken as basis to study their evolution and variability along endurance races. This analysis revealed for present horse-rider dyad a change in strategy toward the end of the race, leading to a clear victory. In case of fatigue that is expected to affect most horse-rider dyads in such races, it would be of interest to determine whether changes may also be triggered by rider-related constraints (e.g. muscle fatigue) or horse-related constraints or a subtle combination of both. **References** Lagarde J, Kelso JA, Peham C, Licka T (2005). *J Mot Behav* 37: 418-424. Wolfram IA, Bosga J, Meulenbroek RGJ (2013) *Hum Mov Sci* (in press)

### DEVELOPMENT OF SYNERGY IN TIME FOR A CONTINUOUS ACTION PERCEPTION TASK

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**Introduction** According to the uncontrolled manifold (UCM) hypothesis different components co-vary producing compensatory actions in order to stabilize a motor synergy (Scholz & Schöner, 1999). A negative co-variation of these components has been demonstrated in discrete tasks (Latash, 2008). We aimed to connect the UCM hypothesis to a continuous action perception task and hypothesized that control of constant cycling frequency (RPM) is a dominantly anti-persistent process. **Methods** Six elite male triathletes performed a cycling exercise (Excalibur Sport 925900) consisting in pedalling for 1 min/resting for 1 min at different workload intensities (ranging from 50W to 550 W) and maintaining 70 RPM at each intensity. The RPM, sampled with a time resolution of 100 Hz and magnitude resolution of 1 RPM, were continuously recorded for further analysis. The DFA method with linear fit was applied to the residuals of the RPM time series in order to obtain spectral slopes ( $\alpha_1$  and  $\alpha_2$ ) from the log-log plot of the strength/time relationship in interval 0.2-0.9s and 0.9-10s, respectively. The Chow test was used to compare the slopes and to obtain the corresponding p values. Results Anti-persistent fBm of the RPM variable was found in 70% of the time series for interval  $\tau \leq 0.9s$  and 76% of the series for interval  $\tau > 0.9s$  across different subjects and different exercise intensities. A crossover in the slopes of the log-log plot of the strength - time interval relation ( $\alpha_1 = 1.25 \pm 0.25$  and  $\alpha_2 = 1.39 \pm 0.15$ ;  $t(46) = -3.47$ ;  $p < 0.001$ ) was observed. Persistent fBm was found in 13% of the time series for the shorter time interval (0.2-0.9s) and in 24% for the longer time interval (0.9-10s) of fluctuations. A persistent Gaussian noise (fGn) profile was found exclusively in the shorter time interval ( $\tau \leq 0.9s$ ), specifically in 17% of the time series. **Discussion** While persistent fGn correlations were detected at the beginning of the task when the system sought to stabilize the cycling synergy, the anti-persistent fBm served to confine the system close to

the target value (70 RPM). So, the crossover between persistent fGn and anti-persistent fBm may be seen as a compromise strategy between exploring and confining close to a constant cycling frequency on different time scales. These observations comply with the UCM hypothesis and show that the stabilization of the continuous cycling RPM is of an anti-persistent nature. References Latash, M.L. (2008). Synergy. University Press, Oxford. Scholz, J.P., Schöner, G. (1999). *Exp Brain Res.*, 3, 289-306.

### PERCEPTION AND ACTION DURING INDOOR CLIMBING: EFFECTS OF SKILL LEVEL

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1: CETAPS (Rouen, France), 2: SENS (Brisbane, Australia), 3: FiDiPro (Jyväskylä, Finland) Introduction Ecological dynamics is an applied ecological psychology and behavioral dynamics framework for educating perception and action based on representative individual, task and environmental constraints (Davids et al., 2012). During climbing, skill level shapes the intentions, perceptions and actions of individuals (Seifert et al., 2013). For example, perceptions of low experienced (LP) climbers appear principally constrained by information and cognitions related to stability (hold size, depth) whereas, experienced (EP) climbers appear constrained by performance goals (movement progressions, crux points) (Boschker et al., 2002). It is unclear, whether perceptual-cognitive characteristics are commensurate with behavioral dynamics observed during climbing performance. Hence, the aim of this study was to explore skill effects on the relationship between perception and actions when climbing an indoor wall. Method Six LP participants (5b-5c ability) and six EXP (6a-6b), were observed undertaking one ascent on the same indoor climbing route (5c). The climbing wall was vertical, 10.3 m high, with 20 holds. Each hold included at least one vertical and one horizontal grasping edge. Instructions were to fluently climb at a self-preferred pace without falling, allowing perception and action processes to naturally emerge. Behavioural data were video-recorded for each hold and perceptions recorded via a validated questionnaire. Results The occurrence of falls in the LP group was higher than in the EP group,  $U=3$ ,  $z=2.80$ ,  $p=0.01$ . At crux points, differences emerged in left vertical,  $U=7.5$ ,  $z=2.02$ ,  $p=0.04$ , and left horizontal,  $U=6$ ,  $z=2.17$ ,  $p=0.03$ , grasping between the LP (respectively:  $Mdn=1$ ,  $Mdn=1$ ) and EP ( $Mdn=1.5$ ,  $Mdn=0.5$ ) groups. The LP group reported, on average, lower ratings of graspability and usability for the holds ( $M=3.04$ ,  $SD=1.24$ ) than the EP group ( $M=4.67$ ,  $SD=1.13$ ),  $t(12)=2.43$ ,  $p=0.48$ . Discussion Data suggested interrelated differences in perception and action based on skill level. LP climbers did not appear to have clear perceptions of structural or functional hold properties. At crux points this may be related to a tendency to touch holds dedicated to the feet and utilize holds in an intrinsically stable manner. In contrast, the higher levels of perceived structural and functional aspects of the holds in the EP group may be related to a richer behavioral repertoire at the crux points, reflecting acquired functional grasp variability (Seifert et al., 2013). Future work should develop learning design that educates functionality in both perceptions and actions of individuals. References Boschker, M., Bakker, F., & Michaels, C. (2002). *J Motor Behav*, 34(1), 25-36. Davids, K., Araújo, D., Hristovski, R., Passos, P., & Chow, J. (2012). Skill Acquisition in Sport pp. 112-130. Oxon: Routledge. Seifert, L., Button, C., & Davids, K. (2013). *Sports Med*, in press.

### THE CONSTRAINT IN THE IMAGERY OF HAND-FOOT COORDINATED MOVEMENT.

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1Graduate School of Sport Sciences, Waseda University (Saitama, Japan) 2Research Fellow of the Japan Society for the Promotion of Science 3College of Economics, Nihon University (Tokyo, Japan) 4Faculty of Sport Sciences, Waseda University (Saitama, Japan) INTRODUCTION Rhythmic multi-limb coordination is restricted by various constraints. For instance, moving the ipsilateral hand and foot in the sagittal plane in the opposite direction is much more difficult than the one in the same direction (Baldissera et al., 1982). The relative contribution of motor and cognitive processes in generating this constraint (directional constraint) has not been well understood. The purpose of the present study is to investigate the cognitive contribution to the directional constraint by comparing physically executed and imagined coordinated movements. METHODS Subjects performed three kinds of tasks. First, they did 10 cyclical coordinated movements of right hand and foot as fast and precise as possible. Second, the same movement was done in imagery. Finally, the movement was done in the combination of real execution in one limb and imagery in the other. Each task was performed under two modes; the same directional and the opposite directional movement. To evaluate the performance of imagined coordination, we measured the time that is taken to accomplish each task (Guillot & Collet, 2005) by pressing the switch in subject's left hand at the start and finish of a task. RESULTS & DISCUSSION In the imagery and combination tasks, the opposite directional movement significantly took longer than the same directional movement, which is the same as observed for executed movements. It has been shown that when a motor imagery task is difficult, the time spent for imagery tends to be longer. Thus, it indicated that even in imagery, the opposite directional movement was more difficult than the same directional movement. This result suggests that the directional constraint can be occurred only with cognitive process. ADDITIONAL EXPERIMENT To investigate the possibility that the directional constraint in the mental imagery were the result of subject's preconception about the constraint, we asked subjects who were perfectly naïve about the directional constraint to perform the imagery task before they experience/know the constraint by physically execution. The result showed that the temporal difference between the opposite and the same directional movement in imagery appeared irrespective of preconception. CONCLUSION The constraint in hand-foot coordination should depend substantially on cognitive process. REFERENCE Baldissera F. et al. (1982). *Neurosci Lett*, 34(1): 95-100. Guillot A. & Collet C. (2005). *J Mot Behav*, 37: 10-20

### MOVEMENT SELF-CONSCIOUSNESS AND CONSCIOUS MOTOR PROCESSING <'REINVESTMENT'> IN A SURGICAL CONTEXT

Malhotra, N., Poolton, J.M., Wilson, M.R., Fan, K.M., Masters, R.S.W.

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Objective This study investigated how two dimensions of movement specific reinvestment (conscious motor processing or movement self-consciousness) explained differences in performance of a laparoscopic surgery task under pressure. Background The impact of psychological pressure on performance has been extensively investigated in the sport science and motor skill learning domains. Surgical educators have recently recognized the potential benefits of interdisciplinary research, yet the focus remains on identifying external factors that cause performance breakdown, without accounting for individual differences in the ability to cope with stress. One individual difference that has been implicated in failure to meet task demands in motor skill learning and recently in laparoscopy is 'reinvestment', the propensity to consciously monitor and control movements. The potential to 'reinvest' is reflected in the propensity to become self-conscious about movements (movement self-consciousness; MSC) and the propensity to manipulate conscious knowledge to control the

mechanics of movements (conscious motor processing; CMP). Methods Undergraduate medical students with no prior experience in laparoscopy were scored on the Movement Specific Reinvestment Scale and subsequently trained to proficiency on a fundamental laparoscopic task. Participants were invited back for a delayed retention condition followed by two conditions designed to evoke either movement self-consciousness or conscious motor processing. In the delayed retention condition, participants were simply asked to do their best, as they had in training. In the reinvestment conditions participants performed under time constraints and were informed that they would be evaluated by a senior surgeon. In the MSC condition, the surgeons' assessment was on the basis of a video of the participant and in the CMP condition the assessment was based on performance as seen from the laparoscopic camera. Performance measures included completion time and number of errors and kinematic data was collected using a previously validated motion analysis system. Stress levels were assessed using a shortened version of the State Trait Anxiety Inventory (STAI). Results All participants demonstrated increased anxiety levels from delayed retention to the reinvestment conditions as indicated by their STAI scores. Overall there was a positive relation between total reinvestment scores and completion times at delayed retention as well as in the MSC reinvestment condition. Similar trends were observed for the movement self-consciousness factor which seemed to be explained by the kinematic data. Scores on the conscious motor processing factor, however, were not associated with performance at delayed retention or either of the two reinvestment conditions. Conclusion The relationship between reinvestment and laparoscopic performance under normal and pressured situations for trained medical students seems to be better explained by the movement self-consciousness factor.

### SENSORIMOTOR INTEGRATION FOR TACTILE PERCEPTION IN ARCHERS

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Introduction Sensorimotor integration is the foundation of movement coordination. The cerebellum has been long regarded as an essential brain organ for movement coordination. In our previous study of visual duration perception, findings from healthy participants suggest that cortical computation could be saved by receiving integrated sensory information from the cerebellum (Shih, Yeh, Kuo, Tzeng, & Hsieh, 2010; Shih, et al., 2009). The present study aims to extend our previous findings by examining the sensorimotor integration for tactile perception in archers, who are mastery of movement coordination. Methods 47 participants, 16 archers, 15 runners and 16 novices, were recruited in the current study. Participants were instructed to passively sense or actively compare the tactile stimulation on their finger. Functional magnetic resonance imaging was used to investigate the difference of sensorimotor adaptation among these three groups. Results It was found that the somatosensory associative cortex (BA7) and the cerebellum yielded significantly higher activations in both runners and novices than in archers. Discussion In accord with the predictions of sensory acquisition hypothesis of the cerebellum (Bower, 1997), the cerebellum plays an important role in tactile discrimination (Gao, et al., 1996). In addition, through the process of the sports training, the expert brain adapts itself to a more economic mode for saving the neural processing loading in the related sensory areas, i.e. somatosensory associative cortex and the cerebellum. References Bower, J. M. (1997). Is the cerebellum sensory for motor's sake, or motor for sensory's sake: the view from the whiskers of a rat? *Prog Brain Res*, 114, 463-496. Gao, J. H., Parsons, L. M., Bower, J. M., Xiong, J., Li, J., & Fox, P. T. (1996). Cerebellum implicated in sensory acquisition and discrimination rather than motor control. *Science*, 272(5261), 545-547. Shih, L. Y., Chen, L. F., Kuo, W. J., Yeh, T. C., Wu, Y. T., Tzeng, O. J., et al. (2009). Sensory acquisition in the cerebellum: an fMRI study of cerebellar interaction during visual duration discrimination. *Cerebellum*, 8(2), 116-126.

### WRIST PROPRIOCEPTION ACCOUNTS FOR PERFORMANCE IN FREE-THROW SHOOTING IN BASKETBALL

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Introduction The free-throw in an unhindered basketball shot generally awarded to a player as an opportunity to score points after being fouled by the opposing team. Theoretically, it should be considered one of the easiest shots, as the player stands close to the basket with no interference from the opposing team, but NBA statistics (<http://www.nba.com>) do not necessarily confirm this relative simplicity. Given that the trajectory of a thrown ball is fully determined by conditions at release, those conditions dependent on the configuration of the entire body, and given the critical role of proprioceptive information in controlling multi-segmental motor skills (Cordo et al., 1994; Sarlegna et al., 2006), this study questions the possible link between success rate and players' proprioceptive ability at the wrist and/or elbow joints. Methods Fifteen members of the Aix-Marseille University basketball team volunteered to participate in this study. We designed an experimental protocol to directly correlate their performance on a seated free-throw task (to emphasize the role of upper-limb) and on an elbow and wrist Joint Position Matching (JPM) task (Goble, 2010). Results A Pearson product correlation coefficient revealed an interrelation between performances at the seated free-throw and JPM tasks at wrist joint; with both JPM absolute errors (AE) and variable errors (VE) being negatively correlated with free-throw success rate ( $N=-0.59$  and  $N=-0.73$  for AE and VE respectively,  $p<.05$ ). No correlation was found between the success rate and the JPM task at elbow level. Discussion The main result of our study concerns the significant relationship between the free-throw success rate and the basketball players' joint position sense for the wrist but not for the elbow joint. This result reveals that free-throw success rates are, at least partly, determined by the wrist proprioceptive ability of the subjects. From a motor control point of view, our results suggest that basketball players organize their throwing behavior on the basis of this sensory modality. At a more practical level, it can represent a first line of evidence to explain why some highly skilled basketball players remain poor shooters after many years of practice and may therefore lead to new techniques to enhance throwing efficiency. References Cordo, P.; Carlton, L.; Bevan, L.; Carlton, M. & Kerr, G. K. (1994). *J Neurophysiol*, 71, 1848-1861. Goble, D. J. (2010). *Phys Ther*, 90, 1176-1184. Sarlegna, F. R.; Gauthier, G. M.; Bourdin, C.; Vercher, J.-L. & Blouin, J. (2006). *Brain Res Bull*, 69, 404-415.

### INVESTIGATION OF THE ACQUISITION OF A SERIAL MOVEMENT TASK AS A FUNCTION OF ATTENTIONAL FOCUS INSTRUCTIONS

Chow, J.Y.1, Woo, M.T.2, Koh, T.H.2

*1:Nanyang Technological University, 2: Republic Polytechnic*

Introduction The effect of externally-focused and internally-focused attentional instructions have been extensively investigated in both discrete and continuous skills rather than serial skills. External focus of attention instructions seem to be beneficial as it promotes a more automatic type of control as it reduces conscious interference to the lower levels of control at the central nervous system (CNS) (Peh, et al., 2011; Wulf, et al., 2001). However, novice learners can also benefit from internal focus of attention instructions especially in learning of movement forms in some instances. The purpose of this study was therefore to examine the effect of different attentional focus instruc-

tions on learning a serial task (i.e., taekwondo routine). Methods Fifteen participants, aged  $30.4 \pm 4.5$  years, with no prior experience in any form of martial arts, were assigned to either an internal focus condition (IFC,  $n=8$ ) or an external focus condition (EFC,  $n=7$ ). Participants underwent 12 training sessions with their respective instructional conditions over 8 weeks with 30-minute per session during the intervention phase. Serial skill tasks (hand techniques, kicking techniques and 10-step routine) were recorded at three different periods – “the 12th training session”, “1-week after last session”, and “1-month after last session”. Performance videos were viewed by 3 certified coaches, and assessed in three main categories – Accuracy, Mastery and Presentation. Results EFC group has significantly greater number of high scorers in 10-step routine compared to IFC for ‘1-week after last session’ compared to “the 12th-training-session” ( $p < 0.05$ ,  $r = -0.51$ ). Performance scores of the “Mastery component” at EFC was significantly higher for kicking techniques at ‘1-week after last session’ ( $p < 0.05$ ,  $r = -0.59$ ). Scores from IFC decreased significantly from “1-week after last session” to “1-month after last session” for 10-step routine ( $p < 0.0167$ ,  $r = 0.63$ ) and kicking techniques ( $p < 0.0167$ ,  $r = 0.63$ ). Discussion In general, participants from EFC performed better in all three components of the serial skill task, highlighting the effectiveness of such instructions for a serial movement. However, some individuals of this study also benefited from internal focus of attention instructions. Future studies could examine learner’s inclination for different types of attention instructions by assessing individual performer’s preferences. References Peh, Y.-C. S., Chow, J. Y., & Davids, K. (2011). Focus of attention and its impact on movement behaviour. *Journal of Science and Medicine in Sport*, 14, 70-78. Wulf, G., McNevin, N. H., & Shea, C. H. (2001). The automaticity of complex motor skill learning as a function of attentional focus. *Quarterly Journal of Experimental Psychology A*, 54, 1143-1154.

**15:00 - 16:00**

## Mini-Orals

### PP-SH07 Physical Education and Pedagogics [PP] 5

#### IDENTIFYING DEVELOPMENTAL CAPACITY IN A PHYSICAL EDUCATION SETTING; THE KÖRPER KOORDINATIONEN TEST FÜR KINDER

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Introduction According to Dutch physical education (PE) teachers, a main capacity of a child with the potential to reach the elite level is ‘developmental capacity’ (Platvoet et al). This is in line with Bailey and Morley’s model of talent identification (2006). The next challenge is to identify developmental capacity in a PE setting which is currently not feasible. The Körper Koordinations Test für Kinder (KTK) is a valid and reliable tool to evaluate gross motor skills from 5-15 years (Kiphard and Schilling, 2007). These skills are mandatory to become an elite athlete (Vandorpe et al., 2012). The aim of the current study was to test whether a longitudinal design applying the KTK repeatedly is suitable to measure developmental capacity in 6-8 year old children. Methods In this study, 147 children (90 girls) participated with mean age of  $6.7 (\pm 1.6)$  years. The KTK consists of four subtasks; (1) Walking backward over beams, (2) hopping on one leg over piles of pillows, (3) moving sideways on wooden boxes for 20s and (4) Jumping sideways (two feet) for 15s. The raw scores of the subtests were corrected for age and gender (based on normative values) and result in one motor quotient (MQ). The KTK was assessed three times (Week 1, 4 and 7). In each of the four PE lessons between the KTK assessments, children trained gross motor functioning for about 10 minutes. The total scores of the KTK were tested using a repeated measures ANOVA ( $\alpha=0.05$ ) and post-hoc t-tests. Results The mean MQ of the KTK for T0, T1 and T2 were respectively  $78.04 \pm 11.9$ ,  $84.36 \pm 13.5$  and  $87.06 \pm 13.3$  ( $F(1,146)=88.141$ ,  $p < .001$ ). The MQ-scores increased per assessment ( $T1 > T0$ ;  $p < .001$ ,  $T2 > T0$ ;  $p < .001$  and  $T2 > T1$ ;  $p = .024$ ). Further, Cohen’s effect size values ranged from small to large with the largest effect between T2 and T1 ( $T0-T1$ ;  $d = .50$ ,  $T1-T2$ ;  $d = .20$ ,  $T0-T2$ ;  $d = .70$ ). Discussion The results show that, in 6 weeks of just one hour of PE per week, scores on the KTK improve. This suggests that the KTK can be used to measure developmental capacity on gross motor skills. The next step is to study whether children with high developmental capacity are indeed children with potential to become an elite athlete in the future. References Bailey R, Morley D. (2006). *Sport Educ Soc*, 11(3), 211-30. Kiphard EJ, Schilling F.(2007). *Körperkoordinationstest für Kinder*. 2.Uberarbeitete und ergänzte Auflage. Beltz Test Gesellschaft, Göttingen Platvoet S, Niet M de, Elferink-Gemser M (2012). *Lichamelijke Opvoeding*, 100 (6), 4-5. Vandorpe B, Vandendriessche J, Vaeyens R, Pion J, Matthys S, Lefevre J, Philippaerts R, Lenoir M. (2012). *J Sci Med Sport*, 15(3), 220-5.

#### BALANCE AND BILATERAL SKILLS OF SELECTED ADOLESCENTS IN THE STELLENBOSCH REGION, SOUTH AFRICA

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Introduction Physical development is crucial for the holistic well-being of all children. Thus, it is vital that physical development is addressed during the early years of maturation. Methods One school was selected from a previously disadvantaged community in the Stellenbosch region. The study sample consisted of children ( $N=67$ ) between the ages of 10 and 12 years-old. Two classes in the school were recruited and thereafter randomly selected as either the experimental ( $n=35$ ) or control group ( $n=32$ ). The experimental and control groups completed the Short Form of the Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2) (Bruininks & Bruininks, 2005), during the pre- and post-tests. Only the experimental group participated in a self-designed motor skills development programme for 12 weeks. Results are presented as means and standard deviations and a 5% significance level ( $p \leq 0.05$ ) was used as a guideline. Results No significant improvements in mean standard scores or mean percentile ranks were found for the experimental or the control group. There was very little variance in the scores achieved by all the participants as most of them were able to achieve the maximum score on the selected subtests activities according to the Short Form of the BOT-2. No significant improvements were observed in either the experimental or control group for the fine motor precision, fine motor integration and upper limb coordination subtests of the Short Form. The experimental group, however, showed a significant improvement in manual dexterity when compared to the control group after participation in the motor skills development programme. An unexpected significant improvement was observed in the running speed and agility score of the control group, compared to relatively no change in the score of the experimental group. No significant improvements were observed in either the experimental or control group for the full push-up activity. Discussion Balance and bilateral coordination plays such an important role in the physical activity participation of children. According to literature, children should have mastered the

basic fundamental motor skills (FMS) by the age of seven. Yet, as seen in this study, children between the ages of nine and 12 years still struggle to perform some of the most basic balance and bilateral coordination tasks, such as skipping or balancing on one leg. This suggests that the children of today are struggling to master their FMS during the relevant windows of opportunity and thus experience delays in motor skill proficiency, subsequently affecting their participation in physical activity. REFERENCES BRUININKS, R.H. & BRUININKS, B.D. (2005). BOT2 Bruininks-Oseretsky test of motor proficiency manual (2nd ed.) Minneapolis: NCS Pearson.

### **SELF-PERCEIVED MOTOR COMPETENCE, PHYSICAL ACTIVITY LEVEL AND FITNESS IN ADOLESCENTS.**

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*University of Murcia*

**Introduction** Motor competence has been considered to be a possible determinant of children's physical activity. Earlier studies have found a relationship between poor physical fitness outcomes and a reduced level of physical activity for children with low motor competence compared with their peers with better motor skills. The aim of this study was to determine the relation between self-perceived motor competence and physical conditioning in adolescents. **Methods** A total of 533 adolescents (mean age:  $15.43 \pm 1.14$  years) participated in the study. Physical fitness measures included the handgrip strength, the number of curl-ups in 60 seconds, Ruffier-Dickson test and sit-and-reach test. The short version of the International Physical Activity Questionnaire was used to determine physical activity patterns. Self-perceived motor competence was determined by adolescents among three categories (high, intermediate or low). **Results** In total, 25.5% of the adolescent were classified as physically active. Males were significantly more active than females. The results showed a moderate and significant correlation between self-perceived physical competence and level of physical fitness. Sex differences were also found with males demonstrating more physical fitness and reporting higher perceived physical competence compared with females. **Discussion** Motor competence is a variable which predicts the adolescents' positive behavior towards physical activity (Moreno et al., 2007). The current study showed a positive relation between self-reported motor competence and fitness level. Vedul-Kjelsås et al. (2012) reported that physical fitness was highest correlated with perception of athletic competence in boys but with perception of social acceptance in girls. Ruiz et al. (2008) found that subjects with low motor coordination abilities had a poor fitness self-perception. In another study, Cairney et al. (2005) suggested that young with coordination disorder are less likely to be physically active. The results of this study indicate that physical activity level and fitness condition are positive and significantly associated with the self-reported motor competence in adolescents. Because motor competence is a determinant of physical activity, then strategies that increase movement skills in childhood and adolescence may be an important target for helping to increase physical activity and health in youth. **References** Cairney J, Hay JA, Faught BE, Wade TJ, Corna L, Flouris A. (2005). *J Pediatr.*, 147, 515-20. Moreno JA, Cervelló E, Moreno R. (2007). *Psicología y salud*, 17, 261-267. Ruiz LM, Mata E, Moreno JA. (2007). *Mot. Eur. J. Hum. Mov.*, 18, 1-17. Vedul-Kjelsås V, Sigmundsson H, Stensdotter AK, Haga M. (2012). *Child Care Health Dev*, 38, 394-402.

### **RELATIONSHIP BETWEEN THROWING MOVEMENT AND MOVEMENT RECOGNITION IN ELEMENTARY SCHOOL CHILDREN**

Fukuda, T.1, Ueda, T.1, Murosaki, K.1, Ueda, M.2, Ishii, Y.1, Kurokawa, T.1

*1)Hiroshima University, 2)Yamaguchi University*

**Introduction** The purpose of this study was to examine if elementary school children can recognize and improve their own throwing movements. **Methods** Subjects included 17 children (8 boys and 9 girls) aged 10 to 12 years. Subjects were asked to throw a tennis ball twice with a maximal effort. No other instructions were given. After the first trial, they were instructed regarding four points about their throwing form: 1) lifting the elbow over the shoulder, 2) extending the elbow, 3) pulling the elbow of the throwing arm and following through with the shoulder, and 4) turning the shoulder after turning the waist. They were then asked to throw a tennis ball twice with maximal effort again. In addition, they answered questions about how they thought they did in regard to the four points. The four throwing attempts were analyzed using a three-dimensional movement analysis system (Venus 3D, Tokyo). The relation of self-knowledge about throwing form to real biomechanical movements was compared between before and after instructions using t-tests. **Results** Children who could recognize their movements did not always improve their throwing form after receiving instructions. On the other hand, children who could not recognize their movements did not always get worse after receiving instructions. Children who indicated they focused on the single point of extending the elbow or pulling the elbow of the throwing arm and following through with the shoulder showed significant improvements in their movements ( $p < 0.05$ ) after receiving instructions. However, children who indicated they focused on lifting the elbow over the shoulder or turning the shoulder after turning the waist did not show improvements in their movements after receiving instructions. **Discussion** In the present study, the throwing form did not affect whether children were able to recognize their own form or not. It appeared that children were not able to recognize any series of actions involved in their throwing motion. After they focused on one of two specific points of movements provided in the instructions, it was possible to improve their movements. However, they could not improve their movement when they focused on other points of the instruction.

### **COORDINATIVE CONTROL OF POSTURE AND EQUILIBRIUM IN HIGH LEG KICK**

Liang, Y., Sakaguchi, M., Kanosue, K.

*Waseda University*

**Introduction** In the organization of a given motor act, the central nervous system has to not only coordinate the movement with posture but also coordinate equilibrium control with the postural stabilization of specific segments. The goal of this study was (1) to investigate whether or not non-acrobatic (N-A) athletes can accomplish a stable dynamic equilibrium than novices during single leg stance of high leg kick; and (2) to investigate whether or not the instruction on arm movement is helpful to maintain a good posture. **Methods** Ten collegiate male players with at least 7 years experiences in baseball or track and field, and ten college male students without any experience in intensive or long term training were asked to perform high leg kick. The movement was carried out in two conditions: with and without instruction on arm movement. Participants performed with barefoot while their body motion was captured with an 8-camera motion analysis system (Motion Analysis Corp., Santa Rosa, CA). **Results** ANOVA revealed the significant effect of condition in ML direction of CoM-ankle inclination angle ( $F=15.822$ ,  $p < 0.05$ ) and trunk angle to supporting leg ( $F=29.981$ ,  $p < 0.05$ ) at initial in single leg stance, and a significant interaction between condition and group in range value of CoM-ankle inclination angles in direction of A/P ( $F=6.573$ ,  $p < 0.05$ ) and M/L ( $F=4.915$ ,  $p < 0.05$ ). The post hoc paired t-test showed ML direction of CoM-ankle inclination angle was significantly less in with instruction condition. ANOVA revealed a main effect of condition ( $F=33.581$ ,  $P < 0.05$ ) and a main effect of group ( $F=8.764$ ,  $P < 0.05$ ) in A/P

direction of trunk inclination angle at initial; an interaction between condition and group ( $F=4.569$ ,  $p<0.05$ ) in peak value of trunk inclination angle in A/P direction as well, and no significant difference in post hoc paired t-test. Discussion In the condition of with instruction, the novices presented inferior dynamic equilibrium in whole motion of single leg stance after instruction was given. Arm instruction was incapable of helping both groups to maintain a good posture in single leg stance, and novices seemed performed more hard than non-acrobatic athletes. Our results in favor of the general motor ability hypothesis from Adams that is any human skill should remain observable among various tests. We suggest that arm movement is better to coordinate after beginners are capable to control their posture with unconsciously. References 1. Massion, J. (1992). Movement, posture and equilibrium: interaction and coordination. *Prog Neurobiol*, 38, 35-56. 2. Adams, J.A. (1987). Historical review and appraisal of research on the learning, retention, and transfer of human motor skills. *Psychol. Bull.*, 101, 41-74

### **MOTOR SKILLS AMONG 4 TO 7 YEAR-OLD SERBIAN PRE-SCHOOL CHILDREN**

Jaksic, D., Bala, G., Krneta, Z., Vujkov, S., Drid, P.

*University of Novi Sad*

Introduction In preschool ages, it could be very big impact on forming motor development of children. Based on previous practical experiences in work with children, we can suppose that motor skills, which could be observed like motor development, are qualitative different in compare with school age and especially with older children. Education and motor activities at kindergarten contribute significantly to the development of motor abilities (Bala & Katic, 2009; Bala, Krneta, & Katic, 2010). Methods Sample of participants was conducted of 200 preschoolers. It was applied 7 motor ability tests. Before we started, we divide sample of participants into three subgroups. The criteria for dividing was years of age, where subsamples were made according to decimal years, i.e. first subsample – 4.5 to 5.5, second 5.5 to 6.5 and third 6.5 to 7.5. Differences between subcategories were calculated with using MANOVA and ANOVA statistics techniques. Results Differences between first and second subgroup were distinguished in: 20m dash, Polygon backwards, Arm plate tapping, Standing broad jump, Bent-arm hang and Crossed-arm sit-ups. In second case, between second and third subsample differences were in following tests: 20m dash, Polygon backwards, Arm plate tapping, Standing broad jump and Crossed-arm sit-ups, almost same like previous but without Bent-arm hang test. Discussion Determination of quantitative differences in selected variables between children of different years of age had final goal to show those differences and significance, not to explain them. It was seen that significant differences were between "neighbor" age categories, but not at all. Motor abilities have great impact on successfulness in most of sports activities. Because of that, in development of those abilities must devote a full attention in working with preschool children. During the many-years training process there are much greater requirements for development of those motor abilities, and it must be take into account that manifestations of motor abilities are not only result of genetic predispositions and environment's factors but, also, timely and methodic adequate prescribed plan and program of training. References 1. Bala, G. (2002). Strukturalne razlike motoričkih sposobnosti dečaka i devojčica u predškolskom uzrastu [Structural differences of motor abilities between boys and girls in preschool age]. *Pedagoška stvarnost*, 9-10, 744-751. 2. Bala, G., & Katic, R. (2009). Sex Differences in Anthropometric Characteristics, Motor and Cognitive Functioning in Preschool Children at the Time of School Enrolment. *Collegium Antropologicum*, 33(4), 1071-1078. 3. Bala, G., Krneta, Z., & Katic, R. (2010). Effects of kindergarten period on school readiness and motor abilities. *Collegium Antropologicum*, 34(Suppl. 1), 61-67.

### **COMPARISON OF 3 KINDS OF ENDURANCE RUNNINGS IN JAPANESE HIGH SCHOOL IN VIEW OF PHYSIOLOGICAL AND BIOMECHANICAL CHARACTERISTICS**

Kenta, N., Takashi, K., Goro, M., Dota, O., Keita, A., Takashi, U.

*Hiroshima university*

Introduction The aim of this study was to investigate the characteristics of 3 kinds of endurance runnings performed in the physical education class of Japanese high school by observing continuous change in physiological and biomechanical variables during running. Methods Twenty-seven male high school students were coached by three methods. The all-out method, in which the students ran 3,000m at full exertion, the inner/outer track (I/OT) method, in which the duration of exercise was nearly equalized by having slower/faster runners use the inner/outer running tracks (210m, 250m, 300m), and the RPE method, in which the students ran 3,000m according to Borg's RPE13 (ratings of perceived exertion) scale. The heart rate (HR) was measured by a HR monitor (Poral Electro co.), and the running pace, the stride length, and the stride frequency were measured by a stride sensor (Poral Electro co.) every 5 seconds during the whole running. The average of these parameters were calculated by every 300m laps. Result In the all-out method, the maximum running speed was 310 m/min in the 1st lap, and the minimum was 267 m/min in the 8th lap. It decreased significantly within the progress of running ( $p<0.01$ ). The maximum stride frequency was 94.2 steps/min in the 2nd lap, and the minimum was 89.2 steps/min in the 10th lap. Continuous change of the running speed was similar to change of stride frequency, not to the change of stride length. In the I/OT method and in the RPE method, the running speed was kept between 223-264 m/min and 208-243 m/min from the 2nd lap to the 9th lap, respectively. In the I/OT method and the RPE method, the continuous change of running speed was similar to the change of stride length not to the change of stride frequency. Discussion In the all-out method, the running speed may have decreased in the middle and final stages of running due to the high energy demand by the high stride frequency in the early stage of running (Högberg, 1952). Therefore, it was suggested that maintaining the appropriate stride frequency, considering the running ability of each runners, was important for maintaining the running speed. In the I/OT method and the RPE method, the running speed was maintained by the adjustment of stride length. It was considered that the running speed was maintained by the external information of following the other runners in the I/OT method, and by the internal information due to the ratings of perceived exertion in the RPE method. Therefore, it was suggested that the I/OT method and the RPE method were effective coaching methods in learning the pacing of running. Reference Högberg P(1952) *Arbeitsphysiologie*, 14: 437-441.

### **CONTENT ANALYSIS OF BODY REPRESENTATION IN AN EARLY CHILDHOOD EDUCATION TEXTBOOK**

Marfínez-Bello, V.

*University of Valencia*

Introduction Bodies are naturally and socially constructed. The social construction of the body influences the perception of self and others. Textbooks transmit a society's cultural capital to its youngest citizens. The aim of the study was to describe how the body is portrayed in images featured in a Preschool textbook for the first grade of early childhood education. Methods A content analysis of the images was performed using a coding frame based on previous studies. Results Girls and boys appeared nearly twice than adolescents, adults and

older people. There was an equal representation of women and men regardless of age. It was found noticeable representation of a whole body dressed with street clothing. The activity level was predominantly static and in more than half of the images was not possible to distinguish the space where the bodies were located. Conclusions The textbook as a conventional curricular material should be analyzed in terms of the hidden curriculum, in order to provide alternative forms of understanding the body as a social and cultural construction. The results suggest the need for further analysis of the textbooks in early childhood education system.

### **PREVENTION AND AMELIORATION OF OBESITY FOR CHILDREN OF PRIMARY SCHOOL THROUGH ATHLETICS AND MOVEMENT GAMES**

Țifrea, C., Hangu, S., Costache, R.

*NATIONAL UNIVERSITY OF PHYSICAL EDUCATION AND SPORTS BUCHAREST*

**Introduction** This research is intended to be a descriptive one and experimental, whose results will be implemented in practical activity in order to improve the quality of life for children of primary cycle, aged 6-11 years by the implementation of one program of athletics and movement games aimed to prevent and to fight against the obesity. Parents and teachers as well, are asked to be aware of the risks that this "disease", involves and to intervene in order to fight against and to prevent it from childhood. A major cause of obesity occurs at a young age and it is the lack of exercise related with an unhealthy eating. The purpose of this work is to contribute in order to realize a project having the reason fighting against the obesity in primary school using athletics and moving games, practicing physical exercises regularly, except physical education and collaborating with specialists: doctors, counselors, nutritionists. **Methods:** To carry out a medical check up, their lifestyle, cardiology investigations on body mass index, adiposity, physical activity index, previous driving experience, as well as the FC drive. **Pedagogical experiment** was conducted over a period of one academic year within several schools from Romania, during the experiment the students aged 6-11 were tested. And there were realized: Anthropometric measurements and somatic, driving tests, moving games, statistical and mathematical method (arithmetic mean of the group, the mean, coefficient of variation, Student test, ANOVA) **Results** After the experiment was applied to the samples, the scientific research revealed that: applying a physical exercise program of athletics and movement games 3 times per week for children from primary cycle having obesity problems lead to losing weight and resistance increasing to effort. Practicing systematically these exercise programs lead to integration into society easier and a better intellectual development. The integration of these children into a movement organized system makes them more responsible and their families as well and accustomed to independent practice exercises and diet control and health status. The implementation of this program leads to the improvement of the quality of life. **Bibliography:** Allen J.B. - Social motivation in youth sport, *Journal of Sport and Exercises Psychology*, 2003 Craplet C., Craplet R., Craplet M., - Alimentation y nutricion del despertista, Ed. Hispano Europea 1998 Javier O., B., - 1169 ejercicios y juegos de atletismo, vol I & II, Editorial Paidotribo, 2007 Juan A. M., Eduardo C., - Motivation in physical activity and sport, Sports Publishing, 2010 Linder M.C. - Nutrition: metabolic and clinical biochemistry, Eunsa, 1998 Tifrea C., - Jogging, health, strength, beauty, Publishing Didactic and Pedagogic Bucharest, 2008 IAAF Athletics School & Youth Programme – World wide Kids' Athletics, 2009

### **ANALYSIS OF THE STUDENTS' COLLECTIVE ACTIVITY ENGAGED IN SITUATIONS OF COOPERATION IN PHYSICAL EDUCATION**

Evin, A.

*MIP universit  de Nantes*

**Introduction** This study is part of a line of research that focuses on social learning in physical education (PE) and especially on the students' activity in cooperative learning tasks (e.g., Evin et al., 2012). It aimed to characterize the dynamics of the collective activity of a group of students during a unit devoted to circus and leading to a mini show. This study was carried out according to the assumptions of the "course of action" scientific program (Theureau, 2006). It focused more particularly on the students' "courses of experience", i.e., the activity that is meaningful from the students' perspectives. **Methods** Three 6th-grade students participated in this study. Their activity was studied during a circus unit of seven lessons in which they had to build a mini-show together that was to be shown to the class during the last lesson. Their behaviours and communications were recorded on video. After each lesson they participated in self-confrontation interviews. The analysis aimed to characterize the dynamics of articulation of the students' courses of experience, to describe their modalities of cooperation and their evolution during the unit. These were described in terms of collective meaningful stories. The analysis also meant to identify the situational conditions involved in these transformations. **Results** The results showed different dynamics of transformation of cooperation modalities between the students. They are differentiated by (a) typical modalities opening and closing of collective meaningful stories (e.g., an opening after a misunderstanding between students), (b) the structure of interactional network among students (e.g., two students acting simultaneously to produce something together and the other partner was juxtaposed in relation to personal interests), and (d) the forms of these interactions. Concerning the situational conditions, the analysis highlighted several key elements involved in the dynamics of transformation of cooperation modalities: (a) the teacher's interventions, (b) the materiality of the situation, (c) the common past experiences of the students, and (d) the shared knowledge among them. **Discussion** These results show that (a) the cooperation is a co-constructed phenomenon that changes over time, (b) the cooperation within a group is not isolated in the classroom environment. These results are discussed from the point of view of the analysis of the conditions for a cooperation among the students to produce a 'collective work', and from the point of view of the design of mechanisms to promote cooperative interactions between the students in this type of situation. **References** Evin, A., S ve, C., Saury, J. (2012). *Phys Educ Sport Pedagog.* Theureau, J. (2006). *Le cours d'action: M thode d velopp e* [Course of action: Developments in methods]. Toulouse, FR: Octar s.

### **LEVEL OF DEFINITION AND COHERENCE OF THE UNITS OF BODY EXPRESSION IN PHYSICAL EDUCATION TEACHER EDUCATION PROGRAMMES**

Lorente, E., Montilla, M.J., Romero, R.

*INEFC University of Lleida/ University of Zaragoza*

**Introduction** There has been in recent years an increase of the literature that emphasizes on the importance of the teaching planning and its evaluation (P rez-Juste, 2000; Zabalza, 2007). In fact, the quality of the programmes plays an important role in European Higher Education Area (Leuven/Louvain-la-Neuve Ministerial Conference, 2009). The purposes of this study are: a) assess the level of definition and clarity of the elements that make up the units of Body Expression, a subject based on creative and mime dance, and b) analyse the coherence between assessment and the other unit constituent elements. **Methods** Eighteen units of Body Expression in different pro-

grammes of Physical Education Teacher Education (PETE) belonging to fourteen Spanish universities have been analysed. The study was conducted through a documentary analysis of the units using ad hoc rubrics elaborated by three university experts in Didactics; later on a descriptive statistical analysis of the results was made. Results The elements of the units better defined are the contents (88.9%), assessment criteria (77.2%) and objectives (44.4%). The 33.3% of the units do not mention the methodology and 83.3% of the cases do not describe the competencies. Regarding to the degree of coherence, the relationship between objectives and assessment criteria represents 76.7% and 77.8% for the coherence between contents and assessment criteria. Otherwise in the methodology, 'nothing or little coherent' values account for more than 50% of the cases. Discussion As main results we highlight the existence of a high degree of definition and clarity in the wording of the objectives, contents and assessment. On the other hand, methodology was little defined and competencies were hardly mentioned. There were important differences between units regarding the coherence between each of the elements and the assessment. The results of this study suggest the need to clearly define the components of the units, which ultimately are the staging of the teaching model of a Department or Faculty. Therefore it will be important that learning outcomes are well defined and consistent with the general and specific lines of the degrees. References - European Standards and Guidelines for quality assurance (Leuven/Louvain-la-Neuve Ministerial Conference, 2009). European Association for quality assurance in Higher Education (ENQA). -Pérez-Juste, R. (2000). La evaluación de programas educativos: conceptos básicos, planteamientos generales y problemáticas. *Revista de Investigación Educativa*, Vol. 18, 2: 261-287. -Zabalza, M.A. (2007). *La enseñanza universitaria: el escenario y sus protagonistas*. Madrid: Narcea.

**15:00 - 16:00**

## Mini-Orals

### PP-SH12 Psychology [PS] 5

#### COMPARATIVE ANALYSIS OF THE LEVEL OF PARTICIPATION IN RECREATIONAL RUNNING EVENTS POLAND AND THE UNITED STATES

Czajka, K., Pluta, B., Stannard, A.B.

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**Introduction** Recreational sports such as running events have become increasingly popular in Poland over the last several years. Interest in taking part in recreational running depends often on one interests in the sport developed at an early age. Research is needed in this area in order to understand participants' background, motivation behind participation in such events, as well as the environment that could foster this increasing trend in popularization of running as a form of recreational sport. For this reason, an attempt was made, to analyze the status of participation in recreational running events based on the characteristics of the educational system from elementary school to high school for sports and recreation at universities in selected Polish and United States cities. This analysis was compared to the responses obtained from questionnaires distributed among runners participating in recreational races. Special attention was paid to runners' motivation behind sport participation and their training status.. **Methods** The study was carried out in selected areas in Poland and USA, similar in many aspects,. In Poland, Poznan was chosen as the city for analysis while in the U.S., it was the city of Lansing, Michigan. In this paper, a diagnostic survey was used. Data was obtained from 70 runners, of which 40 participants were Polish runners. The study used graphical and tabular methods of data presentation. **Results** Surveyed runners from both countries competed in road racing running events 1 to 6 times a year, which indicated a typical recreational approach towards training and competition. The major impact on sport participation was being a former athlete. Runners from US started to run earlier than Polish runner, and also their mileage was higher than Polish runners. Large differences were also visible in the infrastructure and healthcare system, between both areas. **Discussion** Based on this study carried out in Poland and the United States, it can be concluded that physical education classes as well as the culture for physical activity is more developed in US than in Poland. Also, infrastructure in the United States is much better and more accessible than in Poland. Recreational runners were motivated to partake in the running events for internal reasons, while in the United States it resulted from external reasons and was shaped by the educational system. In spite of these differences, participation as well as organization of running events by runners is remarkably similar between the two countries. **References** Gracz J. Sankowski T. (2001). *Psychologia w rekreacji i turystyce*, AWF Poznań, Poznań. Siwiński W. (2004). *Rekreacja ruchowa: zagadnienia teoretyczno-metodologiczne*, WSGHiG, Poznań. Ogles, Masters, Richardson, (2009). *Obligatory running and gender – an analysis of participative motives and training habits*, International journal of sport psychology, Rome.

#### COMPARE THE SATISFACTION WITH LIFE BETWEEN WATERPOLO WITH DEAF AND HEARING PLAYERS AND THEIR NON SPORTING PAIRS

Balogh, L., Gemes, I.

*University of Szeged, Faculty of Juhász Gyula Pedagogy*

**Introduction** The Hungarian national waterpolo team won the Olympics Games nine times, also the national deaf waterpolo team has similar results: they won six Deaflympics. One sport, in which they are the leadings, however they meet different difficulties in the life and in the swimming-pool as well. 10% of the habitants of Hungary live with impaired hearing. They live with discrimination and sociocultural differences, but there's a field where they can forgot about all of them: getting out from their closed community they enter in a new group and change their lives with sporting The actuality of my topic is the lack of the literature of deafsport. There are only a few scripts about sportsmen's satisfaction with life, mainly about the disabled people's. As an athlete I am interested in a language minority's waterpolo's life. **Methods** In Hungary 66, 8% of the men don't do any sports, from this group I asked 15-15 deaf and hearing men (n=30) with the questionnaire of Satisfaction With Life Scale (there are 5 statements that you may agree or disagree with, using the 1 (strongly disagree) – 7 (strongly agree) likert scale). Furthermore, I examined more 15-15 deaf and hearing waterpolo men (n=30). As sampling I used the simple reaching technique. I used descriptive statistic, I calculated min., max., standard deviation, mean. **Results** I worked with the Statsoft statistic program and I measured with ANOVA for each statements in the 4 groups. The probability of these results, assuming the null hypothesis are: 1) In most ways my life is close to my ideal  $p < 0,0003$  2) The conditions of my life are excellent  $p < 0,0006$  3) I am satis-

fied with my life  $p < 0,0037$  4) So far I have gotten the important things I want in life  $p < 0,001$  5) If I could live my life over, I would change almost nothing  $p < 0,071$  It is clearly seen that the deaf waterpolo players' satisfaction is much more higher ( $M1=5,73$   $SD1=1,28$ ) than the non-sporting hearing-impaired's ( $M1=4$   $SD1=1,25$ ) However, for the hearings this result is not true: they are almost equal, but the non-sporting group's results are little bit better ( $M2=5,7$   $SD2=1$ ) than the waterpolo players' ( $M2=5,27$   $SD2=1,03$ ) Discussion From these results we can see it's worth considering care for the deaf's or disabled's sport, because for a hearing-impaired the sport means more possibilities, than a hearing person. Furthermore, sport is about social contacts, this is a great chance to integrate them to the society. References Balogh, L., Szabó, A. et al. (2008) An Analysis of the Components of the "Psychological Contract" in Interactive Hungarian Team Sports. In: Current Issues and New Ideas in Sport Science, 2nd International Scientific Conference, Kaunas. Kaunas, Litvânia, 2008.10.15-2008.10.17. p. cd. Paper cd. Stewart, D.A.: Deafsport: The impact of sport within the deaf community, Gallaudet University Press, 1991.

### TO DIFFERENTIATE SELF-EVALUATION AND SELF-SATISFACTION IN THE PHYSICAL SELF: A MULTITRAIT-MULTIMETHOD ANALYSIS

Margas, N.1,2, Fontayne, P.3

1: Normandy University, France ; 2: UNICAEN, CESAMS, F-14032, France; 3: University Paris Ouest Nanterre La Défense, CeRSM, France

Introduction This study aims to show that the affective component (self-satisfaction) and the evaluative component (self-evaluation) of the physical self can be empirically differentiated in each dimension of the physical self (e.g. physical appearance and sport ability) whereas they are confused in the physical self theory, instruments and terminology. A multitrait-multimethod (MTMM) design is conducted to test convergent and discriminant validity of our proposition. Methods 389 university students (148 women, 241 men;  $Mage=20.07$ ,  $SD=1.85$ ) in sport sciences ( $n=283$ ) or other departments ( $n=106$ ) fill in a questionnaire. Two methods are used to measure self-evaluation (the sport ability and physical appearance scales of the physical self-description questionnaire (PSDQ; Marsh et al., 1997) and two scales adapted to the same dimensions from the self-competence scale of Tafarodi and Swann (1995). Three methods are used to measure self-satisfaction relative to the same dimensions (adaptation to sport ability and physical appearance dimension of the general physical scale of the PSDQ, the self-liking scale of Tafarodi and Swann (1995) and a measure of ideal-actual self discrepancy (Cash & Szymanski, 1995). Results According to our proposition, correlations between methods which measure the same component in the same dimension are always stronger than the ones which measure one component in different dimensions or one dimension in different components. Our theoretical model proposes a good fit of the data according to structural equation modeling ( $GFI=.94$ ;  $NNFI=.96$ ;  $CFI=.98$ ;  $RMR=.03$ ). Moreover, ANOVAs with self-evaluation and self-satisfactions as repeated measures reveal significant interactions between men and women on the appearance dimension [ $F(4, 1548)=7.74$ ;  $p < .0001$ ] and between sport sciences and other students on the sport dimension [ $F(4, 1548)=23.26$ ;  $p < .0001$ ]. Discussion This study shows that self-evaluations and self-satisfactions are different components of the physical self. Moreover, as the scales used here are in part issued from a classic tool of the physical self where they are supposed to measure one same construct, these components appear to be confused in that tool. As terminology, measurement, theory and empirical research are inexorably intertwined (Marsh et al., 1994), further studies are needed to show the specific roles of self-evaluation and self-satisfaction in sport, exercise and health. References Cash TF, Szymanski ML. (1995). *J Pers Assess*, 64, 466-477. Marsh HW, Richards GE, Johnson S, Roche L, Tremayne P. (1994). *J Sport Exerc Psychol*, 16, 270-305. Tafarodi RW, Swann WB. (1995). *J Pers Assess*, 70, 443-483.

### EXPERIENCING AMOTIVATION IN PHYSICAL EDUCATION: THE ROLE OF ACHIEVEMENT EMOTIONS

Jackson-Kersey, R.

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Introduction Amotivation is multifaceted and is evident in physical education (PE) when a student lacks the intention and willingness to participate in compulsory activities (Deci and Ryan, 1985). Achievement emotions are critically important for students' motivation, learning and performance in educational settings (Pekrun and Stephens, 2010). The aim of the current study was to investigate whether change in achievement emotions experienced over the course of a unit of work predicted change in self-reported amotivation (deficiency in ability beliefs, deficiency in effort beliefs, low task value, and unappealing task characteristics). Methods A total of 179 male students (mean age = 14 years) participated in the study by completing a questionnaire at the end of a scheduled PE lesson. Measures included adapted versions of the Academic Amotivation Scale - Physical Education (Shen, Wingert, Weidong, Sun and Rukavina, 2010) and the Achievement Emotions Questionnaire (Pekrun, Goetz and Perry, 2005). Students completed the measures on three occasions during the unit of work which lasted for six weeks. Results Multilevel modeling analyses showed that, at the first measurement occasion, positive achievement emotions such as enjoyment, confidence and pride, were all negatively associated with the four amotivation dimensions. Negative achievement emotions such as anger, tension, hopelessness and boredom, positively predicted 'unappealing task characteristics', whereas embarrassment, hopelessness and boredom positively predicted 'deficiency in ability beliefs'. Across time, for every unit increase in enjoyment, there was a 0.08 decrease in 'deficiency in effort beliefs', whilst for every unit increase in tension, there was a 0.11 increase in 'deficiency in ability beliefs' and a 0.14 increase in 'deficiency in effort beliefs'. Discussion Overall, the findings suggest that discrete achievement emotions are linked with students' experience of amotivation in PE. An increase in tension over time, for example, may have a detrimental effect not only on students' beliefs about their lack of skills but also views about their inability to exert effort. Further work is necessary to determine the causal role played by specific emotions in the development of students' chronic amotivation in PE. References Deci EL, Ryan RM. (1985). New York: Plenum. Pekrun R, Goetz T, Perry RP. (2005). Academic Emotions Questionnaire (AEQ): User Manual. Munich, Germany: University of Munich, Department of Psychology. Pekrun R, Stephens, JE. (2010). Social and Personality Psychology Compass, 4: 238-255. Shen B, Wingert KR, Weidong L, Sun H, Rukavina BP. (2010). *J Teaching in Physical Education*, 29: 72-84.

### WEEKLY ASSESSMENTS OF COACH INTERPERSONAL SUPPORT, MOTIVATION, AND PSYCHOLOGICAL DEVELOPMENT IN DISADVANTAGED ADULTS SEEKING EMPLOYMENT

Cowan, D.T., Taylor, I.M., Baker, J.S.

Northumbria University

Introduction Current unemployment rates in Western countries are worryingly high. In an attempt to enhance the employability prospects of individuals and promote positive and healthy experiences, a number of sports-based educational programs have been delivered. Despite this emerging trend, little theoretically driven evidence exists for the efficacy of such programs. Grounded in self-determination theory (SDT; Vansteenkiste, Niemiec, & Soenens, 2010), this study examined potential interpersonal and motivational processes that

facilitate self-esteem, efficacy beliefs, and future employment in a sample of disadvantaged unemployed adults. **Methods** Participants (N = 39) completed a weekly multi-section questionnaire over the 11-weeks of a sports-based educational program measuring an interpersonally supportive coaching style, three forms of motivation for attending the program (i.e., intrinsic, identified, and introjected motives), self-esteem, and efficacy beliefs. **Results** At the intra-individual level, the relationship between interpersonal support and efficacy beliefs was mediated positively by intrinsic motivation and introjected regulation. At the inter-individual level, identified regulation positively mediated the relationship between interpersonal support and efficacy beliefs, while introjected regulation negatively mediated the relationship between interpersonal support and both outcome variables. Moreover, participants who gained employment reported higher average self-esteem during the program, compared to their unemployed counterparts. **Discussion** This study contributes to the existing literature by suggesting specific processes that may help develop or forestall employment skills amongst disadvantaged adults, as well as offering potential theoretical advancements of self-determination theory. In particular, results support the potential role of interpersonal support in facilitating self-determination, but also present a word of caution by proposing that coaches who socio-emotionally invest in program attendees may also promote introjected motives for participation that reflect only minimal internalization. Thought-provoking differences between time-varying and average relationships among motives, esteem, and efficacy beliefs also emerged, which may add insight into the consequences of promoting different behavioral motives. **References** Vansteenkiste, M., Niemiec, C., & Soenens, B. (2010). The development of the five mini-theories of self-determination theory: An historical overview, emerging trends, and future directions. In T. Urdan & S. Karabenick (Eds.). *Advances in Motivation and Achievement*, vol. 16: The decade ahead (pp. 105-166). UK: Emerald Publishing.

### **INFLUENCE OF PERCEIVED MOTIVATIONAL CLIMATE ON PSYCHOLOGICAL BASIC HUMAN NEEDS SATISFACTION AMONG BASKETBALL PLAYERS**

Franco, E., Coterón, J., Sánchez, G., Pérez-Tejero, J.

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**Introduction** Sport motivation among young has been deeply studied as a key element for improving both sports performance and adherence to the physical activity practice from the tenets of Achievement Goal and Self-Determination Theories. The aim of this study was to analyze the influence of the perceived motivational climate, task-involving (T) or ego-involving (E) over the basic psychological human needs satisfaction, competence (C), autonomy (A) and relatedness (R). **Methods** Perceived Motivational Climate in Sport Questionnaire (PMCSQ-2) and Psychological Needs Satisfaction in Exercise Scale (PNSE) were administered to 131 young basketball players. We used a linear regression analysis to study the effects of T & E on the satisfaction of C, A & R. **Results** Regression analyses showed that C ( $R^2 = 0.14$ ;  $p < 0.001$ ) was positively predicted by T ( $\beta = .43$ ;  $t = 5.18$ ,  $p < 0.001$ ) while no relation was found between E and C ( $t = 1.56$ ,  $p > 0.05$ ). A ( $R^2 = 0.05$ ;  $p < 0.01$ ) was predicted by E ( $\beta = .26$ ;  $t = 3.10$ ,  $p < 0.01$ ) and non by T ( $t = 0.68$ ,  $p > 0.05$ ). Lastly, R ( $R^2 = 0.25$ ;  $p < 0.001$ ) was predicted by T ( $\beta = .49$ ;  $t = 5.85$ ,  $p < 0.001$ ) while no relation was found between E and R ( $t = 1.82$ ,  $p > 0.05$ ). **Discussion** Results agree with most existing literature (Ntoumanis and Biddle, 1999). Relation between T with C and R (Cox & Ullrich French, 2010; Escartí & Gutiérrez, 2001) is consistent with the predictions of the AGT; in task-involving settings, it is more likely that the individual holds in the task, focuses on the intrinsic rewards of learning and maintains high perceptions of competence and relatedness, as there is no comparisons among subjects. No previous references have been found about relation found between E and A. However, we must take into consideration that when subjects feel identified with the action they do, their perceived autonomy grows (Moreno, 2006). It makes sense that the sample, formed by players participating in the highest competition league at those ages, could feel well-identified with the features of E, where competition is emphasized. **References** Cox, A., & Ullrich-French, S. (2010). The motivational relevance of peer and teacher relationship profiles in physical education. *Psychology of Sport & Exercise*, 11, 337-344. Escartí, A., & Gutiérrez, M. (2001). Influence of the motivational climate in physical education on the intention to practice physical activity or sport. *European Journal of Physical Education*, 1(4), 1-12. Moreno, J. A., & Martínez, A. (2006). Importancia de la teoría de la autodeterminación en la práctica físico-deportiva: fundamentos e implicaciones prácticas. *Cuadernos de Psicología del Deporte*, 6(2), 39-54. Ntoumanis, N., & Biddle, S. (1999). A review of motivational climate in physical activity. *Journal of Sports Sciences*, 17, 643-665.

### **EFFECTS OF TWO DIFFERENT TYPE OF AEROBIC EXERCISE ON LIFE SATISFACTION AND BECK DEPRESSION LEVEL**

Atan, T., Cicek, G., Imamoglu, O., Yamaner, F., Gullu, E., Unlu, C.

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**Introduction** The positive effects of regular aerobic exercises on increasing self-confidence, getting away from negative thoughts, regular sleep and adapting to stress, decreasing depression risk, and life quality are dealt with. The aim of this study was to search the effect of the two different type of eight-week aerobic exercises on Life Satisfaction and Depression level according to sedentary women. **Methods** The groups were formed by total 56 voluntary sedentary women. 25 of them (age;  $33.44 \pm 4.51$  years, height  $158.76 \pm 5.88$  cm) were separated as an aerobic-step group and the rest 31 women (age;  $34.87 \pm 4.80$  years, height  $157.25 \pm 5.49$ ) were separated as an aerobic-core group. The groups were made to do aerobic-step or aerobic-core exercises at a severity level of 60-70 percent of their heart beat rate for 60 minutes in 4 days during 8 weeks. Before and after the exercise programme, Life Satisfaction Inventory and Beck Depression Inventory were applied to the experimental subjects. For the statistical analysis "student t" test and "paired t" test were used. **Results** Body weight and Depression level of each group after the exercise decreased compared to the ones before exercise ( $p < 0.01$ ). Life Satisfaction level of both groups increased after two-month exercise ( $p < 0.01$ ). The Body weight, Life Satisfaction and Depression level measured before the start of the two-month exercise did not show meaningful difference between two groups ( $p > 0.05$ ). But when the values after two months were compared, it was found that the Depression level of the group doing aerobic-step exercise was statistically lower than that of the group doing aerobic-core exercise ( $p < 0.01$ ). Body weight and Life Satisfaction level measured after two months did not show meaningful difference between those two groups ( $p > 0.05$ ). **Discussion** By studying the link between depression and exercise in many researches, it has been revealed that regular exercise is useful for mental disorders (Salmon, 2000). It has been revealed that exercise could be used both directly and collaterally in the treatment of low and bland severity of depression, and that exercise is good way of response to control or prevent depression and it is as curative as drugs. (Dun et al., 2005; McAuley et al., 2003). According to these studies, this supports the results obtained from this research, and aerobic exercise increase the life satisfaction scores in women and decrease the symptoms of depression. However, aerobic-step exercise has been observed to decrease the level of depression more than aerobic-core exercise. **References** Salmon P. (2000). *Clinical Psychology Review*, 21, 33-61. Dunn AL, Trivedi MH, Kampert JB, Clark CG, Chambliss HO. (2005). *American Journal of Preventive Medicine*, 28, 1-8. McAuley E, Jerome G J, Marquez DX, Elavsky S, Blissmer B. (2003). *The Society of Behavioral Medicine*, 25, 1-7.

## MOTIVATIONAL PROFILES AND PERFORMANCE IN YOUNG ELITE FOOTBALL PLAYERS: A PERSON-ORIENTED APPROACH

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**MOTIVATIONAL PROFILES AND PERFORMANCE IN YOUNG ELITE FOOTBALL PLAYERS: A PERSON-ORIENTED APPROACH** Introduction The influence of motivational variables on athletic performance is undisputed. What is unclear, though, is how the motivational system must be constituted in order to promote performance as much as possible. In terms of motivational psychology, this raises the question how the motivational constructs Self-Determination, Hope for Success (HS), Fear of Failure (FF) and Achievement Orientation interact with each other (Conroy et al, 2007). This holistic approach leads to a person-oriented methodology that studies how patterns of such variables affect the development of performance (Bergman et al., 2003). Methods A sample of 95 young, male football talents (MAge = 12.26, SD = 0.29) were questioned concerning their self-determination, HS and FF as the facets of their achievement motive, and their competitive orientation. Their athletic performance was assessed a year later by national youth team coaches, using a 2-step scale (1= low level of performance, 2= high level of performance). The clusters found (Ward, squared Euclidian distance) were examined in terms of the transition probabilities between the performance categories. Results Four clusters are identified (52.85 % explained variance). The "high achievement motivated" athletes are found to move into the group of high-performance players at a higher-than-random frequency (odds ratio = 1.3). "Extrinsically motivated" athletes, display a higher-than-random transition into the lower performance category (OR =1.5). No higher-than-random paths were observed among those "fearful of failure" and those "intrinsically motivated and not achievement-oriented". Discussion The results indicate the importance of specific sets of variables for the medium-term development of performance among young talents in competitive sports. Further longitudinal studies are needed in order to decide whether the patterns of variable can contribute to talent selection and promotion in the longer term too. References Bergman, L.R., Magnusson, D. & El-Khoury, B.M. (2003). Studying individual development in an interindividual context. A person-oriented approach. Mahwah, N.J: Erlbaum. Conroy, D. E., Elliot, A. J., & Coatsworth, J. D. (2007). Competence motivation in sport and exercise: The hierarchical model of achievement motivation and self-determination theory. In M. Hagger & N. Chatzis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 181-192). Champaign: Human Kinetics.

## MOTIVATION AMONG BASKETBALL PLAYERS: DIFFERENCES ACCORDING TO THE COMPETITION.

Franco, E., Coterón, J., Sánchez, G., Refoyo, I.

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Introduction Adolescence is a key period to become regular practitioners of physical activity or to completely abandon it. Existing literature has set the importance of the context where activity takes place as a factor which can predict many other motivational outcomes. The aim of this study was to analyze differences that young basketball players show in the perception of important motivational variables from the tenets of Self Determination Theory according to the league they take part in. Methods Psychological Needs Satisfaction in Exercise Scale (PNSE), Sport Motivation Scale (SMS) and the Intention to be Physically Active Scale (IPAS) were administered to 204 young basketball players. One factor ANOVA was used to find possible differences among players belonging to preferred federated (PF), federated competition (A) and municipal sport games competition (MSG). Scheffé post-hoc tests were used to compare groups. Results Differences were found in future intention to be physically active (I;  $F=3.41$ ,  $p < .05$ ) and in relatedness (R;  $F=3.47$ ,  $p < .05$ ). Post-hoc test revealed PF players ( $M=4.49$ ;  $SD=.57$ ) scored higher in I than MSG ( $M=4.18$ ;  $SD=.73$ ). Also, PF players ( $M=3.93$ ;  $SD=.58$ ) got higher scores in R than F ( $M=3.64$ ;  $SD=.61$ ) and MSG ( $M=3.65$ ;  $SD=.44$ ). No differences were found in the rest of variables: competence, autonomy and intrinsic motivation ( $p > .05$ ). Discussion PF players showed higher scores both in I and R. Existing literature (Carpenter, et al., 2002 & GarcíaCalvo, et al., 2010) has shown a relation between R and adherence to the physical activity, which, in our study, could be reinforced by the higher level of I in PF sample. These players have chance of promoting to elite basketball teams which could explain their higher levels of I due to an extra-motivation. Furthermore, players from this league spend more time together due to longer training sessions, travels, etc. which can improve the quality of their friendship and so, support feelings of R (Cox, et al., 2008). It seems that players from different competitions have disparate motivational profiles and which thus should receive adapted interventions. References Cox, A., Smith, A., & Williams, L. (2008). Change in physical education motivation and physical activity behaviour during middle school. *Journal of Adolescent Health*, 43, 506 - 513. García Calvo, T., Cervelló, E., Jiménez, R., Iglesias, D., & Moreno, J. A. (2010). Using self-determination theory to explain sport persistence and dropout in adolescent athletes. *Spanish Journal of Psychology*, 13(2), 677-684. Guillet, E., Sarrazin, P., Carpenter, P., Troullidou, D., & Cury, F. (2002). Predicting persistence or withdrawal in female handballers with Social Exchange Theory. *International Journal of Sport Psychology*, 37, 92-104.

## THE MOTIVATION OF YOUTH SPORT PARTICIPANTS

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Introduction According to Murray (1983), the differences of motivation can explain different types of involvement in an activity. Currently, the investigation of motivational processes among youth sport participants has been to adopt a goal perspective approach (DUDA, 1992). Two major goals have been found to exist in achievement situations (WHITE, DUDA and KELLER, 1998), i.e., task or ego orientation. Methods In this study took part 62 youth sport participants, 12 girls (mean age of  $12.77 \pm 1.2$  years) and 50 boys (mean age of  $13.8 \pm 2.4$  years), participants of modalities struggles, futsal, swimming, artistic gymnastics and volleyball. All subjects volunteered to participate in the study. We used the questionnaire the Task and Ego Orientation in Sport Questionnaire - TEOSQ (DUDA and NICHOLLS, 1992), translated, adapted and validated by Hirota and De Marco (2006), where we can identify whether the individual is ego oriented or task oriented. The internal consistency of the task and ego orientation subscales was determined by Cronbach's Coefficient Alpha and an average orientation of each to identify the motivational orientation of participants. Results The results obtained by Cronbach's Coefficient Alpha task orientation reached a value of 0.81, while the ego orientation a value was 0.71. We recorded the following average,  $4.28 \pm 0.19$  and  $2.44 \pm 0.14$ , respectively, task orientation and ego, showing results consistent with existing literature. There was no significant change for the different sports. Conclusion The results showed that participants are task orientation, i.e., they are self-determined, self-confident, creative and cooperate more with the group. References DUDA, J. L. Motivation in sport setting: A goal perspective approach. In G. Roberts (Ed.), *Motivation in sport and exercise* (pp. 57-91). Champaign, IL: Human Kinetics, 1992. DUDA, J. L. & Nicholls, J. G. Dimensions of achievement motivation in schoolwork and sport. *Journal of Educational Psychology*, vol. 89, p. 290-299, 1992. HIROTA, V.B., DE MARCO, A.

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### **PREDICTING PSYCHOLOGICAL NEED THWARTING AND AMOTIVATION: COACHES ALSO EXPERIENCE THE DARK SIDE**

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**Introduction** Coaches play a key role in the psychological development of the athletes they train. Given the crucial importance of coaches, recent research has studied their feelings and motivations within sport environment (e.g., Stebbings et al., 2012). Depending on the influence received from the environment, coaches' experiences can be either positive or negative, as in the case of athletes (e.g., Bartholomew et al., 2011). Framed in the Self-Determination Theory (e.g., Deci & Ryan, 2000), the aim of this work is to present a model in which we assess the coaches' negative experiences. Specifically, we hypothesize that pressures from the social environment would thwart coaches' basic psychological needs, which in turn would lead them to feelings of amotivation. **Method** One hundred and forty-nine coaches (Mage = 27.75, SD = 8.79, range = 15-52, 94% male) responded to our multi-section questionnaire. The coaches trained football (82%) or basketball (18%). **Results** All the analyses were carried out using Mplus 7.0. First, we compared the measurement models obtained with the confirmatory factor analysis (CFA) approach and the exploratory structural equation modelling (ESEM) approach. For each instrument, we chose the one that fitted better to the data. Then, the structural equation model (SEM) was tested. Fit indices of this model showed a good fit to the data:  $\chi^2(226) = 375.142, p < .001, CFI = .955, TLI = .950, RMSEA = .067$ . The results revealed that perceptions of the environmental pressures were a positive predictor for coaches' psychological need thwarting, which in turn positively predicted their amotivation. **Discussion** Our work confirmed a model that examines the dark side of coaching. Thus, when a coach perceives pressure from the social environment (e.g., club managers), he/she feels their psychological needs thwarted. When this situation occurs, the coach will probably experience a sense of amotivation. Future research should include other influences from the social environment to test the conditions in which the coaches would have positive (i.e., psychological need satisfaction, self-determined motivation) or negative coaching experiences. **References** Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., & Thøgersen-Ntoumani, C. (2011). Psychological need thwarting in the Sport context: assessing the darker side of athletic experience. *Journal of Sport & Exercise Psychology*, 33, 75-102. Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11, 227-268. Stebbings, J., Taylor, I. M., Spray, C. M., & Ntoumanis, N. (2012). Antecedents of perceived coach interpersonal behaviors: The coaching environment and coach psychological well- and ill-being. *Journal of Sport and Exercise Psychology*, 34, 481-502. Note. This research was funded in part by the Ministerio de Economía y Competitividad (DEP2010-15561).

### **THE WHAT, WHY AND WHERE OF EXERCISE BEHAVIOR: EXPLORING ASSOCIATIONS BETWEEN PHYSICAL ACTIVITY QUANTITY, INTENSITY, ENVIRONMENT AND MOTIVATION.**

Welch, A.S., Banks, A.K.

*Johnson State College & Iowa State University*

**Introduction** High rates of physical inactivity and associated health problems mean that understanding physical activity (PA) behavior patterns is a public health priority. Self Determination Theory research has demonstrated that intensity, duration and frequency of PA are all positively associated with more autonomous reasons for exercise (Duncan et al., 2010), but little attention has been given to where those activities take place. Furthermore, exercise in environments with natural features has been shown to provide physical and mental health benefits (Pretty et al., 2005). Thus, the purpose of the present study was to explore the relationships between PA environments, behaviors, and motivations, with emphasis on differentiating nature-based and outdoor PA. **Methods** Participants were 849 physically active US adults (M age = 43.5 years; SD = 11.1) who completed an online survey including the 7-Day Physical Activity Recall questionnaire to assess PA behaviors (modified to assess PA location) and the Behavioral Regulations in Exercise Questionnaire-2 to assess motivations. **Correlations** between motivations (intrinsic, integrated, identified, introjected, external, amotivation), PA environment (%outdoor, %nature), moderate (MPA; METS) and vigorous (VPA; METS) intensity, duration (minutes), and frequency (days/week) of PA were analyzed. **Results** Percentage of physical activities that took place in nature (%nature) had small but significant positive correlations with intrinsic ( $r = .08; p < 0.05$ ), integrated ( $r = .08; p < 0.05$ ), and identified regulation ( $r = .07; p < 0.05$ ), but no associations with exercise behavior variables. In contrast, %outdoor was inversely associated with VPA ( $r = -.16; p < 0.01$ ), integrated ( $r = -.11; p < 0.01$ ), identified ( $r = -.10; p < 0.01$ ), and introjected regulation ( $r = -.13; p < 0.01$ ). MPA and frequency of PA had significant positive associations with % outdoor. Consistent with other research, positive correlations between autonomous regulations and VPA were observed ( $r = .27$  to  $.30; p < .01$ ), but MPA was negatively associated with all autonomous regulations. **Discussion** Those who engage in more nature-based activities are regulated by more autonomous motivations. Incongruous associations between % outdoor, MPA and autonomous motivations may be explained by outdoor work-related physical activities being reported as moderate intensity activities. Careful consideration should be paid to the assessment of type and location of PA in the search to understand PA behavior. **References** Duncan, L. R., Hall, C. R., Wilson, P. M., & Jenny, O. (2010). Exercise motivation: a cross-sectional analysis examining its relationships with frequency, intensity, and duration of exercise. *International Journal of Behavioral Nutrition and Physical Activity*, 7, 1-9. Pretty, J., Peacock, J., Sellens, M., & Griffin, M. (2005). The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research*, 15, 319-337.

15:00 - 16:00

## Mini-Orals

## PP-SH16 Misc. topics 3

**ATTITUDES TOWARDS DOPING: A COMPARISON AMONG DIFFERENT SPANISH OLYMPIC CYCLING NATIONAL TEAMS**

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ATTITUDES TOWARDS DOPING: A COMPARISON AMONG DIFFERENT SPANISH OLYMPIC CYCLING NATIONAL TEAMS Morente-Sánchez, J. Freire, C.1, & Zabala, M.1,2 1 Faculty of Sport Sciences, University of Granada (Spain) 2 Spanish Cycling Federation, Madrid (Spain) Introduction According to Morente-Sánchez and Zabala's systematic review about doping attitudes, beliefs and knowledge in elite athletes [1], there were no previous specific studies that assessed attitudes towards doping in elite athletes by means a validated scale. The aim of this study was to know and compare the attitudes towards doping among different Spanish Olympic cycling national teams using a validated tool. Methods A total of 72 Spanish national team cyclists, (mean age: 19.67±4.72 years) participated in the study. The gender distribution was 70.1% males (n=51) and 29.9 % females (n=21). The total sample was divided into four groups according to the 4 different Olympic cycling disciplines: Mountain bike -MTB- (n = 18; 83.3% men), Bicycle Moto Cross -BMX- (n = 12; 100% men), Track -TRA- (n = 9; 77.8% men) and Road -ROA- (n = 33; 54.5% men). Descriptive design was carried out by means of a validated questionnaire, Performance Enhancement Attitudes Scale (PEAS) [2] of 17 questions using a Likert scale from 1 (Strongly Disagree) to 6 (Strongly Agree) for different statements that supported the use of doping in sport. Mean value ± Standard Deviation was obtained for each item and Mann Whitney test for independent variables with Bonferroni post hoc was carried out. Results Regarding results from PEAS for the whole sample, mean score (1-6) was 2.13±0.55 and a overall score (17-102) was 36.12±9.39. Taking the different analyzed groups into account, mean and overall scores were, respectively: MTB: 1.80±0.43, 30.28±6.92; BMX: 2.50±0.62, 42.46±10.74; TRA: 2.54±0.71, 43.22±12.00; ROA: 2.06±0.39, 34.91±6.62. Regarding mean score and overall score significant differences were observed between MTB and BMX (p=0.001; p=0.002, respectively) and between MTB and TRA (p=0.002; p=0.003, respectively). Discussion According to PEAS, higher scores represent a more lenient attitude toward doping. Cyclists of the Spanish Olympic national teams, in general, are not tolerant in relation to doping, though BMX and Track riders were little more permissive attitudes towards doping than MTB and road. These scores are relatively far from non-elite confessed doping users have also been assessed (46.8±13.32, [3]; 46.8±13.32, [4]) however, a deep analysis and monitoring of this sample appears necessary. References 1. Morente-Sánchez J, Zabala M. Sports Medicine 2013 May; 43(2): ahead of print. 2. Petroczi, A., Aidman E. Psychology of Sport and Exercise. 2009; 10: 390-396 3. Uvacek M, Nepusz T, Naughton DP, et al. J Med Sci Sports. 2011; 21 (2): 224-34 4. Morente-Sánchez J., Freire C., Ramírez-Lechuga J., Zabala M. (2012). Book of Abstracts of the 17th Annual Congress of the ECSS. 4-7 July 2012. Bruges-Belgium. 270-271.

**A PROGRAM OF EMOTIONAL AWARENESS TRAINING AND IMPLICATIONS FOR COACHING EDUCATION**

Schoen, C., Gallo, J.A.

*Salem State University*

Introduction Emotions as a precursor to performance served as the focus of recent research in tennis using an IZOF framework (Schoen & Gallo, 2010). Our preliminary investigation focused on identifying optimal emotions with our athletes using Hanin's (2000) model. We found the following: athletes at the Division III Collegiate level (United States college athletics) have difficulty identifying their emotions; they also failed to recognize how emotions influenced performance and reported feeling mainly negative emotions along with low confidence in prematch and practice challenge match situations more often than positive emotions or confidence. Methods Accordingly, the sport psychology practitioner working with the team developed and implemented a training program throughout the 2011-2012 training and regular season to 1) increase emotional awareness along the lines of Mayer & Salovey's (1997) ability model, 2) practice problem-focused and emotion-focused coping strategies with the athletes, 3) measure first serve percentages to gauge how emotional coping strategies correlated with performance, and finally 4) to emphasize greater team building steps designed to improve intrateam support and cohesion. The team consisted of 8 players, ranging in age from 18-24 (with an average of 7.4 years competitive playing experience) who responded to surveys asking them for self-reported measures of anxiety and confidence before every match and practice challenge scenarios designed to replicate pressure situation in competition. First serve percentage was also measured periodically starting in pre-season and throughout the regular season. Results Improvement in recognizing various emotional states was observed using a content analysis of players' survey responses as indicated by the number and variety of emotional states identified prior to performance, an increase in first serve percentage over the course of the season, and a team climate that was by all measures much more positive and supportive compared against prior observations and data collected from the Schoen and Gallo (2010) study. Discussion Practical implications for coaching education practices will be addressed in terms of selection of team captains (emotional leaders), an emphasis on a higher character team climate as underscored with a team philosophy of mutual on and off court intrateam support, and finally emotional management skills that transcend intercollegiate tennis and transfer to academic performance and/or professional performance after the termination of competitive tennis with this population. References Hanin, Y. (2000). Emotion in Sport. Champaign: Human Kinetics. Mayer, J.D., & Salovey, P. (1997). What is emotional intelligence? In P. Salovey & D. Sluyter (Eds.), Emotional development and emotional intelligence: Implications for educators (pp. 3-31). New York: Basic Books. Schoen, C.H. & Gallo, J. (2010, November). Emotion & Performance in College Tennis. Poster presented at the Petro-Canada Sport Leadership Conference, Ottawa, Ontario.

**ACUTE ACETAMINOPHEN INGESTION IMPROVES TIME TO EXHAUSTION DURING EXERCISE IN THE HEAT**

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Introduction: In thermoneutral conditions core temperature (T<sub>core</sub>) is usually maintained within a physiologically acceptable range of ±1 °C. However, when environmental temperatures exceed 30 °C, human mechanisms of heat loss are compromised and the subsequent rise in T<sub>core</sub> has been shown to negatively effect exercise capacity and performance. The analgesic and antipyretic acetaminophen is

effective in the reduction of Tcore in febrile patients. It has also been shown to reduce Tcore by up to 0.22 °C in afebrile stroke patients. Given this observation, the aim of this study was to assess the efficacy of acetaminophen in moderating the metabolically driven rise of Tcore during exercise in the heat. Methods: 10 physically active male adults (age: 21 ± 1 yrs, height: 184 ± 8 cm, weight: 72 ± 15 kg, VO2max: 44 ± 6 mL•min<sup>-1</sup>•kg<sup>-1</sup>) completed a graded exercise test, a familiarisation time to exhaustion and two time to exhaustion trials (TTE) in hot conditions (30 °C, 50%rh) at a fixed power output equivalent to 70% VO2max. In the TTE trials, subjects ingested either 20 mg/kg lean body mass of acetaminophen or a placebo control in a randomised, cross-over design. During TTE trials Tcore, skin temperature (Tskin), RPE, heart rate and thermal sensation were recorded. Results: Subjects cycled for significantly longer (t9 = -2.34, p < 0.05) following ingestion of acetaminophen (1164 ± 722 s) when compared with the placebo trial (964 ± 547 s). This was accompanied by a significant reduction in Tcore (~0.15 °C), Tskin (~0.5 °C) and TSS (~0.5) in the first 60% of the TTE (p < 0.05). No significant difference in RPE was observed between the conditions (p > 0.05). Discussion: The primary finding of this study was that acetaminophen reduced core and skin temperature during fixed intensity exercise in the heat, which may have contributed to an improved time to exhaustion. Acetaminophen is believed to act through penetrating the blood-brain barrier where it reduces levels of prostaglandin E2 through the inhibition of cyclooxygenase. Whilst this mechanism serves to reduce fever by reducing the elevated hypothalamus' thermoregulatory set-point, it is unclear how this may reduce an exercise-induced elevated core temperature.

### EFFICACY OF HEAT MITIGATION STRATEGIES USING MAGNITUDE-BASED INFERENCE

Tan, P.1, Lee, J.2,3,4

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**INTRODUCTION** The rapid rise of body core temperature (Tc) when exercising in the heat often results in an impairment of exercise capacity and performance (Galloway & Maughan, 1997; Parkin et al., 1999). Heat mitigation strategies used to counteract the debilitating effects of heat strain include behavioural alterations, aerobic fitness (AF), heat acclimation/acclimatization (HA), pre-event cooling (PC) and fluid ingestion (FI). This review objectively scored and ranked the effectiveness of each heat mitigation strategy using magnitude-based inferences (Hopkins et al., 2009). **METHODS** A computer-based literature search was performed using the electronic databases: PubMed, SPORTDiscus and Google Scholar. After applying a set of inclusion and exclusion criteria, a total of 75 studies were selected for evaluation. Each study was assessed according to the intervention's ability to lower Tc before exercise, attenuate the rise of Tc during exercise and extend Tc at the end of exercise. Hedges' g values were calculated based on the differences in mean Tc values, standard deviations and the number of subjects in each study at each of the three phases of Tc. Thereafter, weighted averages (Turner & Bernard, 2006) were calculated for each strategy. **RESULTS** For the lowering of Tc before exercise, HA (g=0.78) was found to be the most effective, followed by AF (g=0.69), PC (g=0.40) and FI (g=0.26). FI (g=0.63) was the most effective strategy in attenuating the rate of rise of Tc, then HA (g=0.26), PC (g=0.07) and AF (g=-0.38). To extend the limit of Tc at the end of exercise, AF (g=1.21) was found to be most influential, followed by PC (g=-0.08), HA (g=-0.11) and FI (g=-0.31). The heat mitigation strategies in order of effectiveness are: HA (g=0.47), AF (g=0.21), FI (g=0.16) and PC (g=0.15). **CONCLUSION** While behavioural alteration is perhaps the most important and effective heat mitigation strategy, HA was found to be the most effective in terms of a strategy's ability to favourably alter Tc, followed by AF, FI and lastly, PC. This knowledge will be useful for athletes, coaches, backroom staff and occupational labourers for determining the priority in which these strategies should be employed, especially when resources are limited. **REFERENCES** Galloway SD, Maughan RJ (1997). *Med Sci Sports Exerc*, 29 (9), 1240-1249. Hopkins WG, Marshall SW, Batterham AM, Hanin J (2009). *Med Sci Sports Exerc*, 41, 3-13. Parkin JM, Carey MF, Zhao S, Febbraio MA (1999). *J Appl Physiol*, 86 (3), 902-908. Turner HM, Bernard RM (2006). *Contemp Issues Commun Sci Disord*, 33, 42-55.

### ADOLESCENT PERFORMERS' PERSPECTIVES OF MENTAL TOUGHNESS AND ITS DEVELOPMENT.

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1: UQ (Brisbane, Australia), 2: UoB (Birmingham, United Kingdom), 3: CUT (Perth, Australia)

**Introduction** Over the past decade sport psychology researchers have attempted to clarify what is meant by the term mental toughness. Despite a burgeoning body of research, previous literature has only examined a homogeneous sample when attempting to define and conceptualise mental toughness. For example, researchers have typically limited their investigations to adult, male, elite, team sport athletes. Further, researchers have offered insight into how mental toughness is developed, but have yet to embed such findings in established theory on human development. In light of previous research, the aim of the current study was to compare adolescents' perspectives of mental toughness and its development across different performance contexts. Bronfenbrenner's (2001) bioecological model was also explored as a possible underlying theory useful for interpreting participants' perspectives pertaining to mental toughness development. **Method** Eighteen adolescents (9 girls, Mage = 15.6 years) from three performance contexts (i.e., sport, academia, and music) and identified by informed others as being mentally tough, participated in focus groups and 1-1 interviews. **Results** Ten personal resources – persistence, high self-expectations, optimistic thinking, forethought, social intelligence, support seeking, self-belief, drive, disciplined focus, and heightened-awareness – emerged from the discussions as comprising mental toughness. Importantly, whilst this group of resources is partially different to findings from past research, no meaningful differences were observed between performance contexts in the current study. Participants considered three higher-order factors as contributing to the development of mental toughness: supportive social agents, critical incidents, and curiosity. Supportive social agents were further categorized by encouragement, autonomy, challenge, and role modeling, whilst critical incidents were categorized by early successes, varied experiences, and failures and setbacks. Curiosity was not categorized further. Participants' perspectives resonated strongly with Bronfenbrenner's bioecological model, with minor omissions. **Discussion** We concluded that mental toughness is: a concept applicable across performance contexts; different between adolescent and adult performers; and underscored by the bioecological model. Future research could support our findings by conducting quantitative research exploring the relationship between the personal resources and developmental factors that emerged in our study. **References** Bronfenbrenner, U. (2001). *International encyclopedia of the social and behavioral sciences*, 6963-6970. Elsevier, New York.

### THE EFFECTS OF 6 WEEK ACSM INTERVENTION ON STANDARD CARDIOVASCULAR MEASUREMENTS IN SEDENTARY OLDER MEN.

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Institute for Clinical Exercise and Health Science, University of the West of Scotland, Hamilton, Scotland ML3 0JB 2University of Wales, Trinity Saint Davids, Camarthen Campus, Camarthen SA31 3EP 3 Institute of Sport and Physical Activity Research, University of Bedfordshire, Bedford MK41 9EA Introduction The American College of Sports Medicine (ACSM) recommends a weekly exercise dosage of 150 minutes for adults (Garber et al., 2011) in order to improve and ensure long term physiological wellbeing. However, there is a lack of supporting evidence for the efficacy of these recommendations in older adults. The present study set out to examine the effect of a 6 week intervention using the ACSM guidelines on cardiovascular measures in sedentary older males. Methods Participants consisting of untrained older males (UT, n= 22, 62.4±5.4 yrs) underwent 6 weeks of training in accordance with the ACSM's guidelines for the development and maintenance of cardiorespiratory fitness (≥30 min.d-1 on ≥5 d.wk-1 for a total of ≥150 min.wk-1). UT underwent telemetric measurement of heart rate (HR) maximal heart rate (HRmax) and heart rate reserve (HRR) and auscultatory measurement of systolic and diastolic blood pressure (SBP, DBP) and resultant mean arterial pressure (MAP) and rate pressure product (RPP). Measures were taken at baseline (Pre) and following 6 weeks of training (Post). At both time points UT were compared with a group of master athletes (MA, n=17, 60.4±5.2 yrs) who acted as a positive control. Data were analysed using SPSS v 20 software using a mixed design ANOVA. Simple effects were investigated using a paired samples t-test. The alpha level was set at 0.05. Results UT had a significant fall in resting SBP and DBP (p<0.05) with subsequent reductions in RPP and MAP (p<0.05). HRmax and HRR significantly increased from Pre to Post (p<0.05). At Pre UT had significantly higher SBP, DBP, MAP, and RPP with lower HRR (p<0.05). Following 6 weeks training none of these variables were significantly different from MA. Discussion These data suggest that the ACSM guidelines are effective as a short term exercise intervention in improving cardiovascular function in older sedentary populations. The magnitude of change was such that cardiovascular measures following the 6 week intervention in the previously long term sedentary older participants were not distinguishable from age matched masters athletes. This suggests that the ACSM guidelines are an effective method of improving the cardiovascular health of an ageing sedentary population. References Garber, C. E., Blissimer, B., Deschenes, M. et al. 2011. Med Sci Sports Exerc, 43, 1334-59.

### THE EFFECTS OF A 6 WEEK ACSM INTERVENTION ON AEROBIC FITNESS IN SEDENTARY OLDER MEN.

Herbert, P.2, Ratcliffe, J.I, Sculthorpe, N.I, Baker, J.I, Richards, J.3, Grace, F.I

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Institute for Clinical Exercise and Health Science, University of the West of Scotland, Hamilton, Scotland ML3 0JB 2University of Wales, Trinity Saint Davids, Camarthen Campus, Camarthen SA31 3EP 3 Institute of Sport and Physical Activity Research, University of Bedfordshire, Bedford MK41 9EA Introduction A low aerobic capacity can heavily impact an individual's quality of life, and is widely regarded as a risk factor for cardiovascular disease. The American College of Sports Medicine (ACSM) recommends a weekly exercise dosage of 150 minutes for adults (Garber et al., 2011) in order to improve and ensure long term physiological wellbeing. However, there is a lack of supporting evidence for the efficacy of these recommendations in older adults. The present study set out to examine the effect of a 6 week intervention using the ACSM guidelines on aerobic fitness in sedentary older males. Methods Participants consisting of untrained older males (UT, n= 22, 62.4±5.4 yrs) underwent 6 weeks of training in accordance with the ACSM's guidelines for the development and maintenance of cardiorespiratory fitness (≥30 min.d-1 on ≥5 d.wk-1 for a total of ≥150 min.wk-1). At baseline (Pre) and following 6 weeks of training (Post), participants performed an incremental exercise test to exhaustion (VO2max) on a cycle ergometer (Wattbike UK). Breath-by-breath analysis (Metamax II, Cortex, Leipzig, Germany) enabled measurement of gas exchange variables, including VO2max, absolute VEmax, VT as a % of VO2max. At both time points UT were compared with a group of master athletes (MA, n=17, 60.4±5.2 yrs) who acted as a positive control. Data were analysed using SPSS v 20 software using a mixed design ANOVA. Simple effects were investigated using a paired samples t-test. The alpha level was set at 0.05. Results UT experienced significant increases in VO2max (p<0.01), absolute VEmax (p<0.05), and VT expressed as a % of VO2max (p<0.05). At Pre, UT had significantly lower VO2max, absolute VEmax, maxO2 pulse, and power at VO2max (p<0.01). Although significant increases in VO2max, absolute VEmax, and VT expressed as a % of VO2max occurred after 6 weeks of training in UT, MA still maintained significantly superior values for these variables at all measurement points. Discussion These data suggest that the ACSM guidelines are effective as a short term exercise intervention in improving aerobic fitness in older sedentary populations. The benefits of participating in a continuous exercise training programme, following standard guidelines, may present a powerful method of health promotion and treating age associated functional decline. References Garber, C. E., Blissimer, B., Deschenes, M. et al. 2011. Med Sci Sports Exerc, 43, 1334-59.

### DIFFERENCES IN ACTN3 GENOTYPE IN SPANISH FEMALE SWIMMERS

Díaz-Ureña, G., Muniesa, C.A., De la Calle, L.

*European University of Madrid*

Introduction Performance depends on different factors, among them, the genetic factor. The ACTN3 R577X gene is associated with power and velocity performance in elite athletes. Therefore, the purpose of this study was to analyse the differences in ACTN3 R577X genotype between sprint female swimmers compared to middle-distance and non-athletes females. Methods The sample of this study is composed of 39 female elite swimmers (20 sprinters) and 166 non-athletes females. All swimmers participated at least in one Absolute Spanish Championship in swimming pool. Genomic DNA was isolated from buccal epithelium or peripheral blood, and genotyping was performed in the Genetics Laboratory of Universidad Europea de Madrid, Spain. We compared genotypic frequencies among sprint (50m and 100m), middle-distance (>200m) and non-athletes females using a Pearson Chi-Square test. When the assumptions were not met, it was calculated p value with Monte Carlo approximation. Results The genotype frequencies of the ACTN3 R577X polymorphism in the different study groups were: Non-athletes (RR:31,9%; RX:48,2%; XX:19,9%); Sprint swimmers (RR:40,0%; RX:45,0%; XX:15,0%); and Middle-distance swimmers (RR:26,3%; RX:47,4%; XX:26,3%) There were no significant differences in genotype frequencies among all groups ( $\chi^2(4) = 1,26; p > 0,05; IC95\% \text{ for } p: 0,874-0,887$ ). Discussion The results showed no association of the RR genotype with the typology of swimming competition. Chiu et al. (2011) studied the ACTN3 genotype frequency in elite Taiwanese sprint swimmers and observed that the frequency of the ACTN3 R-allele was significantly higher in elite sprint female swimmers (< 400 m) compared to the general population. References Chiu LL, Wu YF, Tang MT, Yu HC, Hsieh LL, Hsieh SS. (2011) ACTN3 genotype and swimming performance in Taiwan. Int J Sports Med: 32: 476-480.

15:00 - 16:00

## Mini-Orals

## PP-SH19 Sociology [SO] 3

**THE CATALAN SPORTS OBSERVATORY. THE DATA OF SPORT IN THE SPOTLIGHT**

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Introduction The Catalan Sports Observatory (<http://www.observatoridelesport.cat>) is an initiative of the Secretariat General of Sports of the Generalitat of Catalonia. INEFC and other institutions involved in sport are in charge of its development. It is aimed at individuals and organizations involved in the field of sport to provide them information about the evolution of sport in Catalonia. The Observatory is part of the definition of sport that the European Sports Charter offered in May 1992, and provides data of both sport performance and the extra-curricular sport activities, sports activities with the elderly, adapted physical activities, etc... Methodology The information is provided by six broad dimensions that incorporates the overall sports phenomenon: Sport participation, Organisations and facilities, The economy of sport, Training, research and professions, International renown and Legal and Political framework. Information can be acquired in two different ways according to the dimension approached: - Information from existing sources (surveys, yearbooks, reports ...) that others have collected in our region and that we adapt to our formats using a secondary method. - Information generated by the Observatory on topics for which there was no information, along with other organizations that establish the methodology that will be implemented in the study to be carried out. The main method that has been used in these researches is the standardized surveys, which was conducted face to face with those individuals involved. Results The Observatory discovered 206 indicators and it currently has 234 with an expected increase to 250 by emptying several studies with other agents. It has presented 22 communications in national and international conferences, exhibiting 12 research studies and has participated in 26 events related to sport. In recent years the Centre has received 67 inquiries from various publics, private and individuals to whom they have provided with some information. The website has received almost 90.000 visits since its inception and has begun to develop trends, such as the dimension of sports participation, which discusses the evolution of the number of sport licenses in Catalonia and Spain. The number of licenses has increased a 12% in recent years, from 545.946 athletes in 2006 to 611.991 in 2011. It also explains the evolution of the number of elite athletes who have dropped a 16% between 2007 and 2011, decreasing from 553 to 461 athletes. Discussion Through these methods, the Observatory aims to disseminate these trends of the evolution of the sports phenomenon that show what the behavior of the different aspects analyzed in recent years was, and predict what direction sport will take in the future in its various aspects.

**MODERNITY AND THE REGULATION OF BODIES: ELIAS MEETS FOUCAULT**

Martins, C.

*UNESP*

This paper seeks to reflect on the possibility of a meeting ground where Michel Foucault and Norbert Elias' thought comes together around the issue of the regulation of drives and bodily practices within modernity. Such drives – among which we highlight the use of force and violence, as well as the acceptable regulation of their release and applications – have been the object of particular procedures within the modern era, whether seen in relation to individuals or from to the social body. Several chapters in the history of the body in modernity may be considered emblematic and relevant to the search for satisfactory and socially acceptable compromises to the problem of the governing and self control of the different drives, forces and conflicts originating in the bodies of individuals constituted through social practices. These drives – among which we could give particularly salience to the use of force and violence, as well as to the acceptable regulation of the way the latter are released and applied – have been the object of particular procedures in the modern era, whether seen from the perspective of individuals or approached from the angle of the social body. Approaches that are particularly worthy of merit may be found in the Michel Foucault's history of the emergence of disciplinary and bio-political practices and Norbert Elias' work on the socio-genesis of modern sport, both exemplary as distinctive theoretical contributions. The processes these thinkers describe and identify are, in origin, development and ramifications, phenomena that can be periodized in terms of the "long duration". In this article, we intend to look at possible points of convergence in the contributions that these two authors make to our thought on the regulation of bodily practices and impulses within modernity. For such purposes, we will construct an overview of problems of the political management of bodies and populations within modernity, from the perspective of the "civilizing process". Both of these authors, each with the singularity of his own thought, made enormous contributions to the critical diagnosis of the role of different forms of regulation and self-governance of the functions and practices of bodies within modernity. Our purpose here has been to establish the possible convergences between them, while attempting to articulate them within a broad and complex panorama of the issues at stake.

**EXCHANGE PROGRAMS/INTERNATIONAL LEISURE COOPERATION IN THE AREA OF THE NATIONAL RESEARCH GROUPS CONTEXT**

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EXCHANGE PROGRAMS/INTERNATIONAL LEISURE COOPERATION IN THE AREA OF THE NATIONAL RESEARCH GROUPS CONTEXT Introduction The higher education internationalization process, which includes academic mobility programs and other international cooperation actions, often workable by research groups (GP), is not a novelty. However, the theorization in many specific subject areas, such as leisure, is still not largely explored in this scenario (Lo Bianco, 2009). Therefore, the intent of this study is to deliberate on exchange programs/international cooperation in the line of leisure developed by Brazilian RGs. Methods We conducted a descriptive exploratory research with quantitative and qualitative approach in two phases: initially, we performed a mapping of GP in the leisure area in Brazil, registered in the database 'Directory of Research Groups' of the National Council of Scientific and Technological Development (CNPq). We found 211 RGs related to leisure. In the second phase, the representatives of these groups were invited, via email, to answer a questionnaire. Fifty-four researchers took part of the study, signing a consent form. Data were analyzed using descriptive statistics and content

analysis technique. Results Nine RGs who develop international programs in the line of leisure were found. These groups are centered in public higher education institutions and are distributed in the Southeast, Northeast and Southern regions of Brazil. International programs are associated with shares in New Zealand, Israel, Canada, Colombia, Spain, Portugal, Germany and France. Three groups develop only specific actions such as visits of professors and renders international collaboration for the development of scientific materials. The other groups coordinate consolidated exchanges programs and various actions of international cooperation by means of agreements with institutions abroad and financing of development agencies like CNPq, ERASMUS Program, Fundación Carolina and the Sports Ministry. Discussion This study revealed the existence of updated proposals that are challenging and promising which may Grant contribution to multiculturalism and for professional training in the area. Although some groups have reported only the development of certain actions of international cooperation, Duca et al. (2011) stresses that such initiatives can enable new alliances between researchers and thus facilitate the process of internationalization of a particular area. References Lo Bianco AC (2009). *Revista latino-americana de psicopatología fundamental*, 12(3), 445-453. Duca GFD, Garcia LMT, Silva KS, Nascimento JV (2011). *Revista Brasileira de Educação Física e Esporte*, 25(4), 607-617.

### THE ROLE OF SPORTS COMMUNITY FOR QUALITY OF LIFE IN STRICKEN AREA FROM DISASTER

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Introduction Most of the north part of Japan was severely hit by the Great East Japan Earthquake two years ago. Now, residents in stricken areas are recovering from the disaster. Under such situation, to maintain physical and mental health is important in order to achieve recovery early. In recent years, it was found the social capital may be a useful factor in the maintenance of physical and mental health. Social capital is composed by cognitive component and structural component, in further structural component is distinguished to some communities such as neighborhood association and other communities (sports, recreation, hobby, culture community). Given exercise have effects on the prevention of life style related disease and mental illness, the sports community might be more effective component than neighborhood association and hobby and culture community. Therefore, the purpose of this study was to compare effect of sports community for quality of life (QOL) with it of other communities in Sendai city that is the stricken area. Methods Questionnaires were distributed to 2000 people who aged 20 and older in Sendai city by mailing method. We received 477 valid questionnaires. QOL was measured by the WHO-QOL 26 and summed to calculate a score ranging from 0 to 100. Cognitive social capital was measured by trust (low/high). Structural social capital was measured by membership in 1) neighborhood association (Yes/No), 2) sports community (Yes/No), and 3) hobby or culture community (Yes/No). Effects of three types of structural social capital were compared by ANCOVA with individual confounders (gender, age, income, education attainment, smoking habit, drinking alcohol habit, physical activity, and cognitive social capital). Results ANCOVA results revealed high levels of neighborhood association (regression coefficient = 2.98, SEE = 1.33,  $p = 0.025$ ) and sports community (regression coefficient = 6.25, SEE = 1.51,  $p < 0.001$ ) significantly were associated with better QOL. Association between culture community and QOL was not significant (regression coefficient = 0.63, SEE = 1.87,  $p = 0.738$ ). Discussions We found that the positive effect of sports community on QOL was also higher than effects of neighborhood association and hobby or culture community, after adjusting for confounders including physical activity. Sports community may particularly contribute to enhance mental health as well as physical health in the stricken area.

### A COMPARISON OF PUBLIC-PRIVATE PARTNERSHIPS IN CONSTRUCTING PROFESSIONAL SPORTS FACILITIES BETWEEN THE UNITED STATES AND TAIWAN

Lee, K.W., Lee, P.C., Yang, C.W., Fang, C.C., Yu, C.H.

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Introduction Sports complexes is widely perceived as giving cities a competitive advantage in attracting new businesses, residents, and tourists. Moreover, cities seek to associate themselves with professional sports teams and facilities, and often pay a premium to do so (Long, 2012). Therefore, this research based on research questions that concern the partnership models that U.S. and Taiwan governments used to promote private sectors in building sports complexes. Methods The document analysis was used to collect research data from three professional sports facilities in the U.S. and two facilities in Taiwan. Public construction, land and infrastructure cost data is largely drawn from primary sources, including local and state governments. Results In Taiwan, the public-private partnership of constructing professional sports facilities was Build-Operate-Transfer model (BOT). In the partnership, all the constructing costs belonged to private sector's responsibilities. The government then commissioned the operation of the facility project to the same private institution. Upon expiration of the operation period, the facility ownership and the right to operate reverted back to the government. In the U.S., the constructing projects benefited from numerous government incentives and other forms of economic assistance. The most substantive of these financing tools were tax credits, bonds, and tax-increment financing, along with other loans. Discussion The research question was concerned with the similarities that existed in the partnerships between the U.S. and Taiwan. The findings revealed that the facility projects were undertaken jointly by public and private entities, where there is significant and direct financial participation by both partners and where responsibilities are formalized in a legal contract. These are fundamental tenets of public-private partnership (Crompton, 2004; Murray, 2009). Moreover, those projects were publicly administered but within a framework that allowed for private finance, design, operation, and possibly temporary ownership of a building or real property. The findings also verified previous research that participants in sports facility deals can be categorized as public partners that include municipal, county, state, and other public institutions, and private partners that include team and other private entities. Among public partners, municipal governments are the most active public participants in sports facility financing (Long, 2012). References Crompton, J. (2004). Beyond Economic Impact: An Alternative Rationale for the Public Subsidy of Major League Sports Facilities. *Journal of Sport Management*, 18(1), 40-58. Long, J. (2012). Public/private partnerships for major league sports facilities. Routledge. Murray, D. (2009). Reflections on Public Funding for Professional Sports Facilities. *Journal of The Philosophy of Sport*, 36(1), 22-39.

### AN AUTOETHNOGRAPHIC EXPLORATION OF CANCER AND ALCOHOLISM WITHIN A FATHER/SON RELATIONSHIP

McInch, A.

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Several autoethnographic studies have explored the parent/child relational identity that has been affected by homophobia (Adams, 2006), Alzheimer's Disease (Fox, 2010) and absent parents (Jago, 2006). The aim of this study was to explore a father/son relational

identity that has been long affected by alcoholism and more recently cancer. In adopting an embodied autoethnographic methodology, three body narratives are presented that explore the highly contextual tensions and dilemmas that both illnesses have inflicted on the relationship. The findings suggested that the metaphorical discourse used in the text is a result of a sporting, relational identity shared by father and son. The findings also positively confirmed an ethical ideology that likened the author to Frank's (1991) Communicative Body, one that shares experience[s] as result of one's own adverse circumstances. On a journey of understanding the self, the author also came to realise that a reflexive way of knowing was also for self preservation as well as others and that all identity can be considered as relational. Directions for future research are provided.

### **BIGGER MUSCLES AND MORE SEX: AN ALTERNATIVE INTERPRETATION OF YOUNG MEN'S USE OF ANABOLIC STEROIDS**

Christiansen, A.V.

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Over the last decade the use of anabolic androgenic steroids (AAS) in gyms and fitness centers has received increasing attention from policy makers, stakeholders and the media. However, the use has not declined. Prevalence measurements from Scandinavia, Europe, USA and Australia indicate that between 1-4 per cent of the male population have experiences with AAS and similar drugs (e.g. Barland & Tangen 2009; Hoare & Moon 2010; Johnston et al. 2010). Scholars have generally explained the use of AAS as a consequence of a cultural preoccupation with body and appearance. In recent years a theory on 'a masculinity in crisis' has been added to this (Klein 1993; Pope et al. 2000). But the rather uniform prevalence data challenges the explanatory power of the 'culture and crisis hypotheses'. Building on long qualitative interviews with AAS using young Danish men this paper evaluates the 'culture hypothesis' in relation to theories on evolutionary psychology (e.g. Kenrick et al. 2004; Konner 2003). The ambition is to provide the basis for a more solid understanding of the use of AAS in and around gyms, and by that potentially contribute to improved education and policy on the area. References Barland, B. & Tangen, J. O. 2009. Kroppspresentasjon og andre prestasjoner - en omfangsundersøkelse om bruk av Doping, Politihøgskolen, Oslo, 2009:3. Hoare, J. & Moon, D. 2010. Drug Misuse Declared: Findings from the 2009/10 British Crime Survey, England and Wales, Home Office Statistical Bulletin, London, 13/10. Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. 2010. Monitoring the Future: National Survey Results on Drug Use, 1975-2009. Volume II, College Students and Adults Ages 19-50., National Institute on Drug Abuse, U.S. Department of Health and Human Services, NIH Publication No. 09-7402. Kenrick, D. T., Trost, M. R., & Sundie, J. M. 2004. 'Sex Roles as Adaptations. An evolutionary perspective on gender differences and similarities,' In *The psychology of gender*, 2. ed. ed. A. H. Eagly, A. E. Beall, & R. J. Sternberg, eds., New York: Guilford Press, pp. 65-91. Klein, A.M. 1993. *Little big men: bodybuilding subculture and gender construction*, Albany, State University of New York Press. Konner, M. 2003. *The tangled wing: Biological constraints on the human spirit*, Holt Paperbacks. Pope, H.G., Phillips, K.A., & Olivardia, R. 2000. *The Adonis complex. How to identify, Treat, and Prevent Body Obsession in Men and Boys*, New York, Free Press.

### **COMPARISON OF SPORT HABITS BETWEEN HUNGARIAN AND US SOLDIERS SERVING IN AFGHANISTAN**

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Introduction: Ordinary people do not know much about everyday lives of soldiers serving in foreign countries. This is one of the reasons why they cannot imagine how burdensome it could be, especially for a longer period of time, without having a holiday, or how those soldiers spend their leisure time between duties. Aims: A comparison study about the sport habits of soldiers serving at an operational area in Afghanistan. Methods: A multiple-choice type, anonymous survey was used. The questionnaires were filled in by the soldiers of the Hungarian Defence Forces (n = 48) and the United States Ohio National Guard (n = 46). Results: Before the mission majority of US soldiers did team sports and played different ball games. Besides these, Hungarian soldiers did several individual sports previously. In the mission body building became the most popular type of movement among the soldiers of both nations. There were no professional athletes among US soldiers before the mission. Most of them did sports as hobbyists. Half of the Hungarian soldiers were amateur athletes earlier and there were a few professional sportsmen. After the mission, almost all soldiers of both nations became hobbyists, only a few Hungarian amateur athletes remained. Before the mission or in the operational area Hungarian soldiers spent more time on doing physical exercises in their leisure time. Conclusions: Soldiers serving in foreign countries have national particularities regarding their sport habits during deployment. Soldiers serving in mission spend a significant proportion of their leisure time improving their physical condition. Limited sport facilities simplify the sport habits of the soldiers. In this aspect, soldiers of the two nations become uniform. Results of this survey seem to be useful in the process of pre-deployment preparation of soldiers. These results would help the top-level missions of the soldiers at the operational area.

### **THE DOUBLE ARTICULATION OF THE RELATIVE AGE EFFECT ON SWEDISH FOOTBALL PLAYERS**

Petersson, T.

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Introduction In a study including all children born 1984 within the Swedish Football Association, the Relative Age Effects (Cobley et al 2009) are documented on all levels of the selection systems (Peterson 2011). Even the selection of players who had been rejected by the selection system, but still became elite players, was heavily influenced by relative age effects. Methods Three empirical materials are used in the study. The first one is a longitudinal study, where 1117 individuals were selected from 46 teams in 31 football clubs in a strategic sample based on sex, the clubs position in the Division System and their geographical and demographical location. Both quantitative and qualitative methods were used. Two methods are used to measure the Relative Age Effect on the selection of individuals on different levels of the selection systems - Index and Odds Ratios. The second material is the official statistics of the Swedish Football Association, mostly regarding the cohort of 1984, during 1999-2009. The third empirical material contains data about all 61 men and women born 1984, who 2009 belonged to the Swedish football elite, playing in Sweden or abroad. This information was obtained mainly through club home pages after the season of 2009. Results In 2009, at the age of 25, there were 61 players (46 men and 15 women), born 1984, playing abroad, in the first division for men and for women, or in the second division for men, in Sweden. 27 out of 61 players did not belong to the group of players picked by the selection system. The system did not manage to find more than half of the males (23-23) who would play professional football at the age of 25. For the women the system found 11 out of 15. Discussion The 1984 cohort's contribution to the Swedish football elite was 61 individuals. If all potential talent in a cohort in the moment of birth was to be transformed into

"confirmed Elite" in adult age, the distribution of days of birth for the "confirmed Elite" should correspond to that of the entire cohort. The results presented in this article indicate that the selection system of Swedish children- and youth football for the cohort of 1984 was heavily influenced by relative age effect. In 42.6% of the cases the positions were filled with individuals that should not have been there, as a result of Relative Age Effects. Out of the individuals identified as future elite players by the selection system, half of the men and one fourth of the woman were not to belong to the "confirmed elite". They were replaced in the elite football by individuals who had been rejected by the selection system, because of relative age effects, and left to creating a carrier for themselves outside the system. These empirical findings suggests that the Swedish football elite is not created by the selection system, it is rather created in spite of it. References Cobley S, Baker J, Wattie N, McKenna J. (2009). *Sports Med*, 39 (3): 235-256 Peterson, T (2011) *SISU Idrottsböcker*.

#### **THE RELATIONSHIP BETWEEN SCHOOL SPORTS AND IDENTITY FORMATION: SOCIALIZATION OR SELECTION?**

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It seems common knowledge that school sport participation leads to all kinds of social and educational effects (Coakley, 2009), such as school bonding and long-term sport participation. However, it may also be the case that students with a certain predisposition, sometimes referred to as sporting capital (Wheeler, 2011), are more inclined to participate in school sports. The present study used a longitudinal design to investigate whether participation in an elementary school sport competition actually brings about changes in children (socialization hypothesis), or whether children with a certain predisposition are more inclined to participate in the competition (selection hypothesis) (Brandl-Bredenbeck & Brettschneider, 1997). In a survey of 304 students, student identity was used as an indication of school bonding and sport identity was used as an indication of sporting capital and long-term sport participation. The results of the study showed that boys and girls with a strong sport identity are more inclined to participate in the school sport competition, but that participation in the competition did not alter their sport identity. No relationship existed between participation and student identity. In contrast to commonplace assumptions about the socializing effects of school sport participation, the present study suggests that a selected, predisposed group of children tends to participate in school sports. This indicates that effects related to school sport participation may already have been present before participation started. The absence of socializing effects of a school sport competition can be explained by findings of other studies (e.g., Birchwood et al., 2008; Wheeler, 2011) that suggested that (sporting) capital is mainly transmitted through the family. References Birchwood, D., Roberts, K., & Pollock, G. (2008). *European Physical Education Review*, 14(3), 283-298. Brandl-Bredenbeck, H. P., & Brettschneider, W.-D. (1997). *International review for the sociology of sport*, 32(4), 357-371. Brewer, B. W., Vanraalte, J. L., & Linder, D. E. (1993). *International Journal of Sport Psychology*, 24(2), 237-254. Coakley, J. J. (2009). *Sport in society: issues and controversies* (10 ed.). St. Louis: Mosby. Wheeler, S. (2011). *International review for the sociology of sport*, 47(2), 235-252.



# e-poster not debated

## Adapted Physical Activity

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### THE INFLUENCE OF HYDROTHERAPY IN INDIVIDUALS WITH DUCHENNE MUSCULAR DYSTROPHY.

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Objective: To determine whether hydrotherapy is beneficial in terms of functional mobility in individuals with Duchenne muscular dystrophy evaluated by EK Functional Motor Scale, and its influence on BMI and percentage of fat mass. Methods: The sample contained seven individuals, males, six of which did not practice hydrotherapy and other individual obtained hydrotherapy classes once or twice a week for 45 minutes. Was applied the EK scale was applied and non-parametric tests of Wilcoxon and Mann-Whitney. Results: The variables analyzed were hydrotherapy, values of functional motor scale EK, BMI and percentage of body fat by testing the influence of these on the first. The results showed that as the BMI value increases, so is the percentage of fat mass higher, and thus brings major motor limitations to individuals, which means higher values on the EK scale. Conclusions: There were no statistically significant differences and there was a decreasing tendency of EK values in the individual with classes, compared to those who didn't practice, with these being higher. The values of correlation between the BMI and EK variables are considered 'Fairly Good', though there were no statistically significant differences. When comparing the variables% MG and EK, there are values considered 'very good', since the increase of one raises the other with a statistical significant value of 0.006.

### THE RELATION BETWEEN PHYSICAL ACTIVITY HABITS, THE HEALTH-PROMOTING LIFESTYLES AND ACADEMIC ACHIEVEMENTS OF PHYSICAL EDUCATION AND SPORTS STUDENTS

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Introduction Existing information shows that activities of physical education, health-promoting lifestyle behaviors and physical activities contribute to academic achievement. However, it is not very clear what the relationship is between the physical activities, health-promoting lifestyle behaviors and academic achievements of the students of the Physical Education and Sports(PES). Purpose The purpose of this research is to determine the relationship between health-promoting lifestyle behaviors, physical activities and academic achievements of the students studying at the School of PES and to explain the influencing factors. Methods The research was conducted with the participation of 91 students aged 18-25 studying during the 2011-2012 academic year at the Ankara University School of PES. The physical activity habits and health-promoting lifestyle behaviors of the students were measured with the International Physical Activity Questionnaire (IPAQ), (long form), along with the Healthy Lifestyle Behaviors Questionnaire (HLBQ), while their academic achievements (AA) were determined through obtaining the student's grade scores averages from the Student Information System (SIS). AA was analyzed from the aspects of departments (Teaching Education, Sports Management, Coaching Education), activity level (active and very active), places of living (with family, dorms, lodging houses and houses), working condition (working or not working in any kind of job), sportsmen with and without licenses. Results Fifty one (56%) of the students participating in the study were evaluated as active, while 39 (42.9%) were assessed as very active. From the aspect of physical activity values, significant differences were found between students living with their families and those living in dorms and also between students living in lodging houses and those living in dorms. It was determined that students living in lodging houses had higher values of physical activities, while the students living in dorms had lower values ( $P < 0.05$ ). A significant negative relationship ( $r = -0.23$ ) was found between exercise, which is a subscale of HLBQ and grade scores average. Significant differences were seen between the total HLBQ scores and students of the departments of Physical Education and Sports, and Sports Management ( $P < 0.05$ ). It was observed that students of the department of Physical Education and Sports Teaching had gained high points. Significant differences were also found in self-actualization, nutrition, interpersonal relations, stress management, health responsibility and exercise points between departments ( $P < 0.05$ ). Conclusion Results show statistically there was no relationship between physical activity habits, the health-promoting lifestyles and academic achievements in physical education and sports students.

### RELATIONSHIP BETWEEN THE FUNCTIONAL CLASSIFICATION AND PERFORMANCE IN WHEELCHAIR BASKETBALL MALE PLAYERS

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Institutions 1Department of Physical Activity and Sport, Faculty of Physical Activity and Sports Science, University of the Basque Country, UPV/EHU 2Gipuzkoa Adapted Sport Federation Acknowledgements We would like to thank Salto Bera-Bera for participating in this study and also the Department of Physical Activity and Sport (UPV/EHU) for the financial support Introduction The aim of this study was to analyze the performance of wheelchair basketball (WB) players with regard to their anthropometric parameters, functional classification and training history. Methods 14 WB male players (age  $33.07 \pm 7.75$  years, body mass  $75.8 \pm 20.82$  kg and sitting height  $86.8 \pm 6.67$  cm) belonging to a team of the Spanish national WB third division league participated in this study. Players were classified according to the Classification Committee of the International Wheelchair Basketball Federation (IWBF): class 1 (n=1), class 1.5 (n=2), class 2 (n=3), class 2.5 (n=1), class 3 (n=2), class 3.5 (n=2), class 4 (n=1) and class 4.5 (n=1). Their training history was recorded ( $5.71 \pm 4.17$  years). The following measurements were performed: Anthropometry (body mass, measured in kg; sitting height, in cm; sum of skinfolds, in mm: subscapular + tricipital + abdominal + suprailiac) and performance tests: sprint, measured in s (5 m and 20 m without the ball, and 5 m and 20 m with ball, 20 m with ball); agility, in s (T-test and Pick-up test), strength (handgrip in kg, maximal pass) and medicinal ball throw, both in m) and endurance (Yo-Yo intermittent recovery test adapted to 10m). Pearson's or Spearman's correlations were performed between the measured parameters, IWBF class and training experience. Results Positive significant relationships were observed between the IWBF class and sitting height ( $r=0.768$ ,  $p=0.004$ ), body mass ( $r=0.683$ ,  $p=0.014$ ), handgrip ( $r=0.566$ ,  $p=0.05$ ), maximal pass ( $r=0.625$ ,  $p=0.04$ ) and medicinal ball throw ( $r=0.685$ ,  $p=0.02$ ). Training experience was significantly correlated with the sprint test 20 m with ball ( $r= -0.617$ ,  $p=0.043$ ) and the agility T-test ( $r= -0.645$ ,  $p=0.032$ ). Body fat was not correlated to performance. Conclusions In this group of WB players

the IWBF class was related to the strength tests. Thus, players with lower levels of disability performed better than more disabled players. Not only disability, but also body size may have influenced the results in the strength tests. However, in the more skillful tests, such as the sprint with ball and the agility, most experienced athletes in wheelchair training had better performance, independently of the disability. On the other hand, unlike other sports body fat did not (negatively) correlate with performance, maybe due to the fact that disability and skill are more important in this particular sport. References 1 De Groot S, Balvers IJ, Kouwenhoven SM, Janssen TW. Validity and reliability of tests determining performance-related components of wheelchair basketball. *J Sports Sci.* 2012; 30(9):879-87.

### CHANGE OF DIRECTION ABILITY IN WHEELCHAIR BASKETBALL PLAYERS

Yanci, J.I, Granados, C.I, Badiola, A.I, Otero, M.I, Olasagasti, J.2, Bidaurrazaga-Letona, I.I, Iturricastillo, A.I, Gil, S.M.I

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**Introduction** The aims of the present study were to determine the reliability and reproducibility of the agility T-Test and to determine the change of direction ability (CODA) measured by the agility T-Test in wheelchair basketball (WB) players. **Methods** 16 WB players (33.12 ± 7.36 years, 71.89 ± 21.71 Kg and sitting body height 86.07 ± 6.82 cm) belonging to the Spanish national WB third division league participated in this study. The agility T-test previously used in able-bodied (AB) players (Pauole et al., 2000) was performed on alternate days. A photocell (Migrogate Polifemo Radio Light, Bolzano, Italy) was used to record the time. The coefficient of variation (CV = SD/Mean\*100) (Atkinson et al., 1998) and the intraclass correlation coefficient (ICC, test-retest) was used to assess the T-Test reliability and reproducibility. **Results** Good reproducibility values (ICC = 0.74) were showed in T-test. The mean result of this test was 16.96 ± 1.14 s. The results according to the International Wheelchair Basketball Federation (IWBF) class in agility T-test were 17.01 ± 0.34, 16.37 ± 0.88, 15.13, 15.74 ± 0.16, 18.82 ± 0.08, 17.33, and 17.30 ± 0.02 s for the 1-4.5 IWBF class, respectively. **Discussion** In this study, T-Test with WB players showed good reproducibility values. This reproducibility could be considered good because it has yielded a value greater than 0.70 (Coppieters et al., 2002). In our study, the CV was 2.58% in the T-test showing an optimal assessment of reproducibility. Similar findings have been observed in other T-design tests (Sassi et al., 2009) in AB players. These results indicate that the T-Test can be used in the evaluation of the training programs in WB players. **Acknowledgments** The authors would like to thank Bera-Bera wheelchair basketball players and coaches for the opportunity to carry out this investigation. **References** 1. Atkinson G, Nevill AM. Statistical methods for assessing measurement error (reliability) in variables relevant to sports medicine. *Sports Med.* 1998;26(4):217-38. 2. Coppieters M, et al. Reliability of detecting 'onset of pain' and 'submaximal pain' during neural provocation testing of the upper quadrant. *Physiother Res Int.* 2002;7(3):146-156. 3. Pauole K, et al. Reliability and validity of T-test as a measure of agility, leg power, and leg speed in college-age men and women. *J Strength Cond Res.* 2000;14:443-450. 4. Sassi RH, et al. Relative and absolute reliability of a Modified Agility T-Test and its relationship with vertical jump and straight sprint. *J Strength Cond Res.* 2009;23(6):1644-1651.

### SPRINT PERFORMANCE IN WHEELCHAIR BASKETBALL PLAYERS

Yanci, J.I, Granados, C.I, Badiola, A.I, Otero, M.I, Olasagasti, J.2, Bidaurrazaga-Letona, I.I, Iturricastillo, A.I, Gil, S.M.I

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**Introduction** The aim of the present study was to determine the generic sprint performance measured by 5 m and 20 m tests and the specific sprint capacity measured in the same distances with ball, in wheelchair basketball (WB) players. **Methods** 16 male and female WB players (33.12 ± 7.36 years, 71.89 ± 21.71 Kg and sitting body height 86.07 ± 6.82 cm) participated in this study. The subjects undertook a sprint running test consisting of three maximal sprints of 20 m (Vanlandewijck et al., 1999). Time was recorded using photocell gates (Microgate, Polifemo Radio Light, Bolzano, Italy). The timer was activated automatically as the volunteers passed the first gate at the 0.0 m mark and split times were then recorded at 5 m and 20 m. The maximal sprint test with ball was performed using the same protocol and material, adhering to the International Wheelchair Basketball Federation (IWBF) rules for dribbling (De Groot et al., 2012). **Results** The mean results of the 5 m and 20 m sprint test in WB players were 1.87 ± 0.21 s and 5.70 ± 0.43 s, respectively. For the 5 m and 20 m with ball, the mean results were 2.10 ± 0.30 s and 6.59 ± 0.61 s, respectively. **Discussion** In this study, the mean velocity in 5 m was better than the results obtained by De Groot et al., (2012), in Premier league, Tournament A and Tournament B wheelchair players (2.4 s, 2.5 s, 2.6 s, respectively). Comparing to the values obtained in 20 m sprint, our results were also better (3.8%) than reported by Vanlandewijck et al. (1999) in national and worse (5.3%) than in international WB players reported by Chapman et al. (2010). Concerning to the sprint 20 m with ball, the values reported in our study (6.59 s) were better than those obtained by De Groot et al., (2012) in Premier League players (7.00 s), Tournament A (7.40 s) and Tournament B (8.70 s). In any case, it is difficult compare the results of different studies that have measured sprint time in WB players because they differ in the method of measurement. **References** 1. Chapman D, et al. Anthropometric and physical performance characteristics of elite male wheelchair basketball athletes. *J Strength Cond Res.* 2010;24(1):1. 2. De Groot S, et al. Validity and reliability of tests determining performance-related components of wheelchair basketball. *J Sports Sci.* 2012;30(9):879-887. 3. Traballesi M, et al. Improvement in metabolic parameters and specific skills in an elite wheelchair basketball team: a pilot study. *Med Sport.* 2009;62:1-16. 4. Vanlandewijck YC, et al. Field test evaluation of aerobic, anaerobic, and wheelchair basketball skill performances. *Int J Sports Med.* 1999;20:548-554.

### EFFECTS OF EXPERIENCE OF WHEELCHAIR BASKETBALL ON PSYCHOSOCIAL ATTITUDE IN YOUNG PEOPLE

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**Introduction** Recently, adapted physical activities including wheelchair sports are conducted for non-disabled people to facilitate their interaction with disabled players. It can improve to understand the disabled and promote normalization (Tripp et al., 1995). Wheelchair sports have come to be known in Japan these days, however, it is still insufficient for generalization. The aim of this study was to investigate about the effects of experience of wheelchair basketball on young people's awareness of the wheelchair and disabled sports, as a first step to introduce wheelchair basketball to university students to make them recognized wheelchair basketball as just one kind of sport. **Methods** We conducted a program in which 82 non-disabled university students experienced wheelchair basketball. The program included orientation, practice to control wheelchair, and games for 1 hour. Before and after the program, subjects were asked to answer the question about their awareness of the wheelchair and wheelchair sports, disability and disabled people, and mood by marking "strongly think (1) ", "somewhat think (2) ", "somewhat not think (3) " or "not think at all (4) ". Then we analyzed subjects' each answer was

scored from one to four to compare awareness before and after the program. Results To the question "is a wheelchair a special vehicle of disabled people?", the score increased from  $1.88 \pm 0.82$  to  $2.83 \pm 0.83$  ( $p < 0.05$ ). The score of the question to "Do you feel challenged to sit in a wheelchair as a non-disabled?", was  $2.50 \pm 0.95$  before and  $3.20 \pm 0.81$  after the programs ( $P < 0.05$ ). "Do you think wheelchair sports is the sport for the disabled?", the average score changed  $2.07 \pm 0.84$  to  $2.95 \pm 0.91$  ( $P < 0.05$ ). "Do you think that anyone can enjoy wheelchair sports regardless of disability?", before was  $2.13 \pm 0.80$ , after was  $1.43 \pm 0.65$  ( $P < 0.05$ ). For the question "Do you feel charm for wheelchair sports?", subjects answered more positive after the program ( $1.54 \pm 0.74$ ) than before ( $2.12 \pm 0.85$ ) ( $P < 0.05$ ). Discussion After participants played wheelchair basketball, their impressions of wheelchair sports and disabilities positively changed. The view that a wheelchair is a vehicle for a disabled person is reduced by experience of this program and it is thought that the specialty of wheelchair was wiped away. Similarly, subjects had less negative image of disability. In addition, it became clear that a participant's awareness is changing that it is a sport which can be enjoyed regardless of the existence of disability. The experience wheelchair sports with disabled people can make participants' awareness changed positively (Yasui, 2004). These results suggest that the experience of wheelchair basketball could affect participants' attitude toward not only wheelchair sports itself but also disability in general. References Tripp A., French R., Sherrill C. (1995). *Adapt Phys Activ Q*, 12, 323-332. Yasui T. (2004). *Japanese Journal of Adapted Sport Science*, 2(1), 25-30.

### **PHYSICAL ACTIVITY LEVELS IN CHILDREN WITH AUTISM**

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Introduction Although social impairments are the defining feature of Autism spectrum disorders (ASDs), motor functioning is lower than in non-ASD peers (Bhat et al., 2011). The aim of the current study was to investigate physical activity levels in ASD children throughout accelerometer data. Methods Fifty-three ASD children (40 boys and 13 girls) from three Special Schools in Madrid were recruited for this study. The average age was 11,9 3,4. Consent forms were signed by their parents before the study. A desensitization program was necessary for the children to accept the accelerometers. Participants wore a portable triaxial accelerometer during waking hours, except bathing or water activities, throughout a 7-d assessment period (5 weekdays, 2 weekend days). Accelerometers were worn on the hip secured by an elastic waist belt. Results Boys were physically more active than girls, mostly sedentary and vigorous-intensity. No significant differences were found between weekday and weekend values ( $P > 0,05$ ). The physical activity average was 9663 step counts weekday and 10135,7 on weekends. No significant correlations were found between physical activity variables ( $P > 0,05$ ). Discussion It was observed that boys' physical activity levels reach the official recommendations, while girls' physical activity levels don't. Thus, boys values were higher than observed in other foreign studies (Feehan et al., 2012). Previous studies affirm that sport practice levels decrease from childhood to adolescence (Macdonald et al., 2011). This descent was not present in our study likely because these Special Centers teach physical education. References Bhat, A. B., Landa, R. J. y Galloway, J. C. (2011). Current Perspectives on Motor Functioning in Infants, Children, and Adults With Autism Spectrum Disorders. *Physical Therapy*, 91(7), 1116-1129. Feehan, K., O'Neil, M. E., Abdalla, D., Fragala-Pinkham, M., Konrad, M., Berhane, Z., y Turchi, R. (2012). Factors influencing physical activity in children and youth with special health care needs: a pilot study. *International Journal of Pediatrics*, 583249. doi: 1.1155/2012/583249. Macdonald, M., Esposito, P., y Ulrich, D. (2011). The physical activity patterns of children with autism. *BMC Research Notes*, 4, 422. doi: 10.1186/1756-0500-4-422.

### **Biochemistry**

#### **VALIDITY OF BLOOD LACTATE MEASUREMENTS USING PORTABLE LACTATE ANALYZER ; LACTATE PRO AND LACTATE PRO2**

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Introduction Measurement of blood lactate is a common practice to assess and monitor exercise performance in sports physiology laboratories worldwide. Graded exercise tests (GXT) and Wingate anaerobic power test (WT) are also accepted as valid and reliable testing protocols to evaluate metabolic capacity. Blood lactate measurements in GXT and WT are often carried out using portable lactate analyzers. However, more information is not clear about the validity of LP2. The purpose of this study was to evaluate the validity of blood lactate measurements using two types of portable lactate analyzer, the Lactate Pro (LP) and Lactate Pro2 (LP2). Methods Blood samples were taken from fingertips of 5 male athletes ( $18.4 \pm 0.5$  yr) immediately after each of two different exercise protocols, a GXT using a cycle ergometer and a 90s WT. For the purpose of this investigation, the BIOSEN C-Line (BI), a highly-accurate lactate analyzer, was used as the benchmark measure. The order of blood sampling analyses was BI first followed by the two portable analyzers in random order. The validity of each lactate analyzer was determined using a linear regression coefficient and 95% limits of agreement of a bias between the lactate analyzer (i.e., LP or LP2) and BI. Results The regression coefficient for LP2 (0.965) was closer to 1 compared with that for LP (0.859). The limits of agreement were -2.9 to 4.2 for LP and -3.0 to 3.4 mmol/l for LP2. However, at low blood lactate concentration ( $< 5$  mmol/l), the coefficient for LP (1.070) was closer to 1 compared with that for LP2 (0.861), and the limits of agreement at low blood lactate concentration were -0.6 to 0.4 for LP and -0.6 to 0.7 mmol/l for LP2. Discussion The validity of Lactate Pro2 at low blood lactate concentration was lower compared with Lactate Pro. However, the validity of higher concentration values with LP2 was greater compared with LP. References David B Pyne, Tanya Boston, David T Martin, Andrew Logan. (2000). *Eur J Appl Physiol*, 82, 112-116. Rebecca K. Tanner, Kate L. Fuller, Megan L. Ross. (2010). *Eur J Appl Physiol*, 109, 551-559. Shigeru M, Jun S. (1997). *The journal of clinical sports medicine* 14, 815-819.

#### **TO WHAT EXTENT COULD THE ANTIOXIDANT CAPACITY ENHANCE PROFESSIONAL SOCCER PERFORMANCE?**

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Introduction Some results suggest that oxidative stress is markedly up-regulated by a soccer game, probably as a part of the exercise-induced inflammatory response, and is accompanied by a marked deterioration of anaerobic performance for as long as 72 hours. However, it remains unknown the effect of the oxidative stress responses on professional soccer performance. Hence, the main aim of this study was to determine the effects of circulating levels of oxidative stress and antioxidant status markers on soccer performance after mid-season in professional soccer players in three different teams belonging to the 3rd Spanish Division. Methods Three teams belonging to the third Spanish Division during the season 2010-2011 were involved in this study: Team A (n=23), Team B (n=21) and Team C

(n=21). Body composition, VO<sub>2</sub>max, Total Antioxidant Status (TAS) and ratio of reduced glutathione (GSH) and glutathione disulfide (GSSG) were measured at the beginning of the season (PRE). TAS and GSH/GSSG ratio were repeated just at the mid-season (4 months) as well as standings for each team (POST). Results All teams showed similar age, height, weight, BMI and % of body fat at PRE. The VO<sub>2</sub>max at PRE for team A, B and C were 58.5±4.5; 57.2±4.8 and 55.4±4.6 ml/kg/min, respectively (A vs C, p<0.05). The ranking position just in mid-season and at the end of the season were 2nd and 1st for team A, 5th and 5th for team B and, 12th and 14th for team C, respectively. Team A showed higher values of TAS and GSH/GSSG ratio at PRE compared to team B and C (p<0.05). Moreover, team B had higher GSH/GSSG ratio at PRE compared to team C (p<0.05). All teams reduced their TAS and GSH/GSSG ratio after mid-season compared to PRE (p<0.05). The differences in TAS and GSH/GSSG ratio were higher in team C compared to A and B (p<0.05), while team B showed a trend to be higher than team A (p=0.09 and 0.08, respectively). The differences in TAS and GSH/GSSG ratio were inversely correlated with wins (r=-0.52; p<0.05), and directly correlated with losses (r=0.34 and 0.56 respectively, p<0.05), and with the ranking position at mid-season and at the end (r=0.43 and 0.56 respectively, p<0.05). Moreover, differences in GSH/GSSG ratio was inversely correlated with VO<sub>2</sub>max and scoring goals (r=-0.30 and -0.42, respectively, p<0.05). Finally, VO<sub>2</sub>max was correlated positively with wins and inversely with losses (r=0.27 and -0.28, respectively, p<0.05). Conclusion Our results suggest that oxidative stress is markedly upregulated after mid-season of professional soccer league, and were more accentuated in the team with lower standings. Hence, aerobic and antioxidant capacity seem to be crucial for soccer performance.

### EFFECT OF ONE MONTH OFF-SEASON ON THE ANTIOXIDANT CAPACITY OF ELITE SOCCER PLAYERS: DIFFERENCES BETWEEN MALE AND FEMALE PLAYERS.

Gravina, L.2, Bidaurrazaga-Letona, I.1, Zabala, J.1, Santos-Concejero, J.4, Lekue, J.A.3, Badiola, A.1, Gil, S.M.1

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Institutions: 1Department of Physical Education and Sport, University of the Basque Country, UPV/EHU. 2Department of Nursing, UPV/EHU. 3Athletic Club de Bilbao. 4University of Cape Town, South Africa. Introduction Playing a soccer match can produce oxidative stress in both males and females<sup>1</sup>. Different antioxidant status responses have been shown following a soccer game and during recovery<sup>2</sup>. However, little is known about the effect of the off-season period on the antioxidant capacity in soccer players. The aim of this study was to analyse the impact of one month off-season in the plasma markers of oxidative stress in male and female elite players. Methods Two elite teams from the Athletic Club of Bilbao participated in this study: Male Elite Team (24 ± 3, n=15) and Female Elite Team (25 ± 5.1, n=14). Blood samples were obtained at the end of a competitive season (T1) and 1 month afterwards, at the beginning of the next season (T2). During that month, soccer players were off-season. Serum levels of Total Antioxidant Status (TAS, mmol/l), Reduced Glutathione (GSH, μM), lipid peroxidation (MDA, μM) and protein oxidation (carbonyl, nmol/mg) were measured, as well as the activity of antioxidant enzymes: Superoxide Dismutase (SOD, U/ml), Glutathione Peroxidase (GPx, nmol/min/ml) and Catalase (CAT, nmol/min/ml). Paired T-Student Test was used for the statistical analysis. The significance level was set at p<0.05. Results The Male Team showed higher level of TAS in T2 (0.85±0.1 vs 1±0.5, p<0.01), MDA (11±7.8 vs 34±20, p<0.01), CAT activity (37±17 vs 103 ± 23, p<0.001), and lower SOD (0.16±0.05 vs 0.08±0.04, p<0.01), GSH (1464±142 vs 748±142, p<0.001) and carbonyl (0.36±0.08 vs 0.15±0.05, p<0.001) comparing to T1. The Female Team also presented higher activity in T2 of CAT (17±7 vs 54±18, p< 0.001) and MDA (16±12 vs 51±32, p< 0.05), but lower GPx (121±21 vs 93±23, p< 0.05) and protein carbonyl (0.3±0.05 vs 0.13±0.03, p< 0.001). Moreover, in T1 the activity of SOD (p<0.05) and CAT activity (p<0.001) were significantly higher in the Male Team than the Female Team. In T2, male players showed lower SOD (p<0.05) but higher CAT (p<0.001) and TAS level (p<0.001) than female players. Conclusions One month off-season provoked similar effects in the antioxidant capacity in both elite soccer teams. Male and female players showed higher catalase activity although higher lipid peroxidation and lower reduced glutathione was observed after this month. The lower amount of carbonyl in both teams demonstrates that the cumulative effects of oxidative stress disappeared after this period off-season. Only the Male Elite Team presented higher total antioxidant status. References 1Andersson H, et al. Scand J Med Sci Sports. 2008; 23:1-9. 2Fatouros I, et al. J Strength Cond Res.2010; 24(12): 3278-86.

### SAGITTAL SPINAL CURVATURES AND PELVIC INCLINATION IN STANDING OF HIGHLY-TRAINED CANOEISTS

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Introduction Systematic sport training may generate specific spinal adaptations depending on the postures adopted during training. The canoeing discipline of sprint paddling is basically a repetitive movement of the upper segments and trunk for long periods. Canoeing is characterized by kneeling on one knee in the canoe and performing dynamic strokes on one side only. The stroke requires significant flexion and rotation of the trunk and a slight lateral inclination. This may influence the sagittal spinal curvatures (López-Miñarro et al., 2011). For this reason, the purpose of current study was to describe the thoracic and lumbar postures and pelvic inclination while relaxed standing in young canoeists. Methods Sixty-nine highly-trained young canoeists (mean ± SD, age: 16.19 ± 2.27 years) participated in this study. The Spinal Mouse system (Idiag, Fehrltdorf, Switzerland), was used to measure sagittal spinal curvatures (thoracic and lumbar spine) and pelvic inclination in a relaxed standing position. The subject assumed a relaxed position, with the head looking forward, the arms hanging by the side, the knees normally extended, and the feet shoulder-width apart. Results The means (± standard deviation) for thoracic and lumbar curvatures and pelvic inclination in relaxed standing were 45.20 ± 8.23°, -29.75 ± 7.91° and 13.88 ± 6.27°, respectively. Discussion Some differences in spinal curvatures between sports have been associated to specific positions and movements during the training. In the current study, canoeists showed a trend to thoracic hyperkyphosis in standing whereas the lumbar curve presented a neutral posture. These results are in concordance with a previous study in kayakers (López-Miñarro et al., 2010). López-Miñarro et al. (2011) found that canoeists adopt a lumbar flexed posture and reduced thoracic kyphosis at the catch phase of the stroke. The increased thoracic kyphosis in standing might be more related to growth variables and spinal posture in the daily activities than to the specific position in the canoe. Wojtyś et al. (2000) reported that a high exposure of intensive athletic training might increase the risk of developing a hyperkyphosis posture in certain sports. The increase in spinal curvatures might also be due to loss of disk height, which would tend to reduce the length of the anterior column of the spine, thereby increasing thoracic kyphosis and lumbar lordosis. Postural training should be included in the training program of canoeists to improve the thoracic posture in the standing position. References López-Miñarro PA, Muñoy JM, Alacid, F. (2010). Med Sport, 63, 509-519. López-Miñarro PA, Muñoy JM, Alacid, F. (2011). J Hum Kinet, 29, 41-48. Wojtyś E, Ashton-Miller J, Huston L, Moga PJ. (2000). Am J Sports Med, 28, 490-498.

## VARIATION OF DISTRIBUTION AMONG POWER-ORIENTATED ATHLETES AND SEDENTARY VOLUNTEERS

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Physical performance is influenced by several factors, including body composition, biological maturity status, level of habitual physical activity, and muscular strength. It is known that genetic endowments play a key role in many of these factors related to performance: many recently discovered polymorphisms that may affect sports performance have been described in animal or other human based models. In this study, in line with previous researches, we investigated the probability that there is a strong association between polymorphism and performance. We compared genetic profile analysing various polymorphisms on sixty professional Italian soccer players, considered "power-oriented athletes" and thirty sedentary volunteers. Samples of venous blood were obtained by standard clinical procedures and anticoagulant-treated blood was used to prepare genomic DNA. The polymorphic sites were scanned using PCR-RFLP protocols with different enzyme. Being an elite athlete is a complex attribute that may result from the combined influence of hundreds of genetic polymorphisms. For this reason it is difficult to identify with association studies, that is, studies showing between-group differences in the genotypic/allelic frequency of a given polymorphism. We analysed specifically genetic polymorphisms in the PPAR $\alpha$ -PPARGC1A-NRF2 (A/G; C/T) pathway; moreover, we examined that the ACTN3 polymorphism, that has functional significance in muscle function and metabolism. The odds ratio (OR) of power-oriented athletes compared with the sedentary control group has shown a variation of genotype distribution of the analysed polymorphisms: in fact professional soccer players possess "theoretically" a genetic background that is more suitable for mitochondrial biogenesis.

## THE EFFECTS OF N-ACETYLCYSTEINE SUPPLEMENTATION ON INFLAMMATORY AND PERFORMANCE RESPONSES FOLLOWING REPEATED FOOTBALL MATCHES DURING A SIMULATED MICROCYCLE

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The major thiol-disulfide couple of reduced (GSH) and oxidized glutathione (GSSG) regulates major intracellular signaling pathways regulating inflammation and recovery following exercise-induced injury. On the other hand, antioxidant supplementation may hamper exercise-induced cellular adaptations and performance. The aim of this study was to investigate how thiol-based antioxidant supplementation affects inflammatory and performance responses following repetitive games during a simulated in-season microcycle. A double-blind, 4-group design was utilized. 40 high-level football players were randomly assigned to one of four groups (N=10/group): a) placebo match group, received placebo and participated in football matches (PM), b) control training group, received placebo and participated only in training but not in matches (PT), c) NAC match group, received NAC (20 mg/kg/day) and participated in football matches (NM), d) NAC training group, received NAC and participated only in training but not in matches (NT). Three days following an initial 8-day preparatory period consisting of daily training, CM and NM played the first match. The second match took place 3 days after the first match and the third match was performed 4 days after the second one (Sunday-Wednesday-Sunday matches). In between matches, players from all groups participated in daily training according to an in-season training model. NAC and placebo was administered throughout the experimental period. GPS technology was used to measure performance during each match and each training session. Blood samples were collected and repeated sprint ability (RSA) was measured before and three days after the preparatory period, before each match, immediately post and 2h after each match as well as daily after each match (for three days after the last match). Blood was analyzed for inflammatory markers (creatine kinase activity, c-reactive protein oxidative stress markers, adhesion molecules). Data analysis revealed that NAC supplementation maintained a higher GSH/GSSG ration, reduced inflammation following each match and contributed to a faster performance recovery following the first and the second match. Furthermore, NAC increased high-intensity efforts during the first match compared to placebo. These results suggest that thiol-based antioxidant supplementation may induce a faster recovery following repeated football matches during a weekly microcycle.

## Biomechanics

### THE VELOCITY AND TRAJECTORY OF LEG MOVEMENT IN JUDO DURING THROWING TECHNIQUES

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1: Faculty of Physical Education, State University (Tetovo) 2: Faculty of Physical Activity and Recreation, Sports University (Tirana, Albania) 3: Faculty of Physical Education, AAB University (Pristina, Kosovo) Introduction Judo is a combat and Olympic sport emphasizing in throwing and dynamic footwork, where osoto gari and sasae tsurikomi ashi are two of the most effective throws. The coaches of this sport always focus on maximum efficiency with minimum effort during the early phase of throwing teaching (Imamura, Misaki, Alan, & Rafael, 2007). This study aim to compare (1) the velocity of attacking foot, and (2) the velocity of blocking foot, as well as movement trajectory of both feet during throwing performance by black belt master of Judo. Method A black belt master (age = 31 y; mass = 74 kg; height = 1.68 m) served as the tori (thrower) and ten subjects (age = 29  $\pm$  2.34 y ; mass = 68  $\pm$  3.46 kg ; height = 1.64  $\pm$  1.36 m) served as uke (fallers). Two throws, (1) osoto gari and ( 2 ) sasae tsurikomi ashi were executed against ten uke in consecutive way. Velocity performance and trajectory of both tori's leg movement, (1) attacking leg and (2) supporting leg, was assessed by the APAS system of bio mechanic analyses. Results The results showed greater linear velocity in anteroposterior direction of attacking foot in osoto gari ( $v=5,065$  m/s) than sasae tsurikomi ashi ( $v=4,47$ m/s). Considering the trajectory of foot joint, was found a anteroposterior displacement of 102,37 cm in osoto gari vs. 83,37 cm in sasae tsurikomi ashi. While in mediolateral direction the foot displacement in osoto gari was 36,26 cm, and in sasae tsurikomi ashi was 8,85 cm. Discussion The results of this study showed that in those throwing technique of Judo where attacking (cutting) leg performs actions like cutting the opponent leg or other part of his body, linear velocity of foot and knee joint is greater than the techniques where role of leg is blocking or supporting, and as consequence, force applied to opponent's body is higher. In addition, in contest situation, the fast movement of the thrower do not let enough time for the faller to react (Harter and Bates, 1985). These data can help the judo coaches to understand the importance of velocity training of lower limbs for improving performance of their students during the competition. References Imamura, R. T., Misaki, I., Alan, H., & Rafael, E. F. (2007). A kinematic comparison of the judo throw Harai - goshi

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## ANKLE JOINT MOMENT IS SUBSTANTIALLY UNDERESTIMATED WHEN MEASURED WITH CLASSICAL ERGOMETERS MOUNTED WITH A UNI-DIMENSIONAL FORCE SENSOR

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**Introduction** Assessment of mechanical properties of ankle joint muscles during isometric and/or dynamic conditions is usually performed to estimate, for instance, the impact of a (re)training program, of an immobilization or of aging. This assessment is usually achieved by means of either specific ankle ergometers or by means of isokinetic ergometers. For all these devices, moment developed at the ankle joint is measured via either a pedal connected to a unidirectional (1D) force sensor (generally placed away from the axis of rotation of the ergometer) or either by a pedal connected to a 1D torque sensor placed at the axis of rotation of the ergometer. However, plantar-flexion (PF) actions are systematically accompanied by inversion and supination actions. This means that a multi-dimensional effort is measured by ergometers mounted with a 1D force (or torque) sensor. While a 1D sensor allows to assess the moment exerted around the transverse X axis, it cannot allow to assess moments during PF that can be exerted around the sagittal Y and longitudinal Z axes. One can then assume that such ergometers should underestimate the maximal resultant moment that can be recorded at the ankle joint. Then, the purpose of this study was to determine whether the ordinary use of a 1D force sensor, compared to a 3D sensor, can provide a reliable assessment of PF moment. **Methods** Ten healthy male volunteers took part in this investigation. Ankle PF maximal voluntary isometric contraction moments (M<sub>Amax</sub>) were measured using a new and validated ankle ergometer mounted with a 3D force sensor (force-torque sensor – Sensix, Poitiers-France). All measurements were performed in the sitting position with the dominant lower limb extended and with the ankle joint at 90°. M<sub>Amax</sub> was calculated as follows: 1D\_ M<sub>Amax</sub> = Fz\*d and 3D\_ M<sub>Amax</sub> = (M<sub>Ax</sub><sup>2</sup> + M<sub>Ay</sub><sup>2</sup> + M<sub>Az</sub><sup>2</sup>)<sup>0.5</sup> with M<sub>Ax</sub> = M<sub>Ox</sub> + Fy\*h – Fz\*d; M<sub>Ay</sub> = M<sub>Oy</sub> – Fx\*h; M<sub>Az</sub> = M<sub>Oz</sub> + Fx\*d; F and M<sub>O</sub>: forces and moments recorded at the origin of the 3D force sensor (O); d: Y distance between O and the ankle joint center of rotation (A); h: Z distance between O and A. **Results** Paired t-test revealed a significant effect of the number of dimensions of the force sensor (1D vs 3D) on the assessment of maximal ankle joint moment: 1D\_ M<sub>Amax</sub> (100.5 ± 19.1 N.m) was significantly lower than 3D\_ M<sub>Amax</sub> (159.8 ± 40.3 N.m) (p<0.001). **Discussion** The results showed that the use of a 1D, instead of a 3D, force sensor significantly underestimated (-37%) the resultant ankle moment exhibited by the plantar-flexors. Since ergometers classically used in clinical and biomechanics research are usually built with a 1D force (or torque) sensor, care must be taken when assessing muscle actions that are characterized by multi-dimensional components.

## BIOMECHANICAL ANALYSIS OF GAIT IN PREGNANCY AND POSTPARTUM: A LONGITUDINAL STUDY

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**Introduction** The purposes were to quantify the kinematic variables and mechanical load exerted on the structures of the lower limb during gait, and compare it between the first (1T), second (2T), third (3T) trimesters of pregnancy and in the postpartum period (PP) in 8 women. **Methods** A longitudinal three-dimensional analysis was performed. Kinematic data: 10 infrared high-speed cameras (Qualisys, 200Hz). Kinetic data: 2 Kistler platforms (1000Hz). Qualisys Track Manager software was used. Markers setup: Cappozzo (1997) for lower limb; CODA (Charnwood Dynamics) protocols for pelvis segment. Women walked a distance of 10m between two points, barefoot in a straight line at a natural and comfortable speed (Falola 2009; Huang, 2002), for 3 min. **Results** Significant differences were found in the following variables. Double limb support time and right foot support time between the 4 periods. Kinematic variables in sagittal plane: 1st and 2nd peaks of hip joint. In the ankle, 3rd angle peak in 3T (right leg). In the frontal plane, 1st peak of hip joint in 3T (right leg). In ankle joint, 2nd peak, increase in foot eversion in 3T (right leg). Ground reaction forces (GRF) in the 1st and 2nd peak of anterior and posterior GRF, specifically with a higher brake in PP (both legs) and, a decrease in propulsion in 3T (left leg). Joint moments in the 1st peak of ankle joint, increase of adductors participation in the 3T (transverse plane, left leg). Joint power analysis showed a decrease of hip abductors mechanical energy production, 3T (left limb). **Discussion** While walking in at a self-selected pace, the pregnant woman needs to promote stability of the body (Lymberry & Gilleard, 2005) increasing double and right limb support time. Kinematic data presents more changes in hip, probably because it's near of the abdominal of the pregnant woman, however ankle joint also presents changes in the angle movement. GRF presents differences in the 1st anterior posterior peak but it is only relevant between 1T and PP, which may indicate that PP should also be the focus for more studies. Vertical GRF showed that late pregnancy present less impulse. Joint moments only reveal a higher participation of foot adductors and the joint power only presents less mechanical production in hip abductors. Hip and ankle joints seem to have the major changes and therefore the ones with an overload on lower limb (Foti, 2000). **References** 1. Cappozzo A et al (1997). IEEE Trans. Biom Eng 44(12), 1165-74 2. Falola JM et al (2009). Science & Sports 24(1), 49-51 3. Huang TH et al (2002). Biom Eng Appl, Basis & Communications, 14(2), 4 4. Lymberry JK Gilleard W (2005). J Am Pod Med Assoc 95(3), 247-53 5. Foti T et al (2000). J Bone & Joint Surg Am, 82A(5), 625-32

## DEVELOPMENTAL DIFFERENCES IN TENDON HYSTERESIS: IMPLICATIONS FOR PAEDIATRIC MOVEMENT EFFICIENCY?

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**INTRODUCTION.** Children are less efficient than adults when performing cyclic motor tasks such as walking; however, the mechanisms underlying such differences are not fully understood. One mechanism that may contribute to age-related differences in task efficiency is the tendon's dissipative properties, as low tendon hysteresis values have been previously linked with higher movement efficiency in adults [1]. The aim of this study was to determine Achilles tendon hysteresis in prepubertal children and compare with that of adults. **METHODS.** Achilles tendon hysteresis was obtained in eight prepubertal children (6.0 ± 0.6 years) and eight adults (24.3 ± 2.8 years) from maximal isometric plantarflexion contractions. Tendon elongation was measured using ultrasonography and peak plantarflexor moment using dynamometry. Tendon elongation due to ankle rotation was accounted for using a combination of 3D motion capture and anthropometry. Tendon force was calculated as the ratio of plantarflexor moment and Achilles tendon moment arm, which was obtained by means of the tendon excursion method. The slopes of the ascending and descending phases of the force-elongation curves (normalised to peak force) were fitted to second-order polynomials. Achilles tendon hysteresis was calculated as the difference between the areas under the ascending and descending portions of the force-elongation plots. Statistical differences in hysteresis values between children

and adults were examined using an independent t-test. Statistical significance was accepted at  $p < 0.05$ . RESULTS. Mean ( $\pm$ SD) hysteresis values for children and adults were  $40.2 \pm 13.7\%$  and  $26.1 \pm 7.0\%$ , respectively. These findings were statistically different ( $p = 0.022$ ). CONCLUSION. Our results demonstrate that the dissipative properties of the Achilles tendon are different between children and adults, which expand upon previously demonstrated differences in other tendon viscoelastic properties between these populations [2]. It is possible that decreases in Achilles tendon hysteresis with age may influence movement efficiency in children as they develop, which is an important area of future research. REFERENCES [1] Fouré A, Nordez A, and Cornu C. (2010) *J Appl Physiol* 109: 849-54. [2] Waugh CM, Blazevich AJ, Fath F, and Korff T. (2012) *J Anat* 220(2):144-55.

### **KINEMATIC DIFFERENCES OF TWO TYPES OF SCULLING ACTIONS IN DISPLACEMENT**

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**Introduction** Sculling is a basic propulsive action with four hand movements: outward, supination, inward and pronation (Arellano et al., 2006). Analysis 3D showed a zigzag path, where hand displacement is mostly forward, with strong hand rotations during the direction's change (Arellano, 2011). The study aim was to know the effect on kinematic variables of the use of normal and power sculling in displacement. **Methods** Twenty-three subjects participated in the study. Each performed two 20m trials using a normal sculling [NSc] (arms and elbows fixed close to the water surface making and angular displacement of forearm and hand) and power sculling [PSc] (moving arm, forearm and hand, inward and outward). A linear encoder tethered to the swimmer's belt allowed intra-cyclic speed [V] (m/s) recordings (200 Hz) synchronized with video cameras (HD - 60Hz) to measure sculling frequency [f] (Hz). The average speed and sculling frequency were calculated during six sculling cycles and the sculling length [L] (m/cic) from the equation:  $L = V/f$ . Results No significant differences were found between trial mean V [NSc =  $0.48 \pm 0.09$ , PSc =  $0.47 \pm 0.08$ ,  $t = 0.83$  ( $p = 0.42$ )] Meanwhile f and L were statistically different [fNSc =  $1.32 \pm 0.17$ , fPSc =  $1.10 \pm 0.13$ ,  $t(22) = 7.57$  ( $p < 0.01$ ), LNSc =  $0.36 \pm 0.07$ , LPSc =  $0.43 \pm 0.07$ ,  $t(22) = -5.44$  ( $p < 0.01$ )]. Low correlation values were obtained between variables [r (NSc,V,f) =  $0.454$  ( $p = 0.05$ ) and r (PSc,V,f) =  $0.300$  ( $p > 0.05$ )]. **Discussion** The type of sculling action studied did not affect average velocity, however the sculling frequency and length were modified. The longer hand's displacement observed results in slower frequencies, a more similar hand path action plus bigger arm muscles contribution, more similar to the formal strokes than the normal sculling with a more analytical and isolated hand/forearm movement. It is recommended to apply this type of power sculling on stroke technique development instead of normal sculling even though further studies should be performed. **Acknowledgement:** Project funded by Spanish Ministry of Science and Innovation, VI National Plan for Research, Development and Technological Innovation (I+D+i) 2005-2008, Ref: DEP2009-08411. **References** Arellano, R. Transferring applied hydrodynamics to technical training: "The Sculling Project". Portuguese Journal of Sport Sciences, Porto, n.11 (sup. 3), p.69-72, 2011. Arellano, R.; Terrés-Nicoli, J.; Redondo, J. Fundamental Hydrodynamics of Swimming Propulsion. In: Biomechanics And Medicine In Swimming, 10., 2006, Porto. Proceedings of Biomechanics and Medicine in Swimming X. Porto: Faculty of Sports Sciences and Physical Education – University of Porto, 2006. p. 15 - 20.

### **EFFECTS OF ACUTE MODERATE HYPOXIA ON PERFORMANCE AND BIOMECHANICAL PARAMETERS IN 50-M FRONT CRAWL IN ELITE SWIMMERS**

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**Introduction.** Exposure to acute moderate hypoxia induces a significant cardiovascular and metabolic response short after the ascent. However, performance during short high-intensity exercise seems not to be affected by altitude exposure. To our knowledge, only one study has analysed the effect of altitude on swimming technique (Mercadé et al., 2006). We aimed to analyse the effects of acute moderate altitude exposure on performance and biomechanical parameters of a maximal 50-m front crawl swimming test in elite swimmers. **Methods.** 27 elite swimmers performed two 50-m front crawl test at normoxic (N) conditions and 72 h after arrival to a real altitude hypoxic (H) environment (2320 m, CAR of Sierra Nevada, Spain). Tests were performed at 50-m indoor pools and were recorded with three lateral video cameras (50 Hz), two placed underwater and one outside the water. Final time (T50), swimming speed (V), stroke rate (SR), stroke length (SL), and stroke index (SI) were assessed on each trial. Results. T50 time was non-significantly faster ( $-0.5\%$ ,  $p > 0.05$ ) in H ( $27.78 \pm 2.11$  s) than in N ( $27.91 \pm 2.07$  s). Although mean swimming speed did not change ( $-0.3\%$ ,  $p > 0.05$ ), the start time (0-15 m) improved after the ascent ( $2.06 \pm 0.18$  and  $2.13 \pm 0.19$  m·s<sup>-1</sup> in N and H, respectively,  $p > 0.05$ ). SR and SL non-significantly decreased in H compared to N ( $-0.2\%$  and  $-0.7\%$ , respectively,  $p > 0.05$ ), leading to a decrease in SI ( $1.5\%$ ,  $p > 0.05$ ). **Discussion.** Exposure to acute moderate hypoxia seems not to have a significant effect on performance in a 50-m maximal test. The slight, non-significant improvement in T50 might be due to an increase ( $+3.2\%$ ) in speed in the first 15 m. Previous studies have reported an increase in performance in throws, jumps and other force-velocity actions when they were executed at altitude (Levine et al., 2008). Similarly, an increase in jump power on the starting blocks might have led to longer flight time and distance during the swimming start. In conclusion, acute moderate hypoxia does not affect sprint swimming performance and technical variables in elite swimmers acutely exposed to moderate altitude. The slight changes observed in the starts suggest that training in H may be a complement to improve this particular race component. **References** Mercadé JJ, Arellano R, Feriche B (2006). *Revista Portuguesa de Ciências do Desporto*, 6, supl. 2, 148-150. Levine BD, Stray-Gundersen J, Mehta RD (2008). *Scand J Med Sci Sport*, 18, 76-84.

### **HIGH-LEVEL WHEELCHAIR BASKETBALL SPRINT PERFORMANCE ASSESSMENT REGARDING PLAYING POSITIONS USING A LASER SYSTEM**

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**Introduction** The wheelchair optimization and training processes have been evolved during last years but there is limited knowledge for elite wheelchair basketball (WB) players profiling in their preparation to a major competition (Goosey-Tolfrey, 2005). Sprint tests are used by coaches to assess the quality of velocity in their players and to make decisions on the best possible distribution of players in the different positions (Pérez et al., 2010). However, the measuring instruments used are not always accurate enough to help them in their deci-

sion-making. The purpose of this study was to identify and quantify kinematics variables that define the quality of velocity in WB players from different playing positions (guard, forward and centers), using laser system. Methods Eleven men, WB players of the Spanish National team, took part in a 3 series of 20 m sprint test. Distances were measured in real time by a laser system Biolasersport® (Ferro, 2012, Ferro and Floria, 2010) using a LDM301-Jenoptik type 1 Laser at 200 Hz. Average velocities ( $V_m$ ), maximum velocities ( $V_{max}$ ), relative maximum velocities ( $RV_{max}$ ), time to achieve  $V_{max}$  ( $TV_{max}$ ) and its relative value ( $RTV_{max}$ ) over sections (0-3, 3-5, 5-10, 10-15, 15-20 m) were analyzed. Several one-way ANOVAs were applied using as factor the playing position (3 levels) and the dependent variables. The ICC ranged between 0,96-0,99 for all  $V_m$  and  $V_{max}$ . Results There were no significant differences were found in  $V_{m0-20}$  between playing positions but there were significant differences in  $V_{max0-3}$  between centers and guards (3.36,  $s=0.23$  m/s, 3.31,  $s=0.12$  m/s;  $P=0.37$ ) and forwards and guards (3.36,  $s=0.21$  m/s, 3.31,  $s=0.12$  m/s;  $P=0.001$ ). The  $V_{max5-10}$  was higher in guards than in forwards (4.68,  $s=0.23$  m/s, 4.37,  $s=0.23$  m/s;  $P=0.007$ ). The  $TV_{max0-5}$  between centers and guards (1.60,  $s=0.18$  s, 1.67,  $s=0.10$  s;  $P=0.036$ ) and forwards and guards (1.64,  $s=0.21$  s, 1.67,  $s=0.10$  s;  $P=0.006$ ) were higher in guards. And the  $RTV_{max0-5}$  was higher in guards than in forwards (33.59,  $s=1.44$  %, 30.90,  $s=2.94$  %;  $P=0.012$ ). The  $TV_{max3-5}$  was significant higher in guards than in forwards (0.52,  $s=0.08$  m/s, 0.45,  $s=0.16$  m/s;  $P=0.015$ ). Discussion There were specificity kinematics variables regarding playing positions in the sprint test lower than 5 m. The guards were slower than the centers and forwards; they achieved higher peak velocity in the 3-10 m although it was later than the rest of the players. This results seen related with the guards role developed in competition matches. Finally, to identify the velocity qualities of WB players in on-court sprints, more accurate systems, like laser, are needed. References Coutts, K. D. (1994). *J. Rehabil Res Dev*, 31(2), 138-143. Ferro (2012). Trademark n°3019808/9. BOPI:12.06.2012. Ferro, A., & Floría, P. (2010). Patent ES2331170A1 (A61B 5/11-G01S 11/00). BOPI: 22.12.2009. Goosey-Tolfrey, V. L. (2005). *Adapt. Phys. Act. Q.* 22(1), 57-66. Pérez, J., Aragón, C., Rabadán, M., Sampedro, J. (2010). *Rehabilitation: mobility, exercise and sports*. IOS Press: Amsterdam, 412-414.

### THE BIOMECHANICS OF ATHLETIC EXHAUSTION OF THE LOWER LIMB AND ITS RELATIONSHIP WITH THE SKILFUL PERFORMANCE OF COMPOUND SKILLS IN FOOTBALL.

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The biomechanics of athletic Exhaustion of the lower limb and its relationship with the skilful performance of compound skills in Football  
Introduction: The state of exhaustion is one that is a common occurrence in all forms of athletic performance. Physical exhaustion can arise in a number of circumstances in relation to both training and competitive circumstances. Professional team sport athletes who are required to play a number of games over a period of weeks will often complain of a Hard training, especially when the individual components are repetitive, can occasionally result in a similar Physical fatigue. Physical exhaustion is also used to describe the testing processes used to calculate skilful performance measures which is a powerful indicator of endurance sport fitness. This research aims to identify the impact of athletic exhaustion on biomechanical movements for the joints in the lower limb during performing compound skills by the junior football player. Methods: Method: study used the descriptive method through using 3-D biomechanical analysis, and kinematographic analysis. Sample: study was applied to a sample of (6) junior football players selected intentionally from Mansoura Sports Club. Tests: The researchers used the following physical tests: Standing Balance Test - Illinois Agility Test - Quadrant Jump Test - Vertical Jump Test Isometric Leg Strength Test, in order to identify the level of exhaustion in addition to skill tests as well (receive and pass – receive and kick). The researchers used the pre- and post- measurement before and directly after the match and before the players could recover. Tools: In addition, they used the 3-D Motion Analysis by using a 250 Frame/second SportsCam then conducting the kinematographic analysis by using the Simi Motion software. Result & discussion: •The most important results were that the averages values of the biomechanical variables and the physical measurements confirm a decrease in the post-measurement test than the pre-measurements in all the skill performance phases. •Also, the time of performing the two skills under study was shorter in the pre-measurements, which confirms in general that the research sample was significantly influenced by exhaustion. •There is a significant correlation between the physical and the biomechanical variables expressing exhaustion. •In addition, there is a correlation between the physical and biomechanical variables and the skill performance phases in terms of post-measurement, which influences on effectiveness of the skilful performance skills of the compound skills in football for the research sample.

### RELATION BETWEEN SHOULDER AND ELBOW JOINT TORQUE AND MOTION RANGE IN BASEBALL THROWING AND RISK OF SHOULDER AND ELBOW INJURY

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Introduction Shoulder joint torque and motion range in baseball throwing are considered to have relation with the risk of shoulder and elbow injury. Purpose of this study is to investigate the relation among shoulder joint torque and motion range in baseball throwing, shoulder isometric muscle force and static motion range, and the risk of shoulder and elbow injury. Method Twelve baseball pitchers affiliated with the baseball club of the University performed maximum speed ball pitching with motion capture kinematics and kinetics analysis, isometric muscle force tests of shoulder inner rotation, and motion range tests of shoulder external rotation and horizontal abduction. The relation among the kinetic characteristics of throwing, the physical characteristics, and the risk of shoulder and elbow injury was investigated. Shoulder tensile force, shoulder shear force and elbow inversion torque in throwing were as the estimative index of shoulder and elbow injury risk in throwing. Result Shoulder inner rotation torque in throwing has strong correlation with elbow inversion torque ( $R^2=0.869$ ,  $P<0.001$ ). Shoulder horizontal adduction torque in throwing has strong correlation with shoulder shear force ( $R^2=0.871$ ,  $P<0.001$ ). Motion range of shoulder external rotation in throwing has correlation with elbow inversion torque ( $R^2=0.403$ ,  $P<0.05$ ). Motion range of shoulder horizontal abduction in throwing has strong correlation with shoulder shear force ( $R^2=0.784$ ,  $P<0.001$ ). "Upper arm power type group" defined as the top six subjects with large upper arm torque (amount of shoulder inner rotation and horizontal adduction) in throwing have larger elbow inversion torque ( $P<0.1$ ) and larger shear force ( $P<0.05$ ). Conclusion These results suggested that throwing motion without strong upper arm torque and with larger shoulder motion range may decrease the risk of shoulder and elbow injury in throwing. References Burkhart, S. S., Morgan, C. D., and Kibler, W. B. (2003) The disabled throwing shoulder: spectrum of pathology Part III: The SICK scapula, scapular dyskinesis, the kinetic chain, and rehabilitation. *Arthroscopy* 19, 641-661 Fleisig, G. S., Barrentine, S. W., Escamilla, R. F., and Andrews, J. R. (1996) Biomechanics of overhand throwing with implications for injuries. *Sports Med* 21, 421-437 Braun, S., Kokmeyer, D., and Millett, P. J. (2009) Shoulder injuries in the throwing athlete. *J Bone Joint Surg Am* 91, 966-978

## ACCELEROMETRY OUTPUT DURING WALKING AND RUNNING AT DIFFERENT SPEEDS – INFLUENCE OF ACCELEROMETER PLACEMENT

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Background: Accelerometers are often used to measure physical activity and it is important to investigate the validity of the output. It has been suggested that accelerometer placement on the thigh rather than the conventional hip-placement provides a better suited output for detecting activity-types such as walking, running, cycling and stair climbing (1). It is not known, however, if a thigh-placement will yield accelerometry output that is related to the speed of walking or running as is the case for hip placement. Objectives: To compare the accelerometry output from accelerometers placed on the hip and thigh, respectively, during walking and running at various speeds. Methods: 6 healthy subjects (3 m, 3 f, age  $24 \pm 2$  y,  $175 \pm 7$  cm,  $72 \pm 11$  kg) volunteered for the study. Tri-axial accelerometers (Actigraph GT3X+) were fixed with adhesive on the right anterior mid-thigh and on the right hip. Subjects performed several 3 min trials of treadmill walking (3, 5 and 7 km/h) and running (7, 10 and 12 km/h). Accelerometer output was stored as counts per 10 s epoch in each of the three axes. Then, a vector magnitude (VM) was calculated as an index of movement intensity. Mean VM values from each individual during treadmill trials were used for further analysis. Results: Accelerometer outputs (VM) were significantly higher from thigh-placed devices than from hip-placed devices at all walking and running speeds. Using both hip- and thigh-placed accelerometers, there was an approximately linear increase in VM with increases in walking speed from 3 to 7 km/h and a linear regression fitted all subjects with a high correlation coefficient (Hip:  $r = 0.98$ ; Thigh:  $r = 0.97$ ). Also during running, VM increased linearly with increasing speeds, but the correlation was stronger for thigh-placed devices ( $r=0.91$ ) than for hip-placed devices ( $r = 0.60$ ). For hip-placed accelerometers, the linear regression slope was lower for running trials (7-12 km/h) than for walking trials (3-7 km/h). In contrast, similar slopes of the regressions lines were found for walking and running when using thigh-placed accelerometers. Conclusions: Thigh-placed tri-axial accelerometers provide output, which is highly correlated to speed of locomotion and a single common regression line can represent both walking and running at speeds from 3 to 12 km/h. The conventional hip-placed accelerometers give output that is less strongly correlated to speed of locomotion at higher speeds. These preliminary results suggest that a thigh-placed rather than a hip-placed accelerometer may provide a more accurate representation of human locomotion at higher speeds. 1. Skotte et al., *J Phys Act Health*, (in press)

## INFLUENCE OF DORSIFLEXION SHOES ON JUMP PERFORMANCE

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Introduction Sports shoes can modify sports kinematics and signify an advantage/disadvantage for physical performance. Dorsiflexion sports shoes were designed to increase jumping capacity by means of a lower position of the heel in relation to the forefoot, favouring additional stretching of the ankle plantar flexors. Results in previous studies using dorsiflexion shoes are contradictory (1, 2). The aim of this study was to compare a dorsiflexion sport shoe model with two conventional sports shoes in a countermovement jump test. Methods The sample included 35 young and active participants that performed a countermovement jump test with three different volleyball sport shoes, one with dorsiflexion (Springboost, with  $2^\circ$  of dorsiflexion) and two conventional sport shoes (Asics and Kipsta) on a force platform (Kistler Quattro Jump, Switzerland). Participants also evaluated perceived comfort while they wore the shoes. Results In comparison to the conventional shoes, dorsiflexion sports shoes were not effective for improving peak power and jump height ( $P = .841$ ). However, there were significant differences in the way the force was manifested during the jump test: in dorsiflexion shoes peak power was reached quicker ( $P < 0.05$ ). Dorsiflexion also reduced the speed but increased the force at peak power ( $P < 0.05$ ). The drop of centre of gravity in push off was lower with dorsiflexion sport shoes ( $P < 0.05$ ). The comfort perceived by participants was better with conventional sports shoes than with dorsiflexion shoes ( $P < 0.05$ ). Discussion The higher ankle flexion induced by dorsiflexion shoes was offset by a lower drop during push off to propitiate optimal ankle flexion. Dorsiflexion produces a modification in the muscle activation pattern during a maximal jump (3) since peak power was obtained with higher force and lower speed. However, as a practical application for sports performance, dorsiflexion does not mean an improvement in peak power or jump performance. Moreover, dorsiflexion decreases the comfort perceived by participants. References 1. Faiss R, Terrier P, Praz M, Fuchslocher J, Gobelet C, Deriaz O. Influence of initial foot dorsal flexion on vertical jump and running performance. *Journal of Strength and Conditioning Research*. 2010;24(9):2352-7. Epub 2009/11/18. 2. Salinero JJ, Abian-Vicen J, Del Coso J, González-Millán C. The influence of ankle dorsiflexion on jumping capacity and the modified agility T-Test performance. *European Journal of Sport Science*. 2013. 3. Bourgit D, Millet GY, Fuchslocher J. Influence of shoes increasing dorsiflexion and decreasing metatarsus flexion on lower limb muscular activity during fitness exercises, walking, and running. *Journal of Strength and Conditioning Research*. 2008;22(3):966-73. Epub 2008/04/29.

## TWIST BIKE ATLANTIC ® - A NEW BIOMECHANICAL EFFICIENCY CHALLENGE

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INTRODUCTION Twist Bike Atlantic is a innovative bicycle with a new propulsion system in which the pedals run on a rectilinear trajectory very similar to a step movement. The aim of this study was to examine differences in cycling efficiency between a traditional bike (B) and a Twist Bike (TB). METHODS One trained male cyclist (22 years, 71.3 Kg, 174.1 cm) completed an incremental  $\text{VO}_2$  max test (100W+20W/min) to ascertain his Ventilatory Threshold (VT) and a Lactate Test (80W+40W/3 min) to assess his OBLA on a cycle simulator Computrainer Racermate ®. In both cases we have obtained similar results (VT and OBLA at 185W-166 bpm). Subsequently Oxygen Consumption ( $\text{VO}_2$ ), Heart Rate (HR) and forces exerted on the pedals have been recorded in different incremental tests (80W+40W/4 min) with TB and B with comparable gear ratio in order to guarantee the same wheel metric development and effort and to compare them properly. The tests were performed at two different load levels corresponding to a light/medium (LE) and a heavy exertion (HE). A bi-dimensional 5-bar linkage model of the lower limb/crank system in the para-sagittal plane has been applied both to the TB and the B. In this way the internal actions of the muscles are not directly detected but are reduced to an equivalent system, made of three moments acting on hip, knee and ankle, that can be calculated by the measurements of external forces, with a method known as "link-segment modeling", using an inverse dynamics procedure. RESULTS The metabolic efficiency ( $\text{VO}_2/\text{W}$ ) with TB is more advantageous than with a traditional bicycle at LE. Absolute values of  $\text{VO}_2$  and HR were lower compared with the same power level on a B. At HE all physiological values were higher with low levels of exercise sustainability. Biomechanical results suggest that in general the hip and the knee moments are higher with B than with TB pedaling while the ankle moment is lower with B due to the fact that TB prototype was equipped with a non oscillating pedal.

CONCLUSION Cycling efficiency with TB seems to be higher limited to light loads This results might be interpreted as a lower metabolic commitment determined by the use of different muscle groups in number and type. Further studies are necessary to advance this area of knowledge for a better understanding of this innovative bike. REFERENCES Hull ML, Jorge M. A method for biomechanical analysis of bicycle pedalling. *Journal of Biomechanics* 1985;18(9): 631-644 Eftema G, Lorås HW. Efficiency in cycling: a review. *European Journal of Applied Physiology* 2009;106 (1), 1–14

### ACUTE EFFECTS OF BAREFOOT OR MINIMALIST RUNNING ON 3-D KINEMATICS AND LOWER LIMB EMG ACTIVITY

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Introduction Athletes running barefoot adopt a forefoot strike, increase ankle plantarflexion, possibly increase knee flexion and display greater plantarflexor muscle activity, but less activity of tibialis anterior. Research comparing shod and barefoot running biomechanics is limited. Only two studies have examined running biomechanics in minimalist shoes (Squadrone & Gallozzi, 2009; Bonacci et al., 2013) and neither examined muscle activation patterns. Methods Competitive, habitually shod male middle-distance athletes (n=14; age 25±6 yr) completed a randomised series of 6 by 5-min treadmill running bouts, at 2 individualised velocities (70 and 85% of best 5-km time) in 3 scenarios; barefoot, in minimalist and traditional shoes. Three dimensional hip, knee and ankle joint kinematics, spatiotemporal variables and foot strike patterns were recorded. Surface EMG data, recorded from tibialis anterior (TA), medial gastrocnemius (GA), vastus lateralis (VL) and biceps femoris (BF), were temporally and amplitude normalised across stride duration and dynamic maximal EMG, respectively. Results Transitioning from running in traditional to minimalist footwear, or barefoot, did not instantly change running biomechanics. A mid-foot strike was adopted in all conditions at both velocities. No significant differences were recorded in EMG activity of TA, GA or VL. However, some motor pattern plasticity was identified via significant differences in spatiotemporal variables, joint kinematics and EMG activity in BF. From 0 to 10% of the stride, EMG activity of BF was significantly higher barefoot vs. shod (13.3±4.0 vs. 16.5±3.9%; P<0.05). Time to peak BF activity was significantly longer in shod and minimalist conditions vs. barefoot (674±15 and 672±16 vs. 650±16 ms, P<0.05). At both investigated velocities; stride duration, flight time and contact time were significantly shorter (P<0.05), and stride frequency significantly increased (P<0.05) comparing barefoot with shod and minimalist scenarios. Significant footwear effects were detected for hip and ankle angles at initial contact, maximum ankle angle, and hip and knee ROM. The majority of these kinematic differences were most likely due to the cushioned sole allowing for a stronger push-off. Discussion Research reporting biomechanical differences in participants with lengthy experience in barefoot or minimalist running (Squadrone & Gallozzi, 2009) suggests that a familiarisation period is required. Consequently, athletes should probably gradually transition from running in traditional shoes to either barefoot or minimalist running. References Bonacci J et al. (2013). *Br J Sports Med* doi:10.1136/bjsports-2012-091837 Squadrone R, Gallozzi C (2009). *J Sports Med Phys Fit* 49, 6-13.

### ANALYSIS OF VARIOUS BODY DEPLOYMENT STRATEGIES ON TANGENTIAL AND PERPENDICULAR VELOCITY OF SKIS DURING A TURN IN ALPINE SKIING

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ANALYSIS OF VARIOUS BODY DEPLOYMENT STRATEGIES ON TANGENTIAL AND PERPENDICULAR VELOCITY OF SKIS DURING A TURN IN ALPINE SKIING Antichan, F.1-2, Coulmy, N.1, Hintzy, F.2 1 : FFS (Annecy, France), 2 : LPE (Le Bourget du Lac, France) Introduction: In alpine skiing, gravitational force is the main contributor to increase and maintain speed. Nevertheless, the work developed by a skier's muscles may provide effective energy. Meyer et al (2012), have quantified the average total work produced by the skiers during a turn cycle. This work represents approximately 1.5% of the corresponding potential energy change during the turn. This amount should not be neglected as it can make a significant difference in terms of performance due to the possible transfer between potential energy and kinetic energy. The purpose of the study was to measure the effect of various deployment strategies on tangential and perpendicular velocity of skis. Methods: The performances of 2 ex members of the French ski team were analyzed through 8 runs with 7 complete turn during a 20m giant race simulation. 4 runs were performed with an extension during steering phase (stratext) and 4 runs were accomplished in a spontaneous position (stratref). The performance of 1 ex member of the French ski team was analyzed through 5 runs with 10 complete turns during a 20m giant race simulation followed by 12 complete turn during a 13m slalom race simulation. 3 runs were performed with different muscular contraction instruction (eccentric, concentric and plyometric muscle contraction) and 2 runs were accomplished with different body placement instruction (diagonal trajectory, pelvis rest) Tangential velocity of ski was measured with optical navigation sensors Vlink (Novaq, USA) fixed in each ski (Kirby 2009). Pressure distribution on the plantar surface was measured by the use of the bilateral insole measurement system "Pedar" (Novel, Germany). Data were synchronized with a specific software (videomesure). Turn was split into 4 significant zones: transition zone, steering zone, gate crossing zone, glide zone. Results: The results showed that the movement strategy of flexion-extension produced differences concerning the kinetic of the turn. Concerning the different muscular contraction instruction the results showed an increase of the tangential velocity in some case (+4%) during a turn and an acceleration of 7% between the steering phase and the gate crossing zone. Discussion: Extension motion and eccentric muscular contraction seem to increase tangential velocity. This result can be explained by the reduction of inertial moment. However, the pressure under the ski is higher with this strategy. Under certain conditions, it could be negative for the performance in alpine skiing. These interpretations are subject to certain limitations as the number of subjects used in the study was small. Reference: Kirby R (2009). *ILCSS, St Christoph, Austria*. Meyer F (2012). *UNIL, Lausanne,Swiss*.

### INDIVIDUAL MUSCLE THICKNESS AND POSTURE SHOULD BE CONSIDERED WHILE EVALUATING A STANDARD VALUE FOR MUSCLE HARDNESS

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Introduction Changes in muscle hardness are commonly evaluated for medical rehabilitation and conditioning in the field of sports medicine. However, the standard values of muscle hardness in the resting position have not yet been proposed. It is cumbersome to set a standard value for muscle hardness because various techniques are currently being used to evaluate muscle hardness. Recently, we proposed a modified 2-layered spring model that was proposed by Horikawa et al. for evaluating muscle hardness (1993) (Murayama et al. 2008, 2012). In brief, we compared the hardness values of the upper and lower limbs with the subjects in a standing position. These

values were calculated using 5–30% muscle thickness (MT), and we observed that the muscle hardness value E should be calculated using approximately 15% MT in the standing position. However, the feasibility of using any other body part to calculate these normalization values has not been established. The purpose of the present study was to identify a relevant distortion range for evaluating muscle hardness by considering MT in the supine or prone positions and to propose standard values for the biceps (BS), quadriceps (QS), and triceps surae (TS) muscles. **Methods** This study included 257 college students who volunteered to participate in the study. The subjects were instructed to assume a supine, or prone position. In the supine position, they lay on their back on a bed (for BS and QS muscle hardness evaluation). In the prone position, they lay on their stomach on the bed (for TS muscle hardness evaluation). We measured the MT and the subcutaneous tissue thickness by using ultrasonography. A muscle hardness meter was used, which was attached to a stage controller system. The muscle hardness meter could be shuttled linearly on the belly muscle for approximately 25 mm at 40 mm/s by using the stage controller system. **Results & Discussion** According to our previous studies (Murayama et al. 2008, 2012), muscle hardness (E value) was calculated using 15% MT; 15% E. The mean 15% E values and standard errors (SE) in the supine and the prone positions were as follows: (1) BS,  $24.5 \pm 7.1$  kPa (men: m) and  $30.7 \pm 11.0$  kPa (women: w); (2) QS,  $42.6 \pm 13.8$  kPa (m) and  $66.2 \pm 31.9$  kPa (w); and (3) TS,  $50.9 \pm 15.1$  kPa (m) and  $49.5 \pm 13.3$  kPa (w). Significant differences were observed in the muscle hardness values of each muscle between the male and female subjects. In our previous studies, no significant differences were observed between men and women in the standing position. Furthermore, the hardness of the TS muscle was greater in the standing position ( $128.7 \pm 42.7$  kPa (m) and  $119.1 \pm 29.4$  kPa (w)) than in the prone position. Therefore, we suggest that posture and gender should be considered while evaluating muscle hardness. **References** Horikawa et al. (1993) *Med Biol Eng Comput* 31, 623-27. Murayama et al. (2008) 13th Annual congress of the ECSS Book of abstracts, 339 Murayama et al. (2012) 17th Annual congress of the ECSS Book of abstracts, 195

### NEUROMUSCULAR AND KINETIC CHARACTERISTICS OF KENYAN DISTANCE RUNNERS DURING HOPPING

Sano, K., Kunimasa, Y., Oda, T., Akiyama, M., Toyoda, Y., Oda, H., Nicol, C., Komi, P.V., Locatelli, E., Ito, A., Ishikawa, M.  
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**Introduction** The recent years have demonstrated the great success of the east African runners in general and that of the Kenyan runners in particular. Sallin (2003) suggested that one of the possible reasons for their high mechanical efficiency could be the special biomechanical make-up of these runners in their structures and interaction of muscle-tendon unit (MTU). Therefore, this study was designed as an attempt to examine if the elite Kenyan middle and long distance runners possess "such biomechanical qualities" that would help identifying reasons why they are consistently demonstrating performance of excellence in top level international competitions including the World Championship and Olympic Games. The purpose of this study was to examine the characteristics of the neuromuscular behavior together with kinetics during hopping exercises. **Methods** 10-elite Kenyan (KENYAN) middle- and long-distance runners and height-matched control subjects (CTRL) participated in this study. Subjects performed the repetitive maximal hopping exercises. The following parameters were measured during hopping: the medial gastrocnemius (MG) muscle fascicle and tendon length (LAT\_GAS) by musculo-skeletal ultrasonography, the ground reaction force, electromyography (EMG) for MG and soleus and tibialis anterior (TA) together with kinematics for longitudinal direction by high-speed video camera. **Results/ Discussion** The results clearly showed that KENYAN jumped significantly higher than CTRL. The contact time was shorter in KENYAN than in CTRL. The impulse ration of the push-off/braking impulses was significantly greater in KENYAN than in CTRL. The MG and TA averaged EMGs during the preactivation and contact phases were significantly smaller in KENYAN than in CTRL but not the SOL averaged EMG. Although the Achilles tendon stretching and shortening amplitudes were smaller in Kenyan than in CTRL, these results clearly indicate that KENYAN specific muscle-tendon characteristic together with lower EMG activities in KENYAN is likely to have contributed to the effective hopping performance and it may imply that there can be a specific fascicle-tendon behavior to utilize elastic energy effectively. **References** Sallin B. (2003) *New Studies in Athletics*. 18:15-24. **Acknowledgements** This work was supported by MEXT/JSPS KAKENHI Grant Number 23700756 and 23500729.

### RELATIONSHIP BETWEEN THE ACTIVATION LEVEL AND PRETENSION OF THE MUSCLE, AND ITS EFFECTS ON THE MECHANICAL CHARACTERISTICS OF KNEE EXTENSORS

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**Introduction** It has long been documented that a linear relationship exists between activation and tension level of the muscle under isometric contractions (Bigland & Lippold, 1954). Between the pretension and the extent of the following dynamic work also a linear relationship can be detected (Mungiole & Winters, 1991). The aim of this study was to explore whether the activation level or the pretension influences primarily the positive dynamic work. We hypothesized that when muscle is released at low pretension level the velocity of the subsequent concentric contraction will be low, but it can be compensated with maximum activation of the muscle resulting in maximum concentric contraction velocity. **Methods** Nine young ( $19.89 \pm 0.78$  yrs) subjects were measured in Multicont II dynamometer after warm-up. The maximal voluntary isometric contraction (MVC) of knee extensors was measured at 60 degree of knee angle. After reaching 100, 80, 60, 40, 20 % of MVC (QR100, 80, 60, 40, 20) the knee was released from static position and the knee extension started automatically. The pretension was reached in two different ways: with no time constraint (NTC) and with the shortest possible time (SPT). During the contractions the activation level of the isometric phase (rmsEMG) was measured at vastus lateralis (VL) muscle by telemetric EMG. Angular velocity ( $v$ ) and -acceleration ( $\beta$ ) were defined from 60 to 50 degrees at each concentric contractions. **Results** At NTC a significant ( $p < 0.01$ ) linear relationship was established between rmsEMG and pretension level. At SPT no significant relationship was observed between activation and pretension level. There was also a linear relationship between pretension level and  $v$  or rather pretension level and  $\beta$ , whereas in SPT the mechanical work was significantly greater at QR60, QR40 and QR20 compared to those in NTC ( $p < 0.01$ ). **Discussion** Our results indicate that the pretension and activation levels ought to be separated, because these are not related at maximal activation. The amount of positive work in NTC depends mostly upon the amount of elastic energy stored in the patellar tendon since pretension and activation of the muscles increased parallel. In SPT positive work was almost the same at all pretension level, so it can be concluded that maximum activation level is the dominant factor in producing work. However, it should be noted that the difference between the work generated without pretension and work estimated at different pretension level indicates the contribution of elastic energy stored during isometric contraction. **References** Bigland B, Lippold OC. (1954). *London J Physiol*, 123, 214-224. Mungiole M, Winters JM. (1992). *J Biomech*, 25(7), 696.

## KINEAMTICS, GROUND REACTION FORCE AND EMG COMPARISON OF OVERGROUND AND NON-MOTORIZED TREADMILL

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**Introduction** Motor drive treadmill is used by endurance training or exercise and measurement evaluation of a laboratory test such as Oxygen uptake (VO<sub>2</sub>Max). But a difference of stride length, step frequency and knee joint torque were reported by comparison of motor drive treadmill and overground in many research. Recently non-motorized with curve inclination-type treadmill (Curve :woodway) in a runway. However, there are few reports of the influence that special configuration (curve inclination) gives to human body during running movement of this treadmill and effective for practical use to training. The purpose of this study was to compare the kinematic, ground reaction force (GRF) and electromyography (EMG) parameter of non-motorized treadmill running (NR) to those of overground running (OR).

**Methods** Eight health young subjects (age:23.6±2.0yrs, BH:170.8±2.7cm, BW:67.0±8.9kg) ran 30m indoor overground and non-motorized treadmill was attached on force plate at 3m/s and 5m/s. Motion capture (VIOCN MX20 Oxford :200fps) and GRF(Kistler:1kHz) and Bipolar surface EMG (Noraxon :1.5kHz) data for three steps were recorded. As for the running velocity adjustment, as for OR photo cell, NR let velocity curve feed back to a subject. EMG affixed it to lateral gastrocnemius (GA), tibialis anterior (TA), a gluteus maximus (GM), vastus lateral (VL), vastus medialis (VM), rectus femoris (RF), biceps femoris (BP), erector spine (EP) which calculated average integrate EMG (iEMG) of three steps. Lower limb joint angle, GRF (Vertical:Fz, Horizontal:Fy) and EMG data were compared with between NR and OR. Results and Discussion Step frequency was significant difference of between NR and OR in both conditions (3m/s: NR 2.80±0.16 VS. OR 2.59±0.53 Hz p<0.001, 5m/s: NR 3.21±0.25 VS. OR 2.80±0.11 Hz p<0.001). Fz first impact was not observed in OR compared with NR. Statically significant difference in Fz peak force and Fz impulse were identified in 5m/s condition (Peak force:3.08±0.43VS.:3.34±0.34N/BW, p<0.05, impulse:0.320±0.027 VS.0.355±0.018N · sec/BW, p<0.001). Erector spine of NR was indicated tendency higher muscle activity than OR.

**Conclusion** Non-motorize treadmill (curve) was indicated that has high Step frequency and lower COM displacement running form. By Fz first impact lower, reduce an injury risk of a knee, and running training is enabled. References Wank, V., Frick, U. and Schmidtbleicher, D. (1998) *Int. J. Sports Med.*, 19: 455-461. Riley, P.O., Dicharry, J., Franz, J., Croce, U.D., Wilder, R.P. and Kerrigan, D. C. (2008) *Med. Sci. Sports Exerc.*, 40(6):1093-1100.

## IN VIVO MEASUREMENT-BASED ESTIMATION OF THE TRICEPS SURAE MUSCLE-TENDON UNIT LENGTH CHANGE DURING ANKLE JOINT MOVEMENTS

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**Introduction** The muscle-tendon unit (MTU) length is an important parameter that influences its mechanical functions. The triceps surae MTU length has been estimated on the basis of the equation derived from cadaveric measurements using ankle joint angle as an independent variable (Grieve et al., 1978; Hawkins and Hull, 1990). This estimation method is questioned by a recent in vivo study (Iwanuma et al., 2011) indicating that foot deformation caused by ankle joint movement affects the displacement of insertion of the MTU. Additional independent variables should therefore be included to improve the accuracy of the MTU length change estimation. This study aimed to newly develop a prediction equation of the triceps surae MTU length change, taking into consideration foot deformation during ankle joint movements.

**Methods** Healthy young women (n = 10) and men (n = 10) volunteered as subjects. Using a magnetic resonance imaging scanner, sagittal images of the right foot were obtained at rest and during contractions at 10° dorsiflexed, neutral, 10° and 20° plantar flexed ankle positions. The contraction levels were set at 30%, 60% and 80% of the maximal voluntary contraction of isometric plantar flexion. The triceps surae MTU length changes were determined as the displacement of the calcaneal tuberosity on sagittal plane. A multiple regression equation analysis (forced entry method) was used to develop an equation for estimating the triceps surae MTU length change. As the independent variables, the orientation of posterior segment (the line connecting the anterior vertex of talus and calcaneus tuberosity) relative to the longitudinal direction of tibia, the length of the posterior segment and the displacement of the anterior vertex of talus were measured in each condition.

**Results and Discussion** The regression analysis produced an equation with r<sup>2</sup> of 0.968 and the standard error of estimate of 1.5 mm (13.0%). The changes in the triceps surae MTU length estimated by the newly developed equation were similar to those obtained by in vivo measurements. Bland-Altman plot did not show a systematic error of the developed equation. These results indicate that the present equation is useful to estimate the change in the triceps surae MTU length during various ankle joint movements. References Iwanuma S, Akagi R, Hashizume S, Kanehisa H, Yanai T, Kawakami Y. (2011). *J Biomech*, 44(14), 2579-83. Grieve DW, Pheasant S, Cavanagh PR. (1978). *Biomechanics-VI-A*, 405-12. Hawkins D, Hull ML. (1990). *J Biomech*, 23 (5), 487-94.

## QUANTIFICATION OF IMPACTS IN ARTISTIC GYMNASTICS WITH ACCELEROMETRY: AN APPROXIMATION

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Intensity and volume of training in Artistic Gymnastics are increasing as the sooner athlete's age of incorporation creating some disturbance in them. Intensity is commonly measured through impacts and impulses registered by force platforms which suppose a medium-large size and difficult access device for coaches during training sessions. In contrast, accelerometers are smaller, non-invasive and easy-access devices than those ones. The aim of our study was to find the relation between impacts measured with force plate and accelerometers to assess accelerometers values that could be useful to quantify the intensity of gymnast training. Seven female (n=7) gymnasts performed three sets of jump test (SJ & CMJ) and landing test (LT). Accelerometer was fixed on the gymnast's lower back. Peak vertical ground reaction force (N; %BW) and vertical acceleration (m·s<sup>-2</sup>) during take-off and landing phases as variables were collected to establish a significant correlation between both. There was no significant correlation between vertical force and vertical acceleration values of each test. Results could be influenced by different study limitations as the sample size or the location and sample rate of the accelerometer. This study showed an initial approximation for further research works. It is required to solve some limitations in order to assess that accelerometers, as small and unobtrusive devices, could be a valid and reliable tool for quantifying the intensity of training sessions in Artistic Gymnastics.

## EFFECTS OF A SIMULATED GAME ON STRENGTH, ELECTROMYOGRAPHY AND PERFORMANCE OF THE KICK IN FUTSAL PLAYERS.

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**INTRODUCTION** Futsal is composed by intermittent motor actions, however, there are no reports in the literature about studies assessing the influence of the game on biomechanical and performance variables of finishing kick. Thus, the aim of this study was to analyze the peak force (PF), electromyography (EMG) and peak ball speed (PBS) pre and post a simulated game of futsal. **METHODS** Eight participants performed three maximal voluntary isometric contractions (MVC) of 5 s duration and 1 min interval, sitting 90° angle at the hip and knees, pre and post of futsal game simulation. During the MVCs, EMG was monitored from vastus lateralis (VL) and biceps femoris (BF), as well PF. The game was simulated in 4 periods of 6 min. At the beginning, at the end of 2nd period, before the 3rd period and at the end of the game, a set of three finishing kick from 10 m to goal was performed and monitored by lateral video recording. The blood lactate concentration ([Lac]) was monitored in every event mentioned. **RESULTS** Significant differences were found pre and post game for VL for the integrated EMG (iEMG ( $\mu\text{V}\cdot\text{s}$ ), pre=1858.79 $\pm$ 534.70, post=1619.10 $\pm$ 570.48; p=0.004) median frequency (MF (HZ), pre=63.79 $\pm$ 5.40, post=66.58 $\pm$ 7.53; p=0.027), and PF (N) (pre=906.00 $\pm$ 145.77 post=808.63 $\pm$ 93.58; p=0.044). The PBS (km/h) were 93.88 $\pm$ 6.65, 97.29 $\pm$ 7.67, 98.19 $\pm$ 11.89 and 102.77 $\pm$ 15.36 obtained in the 1st, 2nd, 3rd and 4th sets, respectively, and were not significantly different. The average [Lac] was 3.85 mmol/l. **DISCUSSION** The drop of the PF agrees with the findings of Krstrup et al., (2011) in similar protocol with soccer. The same behavior was observed for the iEMG of VL, however, no significant differences were found in PBS, possibly because the participants, even in a decreased muscle activation scenario, still be able to increase the fast twitch fibers recruitment (Miller et al., 2012) to kicks execution, evidenced by a significant increase in MF of the VL. These findings may also be result of reduced intensity of the game simulation, because the average values of [Lac] were lower than found by Castagna et al., (2009), or familiarization with the tasks (MVC and finishing kicks). In conclusion, it is possible that neuromuscular activation (iEMG) reflects directly the peak force capacity, evidenced by a decrease in both at the post game, and the increase of MF, together with the effects of familiarization with tasks and underestimated intensity of game, may have caused the PBS maintenance. **REFERENCES** Krstrup et al., (2011). *Eur J Appl Physiol.* 111(12):2987-95. Castagna et al., (2009). *J Sci Med Sport.* 12(4):490-4. Miller et al., (2012). *Percept Mot Skills.* 114(3):847-56.

## TRUNK STABILITY DIFFERENCES BETWEEN KAYAKERS, JUDOKAS AND RECREATIONAL ATHLETES

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**Introduction:** Although unstable sitting and sudden trunk loading paradigms have been successfully used to assess trunk stability (TS) in pathological populations (Dieën et al., 2010), they have not been used to study the influence of sport practice on TS. The aim of this study was to compare the effect of practicing judo, kayak and recreational physical activities on TS. **Methods:** 12 judokas, 6 kayakers and 16 recreational athletes took part in this study. A battery of static and dynamic tests was performed to measure trunk postural control and dynamic stability while sitting on stable and unstable seats placed on a force plate (Kistler 9286A). Postural and dynamic sway were assessed by analyzing the mean radial error of the COP displacements. In order to measure the trunk response to sudden and unexpected trunk loading in anterior, posterior and lateral directions, the angular displacement and the stiffness of the trunk were calculated for the first 150 ms. In addition, trunk flexor and extensor muscle condition were measured by isokinetic dynamometry (Biodex®). Peak torque and maximum work, and final fatigue ratio, were calculated to assess trunk muscular strength and endurance, respectively. **Results:** Kayakers showed lower mean radial error in unstable dynamic balance tasks and lower trunk stiffness in anterior sudden loading (p<0.05) than judokas and recreational athletes. In addition, judokas and kayakers showed higher trunk flexor endurance (p<0.05) than recreational athletes. **Conclusion:** The kayakers showed better results in unstable dynamic balance tasks and lower stiffness after loading, which could be related to the efforts they do regularly to maintain balance on the kayak. These results support those of Reeves et al. (2006), who observed that an increase of trunk stiffness may impair postural control on unstable sitting. **References:** Dieën JHv, Koppes LJ, Twisk J. (2010). *Spine* 35, 812–817. Reeves NP, Everding VQ, Cholewicki J, Morrisette DC. (2006). *Exp Brain Res* 174, 694-700.

## RELATIONSHIP BETWEEN CORE STABILITY VARIABLES: TRUNK POSTURAL CONTROL AND DYNAMIC STABILITY, TRUNK RESPONSE TO SUDDEN LOADING AND TRUNK MUSCLE STRENGTH AND ENDURANCE

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**Introduction:** The importance of core stability in athletic function and injury prevention is being increasingly recognized (Borghuis et al., 2008; Kibler et al., 2006). However, the assessment of core stability is very complex as it requires the combination of different variables (Borghuis et al., 2008), as for example, trunk postural control, trunk dynamic stability, trunk response against sudden perturbations and trunk muscle strength and endurance. The aim of this study was to analyze the relationship between all these variables. **Methods:** 26 recreational male athletes took part in this study. A battery of static and dynamic tests was performed to measure trunk postural control and dynamic stability while sitting on stable and unstable seats placed on a force plate (Kistler 9286A). Postural and dynamic sway were assessed by analyzing the mean radial error of the COP displacements. In order to measure the trunk response to sudden and unexpected trunk loading in anterior, posterior and lateral directions, the angular displacement and the stiffness of the trunk were calculated for the first 150 ms. In addition, trunk flexor and extensor muscle condition were measured by isokinetic dynamometry (Biodex®). Peak torque and maximum work, and final fatigue ratio, were calculated to assess trunk muscular strength and endurance, respectively. **Results:** Significant correlations were not found between most of the variables. However, higher trunk stiffness and lower angular displacement against anterior sudden loading correlated with a higher mean radial error of the COP displacements during a dynamic test on unstable sitting (circular trajectory). In addition, higher maximum work during the trunk flexor and extensor dynamometric test correlated with a lower angular displacement of the trunk against lateral sudden perturbations. **Conclusion:** The lack of relationship between most of the variables that have been associated to core stability confirms the complexity of its evaluation and indicates that many different measures are needed to explore all the components of core stability in recreational athletes. **References:** Borghuis J, Hof AL, Lemmink KA. (2008). *Sports Medicine* 38, 893-916. Kibler WB, Press J, Sciascia A. (2006). *Sports Medicine* 36, 189-98.

### EFFECTS OF LONG-TERM DETRAINING ON PHYSICAL FITNESS AND BODY COMPOSITION IN JAPANESE JR. YOUTH SOCCER PLAYERS

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**Introduction** It has often been pointed out in the previous studies that regular training generally improves physical fitness (Helgerud et al., 2001). On the other hand, there is little literature researching especially on detraining in adolescent soccer players. Therefore, the purpose of this study was to investigate physical fitness and body composition during long-term detraining in Japanese Jr. youth soccer players. **Methods** Thirty male Jr. youth soccer players (age;  $14.4 \pm 0.5$ yr, height;  $165.4 \pm 6.1$ cm, body mass;  $52.5 \pm 5.9$ kg, %fat;  $11.8 \pm 4.1$ %) volunteered to participate in this study. Subjects were assigned to either a training group (TR;  $n=19$ ) or a detraining group (DT;  $n=11$ ). TR group did about two-hour training six days in a week, on the other hand, DT group did physical education classes (50min/times) only twice a week. Before and after the training and detraining period (from August to February, 7 months), subjects underwent the following fitness tests: squat jump (SJ), countermovement jump (CMJ), countermovement jump with arm (CMJWA), and 6 jump (6J) using a jump mat (multi jump tester, DKH, Japan), 30m sprint test using a photocell gate (coach's monitor, Brower, USA), and Yo-Yo test level 1. In addition, height and body composition were measured with a body composition analyzer (BC-305, TANITA, Japan) before each test. **Results & Discussion** In both groups, height and body weight were significantly increased after experimental period. Body fat (%) in the TR group was not significantly changed after the experimental period, whereas it significantly increased in the DT group (from  $12.4 \pm 3.9\%$  to  $14.7 \pm 5.0\%$ ,  $p < 0.05$ ). In the DT group, SJ, CMJ, CMJWA, and 6J were significantly decreased after the experimental period ( $p < 0.05$ ), on the other hand, those in the TR group were not significantly changed after the experimental period. The difference in sprint time before and after the period was significant in both groups ( $p < 0.05$ ). Running distance for Yo-Yo level 1 test in the TR group was significantly improved from  $1931 \pm 287$ m to  $2476 \pm 332$ m ( $p < 0.05$ ), whereas that of the DT group was significantly decreased from  $1902 \pm 320$ m to  $1392 \pm 311$ m ( $p < 0.05$ ). In addition, there was significant difference between the TR and DT groups ( $p < 0.05$ ). These results suggested that long-term detraining affected several aspects of physical fitness and increased %fat in the case of Japanese Jr. youth soccer players. **References** 1. Helgerud, J. et al., Aerobic endurance training improves soccer performance. *Med Sci Sports Exerc.* 33: 1925-1931, 2001 2. Mujika I and Padilla S., Cardiorespiratory and metabolic characteristics of detraining in humans. *Med. Sci. Sports Exerc.*, 33: 413-421, 2001

### PERIODIZATION: A SIMPLIFIED MODEL

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**Introduction** The system of periodization of the training proposed by Russian scientist Ph.D. Leev Pavlovitch Matveev, in the 50s, based on the theory of General Adaptation Syndrome, became a reference among the coaches of the era, popularizing up worldwide. Some models appear to resolve particularities in each context. According to Gomes (2002) starting in 1970, when it starts the questioning of the classical models of planning, new proposals appeared and an expansion of knowledge in this area. The principles of sports training should be respected by the coach to develop a periodization, and this should know well the concepts of energy systems predominant in the sport to be trained, the theory of general syndrome and supercompensation. **Methods** The proposal adapted by Silva, F.T. starts in the 80s, is called simplified model by the author, by objective form connecting the tasks. Using file formats, the macrocycle similarly to classical model, may to plot the days, periods and phases, however it is proposed mesocycle controls where motor skills are indicated along with the methods and means of training, in this control still show up the location execution training tests indicating chosen. **Discussion** In a study by Dantas et. al (2008) the index of comprehensiveness - IABRAN (in Portuguese) - was demonstrated among authors studied Verkoshanski (2.68), Matveev (3.80), Bompa (3.2), ATR (2.93), Forteza (2.73), only the periodization model of Matveev (Classical) presented a suitability very good. Most studies, including this one, the simplified model of periodization were supported on Traditional System of Periodization. **Conclusion** The proposed application of the simplified model allows objectively its monitoring and control, even for coaches still with little experience, is indicated for the beginner or amateur level of competition. And also is possible use this planning of training focused on health. **References** Dantas, E.H.M. Abrangência dos Modelos de Periodização do Treinamento Esportivo. *Revista Brasileira de Ciência e Movimento*, Vol. 16, No 4. 2008. GOMES, A.C. Treinamento Desportivo - Estruturação e Periodização. p. 41-166, Porto Alegre - RS: ArtMed, 2002. MATVEEV, L.P. Metodologia e Treinamento. *Treino Desportivo*. Guarulhos: Phorte Editora, 1997.

### FEMALE'S 100 METRES RUNNING DYNAMICS

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**Introduction** Sprinting speed has certain dynamics constantly changing throughout the sprint race phases. The velocity curve of top-level sprinters running over the 100m course are already well known, but no one has yet evaluated the sprinting activity of female athletes who have not been trained for sprinting. Therefore, the quality and development of these abilities is becoming even more interesting for training practice. The aim of this study was to determine the 100m running dynamics of female athletes as well as differences of different quality groups. **Methods** The participants were 78 physically active females (age (mean $\pm$ SD)  $20.1 \pm 0.74$  years; height  $167.75 \pm 7.35$  cm; body mass  $60.07 \pm 7.28$  kg). Measurement was conducted by means of an electronic measurement device. Dynamics of sprinting over 100m has been observed across ten segments of ten metres each. The hierarchical cluster analysis (Ward, 1963) has been used to determine relatively homogeneous female groups of different sprinting characteristics (seconds (mean $\pm$ SD) G1  $16.48 \pm 0.21$  (N=9); G2  $14.81 \pm 0.21$  (N=18); G3  $15.28 \pm 0.24$  (N=22); G4  $13.11 \pm 0.37$  (N=8); G5  $14.07 \pm 0.26$  (N=21)). The segment of maximum sprinting speed has been determined for each analysed group. The values of maximum sprinting speed have been reduced by the standard deviation typical for each group. Differences between groups have been analyzed by the ANOVA. **Results** The following segments of sprinting dynamics over the 100m course are known: starting acceleration (0-30m), achieving maximum sprinting speed (30-60m), maintaining maximum sprinting speed (60-80m) and deceleration. In this study more segments have been found: 8 in groups 1 and 2; 7 in group 5; 6 in group 4 and 4 in group 3. The length of particular segments has varied. In starting acceleration, which is a very dynamic part of sprinting, two

segments have been obtained in all observed groups (0-20m). The segment of achieving maximum sprinting speed has become the segment of maintaining maximum sprinting speed which is 20m long in groups 1 and 5 (20-40m) and in groups 2 and 4 (40-60m) whereas in group 3 it is 30m long (20-50m). Discussion According to the length of the segment of maximum sprinting speed, it is possible to conclude that all these groups haven't got efficient running techniques and according to the competition activity, it imposes higher demands on specific sprinting speed endurance. The present study is the first one on females in which the obtained and presented results indicate a quite different structure of running dynamics, although, to be fair enough, certain researchers have pointed to different velocity curves during the course of the 100m sprint event, except in case studies observing world-class sprinters. We assumed that the determination of running dynamics over 100m, performed by the track-and-field's criteria in non-sprinting examinees, would contribute to establishing certain sprinting regularities. In other words, we have tried to indicate the facts that might limit the progress in learning how to sprint over short courses.

### **SOCCER TRAINING PROGRAM TO IMPROVE TECHNICAL SKILL IN OLISTIC VISION**

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Introduction Team sport activity is composed of conditional, technical, tactical features of performance and uses the periodization to put in practice strategies, methods and teachings to develop the individual and collective group skills, to aim to the best goals. (Manno 2002). The periodization includes the division of the training year in specific periods with well-defined aims. (Raiola, 2012) The matter of the research is to verify the conditional improvements reached by the training time and the performance peak close to the competitive time. Method The research has been carried out on two athletes, who have been subjected to several athletic tests. The Tests have been carried out: At the beginning of the preparatory period, At the end of the loading period, At the end of the transformation period (which coincides with the beginning of the competitive period), those tests allowed us to see the improvements reached on different phases of periodization; improvements achieved through the training proposed, based on a gradual load increasing. Results All tests have shown improvements on both the athletes: in the strength peak test (1 Repetition Maximum in half-squat) the athlete n°1 went from 80 kg to 124 kg of the preparatory period of the competitive period, while the athlete n°2 increased from 81 kg of the training period to 114 kg of the competitive period; for the Cooper test the athlete n°1 went from 2960 meters covered by the run-up to 3440 meters on the competitive period, while the athlete n°2 from 2234 meters to 3013 meters on the same period. Discussion The research results show both the athletes improved their conditional skills, and reached the performance peak on the transformation period ending, that coincides with the competitive period beginning. So, the criterion of the gradual loading and the training complexity allows the nervous system to arrange itself progressively and gain improvements, from a quantitative point of view (Oliveira). For this research and for the future mainly, my studies are drawn from the training led by the coach José Mourinho and his staff, through the years. The objective of future researches will be to collect scientific data not only quantitative, as in this, by performing new tests to show the improvement reached using these training methods also from a qualitative point of view. References Manno R. (2002) L'allenamento della forza. Utet, Italy. Oliveira R. / a planificação, programação, e periodicidade do treinamento em futebol. Raiola G., (2012) Controllo e apprendimento motorio, EDISUD, Salerno, Italy.

### **PILOT STUDY ON FOOTBALL PERIODIZATION IN OLISTIC WAY**

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Introduction The research is based on the concept of periodization in the annual training program according to ecological-approach in an olistic vision (Raiola 2012). The subject developed focuses on the concept of periodization, which means the division of the training season in specific periods with clearly defined aims. The goal of the study is to detect the improvements we are at different stages of periodization, that are expected to reach their peak in the competitive period (Bompa 2005) The study has been conducted on the activity of two 22 years old males athletes of a Soccer Team of University Portuguese League to aim the difference. Methods It is utilized an experimental approach by the test of Maximum Strength, Endurance, the Cooper's test and BMI, which helped us to evaluate the improvements of physical performances at different stages of periodization. At the base of periodization, there is the "principle of progressivity of cargo and physiological adaptation". The exercises during the strength training are designed in order to reproduce the technical model in soccer such as tracing movements similar to it, to be executed repeatedly, in order to facilitate the learning. The imitation of technical skills involves the chain of muscles in a way similar to the one used in the analyzed discipline. The exercises and training methods, therefore, must be directed to the movements or the situation that emulate in the match, so as to increase the discharge of motor neurons and to induce the muscles to express athletic movements made of high power and speed. Results From the data obtained we can see how both players have got improvements to all conditionals aspects of in question, especially about the VO2 max test (Cooper test) where the player n.3 from preparatory phase to agonistic has improved 270 meters, and the player n.4 has improved 490 meters. Discussion From the data obtained we see how both athletes, as desired, they reach the peak at the end of the processing period (which coincides with the beginning of the agonistic period). This simple quantitative research is a base for new future studies to be carried out on several samples and with new evaluation tools to validate training further upon the principle of progressivity of the load. References Bompa T. (2005) Periodization training for sport, Human Kinetics, Italy Raiola G (2012) La complessità dello studio in ambito educativo sportivo, Pensa, Lecce, Italy

### **FOSTERING LIFE SKILLS IN ADOLESCENT ATHLETES: LEARNING SITUATIONS REPORTED BY COACHES IN TWO SPORT CONTEXTS**

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Introduction Sport participation should not only promote an active lifestyle and develop motor skills in adolescent athletes, it should also foster life skills development (Côté & Fraser-Thomas, 2007). The purpose of this study was to explore how coaches in two different sport contexts gain their knowledge about life skills and the strategies to teach them in adolescent athletes. Methods The authors conducted a qualitative multiple-case study (Yin, 2009). Semi-structured interviews were held with 24 coaches working in school sport (12 basketball coaches) and amateur sport (12 swimming coaches). All coaches followed a holistic, athlete-centered approach. In the interviews, coaches described how they learned to teach life skills. The discussions were guided by Werthner and Trudel's (2006) model, such that the

coaches' learning processes are categorized into three types of learning situations: (a) mediated, (b) unmediated, and (c) internal. The authors transcribed the interviews, analyzed them deductively and inductively and conducted cross-case analyses. Results The data analysis sheds light on the diverse learning situations in which coaches have gained their knowledge. The results reveal that coaches in the two sport contexts learn principally through internal learning situations, specifically through retrospective reflection-on-action. Discussion Generally, the coaches in this study seek learning proactively, following an individualized learning process. The main results are discussed in light of the literature on life skills in sport, positive youth development, and coaching education. These new findings extend the discussion on coaching development. References Côté, J., & Fraser-Thomas, J. (2007). Youth involvement in Sport. In P. R. E. Crocker (Ed.), *Sport Psychology: A Canadian perspective* (pp. 266-294). Toronto: Pearson Prentice Hall. Werthner, P., & Trudel, P. (2006). A new theoretical perspective for understanding how coaches learn to coach. *The Sport Psychologist*, 20(2), 198-212. Yin, R. K. (2009). *Case study research: design and methods* (fourth edition). Thousand Oaks, California: SAGE Publications.

### **MOTOR IMAGERY AS A TOOL TO IMPROVE ARTISTIC GYMNASTIC PERFORMANCE.**

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**Introduction** The motor imagery is a cognitive process of mental simulation of actions in absence of movement (Jeannerod, 2006). There are two methods to improve skills learning through motor imagery: in first person and in third person (Rymal, 2009). The biological basis on which the motor imagery theory is founded, is formed by: mirror neurons. The aim wants to evaluate the effects of motor imagery practice in training (Rizzolatti, Sinigaglia 2006). The aim is to verify the effects and the potential benefits of motor imagery. (Raiola, 2012). **Methods** It is an experimental approach and it consists of two steps: 1) To administer the questionnaire (Curry et al. 2004). The participants are asked to evaluate the sensation of their own motor act and then their mate's one in accordance with valuation methods of Italian federation of artistic gymnastics. The data will be compared with those of judge/technician. 2) The means used in the second part of the study is the video recording. The participant are given the vision of their own motor gesture that will be stopped and the participant are asked a final forecast of the performance result. The data will be compared with those of judge/technician. The objective is to evaluate if there is assonance between the data. **Results** By the data it is observed a more effective internal evaluation and also an improvement in the performance on about 80% of the gymnasts that performed the round-off flic; with reduction of error of from 1 to 2.5 points. In a time of 6 months. In accordance with the judgment of a technician/judge. **Discussion** In this study two basic aspects of the performance are examined: the motor execution and the motor imagine. Both share the same neuro-motor mechanism: the motor imagery. Concerning the woman artistic gymnastics, it can be useful during the training and the race. So providing the athletes and trainers of a means which uses the motor imagery as a possible application for the improvement of the performance. So in conclusion, the study aims to provide a standard training feasible on a large scale to train the cognitive and physical abilities of an athlete and provide a support tool in the race in order to improve performance, optimize time and to reduce the margin of error. **References** Curry, L.A., & Maniar, S. D. (2004). Academic course for enhancing student-athlete performance in sport. *The sport Psychologist*, 18, 297- 316. Jeannerod, M. (2006). *Motor cognition: What actions tell the Self*. Oxford University Press. Rizzolatti G, Sinigaglia C, (2006) *So quel che fai. Il cervello che agisce e i neuroni specchio*, Raffaello Cortina Editore, Milano. Rymal A M, Ste-Marie M (2009) *Does Self-Modeling Affect Imagery Ability or Vividness* *Journal of Imagery Research in Sport and Physical Activity* Raiola G., (2012). *Controllo motorio ed Apprendimento*, Edisud, Salerno, Italy

### **DECISION MAKING IN EDUCATION OF GOALKEEPER IN FOOTBALL**

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**Introduction** Decision making is a cognitive process through which an athlete elaborates fastly exteroceptive and proprioceptive informations related to the space-time situation that he is currently living, extrapolating just those useful to motor action (Raiola, 2008). The stages that individuals use to transform inputs into output are three: Stimulus identification, Answer selection and Answer planning (Schmidt & Wrisberg, 2000). The time taken to transform the input into output is said reaction time. The aim of this study is monitoring and evaluation of three phases: initial, intermediate and final; two different methods to train the goalkeeper with the use of the applications of decision making theory. **Methods** It is an experimental approach and it uses worksheets. It is formed by two steps: in the first step where coach will shoot 36 penalties (12 high, 12 low and 12 at half-height) giving informations to goalkeeper at first using a verbal language (shouting... "I'm shooting at your right" or "I'm shooting to your left") then a paraverbal language ("if coach lift right arm he will shoot penalty at goalkeeper right side whereas if coach lift left arm he will shoot penalty at goalkeeper left side" or "if coach lift right arm he will shoot at goalkeeper left side whereas if coach lift left arm he will shoot at goalkeeper right side"); in the second step goalkeeper must prove to keep 25 penalty shot by 5 different players. **Results** By the data collected in the three different steps it is observed an improvement of skills to oppose and to neutralize a penalty and it is observed an improvement of skill to filter the informations taking only the useful for the own motor act for 80%. **Discussion** So providing the goalkeeper trainer, especially the beginners, a new means, which uses the process of decision, training methodology that aims to increase goalkeeper decision making in a critical moment such as a penalty. The efficacy of this study can be recognized in contexts motor-sports at all levels. The objective of future researches will be to collect scientific data not only qualitative, as in this, by performing new tests to show the improvement reached using these training methods also from a quantitative point of view. in order to implant a training program appropriate to improve the motor skills of goalkeepers. **References** G. Raiola (2008), "il ruolo della didattica negli ambienti di apprendimento educativo-sportivi", aracne, Roma, Italy. Schmidt, R.A., Wrisberg, G., A. (2000), "Motor Learning And Performance, Human Kinetics, ChampaignIL", USA.

### **ACUTE PHYSIOLOGICAL RESPONSES TO SIMULATED GAMES WITH DIFFERENT DEFENSIVE FORMATIONS IN TEAM HANDBALL: 6-0 VS. MAN-TO-MAN**

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**Introduction** Although 6-0 and man-to-man defensive formations in team handball (TH) are widely used, there is little information with regard to their physiological impact. Therefore, the aim of this study was to examine the acute effect of two simulated games, one using 6-0 and the other man-to-man, on measures of neuromuscular performance in young TH players. **Methods** Eleven TH field players (experience 4.3±0.7 yr, training 6.5±1.6 h.wk<sup>-1</sup>, age 15.1±1.0 yr, weight 73.7±9.7 kg, height 1.77±0.07 m), all members of an academy of a

first league club, played two 20-min simulated matches (separated by two weeks). They were tested before and after each match for handgrip strength (HS), squat jump (SJ) and 20-m Sprint (acceleration phase 0-10 m, Sprint0-10, and maximum speed phase 10-20 m, Sprint10-20). Results The formation 6-0 resulted in the decrease of Sprint (+0.08 s, 95% CI (0.03; 0.12)), Sprint0-10 (+0.05 s (0.01; 0.10)) and Sprint10-20 performance (+0.03 s (0; 0.05)), while the man-to-man formation caused decrease in HS (-3.1 kg (-5.2; -1.0)). Comparing the two formations, the 6-0 had larger effect on Sprint performance (+0.07 s (0.01; 0.12)), while the man-to-man had a larger effect on SJ (+1.4 cm (0; 2.7)). The formation 6-0 and man-to-man resulted in similar mean (179.8 vs. 180.0 bpm) and maximal heart rate (193.7 vs. 196.0 bpm). Conclusions The findings of this study indicate that the choice a defensive formation in TH may result in different physiological responses that are associated with neuromuscular performance. Knowledge about the physiological impact of each formation can help coaches to optimize the use of the various formations during the game and to use them during training in order to elicit different physiological responses.

### **CLIFF DIVING PERFORMANCE: A MODEL TO EVALUATE IMPACT AND TECHNIQUE FOR VIDEO TRAINING**

Napolitano, S., Tursi, D., Raiola, G.

*University of Salerno*

Do not insert authors here Introduction The sport of cliff diving was born fifteen years ago, and has gained enormous success. Beginning in 2013, in light of the World Swimming Championships, the Italian Swimming Federation (FINA) has added this sport among the official swimming disciplines present in the competition. This highly spectacular sport complies particular motary and psychological abilities, which are not possible to train for lack of specific sports facilities. In competitions, the starting platforms are at a height of 25-28 meters, and the impact with the water is at a high velocity that stimulates the entire body in little time (Richard G., al 1967). The goal is to calculate the impact with the water, its form and the hypothetical consequences on the body using video training (Yuan Xiong, ed al 2004) . Methods This study uses three distinct approaches: a case study of single performances, the descriptive research for the contribution of the evaluation of the analyst, and the constitution and elaboration of the data for the contribution of the physics expert. The model consists in the total of three performances of three international competitions: • 2 Red Bull Cliff Diving World Series competitions • 1 World Championship competition The single dives were analyzed, compared with overlapping displays of the performances, the analysis and decoding of the video given by the analyst and the technical expert in the field on water entry with Kinovea software. This specific software was used for simulations...data of coefficient of water impact and entry. Results For each dive impact incidence and eventual consequences on the athlete were calculated. For each athlete both the positive and the negative aspects of their performances were located. The evaluation of the data collected (each single dive for each single athlete, total nine dives each) allowed an individual hypothetical model to use pre-competition. Discussion The results can be used by the athletes themselves, using the video education method, and by technical trainers for training, for the analysis and specific evaluation during competitions according to learning skills theory (Raiola 2012). Furthermore, a more in depth study will be able to demonstrate the danger and the consequences on the athletic organism in Olympic competition. Keyword: video analisi, Kinovea, videoeducation, videodidactics REFERENCES Yuan Xiong, Yi Zhang A Learning-based Tracking for Diving Motions Proceedings of the Third International Conference on Image and Graphics (ICIG'04) 0-7695-2244-0/04 \$20.00 © 2004 IEEE Richard G. Snyder, PhD., and Clyde C. Snow, M.S.. "Fatal Injuries Resulting from Extreme water Impact" Reprinted from Aerospace Medicine, Vol 38, No8, Agust,1967. Von Karman, T. (1929) The impact of seaplane floats during loading, NACA TN 321, October, Washington R.M Alexander, "A minimum energy cost hypothesis for human arm trajectories," Biol. Cybernetics, Vol. 76, pp.97-105, 1997. Raiola G (2012), Motor control and learning, Edisud, Salerno, Italy

### **STUDY ON POSTURE IN RELATION TO DISEASE-WELLNESS IN FEMALE WATER POLO**

Napolitano, S., Cerrotta, M., Tursi, D., Raiola, G.

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Do not insert authors here Introduction The study examines the postural effects on the wellness and the performance of fourteen professional female water polo athletes. (Téczy T Á 2006) There are no written studies on water polo, probably because it is assumed that there is no pain because Archimedes's formula opposes the force of gravity. Currently athletes carry out exercises to compensate and to avoid any eventual pain that then disappears when they are out of the water according to motor control and learning theory (Raiola 2012). The aim is to understand the phenomenon in professional athletes using a tridimensional analysis of the surface of the torso and the baropodometric platform. Methods and Materials This consists in examining the "3D" surface of the torso of fourteen professional water polo athletes, participants in the Italian Championship in the A1 series, and the data of the baropodometric platform. This data highlights curves that will then be considered with regards to athletic performance and well being. The data of performance and well being of the athletes is collected by a trainer for each single athlete. The study was carried out at the specialized center CORPORA of Gricignano (CE) with the following apparatus: "Formetric Spinometer". This allows the morphological 3D image of the torso, with extreme accuracy (error below 0,2 mm), speed, and safety thanks to the radiation free equipment. The postural Formetric check-up supplies a series of indicators which together give a detailed evaluation of the subject's posture. For each athlete a synthesis chart was elaborated, showing a 3D reconstruction of the surface of the torso and the individualization of specific postural parameters with the data collected by the trainers on the athlete's performance and well being. This data was elaborated using a statistic model of linear regression Results The evaluation of the data shows no existent correlation between cases with pseudo pathological curves and their state of well being and performance. While athletes with a near perfect exam often complained about occasional pain. Discussion There is a paradox regarding affection, performance and pain; in some cases it is low, while in some cases, it is the opposite. The results of the Archimedes's principle and the force of gravity probably produce physiological adjustments in water. Keyword: Spinometria Formetric, postura, performancesw REFERENCES Teczely, T., Á, (2006), Investigation of postural stability, reaction time and body measures in basketball players, Acta Physiol Hung. 2006 Jun ;93 (2-3):107-16 17063622 Raiola G (2012), La complessità dello studio in ambito educativo sportivo, Pensa, Lecce, Italy

### **VIDEO ANALYSIS OF ARMSTROKES IN FEMALE WATER POLO: EVALUATION AND INCIDENCE OF THE BALL DURING SWIMMING**

Tursi, D., Napolitano, S., Di Tore, A., Raiola, G.

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Introduction Water polo is a team sport which alternates moments of high intensity where players, with and without possession of the ball, jump, throw, and moments of low intensity and pauses. But, it is also a contact sport where athletes battle against adversaries,

withhold and push them. (Smith, 1998; Van der Wende, 2005). Swimming plays an important role in water polo, as it is used during most of the game. "Water polo consists of high intensity bursts of sprinting, interspersed with short periods of low to moderate intensity swimming." (Hohmann A & Frase R, 1992). Under this aspect the swimming preparation is therefore a determining aspect. Swim training conditions play a constant role in order to obtain the best results (Raiola et al, 2011). The goal of this study is to evaluate the transport incidence of the ball during high intensity swimming, so we are able to supply trainers with useful elements regarding training methodology to use. Materials and Methods The approach to this study consists of two distinct methods: the case study for the technical contribution and evaluation for the analysis of single performances, and theoretic argumentation to elaborate a complete picture in which we define the data. Eleven high level athletes were recruited (participants of Italian championships of the A1 series), and they were tested in 300 Quick Race, once swimming with the ball, and once without. An average was calculated for each athlete, the fastest and the slowest with, and without, the ball. Furthermore, each athlete was filmed in order to analyze the angle of the arm strokes. The analysis was conducted separately for each athlete and each test. Results The data of the athletes' fastest and slowest average times was collocated in charts and histograms, and a linear graph was created comparing the two tests (with and without the ball) of each single athlete. Discussion The data collected shows that swimming in possession of the ball does not always have a negative effect in high intensity swimming. The result can be read in correlation to the athlete's history: high level athletes do not undergo any significant time variation, players that have a professional swimming history noticeably worsen their times, and athletes with a background in water polo improve their times. The video analysis shows a notable difference in the angles of the arm strokes. The results demonstrate how this study can be used as a valid instrument to help trainers use training strategies aimed to improve particular abilities that were analyzed in a unique way and therefore create a specific training regimen to improve performance. References • Raiola G., Capasso A., Di Tore A., (2011), Planning and periodization in swimming: a case study Scientific Report Series Physical Education and Sport, no 15 (1/2010), Pitesti, Romania • Smith, HK. (1998), Applied physiology of water polo. Sports Med.;26(5)317-334.

### **FOSTERING LIFE SKILLS DEVELOPMENT IN HIGH SCHOOL AND COMMUNITY SPORT: A COMPARATIVE ANALYSIS OF THE COACH'S ROLE**

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Introduction Researchers largely agree that the coach is the most significant shaper of values and life skills in adolescent athletes (Danish, Fazio, Nellen, & Owens, 2002; McCallister, Blinde, & Weiss, 2000). Therefore, the aim of this study was to gain a deeper understanding of coaches' perceptions of their role in the development of life skills in adolescent athletes in two different sport contexts. Method A qualitative multiple-case study (Yin, 2009) was conducted. Semi-structured interviews were held with 24 coaches working in school sport (12 basketball coaches) and amateur sport (12 swimming coaches). All coaches followed a holistic, athlete-centered approach. Coaches described the life skills they taught, their motivations, and the strategies they used to foster life skills development in practice. Interviews were transcribed, then analyzed deductively and inductively, followed by cross-case analyses. Results First, results revealed that the coaches taught many common life skills between the two contexts, notably self-confidence and respect. Second, two main motivations for teaching life skills emerged: athletes' needs and coaches' personal values. Third, the most often cited teaching strategies were general discussions, established rules, individual and specific interventions, goal setting, feedback, maintaining high expectations, and modeling. Fourth, the most frequent transfer strategies were specific discussions, followed by asking athletes to apply life skills in other life areas. Certain results are specific to each of the sport contexts: distinctions between high school sport (basketball) and amateur sport (swimming) are identified and discussed. Discussion The main results are discussed in light of the literature on life skills in sport and positive youth development. The considerable similarities between coaches in the two contexts are discussed in terms of methodological considerations: (a) participants' profile, (b) participant selection criteria, and (c) interview type. Finally, a question is raised, with implications for future research avenues: does a holistic, athlete-centered approach outweigh the influence of sport context on how coaches teach life skills? References Danish, S. J., Fazio, R. J., Nellen, V. C., & Owens, S. S. (2002). Teaching life skills through sport: Community-based programs to enhance adolescent development. In V. R. Brewer (Ed.), *Exploring Sport & Exercise Psychology* (2nd. ed.) (pp. 269-288). Washington, DC: American Psychological Association. McCallister, S.G., Blinde, E.M., & Weiss, W.M. (2000). Teaching values and implementing philosophies: dilemmas of the youth sport coach. *Physical Educator*, 57, 35-45. Yin, R. K. (2009). *Case study research: Design and methods* (fourth edition). Thousand Oaks, CA: SAGE Publications.

### **CHANGES IN PERCEIVED MOTIVATIONAL CLIMATE IN SPORT AMONG YOUNG FOOTBALLERS**

Nunes, N., Severino, V., Gonçalves, C.  
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Introduction The athletes' perceptions of their coaches' behavior contribute significantly to the knowledge of the training climate, oriented to mastery or performance. This study aims to analyze the effects of different types of guidance on the perceptions of the climate of two groups of young soccer players. Methods Twenty-two soccer players, aged 13-14 years completed the Perceived Motivational Climate in Sport Questionnaire-2 prior to the first practice in preparation for a tournament, and before the last game. Meanwhile, the under-13 team (n=12) was given a mastery approach by the coach, and the under-14 team (n=10) a performance approach. Results At the baseline, Kruskal-Wallis Test showed no differences between the groups, except for Punishment ( $p=0.05$ ), with the under-13 group presenting higher mean scores. Comparing 1st to 2nd moment, only Cooperative Learning showed significant differences ( $p=0.02$ ), with the under-13 presenting the higher scores. In all the variables the mean scores decreased for both groups, except Punishment which showed a moderate increase. Discussion The under-13 team results on the second time, where were instilled task behaviors and attitudes, were higher in the categories of Cooperation, Importance in Team and Effort/Improvement, related to task orientation. On the other hand, the values of ego orientation categories decreased on average. These results are supported by studies of Seifriz, Duda & Chi (1992), Smith et al. (2005), and Torregrosa et al. (2008), who reported that a motivational climate task oriented relates to a coach who provides many guidelines, encouraging positive feedback after the success or failure in performance, supporting the players and not ignoring the error. The results for the under-14 team on the second time, instilled with ego behaviors and attitudes, were higher in the categories of Punishment and Inequality, related to ego orientation. As for the values relating to the categories of task orientation, dropped from first to second stage of data collection. These findings are supported by studies of Seifriz, Duda & Chi (1992), Smith et al. (2005), and Torregrosa et al. (2008), which state that a climate ego oriented is associated with a high amount of negative feedback, punishment, lack of support, results and individual performance overvaluation. Conclusion The deliberate orientation of the training climate is perceived by the athletes in the same direction as suggested by the coach. Hence, the context of practice can be manipulated by the coach in a negative or positive sense. References Seifriz J. Duda J, Chi L. (1992). *Journal of Sport & Exercise Psychology*, 14, 375-391. Smith S, Fry M, Ethington C, Li

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### **FEET PLACEMENT FOR BACK CORNER SHOTS IN ELITE SQUASH**

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Introduction Movement in squash is, along with racket skills, the most important technical criteria for good performance. Movement consists of proper positioning around the T area (Vučković et al., 2009), movement towards the ball, positioning to play the shot and movement back to the T area. Although positioning has a direct influence on shot selection and accuracy this aspect of players' movements has never been analysed in detail. Methods Six matches played by professional players at the 2010 and 2011 British Grand Prix Squash tournaments were analysed. This consisted of three times two matches played by players in top 8, 9 to 24 and 25 to 50 on world rankings. The SAGIT software system was used to determine shot location and feet positioning. This analysis was restricted to the back corners of the court as these areas account for the majority of shots and only when playing straight and crosscourt drives and straight drop shots as these account for the vast majority of shots. Feet positioning was classified according to which foot was closest to the sidewall at the time the ball was struck (left, right or both). Data was processed in Microsoft Excel and transferred to IBM SPSS statistics package (v19, SPSS Inc., 2010) for analysis. Repeated measures ANOVA were used to determine differences between world ranking levels foot placements and court locations. Results Significant interactions between world ranking level and feet positioning were found for shots played from both back left ( $F = 14.45$ ,  $df = 4, 117$ ,  $p < .001$ ) and right corners of the court ( $F = 2.66$ ,  $df = 4, 117$ ,  $p < .05$ ). Top 8 and 25 to 50 players had similar patterns of feet positioning when playing shots in the back left corner (backhand). They used the traditionally correct (right) foot forward 61% (top 8) and 63% (25-50) of the time. Players ranked 9 to 24, however, played most of their shots with both feet parallel to the sidewall (42%), much higher than the top (19%) and lower (21%) ranked players. In the back right corner (forehand) the pattern was more similar for all groups although the top 8 players hit the ball off the (supposedly) incorrect foot 71% of the time, as did the other two groups 64% (9 to 24) and 67% (25 to 50). Discussion These findings suggest that players are able to perform better (according to conventional coaching practice regarding feet positioning) on their backhand side compared to the forehand side. However given the high proportion of so-called incorrect feet placements on both sides of the court it is unlikely that these elite players consider the traditional feet positioning model to hold true for all situations. The determinants for feet positioning are not known but the time available to play the shot is likely to be a significant factor. Further detailed analysis is needed to determine which parameters affect feet placement and to determine if the coaching manuals currently used to teach squash need updating. References Vučković, G., Perš, J., James, N. and Hughes, M. (2009). *J Sports Sci*, 27, 8, 863-871.

### **VIDEO-ANALYSIS AS DIDACTIC AND EVALUATION TOOL IN THE TECHNICAL LEARNING IN YOUTH FUTSAL**

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Introduction Futsal is a sport where the time variable is very important in the control of motor learning process (G. Raiola, 2012). It is particularly suitable to the development of motor skills unique to the technical characteristics of the game, such as the rules and the field of play for which the time to analyze, evaluate, elaborate, and execute is limited when compared to other team sports (Schmidt & Wrisberg 2008). Futsal is particularly adapted for children, ages 8-10 years, who are learning the specific techniques of play. Furthermore, motor imagery, through the proposition of visual image, may be learned if it is included in the weekly educational planning. The purpose of the study is to verify and compare if members of a sample, exposed to the video projection of model videotapes are better at learning specific techniques (Menichelli R., 2010), compared to a control group, who has not seen any videotape. Methods The sample group will meet at the sports facility 30 minutes before the control group. The team will be exposed to the video projection of three technical gestures, chosen from the game fundamentals: 1. Control of the ball: oriented ball control with the bottom foot (called 'stop by sole'); 2. Driving the ball, moving the ball with the sole; 3. Shooting: tip shoot After they watched the videotapes, the sample group will reproduce the same technical skills observed in videos during the workout, and they will be recorded by camera for next assessments. Results After analyzing the data from the first phase and dividing the group into two homogeneous micro-groups, we compared the findings of the second phase of evaluations, highlighting the improvements of each members of the sample in comparison to the starting point. By reading the data, it was also possible to appreciate the clear improvement in the average of the sample group (+7.4%) compared to the control group (+2.1) tracing a hypothetical trend for the third and last evaluation phase. In particular, the second assessment showed a significant improvements, particularly in players who showed a good skills level already in first phase (+11%). Discussion The data could be explained by a higher relevance of the 'ideomotor' system especially in players who have a good basic technical ability and therefore less correction in the adaptation phase of technical gestures, after viewing the executive technician model. The data trend suggests further improvements and technical refinement in those who have shown significant progress in the second stage of evaluation, with a remarkable difference between the sample group and the control group (> 5%). References Schmidt, RA & Wrisberg, C. (2008) *Motor Learning and Performance: A Situation-Based Learning Approach*, Human Kinetics, USA Raiola G (2012), *Controllo ed apprendimento motorio*, Edisud, Salerno, Italy Menichelli, R (2010) *Guida Tecnica per le Scuole Calcio a 5 – FIGC-LND*, Roma, Italy Hughes, M. (2005). *Notational Analysis*. In R. Bartlett, C. Gratton and C. G. Rolf (eds.) *Encyclopedia of International Sports Studies*

### **EMG RESPONSES TO DYNAMIC MUSCLES ACTIONS PRIOR TO A SPRINT START**

Smirniotou, A., Kesoglou, I., Paradisis, G., Argeitaki, P., Pillianidis, T., Tsigkanos, G.

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Introduction The efficiency of a sprint start depends on the execution of explosive and powerful movements. Improved temporal sequencing of muscle activation and enhanced fast twitch fibre recruitment may contribute to optimal sprint start (Smirniotou et al., 2012). Prior to the starting action the production of a more powerful muscular contraction may maximize motoneuron excitability which expected to benefit the sprint start (Ross et al., 2001). Therefore, the purpose of this study was to investigate the EMG activity of selected lower limb muscles during "jumping" and "skipping" as two common powerful functions prior to a sprint start. Reaction time and 2,5m time were also recorded. Methods 7 recreational sprinters performed 4(2\*2conditions) maximal 10m sprints starts on a running track. Randomly, each subject performed 2s of tuck jumps (1st cond.) or quick skipping (2nd cond.) prior to each sprint start. 20min interval was set between the two conditions. Surface electrodes used to recorder the EMG activity from gastrocnemius lateralis (GA), bicep femoris (BF) and

rectus femoris (RF) muscles of the right leg. The amplified EMG signals were low pass filtered (10Hz). EMG signals magnitude was quantified using the average root mean square (RMS) value of the full wave rectified EMG activity. A 200ms moving window used to analyze the data between the onset and the offset of EMG activities. The EMG activity was accessed by using the DELSYS EMG system, Myomonitor IV wireless Transmission (Delsys Inc). Reaction time (RT) was measured (ReacTime, Lynx USA) as well as times at 2.5m was recorded using photocells (Microgate, It.). Statistical methods were employed, included means and standard deviation ( $\pm$ SD). RMS values for GA, BF and RF were considered for analysis. MANOVA used to investigate the interactions of the variables. All data were analyzed using SPSS 20.0 Results There was not statistically significant difference between tuck jumps and quick skipping. RF activity and RT trend to be different between the two conditions. EMG activity of RF during tuck jumps was  $136.75 \pm 45.6$  mV in contrast to quick skipping which was  $180.35 \pm 75$  mV. Furthermore RT was  $0.216 \pm 54$  s post to tuck jumps and  $179 \pm 41$  s post to quick skipping condition. Discussion The results of the study indicate that tuck jumps and quick feet provide similar activation level. Therefore tuck jumps is a dynamic action that incorporates a slow stretch shortening cycle (SSC) in contrast to quick feet that emphasizes more on quickness (fast SSC) (Schmidtbleicher, 1992). Thus, further research needs to investigate the optimal type of activation prior to a sprint start. Ross A et al (2001) Sports Med 31(6):409-425 Schmidtbleicher D (1992) Training for power events. pp. 169-179 Smirniotou et al (2012) Book of Abst., ECSS Bruges, Belg.

## PERFORMANCE ANALYSIS OF AEROBICS GYMNASTIC IN TEACHING METHOD AND EVALUATION APPROACH TO IMPROVE DIDACTICS

Giugno, Y., Di Tore, A., Raiola, G.

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**Introduction** The Aerobic Gymnastics is a complex sport and the movements are performed continuously, intensely at high speed with the musical accompaniment. Gymnastics may be globally defined as any physical exercise on the floor or apparatus that promotes endurance, strength, flexibility, agility, coordination, and body control. One can directly assess the overall performance to the naked eye, but is not able to assess the individual elements of movement and technical aspects. The video analysis indirectly, through the ability to stop and review the various stages of movement several times, facilitates the evaluation. The aim of this study is to verify whether the use of video analysis in daily training activities can facilitate the evaluations of the coaches. 'The performance analysis can enable the accurate analysis and explanation of the evolution and dynamics of a historical phenomenon and motor sports'. Methods 4 female athletes will be evaluated using the tabs in the Code of Points with annotations for deductions (0.10 slight error, mean error 0:20, 0:50 fault) and after 30 sessions in two different ways. The athletes are divided into two groups: 1) Control which continues to be evaluated with the traditional forms, 2) Experimental which is evaluated through the use of two cameras, one placed opposite to the athlete and the other one on the side, which apply the points of repelle on specific anatomical points. At the end all the athletes will be traditionally evaluated and one will compare the assessments to highlight the difference between the two groups. Results The athletes in the experimental group improved at 0.30 and 0.40 compared to initial assessments made without the video analysis and compared to the control group. The experimental group compared with the control group has a better final evaluations in the matter of execution and cleanliness of the gesture. Discussion Probably the rapidity of correction of the act requested by the coach after watching the video and the subsequent execution of the athlete support proper execution. This new training methodology may be also tested on athletes, in order to allow a self-assessment through the measurement of the movie and the subsequent correction of performance so that it can better understand the errors committed and implicitly suggest the correction. The simultaneous use of video analysis by athletes and coaches during the training could further improve the result.

## COMPOSITE MODEL OF UNIVERSAL K-1 FIGHTER SUPER HEAVYWEIGHT

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**Introduction** Martial arts, as part of total sport specific human movement articulation are special phenomenon with enormous number of elements from different anthropological sphere (Shim, 2003). This article is directed toward identification of parameters that explain real situational positioning of all fighters that come to K-1 Grand-prix tournaments in Tokio 1993-2004 Methods Several competent judges, with extra precise methodology that includes detailed and repeated overview of DVD recorded matches, register 102 types of situation aspects. Each fighter that came to Tokyo was described with each of 102 definitions, which become variables. Data were analyzed with special algorithm (Bonacin 2006.), that allows initial data rescaling to universal bounds (1 – 5). For each entity data were summarized. We register 8 fights on each of 12 tournaments and get 96 entities described with 96 individual parameters derived from 102 variables. Each entity was marked with specific X number (1-96) for numeric or graphical position determination. We calculate level (L) of entity on specific tournament with formula  $L = X - \text{INT}((X-0.5) / 8) * 8$ . Calculated L represents position like in 1993. Year of Grand-prix tournament was easy calculated as  $Y = 1993 + \text{INT}((X-0.5) / 8)$ . Results and discussion Using the simple operation of multiply associating of these values of intensity with oblique saturation of previous step results in a unambiguous model of the universal K-1 fighter with maximized features that will ensure success in combat. Such an operation frames the mass, height and experience just as the most important, and equally almost all other tactical and psychological characteristics with projections at level higher than 0.90. With slightly lower intensity, but still very high are also technical characteristics, whose intensity ranges between 0.70 and 0.88. The values of some technical actions and attack types (0.40-0.65) are mediocre, while of the lowest values are rare kicks, unsportsmanlike moves, injuries and other very specific actions. (< 0.40). Specifically, it has been noticed that there are indeed 4 levels for practicing this sport and that these levels are superior to each other, as well as that each of mentioned levels represents really just an inevitable content that each K-1 fighter must immanently integrate in its widest repertoire of behaviors. Conclusion The results show that the constructed composite can be described as: brash, aggressive, skilled and dangerous. These four characteristics must be possessed by each fighter aiming to be successful, as they represents the immanent part of fighter and equally, the characteristics integrated in developing phases influenced by sport training processes. References Bonacin, D. (2004). Introduction in quantity methods (In Croatian). Kaštela. Croatia. Shim, S.K. (2003). History and properties of martial art in Korea. In FISU: Proceedings of FISU universiade conference Daegu – Facing the challenge, pp. 71-75. Daegu.

## Computer Sciences

**MEASUREMENT OF LIMBS' ACCELERATION IN TABLE TENNIS USING WIRELESS SENSORS NETWORK SYSTEM**

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**Introduction** In Table Tennis, some coaches are eager to acquire the information of player limbs swing's force during the training. But it is difficult to collect the real data of force directly during their movements. However, the acceleration data can be measured easily, and used to assess player's force. The Wireless Sensor Network technology is applied to develop a system to meet the requirement of Table Tennis Coaches. **Methods** Our design is to measure the acceleration data of the athletes' arms while they are swinging. By using of the acceleration data, the upper limbs' force can be evaluated. For example, a three-axis acceleration sensor node is fixed around player's wrist, when they swing upper limbs, the acceleration data are collected. According to Newton's second law  $F=ma$ , obviously, the more the acceleration of wrist is, the more force will put on the shot. **Results** The Wireless Sensor Network technology's main features include the intelligent collection node, automatic network organization, self-management according to the protocols, programmable, wireless mesh network route, two-way signal transmission, etc. This developed measurement system by this MSN technology, more than two acceleration sensor nodes could be available inside this system and could be fixed on different positions of players' limbs to acquire the acceleration data. And not only the acceleration data, but also many other kind of digital signals, such as video signals, pressure force, and angular acceleration. In a test for China Table Tennis male player by this system, the maximum acceleration of his left wrist is 20.62g. **Discussion** Although this system's idea originate from the requirement of Table Tennis, the second prototype has been used in tennis, discus, shot. Due to the miniaturization and lightweight of the sensor node, and multi-nodes available in networking, more than one position's acceleration of players' body can be collected synchronously. And the players' movement video shot by DV and Basler high speed camera could also be collected synchronously in this system for players' action performance analysis. **References** Halit Eren.(2008). Wireless sensors and components: network, design and application. Mechanical Industry Press. Yu Haibin. (2006). Intelligent wireless sensor network system. Science Press. Robert Faludi.(2010). Building Wireless Sensor Networks. O'Reilly Media, Inc. Wang Qing. Research and establishment of athletic ability status diagnosis and monitoring system for excellent athletes in our country [M]. Beijing: People's Sports Publishing House, 2004. Holger Karl, Andreas Willig. (2007). Wireless sensor network protocol and architecture. Electronics Industry Press.

## Health and Fitness

**PHYSICAL ACTIVITY QUANTIFICATION IN ELDER WOMEN.**

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**Introduction** In view of the society's life expectancy increasing, mostly common in women, and the benefits provided by regular physical activity in elder people (Aoyagi & Shephard, 2009), new physical activity initiatives and programs are being taken into consideration. The aim of the study was to make quantification of the physical activity made by elder women and to measure the impact of a structured physical activity program over that physical activity. **Method** A quasi-experimental ex-post-facto design was used in this study, with a sample of 76 women aged 56-84 years (72.01 ± 5.28) from Alcobendas. Taking part, or not, in a structured physical activity program was included as independent variable as well as the age (plus-70 group, under-70 group) and the body-mass index (BMI). Physical activity levels were measured by means of triaxial accelerometers during a whole week. **Results** Women on structured physical activity program showed higher physical activity levels than sedentary women on weekdays (271608 ± 116937 vs. 191816 ± 83865 counts;  $P < 0.05$ ). The number of moderate-intensity physical activity minutes of plus-70 group was significantly higher than under-70's in both weekdays (40,30 ± 27,00 vs. 28,1 ± 22,20 min/day;  $P < 0.05$ ) and weekends (34 ± 26,40 vs. 21,9 ± 21,60 min/day;  $P < 0.05$ ). No significant differences were found ( $P > 0.05$ ) regarding the body-mass index. **Discussion** Women enrolled on structured physical activity programs were physically more active than sedentary counterparts. Besides, elder women were more active in the weekdays than in weekends, as previously noted by other authors (Togo et al., 2008). The amount of moderate-intensity physical activity was lower on elder women by increasing age. **References** Aoyagi, Y., & Shephard, R. J. (2009). Steps per day: the road to senior health? *Sports Medicine*, 39(6), 423-438. Togo, F., Watanabe, E., Park, H., Yasunaga, A., Park, S., Shephard, R. J., & Aoyagi, Y. (2008). How many days of pedometer use predict the annual activity of the elderly reliably? *Medicine and science in sports and exercise*, 40(6), 1058.

**THE EFFECT OF REGULAR PHYSICAL EXERCISE ON BODY COMPOSITION AND PHYSICAL FITNESS IN MIDDLE-AGE ADULTS COMMUNITY**

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**Introduction** The prevalence of obesity has markedly increased in many parts of the world becoming a global epidemic and has been associated with chronic disease such as cardiovascular disease and diabetes. The main causes of obesity are related to nutritional imbalance and lack of regular physical activity. The present study aimed to investigate the effect of Physical Exercise Program (PEP) on body composition and physical fitness in middle-age adults community. **Methods** One hundred thirty one middle-age adults (81,67 % female and 18,32 % male) were randomly recruited. The average age was 50 ± 4 years old. The PEP was performed during 50 minutes in low to moderate intensity for 6 consecutive months, three and two times a week in the following modalities: hydrogymnastics, swimming or gymnastics. We evaluated body mass, height, upper limbs circumferences (forearm, arm, thorax, waist and abdomen), lower limbs circumferences (hip, thigh and calf) (Lohman et al., 1988), percentage of fat mass (Lukaski, 1987), number of arm flexion in 1 minute (ACSM, 2006), lumbar and lower limbs strength and percentage of maximum oxygen consumption estimated by 1 mile test (Kline et al., 1987) before and after 6 months of PEP implantation. **Results** The participants evaluated were classified: 28 % eutrophic, 42 % overweight and 17 % obese I, 9 % obese II and 3 % obese III. The PEP reduced the percentage of fat mass, circumferences of upper limbs (except left forearm) and hip by approximately 5 - 10 % ( $p < 0.05$ ). In addition, PEP induced increase lower limbs circumferences by approximately 1 - 3 %. We also observed an improvement in the number of arm flexion (16.5 to 19 repetition), lumbar strength (45.3 to 50 kg), lower limbs strength (42 to 56 kg) and percentage of maximum oxygen consumption (15 to 28 %) ( $p < 0.05$ ). **Discussion** The PEP implantation reduced

upper limbs circumferences, percentage of fat mass decreasing the risk to cardiovascular disease and increased in physical fitness that also benefit their quality of life. In conclusion, the improvement of body composition and physical fitness in middle-age adults demonstrate the importance of implementing and keeping up health promotion and physical activity programs in community with high prevalence of overweight and obese. References ACSM (2006). Guanabara Koogan, Rio de Janeiro. Kline GM, Porcari JP, Hintermeister R, Freedson PS, Ward A, McCarron RF, Ross J, Rippe JM (1987). *Med Sci Sports Exerc* 19(3): 253-9. Lohman TG, Roche AF, Martorell R. (1988). Human Kinetics Books, Champaign. Lukaski HC (1987). *Am J Clin Nutr* 46(4): 537-56.

### ECG PARAMETERS CONCATENATION DURING BICYCLE ERGOMETRY

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**Introduction** One of the problems to apply complex system theory is the difficulty to understand how different systems of human body or different fractal levels in one system interacts [1]. Adaptation of human body to physical load is an actual task in sports and clinical medicine. Frequently bicycle ergometry test is used to evaluate the functionality of the human body. The aim of work was to evaluate interconnections between some ECG parameters [2] – RR, JT and QRS intervals, to reveal differences in adaptation to load in sportsmen, sprinters (S) and physically inactive (N) groups using new matrix analysis technology. Differences in the changes of the concatenations between intervals (RR;JT) and (RR;QRS) can reveal features of adaptation to load in different groups. **Methods** The standard stress test method of bicycle ergometry work was used. Only males participated in the experiment that consisted of the provocative incremental protocol where the maximal load was 250 W (50 W/min). The evaluation of cardiovascular system reactions was made with the ECG analysis system "Kaunas – Load". The investigated contingent consisted of 10 sportsmen, sprinters (S) ( $M \pm SD = 20.1 \pm 2.23$ ), and physically inactive (N) ( $M \pm SD = 22.5 \pm 1.7$ ) groups. The analysis of concatenations [2] of these ECG parameters – RR and JT, RR and QRS during 5 minutes of the load and 5 minutes of recovery was made. **Results** In both groups during the load the concatenation of (RR/JT) was increasing while the concatenation of (RR/QRS) was decreasing. In the observation of groups dynamics observed differences were – the concatenation of (RR/JT) in the group S was increasing higher ( $M \pm SD = 0.11 \pm 0.02$ ) comparing with group N ( $M \pm SD = 0.08 \pm 0.01$ ). The concatenations of (RR/QRS) in N ( $M \pm SD = 0.42 \pm 0.09$ ) group were decreasing more comparing with S ( $M \pm SD = 0.23 \pm 0.07$ ) group. **Discussion** Interrelation (RR;JT) could be related to activation of body metabolic features it show higher adaptation for S group than for N ( $p < 0.05$ ). This concatenation could serve as an indicator for sportsmen functional state evaluation. Concatenation (RR;QRS) could reflect interrelation between regulatory systems and sportsmen, S group keep it in more stable position than N group (difference between S and N groups,  $p < 0.05$ ). This parameter can be used for evaluation of heart function stability during high loads and to follow up persons overtraining effects. **References** 1. Bruce, J. W. *Where Medicine Went Wrong. Rediscovering the Path to Complexity. Studies of Nonlinear Phenomena in Life Science*. World Scientific, 2006. 335 p. 2. Vainoras, A., Navickas, Z., Poderys, J., Berskiene, K., Bikulciene L. ECG signal for assessment of interpersonal or inter parameter influences. // the 2nd International Scientific Conference "Current issues and new ideas in sport science", [Electronic resource]. Kaunas. 2008.

### EFFECTS OF PHYSICAL ACTIVITY, GENDERS AND BMI CATEGORIES

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**Introduction** Obesity and sedentary behaviors are two universal concerns and its consequences raise several questions on the application and physical activity programs, as well as its impact according to Body Mass Index's (BMI) categories and gender. **Methods** The sample was comprised by 39 participants, with ages between 40 and 75 years old ( $60 \pm 8.9$  years). 25 were women and the remaining 14 male. The intervention program was called by Physical Activity Initiation Program's (PIAF), and comprised 2 weekly sessions, during 8 weeks focusing on the reduction of the cardiovascular risk factors. The data was analyzed with statistics correlation methods and multivariate comparisons, with software SPSS. **Results** At the end of the PIAF participants had reductions on the waist ( $0.001^{**}$ ), hip ( $0.032^*$ ) and abdominal circumference ( $0.000^{**}$ ), increased cardiorespiratory fitness ( $0.025^*$ ), HbA1c ( $0.042^*$ ) and HDL-C ( $0.021^*$ ). Men had higher distance in 6 minute walking test ( $0.005^{**}$ ), higher cardiorespiratory fitness ( $0.005^{**}$ ) and waist/hip ratio ( $0.000^{**}$ ). Between BMI categories, differences were found in the following variables: diastolic arterial pressure ( $0.003^*$ ), resting HR ( $0.037^*$ ), and LDL-C ( $0.022^*$ ). **Discussion** The results agree with others, specifically with the increase of  $VO_{2max}$  in about 0.29MET in two months' time. This increase seems to be related with other variables of the cardiovascular health, such as abdominal girth, systolic arterial pressure, triglycerides, glycaemia and HDL cholesterol (Lee et al., 2010). Literature suggests benefits on HbA1c after 6 months of exercise (Hansen et al., 2009). The short duration of the PIAF (2 months) could contribute to explain the lack of positive effects, as well as the absence of dietary control. Lastly, the literature shows an influence in the BMI categories (Mekary et al., 2010) and in gender (Jekal et al., 2001). Though the results are in line with each other, in the variance analysis, none of the factors, by themselves, explained the differences found. More studies are necessary to understanding how the BMI categories and the gender can mediate the impact of exercise on cardiovascular risk. **References** Hansen D, Dendale P, Jonkers RAM, Beelen M, Manders RJF, Corluy L, Mullens A, Berger J, Meeusen R, Van Loon LJC (2009). *Diabetologia*, 52:1789-1797 Lee DC, Artero EG, Sui XC, Blair SN (2010). *J Psychopharmacol*, 24 (Supl. 4), 27-35. Mekary RA, Feskanich D, Malspeis, S, Hu FB, Willett WC, Field AE (2010). *Int J Obes*, 33 (Supl. 9), 1039-1047

### EFFECTS OF A HYPOPRESSIVE METHOD TRAINING ON WAIST CIRCUMFERENCE, WAIST-HIP RATIO AND BODY MASS INDEX ON WOMEN

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**Introduction.** Body mass index (BMI), waist-hip ratio and waist circumference have been used in recent decades as predictors of cardiovascular risk. The Abdominal Hypopressive Technique (AHT) is a method created in the 80's by Dr. Marcel Caudriez in the field of postpartum rehabilitation to improve the pelvic floor muscles (Bernardes et al., 2012), although other potential effects may include a reduction in WC. **Objective.** The aim of this study was to analyze the effects of hypopressive training on waist circumference as a ways to recommend it also as a method for modifying cardiovascular risk preserving pelvic floor muscles in women. **Methods.** We performed a randomized, controlled, evaluator-blinded, intervention study of two months duration in 42 women, 21 per group (mean age 42, SD 9). Women in the study group were given 3 30-minute sessions of AHT per week on alternate days (Mon-Tues-Thurs) for eight weeks. Controls were indicated to continue normal life. All patients were examined at baseline and after two months. The effects variables were the difference in

waist circumference, waist-hip ratio and BMI, before and after 2 months of follow-up. Measurements were taken by an investigator blinded to the assigned group. The mean difference was compared between groups with Student's test and 95% confidence intervals (CI) were estimated for the differences of means. Results. Subjects were comparable at baseline in terms of age, BMI, waist-hip ratio and waist circumference. After 2 months, the AHT group had reduced its waist circumference in -2.54 cm (95% CI: -1.85 to -3.24), while it was no evident or increased in the control group, being the difference of means -3.39 cm (95% CI: -4.35 to -2.43;  $p < 0.001$ ). The same occurred with the waist-hip ratio [differences of means -0.03 (95% CI: -0.03 to -0.02;  $p < 0.001$ )]. BMI showed no difference between groups [differences of means -0.12 (95% CI: -0.31 to 0.06;  $p = 0.179$ )] Discussion. Waist circumference and waist-hip ratio, but not BMI, may be significantly reduced by hypopressive exercises for 2 months. The effect on other cardiovascular risk factors and on general cardiovascular fitness and health outcomes would need further study, but our results support the benefit of a women specific training on the reduction of waist circumference while preserving pelvic floor. References. Bernardes, B.T., Resende, A.P.M., Stüpp, L., Oliveira, E., Castro, R. A., Järmy di Bella, Z.I.K. & Sartori, M.G.F. (2012). Efficacy of pelvic floor muscle training and hypopressive exercises for treating pelvic organ prolapse in women: randomized controlled trial. Sao Paulo Medical Journal, 130(1), 5-9.

## EXERCISE BEHAVIOR AND SCHOOL GRADES IN JAPANESE JUNIOR HIGH SCHOOL STUDENTS

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Introduction: Over the past few years, numerous attempts have been made by scholars and educators to demonstrate the relationship between the physical fitness and the academic performance (Hillman et al., 2008). What seems to be lacking, however, is to consider the school grades of each subjects as the actual academic performance. The purpose of this study is to determine whether the exercise behaviors were associated with school grades as the academic performance in Japanese students. Methods: Participants were 285 (female: 47.4%, mean body mass index [BMI]: 19.4+/-3.4) 1st grade (7th grade in USA style) students of public junior high school near Sapporo area in Japan. All students and their parent completed the questionnaires about the exercise behavior. BMI and academic performance (school grade) were received from school records. The sum total of the 9 subjects grades (Japanese, social studies, math, science, English, music, arts, home economics/vocational-technology, physical education) were used as academic performance score. Results: Using ANCOVA that controlled for several covariates (gender, BMI, household income, mother's education), exercisers every day (grades: 32.9+/-5.6) had significantly better school grades than exercisers less than 2 days per week (29.2+/-5.9,  $p < 0.05$  after bonferoni modification). Also, exercisers more than 3 hours in weekend (33.2+/-5.4) had significantly better school grades than exercisers less than 1 hour in weekend (30.5+/-6.2,  $p < 0.05$  after bonferoni modification). No difference between more exerciser and less exercisers in weekday was found. Conclusions: These results suggest that more exercise frequency and more weekend exercise practice may have an affect on the school grades as the academic performance among Japanese junior high school students. Acknowledgements: This study was supported by Challenging Exploratory Research (ID: 12852590) and Scientific Research B (ID: 12863511) from Grants-in-Aid for Scientific Research in Japan. References: Hillman, C. H., et al., (2008). Be smart, exercise your heart: exercise effects on brain nd cognition. Nat Rev Neurosci. 2008 Jan; 9(1): 58-65. Review.

## THE EFFECTS OF RESISTANCE, AEROBIC AND COMBINED TRAINING AND DETRAINING ON MUSCLE PERFORMANCE AND BLOOD LIPID PROFILE IN CORONARY ARTERY DISEASED PATIENTS

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Introduction Every year an increasing number of individuals are diagnosed suffering from coronary artery disease while this disease is the number one cause of death worldwide. For combating the risk factors of coronary artery disease many investigations recommended as important factors the exercise training and the avoidance of sedentary life style (Tully et al., 2005; Booth et al., 2012). Methods 60 males with coronary artery heart disease were randomly assigned into the resistance exercise group (n=11), the aerobic exercise group (n=18), the combine exercise group (n=16) and the control group (n=15). The three exercise groups carried out 8 months of resistance, aerobic or combine training consisting of 3 exercise sessions per week. Before the beginning of the study, after 4 and 8 months of training and after 1, 2 and 3 months of detraining knee extensors peak torque, serum triacylglycerols (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL) were measured. Results By the forth and eighth month, all training modes increased muscle strength and favourably affected blood lipid profile compared to the control group. More specifically, after 8 months of training, resistance, aerobic and combine training increased knee extensors torque by 40.3%, 7.7% and 24.8% respectively. In addition, resistance exercise decreased TG, TC and LDL by -10.8%, -9.4% and -6.5% respectively and increased HDL 8.4%. Aerobic exercise decreased TG, TC and LDL by -13.6%, -9.1% and -6.6% respectively and increased HDL 9.5% while combine exercise decreased TG, TC and LDL by -16.1%, -12.6% and -8.2% respectively and increased HDL 8.9%. In contrast, after the detraining period, a reversed action occurred in muscle strength and blood lipid profile. Discussion The purpose of the present investigation was to compare the effects of three types of chronic exercise on muscle performance and blood lipid profile in aged patients suffering from cardiac artery disease. It was found that muscle strength has been increased mainly by resistance and combined chronic exercises, with the former to cause the greatest alterations as it was expected. Lipid profile indices were positively affected by all training modes of training. However, combined exercise appears to be the most effective mode of exercise for inducing favourable changes on blood lipids profile. References Tully MA., Cupples ME., Chan WS., McGlade K., Young IS. (2005) Preventive medicine 41 (2):622-628. Booth FW., Roberts CK., Laye MJ. (2012). Comp. Physiol. 2, 1143-1211. Acknowledgements This work has been granted by the Cyprus Research Promotion Foundation under the framework 'Research Infrastructure', action 'New Infrastructure', Project EPYNE/0506/17.

## 1-YEAR WORKSITE STRUCTURED EXERCISE PROGRAM IMPROVES ACTIVE BEHAVIOR ESPECIALLY AT VIGOROUS INTENSITY

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Introduction Addressing diet, physical activity and exercise in the workplace environment has the potential to improve health status of workers; contribute to a positive and caring image of the company; improve staff morale; reduce staff turnover and absenteeism; enhance productivity; and reduce sick leave, health plan costs and workers' compensation and disability payments. Structured exercise

interventions are particularly effective to improve musculoskeletal fitness levels and as a result health and quality of life, but evidences coming from long-term specific interventions delivered at the worksite are very limited. Methods A group of employees (n=200) completed a 1-year structured exercise program (SEP) at the worksite organized with a linear periodization model, in 4 mesocycles of 12 weeks each one. Participants were randomized in one of the 4 different groups: control group (n=46), 2-days per week (n=51), 3-days per week (n=49), and more than 3-days per week (n=54). A comprehensive fitness test protocol was applied at the beginning, after 6 months of intervention and at the end of the year, after proper familiarization process before the initial testing. Testing included a complete health screening, fitness levels, lipids profile, fasting glucose, physical activity reported by IPAQ and directly measured by accelerometer (Mywellness key, Technogym, Forly, Italy), perceived wellbeing (SF-36), job performance and job satisfaction. The specific fitness testing included VO2 max test (modified Balke protocol), maximal strength (leg press, lat pull and bench press) and flexibility (sit and reach). Results Total activity (MET-min/week) showed a significant reduction in the inactive group ( $p < 0.05$ ), while there were not significant differences within the active groups. Regarding potential differences identified in the type of PA, it is especially important the fact that vigorous PA increased in all active groups, but only significantly in the 3-days/week SEP, while we found a significant reduction in moderate PA in all active groups ( $p < 0.05$ ), and non-significant changes in low intensity PA ( $p > 0.05$ ). Total sedentary behaviour/sitting time increase in the inactive group, but not significantly, and it was significantly reduced in all active groups, especially in the 3-days/week ( $p < 0.05$ ). Discussion A strong commitment to integrate PA and exercise into the lifestyle is challenging for the most of the sedentary population, and despite the multiple benefits supported by evidences, time limitation is always a critical perceived determinant factor for individuals to engage. Previous analysis of the same study reported improvements in cardiovascular risks factors and perceived wellbeing in the active groups, without significant differences based on the frequency of exercise (2-days, 3-days or more than 3-days/week). Our study shows how exercise could provide a more effective use of the time allocated for PA, helping the participants to modify intensity and duration to optimize health benefits.

### APPLICABILITY OF SEGMENTAL BIO-ELECTRICAL IMPEDANCE ANALYSIS FOR ESTIMATING SKELETAL MUSCLE VOLUME IN PREPUBERTAL CHILDREN

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Background The skeletal muscle volume (SMV) is closely related to physical functions, and it increases rapidly during growth stage (Fukunaga et al 1989). There is an increasing interest in the use of bioelectrical impedance analysis to assess body composition (Miyatani et al. 2000, Ishiguro et al. 2006). However, information about the applicability for predicting SMV in children is limited (Fuller et al. 2002). Objective To investigate whether segmental bio-electrical impedance (BI) analysis is usefulness for predicting the total and segmental skeletal muscle volumes in prepubertal children. Methods Ninety-five healthy Japanese children (58 boys and 37 girls, mean age 10.5 yr) volunteered under permission of their parents to participate in this study. Contiguous MRI images with a 1-cm slice thickness were obtained from the first cervical vertebra to the lateral malleoli. SMV was obtained by summing digitized cross-sectional area for each body segment, i.e., arm, trunk, thigh and lower leg, with the separation between segments based on anatomical landmarks visible in the scanned images. The electrical impedance for each body segment was measured by a BI apparatus (500 $\mu$ A, 50kHz). BI index was calculated as the ratio of the segment length squared to the impedance. Results and Discussion The total SMV measured by MRI, was 8604.5 $\pm$  2551.1 mm<sup>3</sup> for the boys and 7671.2 $\pm$  2609.6 mm<sup>3</sup> for the girls. Ratios of the SMV of arms, trunk, thighs and lower legs to total SMV were 9.5%, 36.0%, 40.6%, and 14.0%, respectively, and had no significant sex-related difference. The total and segmental SMV were significantly correlated with the related BI index with the correlation coefficients of 0.775 to 0.903 ( $p < 0.01$ ). This result agrees with the findings of the previous study (Fuller et al 2002). There was no significant difference between the measured and estimated SMV values. The SEE expressed relative to the mean FFM were 6.7 - 8.2%. Thus, the current results indicate the applicability of BI analysis for predicting SMV in children. However, because significant systematic error was found in the Bland-Altman plot, further study is needed to clarify the factors producing the errors of estimate for developing prediction equation for SMV in children. References Fukunaga et al. J Anthropol Soc Nippon. 97:61-62. (1989) Miyatani et al. Eur J Appl Physiol. 91:386-394. (2000) Ishiguro et al. J Appl Physiol. 100:572-8. (2006) Fuller et al. Int J Obes Relat Metab Disord. 26: 684-691, 692-700. (2002)

### EFFECTS OF PHYSICAL EXERCISES IN 2 TYPE DIABETES PATIENTS ROULE OF WHOLE BODY VIBRATION

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Introduction International literature showed aerobic and resistance training, used in therapy of diabetes, are able to improve both metabolism and incidence of diabetes. This is tanks to more sensibility of muscle cells to the insulin. This presentation is a 12 weeks study on 2 type diabetes patients working with aerobic and resistance training. Patients were divided into 2 groups: the first one worked with aerobic training and Whole Body Vibration, the second one with aerobic and resistance training. Methods A total of 21 patients, 12 males and 9 females, were recruited. They were divided into 2 groups: Vibration Group VG n= 10, Resistance Group RG n= 11. People had a specific activity program: 1 hour session for 3 times in a week. Each session had the following structure: VG: 15 minutes aerobic training (30-40% HRR during 1st month, 40-50% 2nd month, 50-60% 3rd); 6 minutes Vibration session in the 1st month, 9 min in 2nd, 12 min in 3rd; 15 minutes aerobic training (30-40% HRR in 1st month, 40-50% in 2nd, 50-60% in 3rd); 6 minutes Vibration session in the 1st month, 9 min 2nd, 12 min 3rd. Total 30 min aerobic exercise and 12, 18, 24 min of Vibration session. Each aerobic training was on treadmill and bike (50 %). Each vibration session (Vertical Vibration Platform) had 6 different static iteration with breaks between exercises: Squat, Lunge R/L, Biceps Curl, Triceps Dip, Push Up, Abdominal Crunch. RG: 30 minutes aerobic training (30-40% HRR during 1st month, 40-50% in 2nd, 50-60% 3rd); Stretching break; 30 min of Progressive Resistance Training. The exercise engaged pectoral, dorsal and abdominal muscles in the 1st session; quadriceps, knee flexors, abdominal muscles in the 2nd session; pectoral, dorsal, abdominal in the 3rd. Work was 60 % of one repetition maximum during 1st month, 65% in 2nd and 70% in 3rd. Results All patients ended training. Results were: Group Weight T0 T1 BMI T0 T1 VO2max T0 T1 HbA1c T0 T1 RG 90,18 88,31 32,29 31,95 18,04 19,02 7,61 7,39 VG 93,26 90,51 32,94 31,99 31,31 37,28 8,56 7,88 All items are better in T1 then T0. Patients felt better in daily live activities and had an high satisfaction in training. Statistic Analysis: Values are statistically significant: VO2max RG/VG .000; HbA1c RG/VG .083. Discussion VG went better then RG to demonstrate WBV is a good instrument with benefit no more weights to improve exercise. WBV has no abnormal stress of bones, ligaments, joints and short training sessions too. References American Diabetes Association Guide Lines (2006). Standards of Medical Care in Diabetes, Vol. 29, Supp. 1. Behboudi, L., Azarbayjani, M.A., Aghaalienejad, H., Mahyar, S. (2011). Effects of Aerobic Exercise and WBV on Glycaemia Control in Type 2 Diabetic Males. Asian J Sports June; 2(2): 83-90.

**RELATIONSHIP BETWEEN PHYSICAL ACTIVITY BEHAVIOR AND HEALTH RELATED RISK FACTORS IN JAPANESE ADULTS**

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Introduction Current evidence suggests that physical activity (PA) levels, time spent in sedentary behavior (SB) and sleep duration are all independent risk factors for health status and chronic diseases (1, 2). The aim of this study is to assess the relationship between PA, SB and sleep and various health related risk factors in Japanese adults. Methods Of the 65 participants, 42 (64.6 %) were women. Mean±SD age was 60.6±7.9 yrs., and the age range was 54 to 80 yrs. Mean body mass index (BMI) was 25.1±2.8 kg/m<sup>2</sup>. Participant's height, weight, BMI, % body fat, waist circumference, blood pressure (BP), bone mass (Quantitative Ultrasound method, AOS-100NW, ALOKA) and lower extremity muscle strength (3) were measured at the outset. PA levels were measured using a triaxial accelerometer (Active style Pro HJA-350IT, Omron Healthcare Co., Ltd) for 7 days. Associations between time spent in SB, and time in light intensity AP (LIPA, 2.0–2.9 METs; metabolic equivalents) and moderate-to-vigorous PA (MVPA, 3 METs or more), and health related risk factors were analyzed using correlation coefficients. Results The mean proportion of time in SB, LIPA, MVPA and sleep duration over a 24 hour period were 47%, 22%, 3% and 28%, respectively. Increased time in LIPA was associated with reduced BMI ( $r=0.06$ ), % body fat ( $r=0.05$ ), waist circumference ( $r=0.06$ ) and systolic ( $r=0.2$ ) and diastolic BP ( $r=0.2$ ) (all  $p<0.05$ ), while increased time in SB was associated with increased systolic ( $r=0.07$ ) and diastolic BP ( $r=0.2$ ) (all  $p<0.01$ ). Increased time in MVPA was associated with reduced % body fat ( $r=0.1$ ) and increased bone mass ( $r=0.2$ ) and lower extremity muscle strength ( $r=0.2$ ) (all  $p<0.01$ ). No significant associations were observed between time in bed and sleep duration with the health indicators. Discussion Although PA research often focuses on moderate and vigorous intensity activity, a new focus on SB has evolved over past year, showing that SB is a distinct risk factor for health independent of PA. On the other hand, even LIPA have been shown to have favorable health effects, at least in older adults. Lifestyle focusing on moving people from less SB to any level of intensity of PA could be useful for health promotion. From the results of this study, it is suggested that increased time spent in LIPA as well as MVPA and less sedentary time were all associated with reduced risk for health related disease. References 1) Katzmarzyk, P.T., et al. *Med. Sci. Sports Exerc.*, 41:998-1005, 2009. 2) Owen, N., et al. *Exerc. Sport Sci. rev.*, 28:153-158, 2000. 3) Osuka, M., et al. *Am. J. Sports Med.*, 78:77-81, 1985.

**ASSESSMENT OF SEDENTARY BEHAVIOR DURING FREE LIVING IN OBESE ADULTS**

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Background: Emerging evidence indicates that sedentary time, independent of overall physical activity level, is associated with increased risk of developing cardiovascular disease and mortality. These findings highlight the need for tools that accurately quantify sedentary time during daily living. Compared with direct observations, Actigraph GT3X (AG; ActiGraph LLC, Pensacola, FL) and activPAL (AP; Physical Activity Technologies, Glasgow, Scotland) have demonstrated good capability of quantifying sedentary time [1,2]. However, these studies were limited to 6-10 hours of observations, and it is not known whether there is agreement between AG and AP measures of sedentary time when monitoring is extended to several days of free-living. In addition, little is known about the congruence between these objective measures of sedentary behavior and a self-reported estimate of daily sedentary time. Objectives: To compare estimates of sedentary time obtained from AG and AP during 7 days of free-living, and to compare these estimates with self-reported daily sedentary time in a population of obese, non-exercising adults. Methods: 16 obese (BMI: 32.3 ± 4.7 kg/m<sup>2</sup>; Mean ± SD) men and women who did not engage in regular exercise (VO<sub>2peak</sub>: 23.2 ± 4.1 mL/kg/min) volunteered for the study. The participants wore AG and AP on the right side of the hip and mid-thigh, respectively (attached by non-allergic adhesive tape), while maintaining regular activity patterns for 7 days. For AG, sedentary time was derived using the 100-counts-per-minute cut point in 10-s epochs, whereas AP provided an inclinometer-based measure of time spent lying/sitting (i.e., sedentary behavior) in 10-s epochs. After the 7-day period, participants provided a self-reported estimate of daily sedentary time. Results: Measures of sedentary time during waking hours were highest in AG (13.0 ± 1.5 hr,  $p<0.001$ ), and higher in AP (10.0 ± 1.6 hr) than by self-report (8.1 ± 3.2 hr,  $p=0.03$ ). Measures of daily sedentary time from AG and AP showed a significant correlation ( $r_2 = 0.41$ ,  $p<0.001$ ), but there were no correlations between self-report and AP or AG measures of sedentary time. Conclusion: While there was a correlation between AP and AG data, the absolute difference in sedentary time between these methodologies warrants further investigation. Although we did not include a criterion measure, our results suggest that sedentary time is underestimated using self-report. These preliminary findings further highlight the necessity of developing and implementing tools for objective assessment of sedentary behavior. References: 1) Kozey-Keadle S. et al., *MSSE*, 2011 2) Lyden K. et al., *MSSE*, 2012 Do not insert authors here

**ANTHROPOMETRIC MEASURES AND PHYSICAL FITNESS TESTS: ARE THEY ALWAYS RELATED?**

Raccuglia, M.1, Bianco, A.1, Spina, S.1, Alesi, M.2, Pepi, A.2, Palma, A.1

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The association between the selected anthropometric measures such as height (H), weight (W), hip circumference (HC), waist circumference (WC), waist/hip ratio (WHR), wrist circumference (WRC) triceps skinfold (SFTR) and the test of physical fitness is well known. Physical fitness tests, such as sit-up (SU), push-up (PU) and squat (SQ) are widely used to evaluate local muscular strength and endurance performances. These tests have the advantage of predicting performance on more measures of muscular strength and endurance (Esco M.R. et al., 2008). Several other aspects are related with the results on this battery's tests and are associated in different ways according to the gender. The purpose of this study was to investigate whether anthropometric measures were related with physical fitness tests and how this fitness tests affected each other on gym's practitioners males and females. The selected health-related anthropometric variables were measured on one hundred healthy subjects (51 men and 49 women) who attended fitness centres. Sit-up test (SU), Push-up (PU) and Squat test (SQ) were also performed in this order. The subjects were asked to perform the maximum number of repetitions for each test. The battery's test also included the Appley scratch test (AS) to evaluate the mobility of the scapulohumeral joint both right (ASRG) and left (ASLF). Through the software Statistica 8.0 (Tulsa, USA) has been conducted the data analysis. A p value less than 0.05 was considered statistically significant. The sample was stratified by gender. The 51 men had an age of 27,4±10,2, height (cm) 173,6±7,0, weight (Kg) 71,5±9,2, WHR (cm) 0,96±0,04, SFTR (mm) 12,7±5,2, WRC (cm) 17,1±0,9. The 49 women had an age of 29,8±10,2, height (cm) 162,7±7,0, weight (Kg) 58,7±8,2, WHR (cm) 0,88±0,05, SFTR (mm) 22,7±6,0, WRC (cm) 15,2±1,8. Men showed a significant negative correlation between ATRG and PU -0,46, ATLF and PU -0,40, ATRG and age -0,53, ATLF and age -0,64, PU and SFTR -0,66, PU and HC -0,49, PU and WC -0,46 and a significant correlation between WRC and HC 0,60, SFTR and WC 0,57, WRC and W 0,78. Women showed a significant positive correlation between SQ and Pu 0,59, SQ and PU 0,52. This pilot study showed that the scores obtained in these tests are related

to each other and with a parameter little considered within the fitness or joint mobility. In fact, the subjects that are able to perform more reps in push ups have more negative values in ASRG and ASLF. The women's group show that the results of SQ and SU, and the scores obtained in SQ and PU are associated. The findings indicate also that the selected anthropometric variables are related with SU, PU and SQ, specially PU and SFTR as regards man. Furthermore, in man joint mobility decreases with increasing of age. The evidence provided by this study can be used by trainers and coaches in the use of SU, PU and SQ for both conditioning and muscular endurance assessment. Therefore, conditioning directed at improving these anthropometric measures would yield a more inclusive conditioning program.

## EFFECTS OF PHYSICAL EXERCISES IN 2 TYPE DIABETES PATIENTS ROLE OF WHOLE BODY VIBRATION

Lucchetti, C., Nart, A., Biancalana, V.

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Introduction International literature showed aerobic and resistance training, used in therapy of diabetes, are able to improve both metabolism and incidence of diabetes. This is tanks to more sensibility of muscle cells to the insulin. This presentation is a 12 weeks study on 2 type diabetes patients working with aerobic and resistance training. Patients were divided into 2 groups: the first one worked with aerobic training and Whole Body Vibration, the second one with aerobic and resistance training. Methods A total of 21 patients, 12 males and 9 females, were recruited. They were divided into 2 groups: Vibration Group VG n= 10, Resistance Group RG n= 11. People had a specific activity program: 1 hour session for 3 times in a week. Each session had the following structure: VG: 15 minutes aerobic training (30-40% HRR during 1st month, 40-50% 2nd month, 50-60% 3rd); 6 minutes Vibration session in the 1st month, 9 min in 2nd, 12 min in 3rd; 15 minutes aerobic training (30-40% HRR in 1st month, 40-50% in 2nd, 50-60% in 3rd); 6 minutes Vibration session in the 1st month, 9 min 2nd, 12 min 3rd. Total 30 min aerobic exercise and 12, 18, 24 min of Vibration session. Each aerobic training was on treadmill and bike (50 %). Each vibration session (Vertical Vibration Platform) had 6 different static iteration with breaks between exercises: Squat, Lunge R/L, Biceps Curl, Triceps Dip, Push Up, Abdominal Crunch. RG: 30 minutes aerobic training (30-40% HRR during 1st month, 40-50% in 2nd, 50-60% 3rd); Stretching break; 30 min of Progressive Resistance Training. The exercise engaged pectoral, dorsal and abdominal muscles in the 1st session; quadriceps, knee flexors, abdominal muscles in the 2nd session; pectoral, dorsal, abdominal in the 3rd. Work was 60 % of one repetition maximum during 1st month, 65% in 2nd and 70% in 3rd. Results All patients ended training. Results were: Group Weight T0 T1 BMI T0 T1 VO2max T0 T1 HbA1c T0 T1 RG 90,18 88,31 32,29 31,95 18,04 19,02 7,61 7,39 VG 93,26 90,51 32,94 31,99 31,31 37,28 8,56 7,88 All items are better in T1 then T0. Patients felt better in daily live activities and had an high satisfaction in training. Statistic Analysis: Values are statistically significant: VO2max RG/VG .000; HbA1c RG/VG .083. Discussion VG went better then RG to demonstrate WBV is a good instrument with benefit no more weights to improve exercise. WBV has no abnormal stress of bones, ligaments, joints and short training sessions too. References American Diabetes Association Guide Lines (2006). Standards of Medical Care in Diabetes, Vol. 29, Supp. 1. Behboudi, L., Azarbayani, M.A., Aghaahnejad, H., Mahyar, S. (2011). Effects of Aerobic Exercise and WBV on Glycaemia Control in Type 2 Diabetic Males. Asian J Sports June; 2(2): 83-90.

## THE EFFECT OF GENTLE SKIN STIMULATION ON AUTONOMIC NERVOUS ACTIVITY AFTER AEROBIC EXERCISE

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[Introduction] Early recovery of parasympathetic nervous activation after exercise has meaningful effect in the field of athletic sports and healthy promotion. Hoshikawa et al. (2012) observed that non-invasive gentle skin stimulation induce early heart rate (HR) recovery after 30-s supramaximal pedaling exercise. Although this HR response would be attributed to parasympathetic nervous activation, no direct evaluation of autonomic nervous activity has been done in their study. Therefore, the purpose of this study was to investigate the effect of gentle skin stimulation on autonomic nervous activity after aerobic exercise [Methods] Seven healthy male college students were participated in this study. They pedaled at 50 W for 2 minutes and then at 75% of their maximal oxygen uptake for 5 minutes three times: with two types of non-invasive skin stimulation (SS1, SS2) and with no skin stimulation(NSS) in randomized order. Immediately after the exercise, they were instructed to be at rest at supine position for 15 minutes. The mechanical stimulation by either elastomer microcornes (SS1, Hotta et al., 2010) or no microcornes (SS2) was applied to inner thigh skin at a frequency of approximately 1 Hz for 10 min after exercise. R-R intervals during recovery period were measured by a heart rate monitor (RS-800CS, Polar). Using these R-R intervals, the root mean square of sequential deviations (RMSSD) in the time domain and high frequency power in normalized units (HFn.u.) in the frequency domain were calculated. [Results and Discussion] Although the RMSSD for SS1 and SS2 during recovery period is higher as compared with NSS, these were no significant difference among three conditions (SS1, 19.4±14.2 ms; SS2, 18.0±13.2 ms; NSS, 11.9±5.6 ms). Likewise, the HFn.u. showed no significant difference among three conditions (NSS, 27.1±25.2; SS1, 31.2±21.3; SS2, and 31.3±12.9). These results seems to be due to highly individual variation for response to skin stimulation. One of the variation factors is thought to be shorter exercise duration. Further research would be necessary for examining the validity of exercise intensity and duration used in this study, as well as individual variation to skin stimulation. [Reference] Hoshikawa, H., Sawazaki, K., Arima, Y., Nakazawa, H., Sato, D., Yoshida, S., Miyamura, T., and Tanaka, S. (2012). Eastern Medicine, 28(2), 45-54 (in Japanese with English abstract) Hotta, H., Schmidt, R.F., Uchida, S., and Watanabe, N. (2010). Eur. J. Pain, 14, 806-813

## CARDIOVASCULAR RISK FACTORS ANALYSIS ON MILITARY MEN OLDER THAN 35 YEARS OLD

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Introduction The increasing prevalence of cardiovascular risk factors is mainly due to habits acquired during one's life. However, military training has physical aptitude as one of its main objectives. The objective of the data analysis was to analyze the practiced physical activity, which is the most active age group and if the intensity of the physical activity influences the various parameters being analyzed. Methodology This evaluation focuses on some cardiovascular parameters like the incidence of family history, medication, smoking habits and blood pressure/heart frequency measurements; data from blood tests to examine the biochemistry; body composition through weight, height, abdominal perimeter and, through DXA, body fat; and with accelerometry the physical activity level has been determined. Results Sedentary physical activity is significantly greater during weekends instead of moderate and intense levels, which occur mainly during work-days. People who are between 45 and 54 years old are the ones who takes more anticholesterolemic medicine and also the one who show the best HDL values. The sedentary level of physical activity is positively and directly related with weight, which presents an inverse correlation with moderate physical activity, and also body fat parameters and abdominal perimeter. The highest

prothrombin time levels and sedimentation speed are associated with sedentary physical activity. However, even though HDL levels are significantly greater when intense physical activity is practiced, this also creates higher values of INR. Intense physical activity is also responsible for some ischaemic heart disease, reflecting an increase in CK-MB values. Discussion The abdominal perimeter proved to be a better predictor of intra-abdominal fat than the BMI. The youngest age group showed really high values of PCR, protein being a contributing factor for heart disease risk (Albert, Glynn & Ridker, 2003). The relation between physical activity and fat was inverse (Cederberg et al, 2011), while HDL results were better as physical activity increased (Gordon-Larsen et al, 2009). Physical activity intensity above average show little to no benefits (Aadahl, Kjær & Jørgensen, 2007), just like the increase of circulation CK-MB however, sedentary ones showed more changes when it came to coagulation. Balanced physical activity was moderate when it came to benefits/disadvantages. References Aadahl M, Kjær M, Jørgensen T (2007). *Eur J Epidemiol*, 22, 369-378; Albert M A, Glynn R J, Ridker P M (2003). *Circulation*, 108; 161-165; Cederberg H, Mikkola I, Jokelainen J, Laakso M, Härkönen P, Ikäheimo T et al. (2011). *Atherosclerosis*; Klein S, Allison D B, Heymsfield S B, Kelley D E, Leibel R L, Nonas C, Kahn R (2007). *Diabetes Care*, 30(6).

### **PHYSICAL FITNESS, PHYSICAL ACTIVITY BEHAVIOURS AND WEIGH STATUS IN PRIMARY SCHOOLCHILDREN OF SOUTHERN SPAIN: THE HAFICA STUDY.**

Jimenez-Pavon, D.1,2, Gómez-Leiva, J.A.2, Moreno-Domínguez, M.A.3, Palma-Reina, M.2

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**Do not insert authINTRODUCTION** Physical fitness and activity behaviours have been related with weight status (WS) in national and international context using representative samples. However, specific information on schoolchildren of southern Spain is not available; and to know this information would be useful in order to promote future interventions. The present study was conducted (1) to examine the relation of physical fitness and activity behaviours with WS in schoolchildren of southern Spain providing gender-specific information. **METHODS** The current report is based on cross-sectional data from the Healthy lifestyle; physical activity, fitness and nutrition in preschool and school children (HAFICA). A total of 558 children (293 girls) with a mean age of 10.5 years and valid data for weight, height and waist circumference, whose examination took place in Córdoba (Spain) during 2009 were included. Physical fitness measurements included cardiorespiratory fitness (20m shuttle run test) (CRF), muscular strength (handgrip and standing long jump tests) and speed agility (4x10m shuttle run test). Active travel to school, sport participation and sedentary behaviours at home were registered using a self-reported questionnaire. Weight, height and waist circumference (WC) were measured and body mass index (BMI) was calculated. Multivariate general lineal models were used after adjusting for age and family affluence. **RESULTS** Boys had significantly higher physical fitness levels than girls (all  $p < 0.001$ ). No differences in activity behaviours by gender were found. The 54% and 45% of boys and girls, respectively, had 3 or more videogame consoles at home, while the 11% of boys and 5% of girls spent 7 or more hours/week playing videogames ( $p < 0.001$ ). Obese boys and girls had significantly lower handgrip relative to weight, standing long jump, speed agility and CRF performances than their normal weight peers (all  $p < 0.01$ ), except for speed agility in girls. When WC thirds were used instead of BMI categories the results did not change. The 70% of the obese girls did not use a physically active transport to school. Finally, those children participating in sport activities after school had significantly higher standing long jump and CRF than those children do not involved in any sport activity (all  $p < 0.01$ ). **DISCUSSION** Physical fitness, particularly muscular strength and CRF, is related with lower WS in schoolchildren of southern Spain. In girls, an active travel to school is related with lower WS. These findings suggest that physical fitness and activity are important tasks, more than sedentary patterns, in preventing obesity in schoolchildren. Then, sport activities and higher physical activity levels should be promoted at those ages in order to prevent or fight again the epidemic of obesity. **ors here**

### **FACTORS LEADING TO REGULAR EXERCISE IN COMMUNITY-LIVING MIDDLE-AGED AND OLDER PEOPLE WITHOUT REGULAR EXERCISE EXPERIENCE**

Kozakai, R., Ando, F., Kim, H.Y., Lee, S., Yuki, A., Shimokata, H.

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**Introduction:** A number of people who had not engaged in regular exercise earlier in their lives started regular exercise in middle age and older in our previous study. Little is known about what contributes to engagement in regular exercise in middle-aged and older people except for the influence of exercise experience. The purpose of the present study was to investigate the primary factors for regular exercise in community-living middle-aged and older people without regular exercise experience. **Methods:** Data was obtained from the National Institute for Longevity Sciences - Longitudinal Study of Aging (NILS-LSA). Inclusion criteria for the present study were as follows: participants who participated in the 4th and 5th study of NILS-LSA, who had completed the questionnaire of regular exercise throughout a person's lifetime, who had never had regular exercise before their first participation and who had participated at least twice during the 1st to 5th study of NILS-LSA. The subjects of this study were 98 men and 166 women aged 40-79 years at the first participation in NILS-LSA. Health and lifestyle factors such as hypertension, smoking status, body mass index, education, self-rated health, depression and grip strength were examined as the primary factors for regular exercise. Cox proportional hazards models were used to analyze the independent effects of health and lifestyle factors on engaging in regular exercise. Both the unadjusted model and the adjusted model for age were performed in men and women separately. Significant probability levels were considered to be less than 0.05. **Results:** The mean length of follow-up was 6.6 (range: 2.0-8.0) years. The participants who started regular exercise during the follow-up were 26 men (26.5%) and 49 women (29.5%). For women, more grip strength (20kg and above) was significantly associated with starting regular exercise (hazard ratio: HR 2.73, 95% confidence interval: 95% CI 1.08-6.90). Adjustment for age did not change the estimate, but slightly decreased the HR and widened the CI (HR 2.47, 95% CI 0.95-6.40). Among men, there were no significant associations of health and lifestyle factors with starting regular exercise in either model. **Discussion:** Of those who had never had regular exercise in earlier life, women who had 20 kg or more in grip strength were more likely to start regular exercise. Although health motives such as advice from doctors positively influence exercise engagement beyond middle age, health problems were reported as the most common barrier to physical activity. The association between physical conditions and exercise engagement is still controversial. Our finding that having a certain amount of grip strength is associated with starting regular exercise in middle age and older even without regular exercise experience in earlier life may help to understand the relationship between physical condition and the inducement to engage in regular exercise.

## PHYSICAL FITNESS LEVELS AND CHILDHOOD OBESITY BETWEEN RURAL AND URBAN CONTEXTS

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**Objective:** this work is aimed at knowing the level of physical aptitude and its degree of association, regarding an urban and a rural area, in children from the primary education schools. **Methodology:**the sample consisted of six schools from the primary education of the county of Fundão: Santa Teresinha school (a central school), and the schools of Valverde, Fatela, Enxames, Alcaria and Peroviseu (peripheral schools). The sample has been selected in order to have a certain number of pupils from a peripheral area and another one from a central area of the city. The total sample is represented by 161 pupils, 76 are female and 85 are male and they are aged between 6 and 10. 85 come from an urban area and 76 come from a rural area. The analysis of the physical aptitude had as a reference the battery Prudential Fitnessgram (2002). **Results:** According to the results obtained in the anthropometry, boys and girls from rural areas are heavier and taller than the boys and girls from urban areas. Regarding the BMI and body fat, it is males in rural areas that show a higher number of pupils in the healthy zone. As far as females are concerned, it is the urban area that has more pupils in that zone. It was also noticed that there are a huge percentage of girls from the rural area in the thin zone. In the differentiation between genders, boys have better results in physical aptitude and obesity levels. Regarding the influence of the living area, there are obviously better results in the urban area than in the rural area. Our study reveals that there are significant differences in the physical aptitude tests when they were applied at two different moments. **Conclusions:** After the analysis and interpretation of the results, we can conclude that boys and girls coming from rural areas are taller and heavier than the ones from urban areas and that they exhibit a lower body mass index. When defining the percentage of subjects classified in the "healthy zone", the BMI numbers in boys from rural areas that are in the healthy zone are higher than those of boys from urban areas. Regarding girls, the ones from urban areas as well as those from rural areas have almost the same percentage in the healthy zone. Concerning fat, it is males in the rural areas that have more pupils in the healthy zone. As for girls, the ones from the urban areas have better results in the three zones, being the healthy zone that has a higher percentage of girls. In the relationship between the genders, boys have better results in the levels of physical aptitude and obesity. In the relationship between the areas, the urban one shows better results. The existence of two periods of analysis allowed us to notice an improvement in all the tests.

## ESTROGENS AND TESTOSTERONE HORMONES, AS RESPONSIBLE FACTORS FOR CHANGES IN LIPID PROFILE AND BODY COMPOSITION IN MALE ELITE ATHLETES

Costa, M.1, Raimundo, A.1,2, Crespo, C.3, Maynar, M.3

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**Introduction** The practice of physical activity and a balanced diet have been identified as strategies to acquire cardiovascular benefits. This study attends to determinate the changes in hormones, testosterone (T) and estrogen (E2) levels, as a result of regular practice, vigorous physical activity and its influence on body composition and lipid profiles in male athletes, since this gender has a higher prevalence of cardiovascular disease. **Methods** In this study where recruited 42 male participants 20 of them professional soccer players (SG) (age 15-28 years) and as control group 22 students (CG) with sedentary lifestyle (aged 18-28 years). The SG workout two times a day, 4 times a week (duration between 60 and 90 minutes each), and competing in football match's at the weekend. The SG is also subject to a medical diet control. Anthropometric evaluation body composition and clinical analysis where used to determinate the lipid profile and the hormone levels. **IPAQ in CG** Results There were significant differences between groups (SG< CG) mainly in abdominal ( $p<0.01$ ), subscapular ( $p<0.001$ ) and thigh ( $p<0.01$ ) skinfolds; hips ( $p<0.001$ ) and waist ( $p<0.01$ ) circumference; in the lipid profile the total cholesterol ( $p<0.01$ : SG< CG), triglycerides ( $p<0.01$ :SG< GC), HDL- C levels ( $p<0.05$ : CG >SG); levels of T ( $p<0.001$ : SG>CG) and E2 ( $p<0.05$ :SG >CG). We noticed a strong correlation ( $p <0.001$ ) between increase physical activity and the levels of T and significant increase among the E2 levels with exercise ( $p <0.05$ ). There's a strong correlation between the increase of T levels and the reduction of subscapular, abdominal skinfolds and waist circumference. **Discussion** The results of the present study suggest that vigorous physical activity have improved the body composition, particularly in the reduction of central fat, in the SG and there lipid profile by increasing the T levels. The findings support that individuals who practice vigorous physical activity in a relation of 'dose-effect' acquire additional benefits which reduces the risk of mortality (Teramoto et al 2009; Tompson et al 2007). **References** 1. Termamoto, Masuro & Bungum, Timothy J. 2010, "Mortality and longevity of elite athletes", *Journal of Science and Medicine in Sport*, (13):410-416 2. Thompson, Paul D.; Franklin, Barry A.; Balady, Gary J.; Steven N. Blair; Corrado, Domenico; Estes III, N.A. Mark; Fulton, Janet E.; Gordon, Neil F.; Haskell, William L.; Link, Mark S.; Maron, Barry J.; Mittleman, Murray A.; Pelliccia, Antonio; Nanette K. Wenger; Willich, Stefan N.; Costa, Fernando 2007, "Exercise and Acute Cardiovascular Events-Placing the Risks Into Perspective", *J. American Heart Association*, (115): 2358-2368. authors here

## ACADEMIA DA TERCEIRA IDADE PROJECT : PREVENTION OF DEPRESSION IN THE ELDERLY

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**Introduction** The elderly population in general lives in a lonely manner, with little opportunity for relationships. The practice of regular physical activities promotes behavioral change, which can provide social transformations. The systematic practice of physical exercise is associated with absence or reduction in symptoms of depression or anxiety. The Academia da Terceira Idade project is developed in the Rio de Janeiro City through the Department of Healthy Aging and Life Quality, aiming to promote physical activity by using specialized gym apparel, focusing on aerobic and strength training. The program is meant to maintain and/or improve participants' functional autonomy, fall prevention and the formation of social networks among them. The participation of the elderly in regular physical activity programs can be considered an alternative non-pharmacological treatment of depressive disorder, represented by low economic cost, easily affordable and efficient in preventing functional decline in the elderly. **Methodology** The sample consisted of 285 elderly men and women with an average age of 69.2 years, all project participants Academia da Terceira Idade (ATI), for a minimum period of 3 months. The instrument used to measure depression was the Geriatric Depression Scale (GDS). The data was processed in the Statistical Package for the Social Science 21 program. **Results** The results show that there was no prevalence of depression in the elderly program, with an average of 3.49 points, highlighting that 81% of the sample presented amounts below 4, which characterizes absence of depression. **Discussion** Through the research results show that elderly participants in the project had low levels of depression, suggesting that the exercise program group had a positive response on the need to extend social contacts. The psychological benefits of physical activity programs

are important indicators for the mental health of the elderly, demonstrating the positive results achieved in Academia da Terceira Idade Project

### **EFFECT OF A PILATES MATWORK EXERCISE IN MUSCLE AND FAT MASS**

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Do not insert authors hereIntroduction Some researches have demonstrated a relationship between systematic physical exercise and positive changes in body composition. A few studies have showed that performing a Pilates method modifies both muscle and fat mass. Segal et al. (2004) analyzed the influence of one hour per week of Pilates matwork in body composition. However, no changes in body composition were detected. To date, no studies have analyzed the influence of different Pilates matwork volumes on a sample of women without chronic diseases. For this reason, the objective of this study was to analyze the influence of Pilates Matwork exercise in muscle and fat mass of adult women. Methods Fourteen women (mean  $\pm$  SD, age:  $41.93 \pm 7.27$  years) with an experience of one year in Pilates Matwork participated in this study. They participated in a Pilates Matwork program of one hour, twice a week, during 16 week. A Level 2 anthropometrist certified by the ISAK taken all anthropometric variables. Participants completed baseline measures over one week before starting the exercise program. Post-test was taken over one week after finishing it. Instruments were calibrated in advance to avoid measurement errors. The temperature of the laboratory which the measurements were performed was standardized at 24°C. To determine body composition strategy five components by Kerr (1988) was used. Results Significant differences were found ( $t(13)=3.12$ ;  $p=0.008$ ) in fat mass between pre-test ( $23.29 \pm 3.87$  kg) and post-test ( $21.14 \pm 3.01$  kg). The percentage of muscle mass was slightly increased in the post-test although no significant differences were found (pre-test:  $23.36 \pm 3.00$  kg; post-test:  $24.21 \pm 3.36$  kg) Discussion The main objective of this study was to analyze the changes in muscle and fat mass after 16 week of Pilates Matwork training. Pilates Matwork involves the use of a machine (the reformer) while Pilates classic is performed on the floor with implements. Women showed a significant decrease in fat mass and a non significant increase in muscle mass estimated by anthropometry. These results are in concordance with previous research in Pilates classic mat (Cakmakçi, 2011; Carvalho et al., 2009). However, participants of these studies were novices and sedentary. A physical exercise program with sufficient intensity, duration and frequency may reduce fat mass. The present study demonstrated that Pilates Matwork exercise may influence fat component in active adult women. References Cakmakçi O (2011). *Coll Antropol*, 35, 1045-1050. Cruz-Ferreira AIC, Pereira CLN, Fernandes JA (2009). *Med Sci Sport Exerc*, 41, 16-17. Kerr DA (1988). [Thesis]. British Columbia: Simon Fraser University. Segal NA, Hein J, Basford, JR. (2004). *Arch Phys Med Rehabil*, 85, 1977-1981.

### **THE INCIDENCE OF A DISEASE IN PROFESSIONAL SPORTS, DEPENDING ON GENDER AND AGE**

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Introduction „Mens sana in corpora sano“has always made us believe that sport is healthy. Doing sports either professionally or as a hobby was a way for humans to be and to feel wholesome. Therefore, the aim of this study was to analyze the relative contribution of sports to a general health profile of athletes. Methods Research was conducted in Institute for Occupational and Sports Medicine in Banja Luka, Bosnia and Herzegovina using health examination of athletes on a semi seasonal basis and results were classified using ICD-10 health care classification system. Total number of 2294 athletes was examined in time period of one years. Results 1843 (80%) were male and 451 (19%) were female athletes. Among male population largest number was between 16 -30 years of age. Total of 1009 (54.7%). At female athletes largest number of examined was younger than 15 years (257 or 56.9%) of age. From total number of both sexes, 1436 (62.5%) had two or three diagnosis and 298 (12%) had more than three. Only 109 (4.8%) were healthy what statistically supports the thesis of this study. Discussion Most common disease diagnosis was revealed in muscular-skeletal and digestive systems and interesting differences in diagnosis occurred between male and female athletes and their ages. Women often suffer from anemia, disturbances of vision and pneumonia, while congenital anomalies, skin changes and injuries are common in male athletes. The fact that only ten most popular sport types were part of this study could lead to discussion stating that this data are not general and only relevant to specific sport types. References The World Health Organization (2010). *International Statistical Classification of Diseases and Related Health Problems*, 10th Revision.

### **TIME-COURSE ADAPTATIONS TO HIGH-INTENSITY AEROBIC INTERVAL TRAINING IN METABOLIC SYNDROME PATIENTS**

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Introduction: Metabolic syndrome (MetS) is associated with a fivefold increased risk for type 2 diabetes and a twofold increased risk for cardiovascular disease (1). Exercise training of enough intensity reduces some of the MetS components. However, which factors are more responsive to exercise and which is the optimal exercise dose remain unresolved. We addressed the monthly progression towards healthy values of MetS components (i.e., waist perimeter, systolic and diastolic blood pressure, blood glucose, triglycerides and HDL-c concentrations) with exercise training. Materials and methods: Forty eight MetS patients (22 men and 26 women,  $52 \pm 8.8$  yrs old) underwent 16 weeks a 3 days per week supervised cycle-ergometer high-intensity aerobic interval training (HIAIT). Each training session was composed of 10 min of warm-up, 4x4 min bouts of pedaling at 90% HRmax interspersed by 3 min at 70% HRmax and 5 min of cool-down (2). MetS components, additional blood metabolites, cardio and metabolic fitness (VO2max and maximal fat oxidation rate (MFO)) and O2 flux from vastus lateralis biopsy were evaluated before, monthly and 48 h after the last exercise session (O2 flux only pre-and-post). Results: After 16 weeks of HIAIT, 29% of the patients reduced MetS factors below three and were thus, momentarily free of the syndrome. Waist perimeter, systolic and diastolic blood pressures were progressively reduced with exercise training ( $P<0.05$ ) achieving  $3.8 \pm 2.9$ ,  $12 \pm 2$  and  $11 \pm 3\%$  respectively, after 4 months of training. HDL-c was progressively augmented up to  $13 \pm 10\%$  after 4 months of training ( $P<0.05$ ). VO2max and MFO monthly increased ( $P<0.05$ ) up to  $22 \pm 15$  and  $36 \pm 25\%$ , respectively after 4 months of training. Vastus lateralis muscle biopsies in seven subjects revealed that mitochondrial O2 flux increased by 61% ( $P<0.05$ ) due to increased mitochondrial content. Glycosylated hemoglobin diminished monthly up to  $3.8 \pm 0.8\%$  after 4 months of training ( $P<0.05$ ). However, blood triglycerides and fasting glucose concentration were not affected by 4 months of HIAIT ( $P=0.11$  and  $P=0.28$ , respectively). Conclusions: The MetS factors responsive to exercise (waist perimeter, blood pressure and HDL-c) improved without a plateau response. Thus, HIAIT beyond 4 months could potentially reverse to normal clinical values those three MetS factors in all patients. The marked cardio-metabolic fitness adaptations to training could be behind the improvements in MetS factors. 1) Alberti KG, et al. Harmonizing the metabolic syndrome. *Circulation*.

2009; 120(16):1640-5. 2) Helgerud J, et al. Aerobic high-intensity intervals improve VO<sub>2</sub>max more than moderate training. *Med Sci Sports Exerc.* 2007; 39(4):665-71.

### PHYSICAL WORKLOAD ON NECK AND SHOULDER MUSCLES DURING MILITARY HELICOPTER FLIGHT - A NEED FOR EXERCISE TRAINING?

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**Introduction** Work-related neck/shoulder pain is a common complaint among military helicopter pilots and crew members. The flight helmet and additional Night Vision Goggles (NVG) place a considerable load on the cervical spine. The aim of this study was to quantify the physical workload on neck/shoulder muscles to assess possible overload that may call for exercise training to improve capacity and prevent neck pain. **Methods** Nine pilots and nine crew members from the Royal Danish Air Force participated in a standardized representative flight sortie encompassing: Patient transportation (A-B flight) and Search and Rescue (SAR flight). A standard helmet was used (1.85 kg). SAR flight was performed with NVG (1.1 kg) and A-B flight was performed +/- NVG. Before take-off, one pilot and one crew member were equipped with 6 wireless electromyography (EMG) sensors bilaterally above m. trapezius (TRA), upper neck extensors (UNE) and m. sternocleidomastoideus (SCM). Maximal Voluntary Isometric Contractions (MVC) was performed for normalization. A modified version of the observational method "Posture Activity Tools and Handling" (PATH) was used for assessing work positions during flights. For every minute, the head position of pilots/crew members were classified as: anatomically neutral (<30° flexed), flexed (>30°), extended (>30°), rotated (>30°) and/or laterally flexed (>30°). **Results** Mean measuring time was for A-B flight: 16.9 ± 5.1 min, for A-B flight + NVG: 22.7 ± 10.8 and for SAR flight: 21.3 ± 11.1. The mean muscle activity in % MVC was highest during SAR flight: pilots 2.9 ± 1.7 (TRA) 12.7 ± 5.2 (UNE) 4.3 ± 2.9 (SCM), Crew members 4.1 ± 3.8 (TRA) 10.5 ± 2.4 (UNE) 2.4 ± 1.5 (SCM). Muscle activity in UNE was significantly higher than in TRA and SCM during all flights, except for crew members when compared to TRA during A-B flight (P = 0.086). For crew members muscle activity in UNE was significantly higher during A-B flight + NVG compared to - NVG (P = 0.021), while no significant difference was found for pilots. Non-neutral head positions in % of SAR flight time were for pilots observed for 88.6% (flexed) and 64.4% (rotated), and for crew members for 93.8% (flexed) and 89.9% (rotated). **Discussion** The mean muscle activity during flights was overall ~10% MVC in UNE and even higher during SAR flight, which is considered a high sustained activity level. Such high workload in combination with the flexed and/or rotated positioning of the head may play a role for the high prevalence of neck/shoulder pain among this occupational group. The present exposure-assessment suggests that strengthening exercises for the UNE, lowering the relative load during flights, could potentially alleviate neck pain.

### REFERENCE VALUES FOR THE PHYSICAL GROWTH OF SCHOOL CHILDREN AND ADOLESCENTS IN BRAZIL CAMPINAS

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**Introduction** Physical growth patterns reflect the nutritional status and life, still important to have references in different cultures and ethnicities (Molinari et al. 2004). Therefore, the aim of this study was to compare the CDC international reference -2012 and build reference values for the physical growth of children and adolescents school of Campinas (Brazil). **Methods** The sample consists of 6531 individuals (3315 boys and girls 3.216) with an age range of 6-17 years. Comparisons were made between the means of study and CDC-2012 reference. Body weight-for-age, height-for-age and BMI-for-age percentiles were obtained using the LMS method. **Results** Men have less weight and height relative to the reference (9-17 years) and BMI (11-17 years) (p < 0.01). Women are lower in weight (6-17 years), height (7-14 years) and BMI (11-17 years) (p < 0.01). **Discussion** The World Health Organization has recommended the adoption of growth charts for the United States where there is a standard area (WHO, 1995), although clearly not reflect the growth patterns of different cultures and different ethnic groups (Silva et al 2012), may lead to bias in the assessment of patients, so that the observed secular changes in body size during the past 30 years, suggesting the use of regional standards for assessing the physical growth trajectory of Campinas in clinical settings or epidemiological studies. **References** Molinari L, Gasser T, Largo R. (2004). TW3 bone age: RUS/CB and gender differences of percentiles for score and score increments. *Ann Hum Biol* 31:421-435. WHO. (1995). Physical status: The use and interpretation of anthropometry. Report of a WHO Expert Committee. WHO Technical Report Series, v.854. Geneva: World Health Organization. Silva S, Maia J, Claessens AL, Beunen G, Pan H.(2012). Growth references for Brazilian children and adolescents: Healthy growth in Cariri study. *Ann Hum Biol*, 2012; 39(1): 11-18

### EFFECTS OF HIGH-RESISTANCE TRAINING ON NEUROMUSCULAR ADAPTATIONS AND FUNCTIONAL MOBILITY IN AN ELDERLY POPULATION

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**Introduction** Aging is associated with decreases in muscle mass, muscle strength and muscle power, which can negatively impact activities of daily living in older adults. High-Resistance circuit training (HRC) is a time-efficient training modality that can elicit demonstrable improvements in health and physical fitness (Romero-Arenas et al., 2013). The purpose of the study was to evaluate the effects of 12-weeks of high-resistance training on the neuromuscular adaptations and functional mobility in an elderly population. **Methods** Thirty-seven elderly (age 61.6±5.3 years, height 1.55±0.07 m and weight 71.9±11.2 kg) were randomly assigned to the traditional strength (TS) group (n = 14, 6RM, 1-3 sets), to the HRC group (n = 16, 6RM, 1-3 sets) or to the control group (CG) (n = 7, no training). Training consisted of weight lifting 2 times a week during 12 weeks. Prior to and at the end of the training program, the functional mobility was evaluated with a 'Timed Up and Go' test. In addition, force per unit of active muscle mass (i.e. muscle quality - MQ) was evaluated by the quotient between maximum isokinetic torque (90°•s<sup>-1</sup>) and lean mass of lower-limb via dual-energy X-ray absorptiometry. **Main and interaction effects** resulting from the intervention were analyzed using single or multivariate analyses of variance (ANOVA) with repeated measures (p ≤ 0.05). **Results** After training, muscle quality was increased in both experimental groups (23.9%, p < 0.001 and 20.0%, p < 0.001; HRC and TS, respectively), being established statistically significant differences between experimental groups and CG (p < 0.05). There was significant increase in functional mobility: the time in "Timed Up and Go" test decreased 13.1% in HRC group (p < 0.001) and 7.8% in TS groups (p = 0.012), there was not significant decreased in CG. **Discussion** The HRC training was as effective as TS for improving muscle quality and functional mobility. Thus, HRC training promoted a similar neuromuscular adaptation as traditional training while using a

shorter training session duration. References Romero-Arenas S, Blazevich AJ, Martínez-Pascual M, Pérez-Gómez J, Luque AJ, López-Román FJ, Alcaraz PE (2013). *Exp Gerontol*, 48(3), 334-340.

### **QUALITY OF LIFE EVALUATION ON ELDERLY PEOPLE WHO TAKE PART IN THE ACADEMIA DA TERCEIRA IDADE PROJECT, IN RIO DE JANEIRO CITY**

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*1 Department of Healthy Aging and Life Quality of Rio de Janeiro City (Brazil), 2 UCB (Rio de Janeiro, Brasil), 3Research Center in Aging (INEPE Rio -UCB – Brasil) Introduction*

Introduction Ageing is a global phenomenon, and in Brazil specially life expectancy had a significant growth, from 43,3 years in 1950 to 68,6 years in 2000, reaching 73,4 years in 2010. To extend longevity and maintain life quality has become this century's great challenge. The city of Rio de Janeiro with the highest percentage of elderlys in the country accounting for 14.9% of its population. Public policies towards this group are a necessity, and so the City trough, Department of Healthy Aging and Life Quality created the Academia da Terceira Idade (ATI) project, aiming to promote physical activity by using specialized gym apparel, focusing on aerobic and strenght training. The program is meant to maintain and/or improve participants' functional autonomy, fall prevention and the formation of social networks among them. Methodology The sample was constituted by 257 people, from both sexes, active, aging  $69,11 \pm 6,8$  years, participants of SESQV's ATI Project. The instrument utilised was the World Health Organization Quality of Life-OLD questionnaire, to evaluate quality of life (WHOQOL-OLD). To analyse statistical data, the chosen tool was the Statistical Package for the Social Sciences, 21(SPSS). Results The average quality of life score was  $61,69 \pm 8,22$ . The highest value was observed in the intimacy domain ( $78,4 \pm 21,5$ ), and the lowest referred to death and dying ( $45,1 \pm 15,2$ ). Linear regression showed good self perception on health issues and improved quality of life scores in 7,3 points. Discussion Results indicate that the Academia da Terceira Idade (ATI) project, developed in the city of Rio de Janeiro, has been achieving its main objectives. Through the interpretation of these informations, SESQV can offer services with various structures of social aid and health care, especially on the identification of the possible consequences of policies about elderly quality of life, adding a clearer comprehension on the investment areas to attain better outcomes in life quality. References Brazilian Institute of Geography and Statistics (IBGE) 2010. Furtado, H. . Physical activity and aging. In: Brasil, Cristiane. (Org.). *Living is the best option: ... Ageing It's part!*. Ied.Rio de Janeiro: Quartet, 2012, v. , p. 183-20

### **FOURTH AGE'S FUNCTIONAL FORCE: EXTENDING THE INDEPENDANCE OF RIO DE JANEIRO'S ELDERLY POPULATION**

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Introduction The intent of an active ageing has become the main groundwork for public policies to the elders. The patterns of physical activity in the brazilian population have begun to be studied recently, having a major role in life expectancy for the older segments. The Qualivida Project is the City trough, Department of Healthy Aging and Life Quality, a gymnastics program to aged people, free and developed in public squares in Rio de Janeiro city. It aims to maintain the daily life activities (AVD), socialization and functional autonomy. The elderly population has the necessity of maintaining reasonable levels of muscular strenght, since the strength decreases with the natural aging process. The loss of muscular mass, and consequently of muscular strenght, is the main responsible for the loss of mobility and functional capacity in an ageing individual. Methodology The sample was constituted by 51 female elderlys from the Qualivida program, homogenised by age group and body mass index, with  $81,8 \pm 1,5$  years e  $26,8 \pm 4,4$  BMI. As na inclusion criteria it was established a minimum if three uninterrupted months in the referred program. The instruments utilised to measure the functional strenght were the Chair stand and the Arm curl from te Sênior Fitness Test. The data was processed in the Statistical Package for the Social Science 21 program. Results In the Chair stand test the obtained value was  $11,2 \pm 3,3$ , and in the Arm curl test it was  $12,9 \pm 3,4$ . Discussion Based on the presented results, it was inferred that the female elderlys that composed the sample group were within the range of the normative indexes in both Arm curl and Chair stand tests. Therefore, the gymnastics program Qualivida was capable of maintaining the group's strenght in physiologically recommended levels. The study verified that, despite having reached advanced ages among the sample, the regular gymnastics program was key to maintain functional autonomy and the AVD. References Pedrinelli, A.; Garcez-Leme, L.E.; Nobre, R.S.A. The effect of physical activity on locomotor the elderly. *Rev. bras. ortop.* 2009; 44(2): 96-101. WHO. *Envelhecimento ativo: uma política de saúde*. Brasília: OPAS, 2005.

### **INCIDENCE OF OBESITY AND ITS RELATIONSHIP WITH PHYSICAL INACTIVITY IN RECREATIONAL CLUB GOERS FROM THE CITY OF FRANCA**

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Introduction In the last three decades, several issues related to obesity are being raised to try to better understand its causes, what better way to identify it and how to prevent it, as well as their consequences. All this, because obesity is currently a public health problem worldwide, mainly in industrialized countries. The morbidities associated with obesity are severe, or the psychosocial point of view of either the biological point of view with various metabolic and osteoarticular disorders, among others. The increased prevalence of obesity has been explained by factors such as sedentary lifestyle and changes in food consumption patterns, for example, higher intake of foods with high energy density. Thus, the objective was to investigate the incidence of obesity and its relation to physical inactivity in the club-entertainment city of Franca, Brazil. Methods Study participants were 64 individuals aged between 20 and 50 years ( $35,3 \pm 9,7$ ), leisure club goers from the region of Franca, Brazil. They responded to an International Physical Activity Questionnaire (IPAQ - version 8) and also underwent an anthropometric assessment. In this, we collected the values of weight (kg) and height (m) and calculated the Body Mass Index (BMI). The subjects were divided into two different groups: active (AG) and sedentary group (SG). Results Characterization of physical activity has been observed that in the AG individuals had an average time of  $559,17 \pm 199,82$  minutes. In the comparison between AG and SG, it was observed that the GA presented increased physical activity ( $559,17 \pm 199,82$  minutes) when compared with the GS ( $165,45 \pm 82,47$  minutes), showing a difference of 393.72 minutes from one group to another ( $p0 .001$ ). When analyzed separately, it was observed that the AG presented a lower BMI ( $21,92 \text{kg/m}^2 \pm 2,68$ ) when compared with the SG Group ( $26,54 \text{kg/m}^2 \pm 2,55$ ), which represents a difference of 4.62 points from one group to another ( $p0 .001$ ). Discussion We believe that physically active individuals have a lower level of obesity compared to sedentary individuals, and thus, we can conclude that physically active children have lower risks for cardio-

vascular and metabolic diseases. Sedentary habits are directly related to obesity. References JÚNIOR, J. C. F.; SILVA, K. S.; Sobrepeso/Obesidade em Adolescentes Escolares da Cidade de João Pessoa - PB: Prevalência e Associação com Fatores Demográficos e Socioeconômicos, Revista Brasileira de Medicina do Esporte, V. 14, n. 2, p. 104-108, 2008. STRONG W.B, MALINA R.M, BLIMKIE C.J, DANIELS S.R, DISHMAN R.K, GUTIN B, et al. Evidence based physical activity for school-age youth. J Pediatr. V. 1. n. 46. p. 732-7, 2005.

### **CORRELATION BETWEEN OBESITY, PHYSICAL FITNESS AND BEHAVIORAL FACTORS IN SCHOOLCHILDREN**

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**Introduction** Obesity as a national public health problem, is a recent event. Despite the reports from the Paleolithic Era on 'burly men', the prevalence of obesity has never appeared in epidemic level as at present, and is advancing rapidly and progressively, without differentiating race, sex, age or social status. In recent years, obesity has ceased to be a mere inconvenience 'aesthetic' and 'sloppiness', despite treated by patients and healthcare professionals, to become an alarming and frightening reality. The substantial increase in the prevalence of obesity is due largely to the two variables are behavioral: low levels of habitual physical activity and sedentary behaviors. This study sought to identify the relation between obesity, usual level of physical activity and sedentary behaviors in students from public schools from city the interior of São Paulo. **Methods** Were used as indicators of obesity the body mass index, fat percentage and waist to hip ratio. The usual level of physical activity was estimated by physical fitness assessed by the Cooper test and questioner. By the same questioner was also estimated the sedentary habits. **Results** It is observed through indicators of adiposity used in the study a different percentage of schools categorized like overweight if considered the normal between the classification criteria. When classified by BMI and fat percentage, the indexes of obesity have reached 10.4% and 7.8% respectively, while for the WHR the index found was higher, 22.1%. Comparing the results between sexes, no significant differences were found regarding BMI and WHR. For the level of regular physical activity we observed that 27.3% of child were in the category of 'active', that is, only just over a quarter of schoolchildren. The school already classified in the categories 'little active' and 'moderately active' represented a value greater than 72. Of the three measures of body fat used in the study, two were highly inverse-correlated with the level of physical fitness: BMI and fat percentage. **Discussion** The level of regular physical activity, assessed by physical fitness has an inverse relation with obesity in schoolchildren. The behavioral factors, assessed by questionnaire, were not correlated with obesity, leading us to conclude that the methodology may have influenced results. **References** RICARDO, G.D.; CALDEIRA G.V.; CORSO A.C.T. Prevalência de sobrepeso e obesidade e indicadores de adiposidade central em escolares de Santa Catarina, Brasil, Revista Brasileira de Epidemiologia, v.12, n.3, p. 424-435, 2009. SILVA K.S.; NAHAS M.V.; HOEFELMANN L.P. et al. Associações entre atividade física, índice de massa corporal e comportamentos sedentários em adolescentes, Revista Brasileira de Epidemiologia, v. 11, n.1, p. 159-168, 2008.

### **INDICATORS OF METABOLIC SYNDROME IN STUDENTS IN HIGH SCHOOL OF PARACATU-MG BARZIL**

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**Introduction** Obesity in childhood and adolescence has a very strong predisposition factor for metabolic syndrome. This study aimed at tracking the risk factors for metabolic syndrome in adolescents in a public school and private one in Paracatu-MG. **Methods** Participated in this study 68 high school students, of both sexes, aged between 14 and 20 years of Paracatu-MG. The anthropometric tests were waist hip ratio (WHR), body mass index (BMI), waist circumference (WC), the relationship age weight and nutritional status (old-growth). The following were performed biochemical analyses: fasting blood glucose (FBG), glycated hemoglobin (GH); triglycerides (TG), total cholesterol (Col. Tot) and HDL fractions. Finally it was also evaluated the blood pressure (BP). **Results** All sample evaluated regarding WC, 11% of students are above normal values (Men and Women 80 cm 94 cm). These show us that the WC in isolation, not presented as a factor indicative of risk for metabolic syndrome in students. On the WHR, 22% of students fall within the values considered at risk (Man more than 0.95 and Woman more than 0.80). BMI did not show up as a good predictor for the risk of SM to the Group of students assessed. The FBG was also not presented values of prediction for SM (average 74, 51mg/dl) to 89% of the group evaluated. But by looking at the data, the high glycemic impact matches for students with higher values of weight and waist circumference, which confirms the high body mass and its relationship with the predictors of SM. The HG was not a good predictor of the SM for the age group studied, since 100% of the Group presented normal values (<6%). This can be explained by the fact that the HG presents itself as a good long-term indicator in adult life. The TG were high in 62% of the group studied, representing an early indicator for the SM. These results are even more important when the TG are associated with other variables, such as Col.Tot (19% of the group with high values) and WHR. On the other hand, the HDL presented important predictor role, since more than half of the Group presented values below the normal range, resembling the occurred with Col. Tot. Finally, although BP has brought in the values to indicate SM just in 11% of the group, this variable was shown to be important for the age group, since it was linked to other indicators with WHR, BMI and TG. **Discussion** Of the 68 students evaluated, the association of up to 2 risk factors was clear in 56% of the group while 6.5% have three risk factors into association. This indicates that these students can be framed as early diagnosis of metabolic syndrome. The causes may be different as cited above. And for the prevention and reduction of risk factors, firstly this modification of the sedentary lifestyle and eating habits. **References** Botezelli JD, Cambri LT, Ghezzi AC, Dalia RA, M Scariot PP, Ribeiro C, Voltarelli FA, Mello MA. Different exercise protocols improve metabolic syndrome markers, tissue triglycerides content and antioxidant status in rats. Diabetol Metab Syndr. 2011;3:35.

### **SIMILAR IMPROVEMENTS IN AEROBIC CAPACITY IN UNTRAINED FEMALES FOLLOWING HIGH-INTENSITY INTERVAL AND MODERATE-INTENSITY CONTINUOUS TRAINING**

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1: Institute of Sport and Physical Activity Research, University of Bedfordshire, 2: Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, 3: Institute of Clinical Exercise and Health Research, University of West Scotland **Introduction** Recent research suggests that high-intensity interval training (HIT) may produce more favourable adaptations to aerobic capacity than moderate-intensity continuous training (MCT) in a variety of populations (Swain and Franklin, 2006). The paucity of data regarding the aerobic response of females to exercise training warrants further study in this population. The aim of this pilot study was to determine whether 10-weeks of HIT, elicits greater improvements in aerobic capacity in untrained females, than isocaloric MCT. **Methods** 27 healthy females undertook assessments of body composition and maximal oxygen uptake (VO<sub>2</sub>max) at baseline, week 4, week 7 and week 10. Participants were

randomly allocated to a no exercise control group (N = 7; age: 21.0 ± 5.2 yr; VO<sub>2</sub>max: 31.4 ± 6 ml/min/kg), or to complete 3 supervised sessions per week of HIT (N = 12; age: 19 ± 2.3 yr; VO<sub>2</sub>max: 34.1 ± 5.4 ml/min/kg) or MCT (N = 8; age: 20.5 ± 3.9 yr; VO<sub>2</sub>max: 31.4 ± 6 ml/min/kg) on a treadmill. HIT consisted of 6 x 3 min high intensity efforts at a running velocity (RV) corresponding to 90% of each individual's VO<sub>2</sub>max, interspersed with 6 x 3 min recovery at an RV of 40% VO<sub>2</sub>max. The intervals were preceded and followed by 4 min 'warm-up' and 'cool down' periods at an RV of 65% VO<sub>2</sub>max. MCT consisted of 44 minutes at an RV of 65% VO<sub>2</sub>max. Protocols were matched for average exercise intensity, distance covered, duration and calories expended (Bartlett et al., 2011). Results VO<sub>2</sub>max significantly increased within HIT and MCT by 4.3 ± 2.2 and 5.2 ± 2.1 ml/min/kg, respectively. No significant differences were observed between groups. % fat mass was unchanged from baseline (HIT: 36.3 ± 8.3, MCT: 39.7 ± 9) to week 10 (HIT: 35.2 ± 7.8, MCT: 38.7 ± 7.3). No changes in any measured variable were observed in the control group. Discussion In healthy untrained females, HIT is equally as effective in increasing aerobic capacity as MCT. However, the suggestion that HIT results in greater increases than MCT does not appear to hold for this population. This does not preclude the possibility that other health benefits may differ between protocols. These results highlight the importance of matching training protocols when comparing their efficacy for improving aerobic capacity and promoting health. References Bartlett JD., Close GL., Maclaren DP., Gregson W., Drust B., Morton JP (2011). Journal of Sport Sciences. 29 (6): 547 – 553. Swain DP, Franklin BA (2006). The American Journal of Cardiology. 97 (1): 141 – 147.

## **RELATIONSHIPS BETWEEN PHYSICAL ACTIVITY LEVELS, BODY MASS INDEX AND SELF-CONCEPT IN YOUTH PEOPLE**

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Introduction: Self-concept is one of the most researched constructs within the framework of educational psychology, psychology of the personality, and social psychology. Self-concept can be defined as the perception that an individual has of him or herself, with contents that are both descriptive, as well as evaluative (Harter, 2003, 1999). In the field of sport and exercise, physical self-concept is also considered very important. It plays a considerable role in sports performance (Carraro, Scarpa, & Ventura, 2010). The present study aims to investigate the role of physical activity and sports participation on physical self-concept and body mass index (BMI) in adolescents. Method: This research analysed the relationship between physical activity (PA), determined with a questionnaire (PAQ-A), body mass index and self-concept measured by other questionnaire which rates 5 constructs (physical ability, physical condition, strength, physical appearance, and general self-concept) A validated survey about physical self-concept (CAF) was administered in a classroom setting by two members of the research team. It was presented as an opinion questionnaire about the perception of physical self-concept. A test about physical activity levels (PAQ-A) was also administered in classroom. The research team registered weight and height of each participant to determine their BMI. Results: We observed positive relationship between physical activity, BMI and different constructs of self-concept in adolescents. Discussion: The positive interaction between PA and physical self-concept suggests a reciprocal relationship between behaviour and perception. Finally it seems possible to assert that adolescents with systematic practice of sport out of school may present a positive physical self-concept and better BMI than persons without regular practice of physical activity. References: Carraro, A., Scarpa, S., & Ventura, L. (2010). Relationships between physical self-concept and physical fitness in Italian adolescents. *Perceptual and Motor Skills*, 110, 522-530 Harter, S. (1999). *The construction of the self: A developmental perspective*. New York: Guilford Press. Harter, S. (2003). *Beyond the debate: Why some adolescents report stable self-worth over time and situation, whereas others report changes in self-worth*. *Journal of Personality*, 71, 1027-1058.

## **PARENT-CHILD PHYSICAL ACTIVITY RELATIONSHIPS USING ACCELEROMETERS. PILOT STUDY WITH GIRLS**

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Introduction Regular physical activity (PA), in youth, needs to be promoted to prevent obesity and subsequent clustering of CVD risk factors. Influences of parental PA on adolescents' activity level have been studied with discordant results, using different methods, making it difficult to compare the influence of parents in their child PA patterns. In this sense, parents are recognized as one of the factors of influence on physical activity of children and can therefore act to prevent obesity and other health problems. Therefore, the aim of the present study is: I) to verify the levels of PA, analyzing the differences between gender and different ages, and the number of subjects that meet the current recommendations, II) to investigate how the parents PA is related to the PA of their children. METHODS: The sample consisted of two matched parent-child groups: 28 adolescent girls, aged between 12 and 15 years. Parents Group - 28 Adults (father/ mother of the previous group of students), 7 male and 17 female. PA was objectively measured over 7 and 5 consecutive days of monitoring, (respectively the group of students and the group of parents) by accelerometers (MTI Actigraph GT3Xs) and the classification of the level of PA has been performed by Evenson et al. (2008) and Troiano et al (cut-off points. Results The main results showed that there's no significant association (R=0,09; p=0,675) between the levels of PA with parents and girls. Interesting to observe that in girls only 17% achieved the 60 min./day recommendations of moderate to vigorous PA (MVPA), and parents were exactly the opposite, with 96% of the parents achieving the recommended 30 min./day of MVPA. Regarding the prevalence's of overweight and obesity (OB), only 25% of girls presented OB and 63% of the parents have OB. Discussion In this context, it is important the implementation of strategies that contribute to increase the girls MVPA aiming to increase the percentage of girls achieving the MVPA recommendations. At this level, female subjects seem worth special attention. Note also the role modeling of parents in the implementation and maintenance of active and healthy lifestyles in girls, was not sustained. Further studies needs to be implemented, particularly of objective measurements of PA. This study was supported by FCT with research projects [references: PEst-OE/SAU/UI0617/2011; PTDC/DTP-DES/1328/2012; PTDC/DES/099018/2008 (FCOMP-01-0124-FEDER-009573)]. References Evenson, K. R., Catellier, D. J., Gill, K., Ondrak, K. S., & McMurray, R. G. (2008). Calibration of two objective measures of physical activity for children. *Journal of Sports Sciences*, 26(14), 1557-1565. Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise*, 40(1), 181-188.

## **SPORT AND PHYSICAL ACTIVITY MONITORING AS A TOOL TO PREVENT DISEASE AND TO IMPROVE A WELLNESS**

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Introduction Sport is a key element in the life of all people, it is the medium that allows us to understand the essential values of life and significant. This means that sport is health, not only for those who choose to practice it at a competitive level, but for all those who, having

morphological imbalances due to physical activity can improve their conditions. During the developmental stages is useful if not indispensable adapted physical activity, to promote and maintain growth and physical development as much as possible harmonious and balanced. The purpose is to provide a tool to identify at an early stage incorrect attitudes to develop a work plan adapted. The Baropodometer is a device consisting of a footboard applied with the sensors connected to a computer system. What the system are measuring the reactions on the ground, in standing and in ambulation. In this way, through an examination baropodometric, various parameters are identified, the correct interpretation which allows to evaluate, with high accuracy, the overall behavior of the system tonic postural of the subject compared to the indices of normality. Acquisitions are accurate, instantaneous, repeatable, non-invasive and can reduce the radiographs. Methods The experimental method used is composed of instrumental measurements and anamnesis with the use of the platform baropodometric on a sample of five children aged between 6/14 years to one year. The platform is used to detect incorrect attitudes, measure the deformation generated by the force applied by the foot on the same and any failures during walking. Tests in static and dynamic. It also administered a questionnaire to collect data about the lifestyle. After three months and at the end of the activity will be repeated the tests and the administration of the questionnaire. The data will be compared to individual and group to correlate the lifestyle and the evolution of any paramorphic attitudes and dysmorphic. Results Detect any changes and compare them with data, especially if they have made improvements to the morphological structure. The correlation between motor habits and evolution of the locomotor system. Discussion The purpose is to provide an analysis tool to support the promotion of exercise and sports in developmental age and monitor the occurrence of possible pathologies. The realization of this project aims to improve the physical condition of the children examined in order to promote this process, given the results obtained, in schools and sports centers occupational health and prevention.

### EFFECTS OF INGESTION TIMING OF HYDROGEN-SATURATED WATER ON EXERCISE-INDUCED CHANGES IN OXIDATIVE STRESS MARKERS.

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Introduction Acute intense exercise causes oxidative stress. To reduce oxidative stress-induced adverse events during sports, antioxidant supplementation has been well documented. Recent studies suggested that molecular hydrogen had potential as a "novel" antioxidant improving oxidative stress by drinking water with dissolved it (Nagata et al., 2009). However, timing of drinking hydrogen-saturated water is unclear. The purpose of this study was to investigate the effects of timing of water ingestion before or after exercise on exercise-induced changes in oxidative stress marker in humans. Methods Twenty-one healthy men participated in this study and were randomly divided into two groups in a cross-over study design: NW (normal water, n=7), and HSW (hydrogen saturated alkaline electrolyzed water, n=7). They underwent a treadmill-running test (30 min) at the intensity corresponding to their 70% heart rate reserve, and drunk 500 ml of prescribed water within 5 min before (pre ingestion) or after (post ingestion) the test. Serum creatine kinase (CK) and lactate dehydrogenase (LDH) activities, and serum hexanoyl-lysine (HEL), and malondialdehyde (MDA) concentrations were measured before, 2 and 6 h after the exercise. Urinary 8-hydroxy-2'-deoxyguanosine (8-OHdG) contents were also analyzed. Results There were no significant differences in changes in serum CK and LDH activities, and HEL concentration among groups. In pre ingestion, there were no significant changes in serum MDA and urinary 8-OHdG contents after exercise 6 hours after exercise recovery. However, the percent increases in serum MDA concentration and urinary 8-OHdG content from baseline levels in HSW were significantly suppressed compared with NW, 6 hours after exercise in post ingestion. Discussion Our results suggest that hydrogen saturated water has a potential to attenuate oxidative damage after a single bout of severe exercise in humans. About timing of ingestion, we showed that post ingestion reduced oxidative marker compared with pre ingestion in HSW. We speculate that hydrogen has scavenged reactive oxygen species under condition such as exercise. In conclusion, these results suggest that consumption of hydrogen saturated water after exercise may have a beneficial role in prevention of oxidative stress. References Nagata K, Nakashima-Kamimura N, Mikami T, Ohsawa I, Ohta S. (2009) *Neuropsychopharmacology*;34:501-508.

### COMPARISON OF THE PHYSICAL AND HAEMATOLOGICAL CHANGES IN HEALTHY MALE AND FEMALE BLOOD DONORS FOLLOWING DONATION

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Introduction Being physically active is more important than ever and fitting this into being a regular voluntary blood donor (DK) can be challenging. Therefore a frequent question in blood banks is: "how is my physical performance influenced by blood donation and when can I expect to perform fully again?" In this study we combine the findings from two independent studies to examine if the acute effect and the subsequent recovery after blood donation are different in women and men. Methods Subjects included in the two studies were donors found via a Danish blood bank. At the time of inclusion, they all met the following criteria: age 20-45 years, regular running activity minimum two times/week, normal BMI 18-30, and a p-ferritin  $\geq 40$  micrograms/L. All subjects, 14 women and 19 men, followed the same protocol consisting of two tests prior to donation measuring baseline values, and four tests placed 3, 7, 14, and 28 days after donation. Blood was sampled, an incremental bicycle VO<sub>2</sub>max and a three km treadmill time trial (TT) was performed on each test day. Results Female subjects had the following mean characteristics ( $\pm$ SEM): height (cm) 169.5  $\pm$ 1.7, weight (kg) 61.6  $\pm$ 1.7, age (yrs) 34  $\pm$ 1.91, VO<sub>2</sub>max (mL O<sub>2</sub>\*kg<sup>-1</sup>\*min<sup>-1</sup>) 47.7  $\pm$ 1.71 and male subjects height 182.7  $\pm$ 1.2, weight 82.1  $\pm$ 2.1, age 33  $\pm$ 2, VO<sub>2</sub>max 49.7  $\pm$ 1.7. The height and weight were lower for women than men, but VO<sub>2</sub>max was similar between genders. After 3 days the blood haemoglobin (mmol/L) was decreased by 6.4  $\pm$ 0.1 and 7.9  $\pm$ 0.2 and was returned to baseline after 14 days for women and 28 days for men; VO<sub>2</sub>max was decreased 5.9  $\pm$ 0.1 and 6.5  $\pm$ 0.1, and was returned to baseline after 28 and 14 days in women and men, respectively. And finally TT performance was attenuated by 5.9  $\pm$ 0.1 and 5.1  $\pm$ 0.2, and were normalised after 14 days, in women and men, respectively. Plasma erythropoietin (EPO) increased after 3 days in both groups and was decreased to baseline in men after 28 days, but remained elevated in women. The plasma EPO concentration was significantly higher in women than men in the last three weeks. Plasma 2,3-DPG remained unchanged through the 28 days and was lower in women than men at all sampling times. Conclusion Overall we demonstrate similar recovery of TT in women and men. However, women have a slower recovery for VO<sub>2</sub>max and a faster recovery for blood haemoglobin compared to men. The higher plasma EPO concentration in women contributes to the faster recovery of blood haemoglobin and yet despite of this the VO<sub>2</sub>max remains attenuated longer in women compared to men.

## CHRONIC BEHAVIOR OF THE BLOOD PRESSURE AFTER SWIMMING TRAINING IN HYPERTENSIVE ADULTS

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**Introduction** Hypertension (HPT) is one of the major health problem throughout the world, affecting about one billion individuals worldwide. It is estimated a prevalence of (HPT) between 22% to 57% (Wolf-Maier et al, 2003). There is few studies involving hypertension and swimming in human beings. Therefore, the aim of this study was to analyse the Chronic behavior of Systolic Blood Pressure (SBP) after Swimming training in hypertensive adults. **Methods** In this investigation, the sample was randomly selected and the subjects were sorted into two groups: the experimental group (EG) and the control group (CG). Thus, the final sample consisted of 30 subjects with mild and moderate hypertension. The EG individuals (n=20) took part in a regular swimming programme consisting of three weekly fifty-minute sessions of training (ST) for 8 weeks, whereas CG individuals (n=10) were instructed not to alter their physical activity and nutritional habits. **Results** At the end of the 8 weeks there was a decrease of 8,82 mmHg in Systolic Blood Pressure (SBP) at rest when compared with the baseline measurements. The Kruskal-Wallis test was used to determine statistical significance ( $p < 0.05$ ). **Discussion** Although some studies (JNC, 2003; AH A., 2003; Pescatello, et al. 2004) recommend swimming as a form of physical activity to be used in the prevention and treatment of hypertension, rare studies involving human beings have verified the relationship between the practice of swimming and hypertension. In relation to the chronic behaviour of arterial pressure at the end of the intervention, there were, on average, decreases of 6.05 % for SBP between the measurements taken before and after the programme. The latest studies aimed at verifying the effects of swimming on hypertension in humans reported results similar to those found in our study (Tanaka et al. 1997; Silva et al. 2009). **References** Wolf-Maier K, Cooper RS, Kramer H, Banegas JR, Giampaoli S, Joffres MR, Poulter N, Primatesta P, Stegmayr B, Thamm M.(2004) Hypertension treatment and control in five European countries, Canada, and United States. *Hypertension*,43:10-17. Pescatello LS, Franklin BA, Fagard R, Farquhar WB, Kelley GA, Ray CA.(2004), American College of Sports Medicine Position Stand. Exercise and hypertension. *Med Sci Sports Exerc* 36:533-53. Tanaka H, Basset Dr., Jr, Howley, Et, ;Thompson DL, Ashraf M, Rawson FL (1997). Swimming training lowers the resting arterial pressure in individuals with hypertension. *J Hypertens*. 15(6):651-7. Silva, J.E; Geraldes, A; Natali, A.; Pereira, J; Vale, R.; Dantas, E.(2009). Acute Effects of Swimming on the Arterial Pressure of Hypertensive Adults. *Maced J Med Sci*. 15; 2(4):330-334.

## IMPACT OF COMPLIANCE WITH DIFFERENT GUIDELINES ON PHYSICAL ACTIVITY DURING PREGNANCY AND PERCEIVED BARRIERS TO LEISURE PHYSICAL ACTIVITY

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**Introduction:** Physical activity (PA) has been reported as a protective factor in pregnant women's health. However, PA generally declines during pregnancy. This study aimed: (1) to analyze PA engagement during the 1st and 2nd trimesters, considering the different guidelines published on PA, (2) to document the individual characteristics associated with the accomplishment of these guidelines **Methods:** A prospective study was conducted with a sample of 133 pregnant women in two stages: at 10-12 weeks' gestation - T1 and 20-24 weeks' gestation - T2. PA was assessed over 7 consecutive days, by accelerometry, during the T1 and T2 evaluation stages. The pregnant women were divided into four groups, according to different PA guidelines (American College of Obstetricians and Gynecologists-ACOG, Centers for Disease Control and Prevention-CDC, American College of Sports Medicine - ACSM and the United States Department of Health and Human Services-USDHHS). Socio-demographic characteristics, lifestyle factors were assessed via questionnaire. **Results:** A large proportion of women (ranging from 32% - USDHHS to 96% - ACOG) did not reach the levels of PA recommended by the guidelines. There were no significant differences between the 1st and 2nd trimesters with regard to compliance with PA recommendations ( $p > 0.05$  for all). However, a decrease in PA levels from the 1st to 2nd trimesters was noted for all recommendations. No associations were found between participants' characteristics (sociodemographic, obstetric and behavioural) and adherence to particular types of guidelines/recommendations in the 1st and 2nd trimesters ( $p > 0.05$  for all). According to the socioecological framework, no statistically significant differences were found in barriers to leisure PA between the 1st and 2nd trimesters ( $p > 0.05$  for all). **Conclusion:** There were no differences between the 1st and 2nd trimesters in compliance with different PA recommendations. Individual characteristics were not associated with PA guidelines' accomplishment.

## IS THERE AN ASSOCIATION BETWEEN DAILY PHYSICAL ACTIVITY AND ALL PHYSICAL FITNESS PARAMETERS IN WOMEN?

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**Introduction** It has been proposed that usual physical activity, and not only physical exercise, is of great importance for health maintenance. However, most of the daily physical activities don't develop, at least apparently, several components of physical fitness, namely, agility, power or even strength. Moreover, aging effects on physical fitness decline are well described on literature, which are aggravated by social status changes. Particularly between women, leisure time seem to decrease with age which may affect their time in organized physical exercise, although total week physical activity may be maintained. So, this study aimed to verify if there is an association between daily physical activity and physical fitness parameters, between women over 40 years old. **Methods** Thirty seven women over 40 years of age (from 41 to 82 yrs), not suffering from any motor incapacity, participated in this study. Daily physical activity was quantified by IPAQ, Body mass Index (BMI, weigh/height<sup>2</sup>), waist circumference (WC), aerobic capacity (6 min walking test), 30sec chair stand, 8 ft up-and-go, and squat jump (SJ). Descriptive data analysis and Pearson correlation between variables was done in SPSS. Significant level was set at  $p < 0.05$ . **Results** Table 1 resumes average ( $\pm$ SD) values of age (years), BMI, WC, 6min walking, 30 sec chair stand, 8ft up-and-go and SJ. Age (years) 54.64 $\pm$ 9.52 BMI (weigh/height<sup>2</sup>) 28.10 $\pm$  WC (cm) 89.92 $\pm$  IPAQ 797.25 $\pm$  6min walking (min) 594.71 $\pm$ 5,718 30 sec chair stand (sec) 22.51 $\pm$ 5,718 8ft up-and-go (sec) 4,7651 $\pm$ ,94482 SJ (m) 0.147 $\pm$ ,03794 Pearson correlation revealed that age is positively associated with WC ( $r = .490$ ,  $p < .000$ ) and with 8ft up-and-go (sec) ( $r = .628$ ,  $p < .000$ ). An inverse association was found between age and SJ ( $r = -.602$ ,  $p < .000$ ), 30 sec chair stand ( $r = -.548$ ,  $p < .000$ ) and with 6min walking (min) ( $r = -.439$ ,  $p < .001$ ). However, daily physical activity (METs) was not correlated none of the measured variables. **Discussion** As it was expected, our results revealed that an age related decline in general fitness occurs. Moreover, considering the debate existing in the literature about the influence of daily physical activity vs. physical exercise (were a rigorous control of training workload occur) effects on health, our results pointed out that daily physical activity may contribute to health maintenance but is not enough. This study has been founded by FCT through PTDC/DES/121575/2010 project.

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## THE EFFECT TO THE LEG MUSCLE STRENGTH OF THE ELDERLY PEOPLE OF AEROBIC DANCE WHO CARRY OUT AT A HOUSE

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Introduction> The purpose our study is to investigate the effect of aerobic dance devised to have on leg strength. It is important to understand the influence of aging on muscle strength of lower limb. Resistance training has been shown to be the most effective exercise for improving muscle strength. Therefore, we devised aerobic dance exercise (ADEx) daily can be carried out in for the purpose of preventing loss of muscle strength. Method> Have been conducted in the elderly aerobic dance program was devise; we measured the morphology and muscle strength before and at the end of the exercise movement. 20 recreationally active women aged  $63.66 \pm 6.66$  years volunteered for the study. 2 monitoring periods are set: one is 2 months-period prior to the start of program, the other is 4 months-periods for the exercise. Program of aerobic dancing exercise (ADEx): This ADEx is created by referring to and replacing the steps of the weight bearing training for aged persons conducted by Yamauchi for skeletal muscle which would suffer from extreme atrophy as the age increases. The exercise time of each ADEx is around 10 minutes, with BPM of from 115 to 120. ADEx of different 5levels are made based on the strength and difficulty of the dances. The subjects choose the exercise time, level, and number of performance, based on their health conditions or paces. Morphology measurement: We measured height, weight, BMI, body fat ratio (TANITA Co), around the hip. Physical Fitness Test: We examine the ability to balance the method using one leg standing with eyes open. Muscle strength :Leg muscle function was measured with a Myutasu F1 (Anima Co.) and the maximum isometric forces (F (max)) . The strength of knee flexor muscles, knee extension muscles, hip joint flexor muscles, and hip joint extension muscles are measured Result> Morphological changes due to the exercise were not observed. Ability to balance the effect of time was able to stand on one leg is extended. As for the isometric leg muscular strength, strength of all of the knee flexor muscles, knee extension muscles, hip joint flexor muscles, and hip joint extension muscles has significantly increased with the activity. Especially, the activity has big effect on gluteus Maximus muscle which produces the strength of hip joint extension muscle. Discussion >: 1) Although did not cause muscle hypertrophy, exercise has contributed to the improvement of neuromuscular function. 2)The program caused a significant increase in isometric strength of all kinds. 3) Providing ADEx that can be carried out at home, may lead to the improvement of exercise habits can be expected. The present results provide a program that can be carried out at home, suggested that prevention of loss of muscle strength is possible.

## A WEB-BASED SURVEILLANCE SYSTEM ON ADOLESCENTS' LIFESTYLES AND OBESITY PREVENTION: ASSO-FTB PRELIMINARY FINDINGS. THE ASSO PROJECT.

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The ASSO Project (Adolescents and Surveillance System for Obesity prevention), financed by the Italian Ministry of Health, aims to develop a surveillance system structured on adolescents lifestyles. It is a prospective study with online data collection, simultaneous descriptive data analysis and real time report. The ASSO-Toolkit is made of questionnaires, forms and a fitness test battery. The aims of this study is to evaluate the predictive validity, the criterion validity and the reliability of ASSO-FTB, in other words to assess how well the system operates to meet its objectives. The ASSO-FTB consists of 20mSRT (Shuttle Run Test) to estimate cardiorespiratory fitness, the handgrip strength test and the standing broad jump to assess musculoskeletal fitness, the 4x10mSRT to assess motor fitness and last but not least the sit up test to estimate muscle endurance. The project is currently spreading in southern Italy, both in urban and rural territories. A comparison has been made between two schools to evaluate if demographic aspects affect adolescents fitness and ensure that the project itself is reliable and reproducible. Forty male adolescents ( $17,32 \pm 1,0$  yrs;  $175,3 \pm 6,0$  cm;  $72,4 \pm 14,7$  kg; waist circ.  $86,2 \pm 12,4$  cm) attending an urban secondary school and forty-nine adolescents ( $15,86 \pm 1,4$  yrs;  $169,8 \pm 8,9$  cm;  $64,3 \pm 15$ ) attending a rural secondary school voluntarily participated to the study . In a school setting, the standardized procedures were administered by the ASSO-FTB specialist in collaboration with the (PE) teacher. All data collected were updated through the already existing website ([www.assoproject.info](http://www.assoproject.info)) and codified by the dedicated ASSO-FTB server. Participants were significantly higher in BMI compared to data published by Espana-Romeo et al in 2010. As expected, the maximal isometric strength showed no differences between urban ( $35,07 \pm 7,3$  kg) and rural ( $33,7 \pm 10,8$  kg) school respectively. Data that remains in line with what published by Espana-Romeo et al in 2010. The standing broad jump ( $178,07 \pm 26,9$  cm) has evinced less distance than Espana-Romeo study ( $183,4 \pm 32,75$ ),  $p = 0,37$ . On the whole findings show that there is a correlation between handgrip and the 4x10 meter shuttle run test ( $r = -0,7$ ) and between handgrip and standing broad jump ( $r = 0,7$ ) underlining that this last test is better indicative of the upper and lower body muscular strength. The only concern comes from the VO<sub>2</sub> max results, showing a mean value of 24 ml/kg/min. It is still to determine if the 20m shuttle run test underestimates this parameter or if adolescents have at this stage of development a reduced cardiorespiratory fitness. The trial showed that the FTB-system is reliable and reproducible. At this stage ASSO-FTB seems to be able to meet scientific standards. More studies are necessary for the ASSO-toolkit validation. Preliminary results are very encouraging.

## History

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### MAX RUBNER <1854-1932> AND HIS CONTRIBUTION TO SPORT NUTRITION

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INTRODUCTION Born in Munich on June 2, 1854 and dying in Berlin on April 27, 1932, Max Rubner is one of the most important physiologists in history. Rubner is renowned for his calorimetric experiments and the discovery of the isodynamic law, which depicts the energetic interchangeability of the energy-delivering macronutrients. His contributions towards physical activity, sport, and sport nutrition have not been equaled since. Rubner was emeritus when he gave a talk on sport and nutrition at the Sportärztetagung 1925, the 2nd congress of the German Medical Association for the Promotion of Physical Activity (Rubner, 1926). Though by then scientific publications on energy expenditure and dietary intake of athletes were available, his presentation was likely the first in the field of sport nutrition at a sports medicine and science congress. As a leading nutritionist of his time Rubner had a comprehensive overview of the entire field of nutritional

research. Thus, his presentation can be considered as the gold standard in sport nutrition of the mid-1920s. SPORT NUTRITION IN 1925 Rubner had serious concerns regarding the presentation of this topic, as nutrition and physical exercise was still a relatively unexplored field. He therefore considered his work as a beginning for future research. Rubner began with topics of general nutrition, and observed that quite often in literature, pseudo-scientific personal opinions were mingled with scientific evidence. He then discussed the energy requirements for muscular work and made the remarkable statement that intense exercise was a pre-requisite for net muscle gain, but that this type of exercise only led to muscle gain when accompanied by sufficient nutrition. Rubner proposed a total «sport proposal» for energy intake of 3472 calories, which could be achieved by consuming 100 g of protein, 100 g of fat and 490 g of carbohydrates. Using a reference body mass of 70 kg, this translates to 1.4 g of protein, 1.4 g of fat, and 7.0 g of carbohydrates per kilogram of body mass. In other words, nearly 90 years later, we are still recommending these same strategies. Rubner closes his presentation with a general discussion on food, covering aspects still relevant today (e.g. vegetarian vs. non-vegetarian diet, meal frequency with increasing energy need, and correct fluid intake strategies). Overall, Rubner's theories in sport nutrition were remarkably modern for such an early period in its development, and despite lacking scientific evidence at the time, they are still valid today. REFERENCE Rubner M. (1926). Ernährung bei Leibesübungen. In Kohlrausch W. (Ed.): Sportärztetagung 1925 des Deutschen Ärztebundes zur Förderung der Leibesübungen. Jena: Gustav Fischer, pp. 36–62.

## **RETROSPECTIVE STUDY OF RESULTS AT SUMMER OLYMPIC GAMES FROM 1908 TILL 2012 IN MEN SWIMMING CATEGORIES**

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**INTRODUCTION:** Identify trends and factors of change in results of swimmers, holders of gold, silver and bronze medals at the Olympic games since 1908 till 2012, and make an assessment of their future developments. **METHODS:** A retrospective study of the results at the Summer Olympic games in swimming for men since 1908 till year 2012, and an analysis of available data on anthropometry of swimmers, training methods, the technique of swimming, diet, swimming pool equipment and appearance. In this study we will also analyse the holders of gold, silver and bronze medals at the Olympic Games since 1908 till today. **RESULTS:** Improving of results correlate with the length of the Olympic cycle, which we take into account during results analysis. We notice that the improvement of the results increases with the number of Olympic cycle on which some discipline maintain and that the correlation between the improvement and the number of cycles between olympic disciplines is greater than 90%. Results have shown a tendency of slowing down improvement of the results in few last olympic cycles, with the exception of the results achieved in the Olympic Games in Beijing 2008, when the use of high-tech suits significantly improved results and 66 Olympic records were beaten. This trend suggests that we are approaching the biological plateau in terms of improving performance in swimming, and we expect on the basis of this research all the minor improvements of results in each subsequent cycle, with the exception of the use of high-tech suits. In the period of 110 years, since the first Olympic games in Athens to present, the results have improved by a whopping 40% of the initial results, which is a man nearing his maximum speed of movement through the water without technological aids. Many factors have contributed to the improvement of the results, and none of this factors cannot be ignored in the research of the development of swimming and improving results. The importance of each of these factors remains a challenge for future researchers. **CONCLUSION:** Advance in swimming since the first Olympic Games in Athens in 1896 until today is made by great number of changes. We can divide them into changing the way and technique of training, changes in eating habits and dietary supplementation, changes in swim suits and changing conditions and ambient of swimming. **REFERENCES:** 1. M. Nevill, Are There Limits to Swimming World Records, *Int J Sports Med* 2007; 28(12): 1012-1017 2. Brubakk, Alf O; Neuman, Tom S (2003). Bennett and Elliott's physiology and medicine of diving., USA: Saunders Ltd. p. 800. 3. L Parsons., Do wet suits affect swimming speed?, *Br J Sports Med* 1986; 4. 'Testimonies about Bodysuits'. *Swimming Science Journal*. San Diego State University, 2012.

## **REGULATION RESEARCH APPLIED TO EPISTEMOLOGICAL THEORY OF PHYSICAL EDUCATION AND SPORT IN ITALY**

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The epistemology of physical education and sport in Italian universities was changed in 1998 by law with the transformation of Higher Education Institute of Physical Education and Sport, called ISEF (Dlgs 178). Previously, ISEF, Italian National Olympic Committee, called CONI, and the National Sport Federations have provided education for teachers, technicians and trainers but neglecting completely the research. The law established two new Academic Fields : Methods and teaching of motor activities, called M-EDF-01 and Methods and teaching of sports activities, called M-EDF-02. These academic fields have been involved to defend the single propriety of the research in a specific academic field. The M-EDF-01 includes the development of theories, techniques and methods for physical education geared to specific age groups; the M-EDF-02 deals with the development of theories, techniques and methods for the training and practice of different sports activities and with the assessment of the performance and the athletic attitudes. Each academic field has the subarea that explains and declares the meaningful of the academic field. In other hand, to recruit the professors in the new field of Physical education and sport it needs many academic fields (D.M. 4 ottobre 2000). The aim is to research the epistemic origin of the Physical Education and Sport. Method is historical and documentary approach. Results are the professors of Physical Education and Sport have to be part of other academic fields, such as Physiology, Biochemistry, Internal Medicine, Physical and Rehabilitation Medicine, General and Subspecialty Pediatrics, Physiology Clinical Biochemistry and Molecular Biology, Experimental Biology, Human Anatomy, Clinical Pathology, Cardiovascular Diseases, Endocrinology, Musculoskeletal System Diseases, Diagnostic Imaging and Radiotherapy, Theories and Science of Education and Social Education, History of Education, Methodologies of Teaching and Special Education, Educational Research, General Psychology, Psychobiology and Physiological, Psychometrics, Developmental and Educational Psychology, Social Psychology, Work and Organizational Psychology, Dynamic Psychology, Clinical Psychology.. In conclusion the professor are the academic fields different from the epistemology origin of Physical Education and Sport and the mix of academic fields that doesn't give a properly epistemological theory also in research activity. **Keywords:** academic fields, motor activities, sports activities, References Gazzetta Ufficiale, 1998, Legislative decree no. 178, may 8th, Roma, Italy Gazzetta Ufficiale, 2000, Ministerial Decree october 4th, Roma, Italy

**EFFECT OF ACUTE AEROBIC EXERCISE ON PGC-1 ALPHA ISOFORMS EXPRESSION IN HUMAN SKELETAL MUSCLE**Bachinin, A.I., Miller, T.I., Popov, D.I.,<sup>2</sup>*1 SSC RF – Institute for Biomedical Problems RAS, 2 M.V. Lomonosov Moscow State University*

Peroxisome proliferator-activated receptor gamma coactivator 1alpha (PGC-1alpha) is a "master regulator" of mitochondria biogenesis in the skeletal muscle. There are at least four transcript variants of PGC-1alpha mRNA. PGC-1alpha-1 is transcribed from the canonical proximal promoter and PGC-1alpha-2, -3 and -4 are transcribed from the alternative upstream promoter. Rodent studies have shown an acute aerobic exercise induced a drastic expression increase of PGC-1alpha-1, -2 and -3 mRNA variants (Miura et al., 2008; Tadaishi et al., 2011). To our knowledge only one study investigated the effect of acute aerobic exercise on expression of two isoforms of PGC-1alpha-1 and -2 mRNA in human skeletal muscles (Norrbon et al., 2011). Recently Ruas J. and coworkers showed the increased expression of PGC-1alpha-4 mRNA and of proteins associated with skeletal muscle hypertrophy in rodent and human skeletal muscle (Ruas et al., 2012). The goal of the present study was to investigate the effect of acute aerobic exercise on expression of PGC-1alpha-1, -2, -3 and -4 transcriptional variants in human skeletal muscle. Seven endurance athletes ( $\dot{V}O_{2max}$  64±8 ml/kg/min) carried 90 min exercise session (61%  $\dot{V}O_{2max}$ ). Biopsies were taken from m. vastus lateralis before, 3 and 5 h after the exercise. The expression of PGC-1alpha mRNA isoforms was evaluated by qPCR. In resting state the expression of PGC-1alpha-2 mRNA was higher and PGC-1alpha-3 mRNA was lower than expression of PGC-1alpha-1 and 4 mRNA isoforms. After acute exercise session PGC-1alpha-2 mRNA isoform showed more pronounced increase of expression than other isoforms. We speculate, that PGC-1alpha-2 isoform has more important functional role, than other transcript variants. The work was supported by M.V. Lomonosov Moscow State University Program of development and by RFBR grant # 12-04-01668-a.

**THE IMPACT OF ANTIOXIDANT SUPPLEMENTATION AND ENDURANCE EXERCISE ON NEURONAL NITRIC OXIDE SYNTHASE EXPRESSION IN SKELETAL MUSCLE OF MICE**

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**Introduction** In skeletal muscles, high levels of the nitric oxide (NO) are generated by the catalytic activity of neuronal NO synthase (nNOS) which may interact with reactive oxygen species (ROS). Both radical systems (NO and ROS) represent important signalling molecules involved in many processes in skeletal muscle. Although antioxidant supplementation with or without endurance exercise leads to well-characterised changes in the ROS metabolism, the impact of this treatment on the nNOS/NO system has not been documented so far. **Methods** We administered a mixture of antioxidants (AOX; 140 mg/l of ascorbic acid, 12 mg/l of coenzyme Q10 and 1% N-acetyl-cysteine) via drinking water to 16 C57BL/6 mice. Sixteen other mice received unadulterated tap water (CON). One cohort of both groups (CON-EXE) and AOX-EXE was subjected to treadmill exercise for 4 weeks (16-26 m/min, incline of 5°-10°). The other two cohorts (CON-SED and AOX-SED) remained sedentary. The mice were euthanized 1 day after the last treadmill exercise (approximately 24 h) by an intraperitoneal injection of pentobarbital (300 mg/kg of body weight). The tibialis anterior (TA) muscle was isolated for an analysis of the gene expression of nNOS at the mRNA and protein level by real-time polymerase chain reaction (RT-PCR) and quantitative immunoblotting. **Results** In CON-SED mice, nNOS expression in TA muscle ( $P \leq 0.05$ ) was higher at both the mRNA (+72%) and the protein (+44%) level than in those undergoing treadmill training. Accordingly, mice that were administered with AOX had a higher ( $P \leq 0.05$ ) nNOS expression in TA muscle at both the mRNA (+57%) and the protein level (+24%) compared to those of the CON-SED cohort. In contrast, combination of AOX supplementation and endurance exercise was accompanied by non-significantly lower ( $P > 0.05$ ) expression of nNOS in TA muscle at both the mRNA (-16%) and the protein level (-5%) compared to that in the CON-SED cohort. **Discussion** Endurance exercise and the supplementation with AOX increase the nNOS expression in TA muscle of mice. If both treatments are combined, the up-regulation of nNOS is blunted. These data suggest that the expression of nNOS in skeletal muscles of mice is susceptible to the treatment with AOX at sedentary conditions. This AOX-sensitivity is impaired, if the mice are simultaneously exposed to AOX supplementation and higher rates of contractility (e.g. by endurance training). **References:** Meier P, Renga M, Hoppeler H, Baum O. (2013), *Cell Biochem Funct.* 31:51-59.

**ADRB2 ARG16GLY AND PPARA G/C GENE VARIANTS ARE ASSOCIATED WITH IMPROVED PERFORMANCE FOLLOWING HIGH-INTENSITY INTERVAL TRAINING**

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**Background** Individual differences in the response to similar exercise training are a well-known occurrence, and are influenced by both environmental and genetic factors. The beta(2)-adrenergic receptor (ADRB2) Arg16Gly (rs1042713), and peroxisome proliferator-activated receptor alpha (PPARA) intron 7 G/C gene variants are candidates to explain some of this variability in training response due to their role in glucose and fatty-acid metabolism (1-2). We have designed a tightly controlled High-Intensity Interval Training (HIIT) study, and used an innovative, bootstrapping, statistical method (to overcome the relatively small sample size) to investigate the influence of ADRB2 Arg16G, and PPARA intron 7 G/C gene variants on performance outcomes. **Methods** Twenty-four moderately-trained, unrelated Australian males (21.6±0.7y) underwent 4 weeks of supervised HIIT training (3 sessions a week). A graded exercise test was performed pre and post training to assess changes in endurance performance. Genomic DNA was extracted from leucocytes and genotyping was performed using the R-T PCR Taq Man method. A linear model, corrected for age and BMI, was developed for each gene variant to estimate the effects of the genotypes on the changes in peak power, lactate threshold, and  $\dot{V}O_{2max}$ . Resampling was performed 5000 times for each gene variant, and a 95% confidence interval of the regression coefficient was calculated (bootstrapping method). The level of significance was set at  $P < 0.05$ . **Results** ADRB2 Arg16Gly, and PPARA G/C polymorphisms were significantly associated with the training response. ADRB2, Arg/Arg homozygotes showed a higher increase in peak power following HIIT compared with Gly-carriers (Arg/Arg: 28.5 ± 2.9 Watts, Arg/Gly: 12.9 ± 3.1 Watts, Gly/Gly: 16.7 ± 5.3 Watts). PPARA, G/G homozygotes showed a higher increase in heart rate at the lactate threshold, and in peak power, compared with G/C carriers (change in heart rate at the lactate threshold, G/G: 18 ± 3 beats/min, G/C: 3 ± 1 beats/min; change in peak power; G/G: 21.0 ± 3.2 Watts, G/C: 9.8 ± 2.1 Watts). **Discussion** We have confirmed that ADRB2 Gly16Gly genotype is associated with better response to training, as previously shown (1), and found, for the first time, that PPARA G/G

genotype is also associated with a greater response to training. References 1. Sarpeshkar and Bentley. (2010). Adrenergic-b 2 receptor polymorphism and athletic performance. *J Hum Genet* 55, 479–485. 2. Eynon N, Meckel Y, Sagiv M, et al. (2010). Do PPARGC1A and PPARalpha polymorphisms influence sprint or endurance phenotypes? *Scand J Med Sci Sports*, 20, e1-6.

### **EFFECT OF ACUTE AEROBIC EXERCISE ON REGULATION OF MITOCHONDRIAL BIOGENESIS, PROTEIN METABOLISM IN SKELETAL MUSCLE OF TRAINED MEN: A TIME-COURSE STUDY**

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Peroxisome proliferator-activated receptor gamma coactivator 1a (PGC-1alpha) is a “master regulator” of mitochondria biogenesis in the skeletal muscle. Previous dose-response studies have shown that an expression of PGC-1a mRNA depends on relative aerobic exercise intensity. To our knowledge no studies of PGC-1alpha expression in relation to duration of exercise were performed. The aim of the study was to investigate the effect of acute exercise duration on regulators of mitochondrial biogenesis (phosphorylation of p38 and AMPK and expression of mRNA of PGC1alpha, PRC, TFAM, TFB2M) and protein metabolism (phosphorylation of p70S6k and eEF2 and expression of mRNA of Myostatin, MuRF1, Atrogin-1) in skeletal muscle of trained men. Eight endurance athletes ( $\dot{V}O_2\text{max}$  64±8 ml/kg/min) carried out three exercise sessions (61%  $\dot{V}O_2\text{max}$ ): 30, 60 and 90 min duration. Biopsies were taken from m. vastus lateralis before, just after, 3 and 5 h after the exercise. The phosphorylation of PGC-1alpha pathway upstream kinases – AMPK and p38 – did not change after 30 min session, but increased to a similar extent after 60 and 90 min session. The expression of PGC-1alpha mRNA was enhanced 3 and 5 h after 60 and 90 min sessions and did not differ between sessions. mRNA abundance of other mitochondrial biogenesis regulators – PRC, TFAM, TFB2M – did not change after all sessions. The abundance of mRNA MuRF1 after 90 min session was higher than after 60 min session, but on the other hand, only 90 min session led to a decreased Myostatin gene expression. There was a tendency for a more pronounced increase of phosphorylation of p70S6k and eEF2 after 90 min session, than after shorter sessions. In conclusion AMPK and p38 kinases activation and PGC1alpha gene expression were increased with elongation of exercise session up to 60 min. 90 min exercise session had higher potential for inducing muscle protein degradation and lower potential for protein synthesis activation than exercise of shorter duration. The work was supported by M.V. Lomonosov Moscow State University Program of development and by RFBR grant # 12-04-01668-a.

### **COMPARATIVE ANALYSIS OF GENE EXPRESSION IN MUSCLE FIBERS OF DIFFERENT TYPES FROM LOCOMOTOR AND RESPIRATORY MUSCLES IN RAT**

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Expression of genes in diaphragm and three different locomotor muscles from hind extremity (m. soleus -S, red and white parts of m. gastrocnemius – RG and WG) of rat were studied by means of real time PCR. Citrate synthase activity in S and RG was found to be much higher than in WG. Correspondingly, level of PGC-1a expression in S and RG was significantly higher than in WG. Transcriptional factors MyoD and myogenin are involved in regulation of myosin phenotype of skeletal muscles in adults. The high expression of myogenin is typical for slow MF, and that of MyoD – for fast MF. In our study the level of myogenin expression in RG was lower than in S, but was higher than in WG, i.e. it was in accordance with MF I content, which was 80-90% in S, 40% in RG and just tiny in WG. Myostatin is a powerful negative regulator of MF growth. The highest level of its expression was found in WG, the 30-fold lower expression was recorded in RG and 150-fold lower – in S. That distribution is in accordance with MF II content in muscles. IGF-1 is a stimulator of muscle protein synthesis. In the locomotor muscles studied expression of IGF-1 mRNA was practically equal. The levels of expression of PGC-1a and myogenin mRNA in diaphragm were in conformity with its myosin phenotype and citrate synthase activity. On the other hand diaphragm was characterized by an unexpectedly high level of MyoD mRNA as well as high content of IGF-1 mRNA and low myostatin RNA. The last two observations seem to indicate the high intensity of protein synthesis in muscle fibers of diaphragm despite their smaller size than in locomotor muscles. Some additional control might exist specifying small size of diaphragm fibers at the background of myostatin low expression and IGF-1 high expression. The work was supported by M.V. Lomonosov Moscow State University Program of development and by RFBR grant # 12-04-01668-a.

### **EFFECT OF MUSCLE DISUSE AND TESTOSTERONE ON AKT/MTOR/FOXO SIGNALING IN MICE**

De Naeyer, H., Lamon, S., Russell, A.P., Everaert, I., De Spaey, A., Vanheel, B., Taes, Y., Derave, W.

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Introduction Research models of muscle disuse atrophy are often associated with reduced serum testosterone levels (1). Because androgen deficiency is associated with significant muscle loss (2), it is likely that the hormonal changes during disuse contribute to the observed muscle atrophy. Moreover, the molecular mechanism by which testosterone may affect muscle mass during disuse atrophy is unknown. Therefore, we examined the effects of tail suspension on serum testosterone levels, and we analysed changes in gene and protein expression of known muscle atrophy and hypertrophy inducing targets (3). Methods Measurements were made in slow-twitch soleus (SOL) and fast-twitch extensor digitorum longus (EDL) muscles following testosterone administration during 1, 5 and 14 days of tail suspension in male C57BL/6 mice. Serum testosterone levels were assessed by LC/MS. Gene and protein expression were analysed by qPCR and Western blotting respectively. Results Tail suspension resulted in a significant decrease in body mass, muscle mass and serum testosterone levels. Atrophy of both muscles was associated with increases in MAFbx/Atrogin-1, MuRF1, myostatin and REDD1 gene expression and a downregulation of IGF1 gene expression. However, these changes were not paralleled by changes in protein levels. Total Akt and p-p70S6K were unchanged, but p-Akt and total p70S6K were downregulated following hindlimb unloading. Testosterone administration during tail suspension was not associated with changes in body mass, muscle mass, gene or protein expression levels. Discussion Restoration of the testosterone levels did not minimize the loss in muscle mass, which suggest that the lower amount of circulating testosterone levels observed during the unloading process do not contribute to the muscle atrophy. Although studies have shown changes in Akt/mTOR/Foxo (4) signalling following androgen deprivation and treatment, we could not provide evidence that the changes in hormonal levels observed during tail suspension affected these pathways. References 1. Amman RP, Deaver DR, Zirkin BR, Grills GC, Sapp WJ, Veeramachaneni DN, Clemens JW, Banerjee SD, Folmer J, Gruppi CM et al. (1992). *J Appl Physiol*. 73:174-185. 2. Bhasin S, Storer TW, Berman N, Yarasheski KE, Clevenger B, Phillips J, Lee WP, Bunnell TJ, Casaburi R (1997). *J Clin Endocrinol Metab* 82

### **INFLUENCE OF GLU298ASP POLYMORPHISM IN HEART RATE RECOVERY AFTER EXERCISE**

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Introduction NOS3 gene is localized to chromosome 7q36 (Robinson, Weremowicz, Morton & Michel, 1994) (National Center for Biotechnology Information, 1994). Nitric oxide synthase endothelial (NOS3) plays a crucial role in the production of nitric oxide, a signaling molecule that acts as an important endothelium-derived vasorelaxant factor (Pereira, et al. 2007). It seems that there is an interaction between the sympathetic nervous system and endothelial function, specifically the relationship between the heart rate recovery (HRR) and endothelial function (Hijmering, et al. 2002). Therefore, the aim of our study was to describe the influence of p.glu298asp in the heart rate recovery during the first, second, third and fourth minutes after maximal exercise. Methods The sample was 68 healthy university Spanish students (age, 18-35 years), 17 females and 51 males, all of them were Caucasian for  $\geq 3$  generations (with p.glu298asp = 31 and without p.glu298asp = 37). They performed a treadmill test with an inclination 3%, and speed increment (beginning at 6 km/h and increasing 2km/h every 2 minutes) until exhaustion, maximal heart rate was obtained as well as heart rate recovery immediately after the exercise during the first minute. Treadmill Lifefitness (USA), MP100 System Hardware. AcqKnowledge Software 3.9-Windows XP. Biopac Systems (USA) and Polar T31 (Finland) were used. Descriptives with Mean and Standard deviation were calculated using SPSS 18 package. Results Heart rate peak was 185.2 bpm. The results suggest that subjects with p.glu298asp have a better heart rate recovery during the first (24.19bpm $\pm$ 8.81), second (40.81 bpm $\pm$ 10.01), third (52.77 bpm $\pm$ 12.06) and fourth (66.77 bpm $\pm$ 9.30) minute after maximal exercise. Conclusion Subjects who are carriers of the Glu298Asp polymorphism of the NOS 3 gene have a better cardiac recovery. Our research was only a descriptive study and needs more research to determine the influence of the Glu298Asp polymorphism of the NOS 3 gene in the heart rate recovery. References Hijmering, M., Stroes, E., Olijhoek, J., Hutten, B., Blankestijn, P., & Rabelink, T. (2002). Sympathetic Activation Markedly Reduces Endothelium-Dependent, Flow-Mediated Vasodilation. Journal of the American College of Cardiology, 39(4), 683–688. National Center for Biotechnology Information. (1994). National Center for Biotechnology Information. Recuperado el 28 de 5 de 2011, de National Center for Biotechnology Information: <http://www.ncbi.nlm.nih.gov/> Pereira, T., Rudnicki, M., Cheung, B., Baum, L., Yamada, Y., Oliveira, O., Krieger, J. (2007). Three endothelial nitric oxide (NOS3) gene polymorphisms in hypertensive and normotensive individuals: meta-analysis of 53 studies reveals evidence of publication bias. Journal of Hypertension, 25, 1763–1774. Robinson, L., Weremowicz, S., Morton, C., & Michel, T. (1994). Isolation and chromosomal localization of the human endothelial nitric oxide synthase (NOS3) gene. Genomics, 19, 350-357.

### **Motor Learning**

#### **DIFFERENTIAL VS. DRILL LEARNING OF THE OVERHEAD BADMINTON SMASH**

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Introduction Based on Coordination dynamics theories, the differential learning approach propose that a high variability of practise including variation of movement parameters as well as structures results in superior motor learning results in superior performance than repeating the same movement many times during acquisition (Frank et al, 2008). Empirical evidence has been given in various sports disciplines such as passing in soccer or the badminton serve (Jaitner & Schinz, 2012). The purpose of this study was to investigate effects of differential learning on the overhead Badminton smash. Methods 22 Badminton players of regional level of expertise participated in a learning experiment with 12 practice sessions. Subjects were divided into a differential training group (DT) and a control group (CG). Following a theoretical instruction, CG performed drills that were characterized by high numbers of repetitions of the same exercises. Feedback was given by demand in order to support the athletes adaption to the ideal technique. For the DT group multiple variations were implemented including initial positions, range and intensity of motion, rackets and environmental conditions, and no feedback on performance was given. In pretest (PR), posttest (PT) and retention test (RT) two weeks after the posttest each participant performed a Badminton specific drill that consist of 4 forehand overhead smashes from the rear zone of the field followed by a short drop at the net. All smashes must be placed longline as closed as possible to the front and side line. Smashing performance was filmed with a highspeed video camera (200 Hz), and maximal shuttle velocity and release height were determined. The best trials of each subject and test were included for the ANOVA. Results For DT, mean shuttle velocities (SV) increased from pre- to retention test (PR: 55,5m/s; PT: 57,0m/s; RT: 57,40m/s), whereas mean release heights (RH) remained stable (PR: 2,40m; PT: 2,41m, RT: 2,39m). Mean SV of the CG increased from pre- to posttest (PR: 60,7m/s; PT: 60,9 m/s), but decreased afterwards (RT: 59,1 m/s). RH of the CG reached 2,47m (PR), 2,53m (PT) and 2,49m (RT), respectively. ANOVA revealed significant effects only for the SV for factor time ( $p < .05$ ;  $\eta^2 = .158$ ) as well as for the interaction between time and group ( $p < .01$ ;  $\eta^2 = .409$ ). Discussion The DT group improved their smashing velocity sustainably, while drill training showed no positive learning effect. Hence, badminton players at regional level did not seem to benefit from drill training, whereas the highly variable training lead to superior performance. These results are in line with previous studies (e.g. Jaitner & Schinz, 2012) and indicate the importance of movement variations to achieve further adaptations in trained Badminton players. References Frank, T.D., Michelbrink, M., Beckmann, H. & Schöllhorn, W. I. (2008). Biological Cybernetics, 98, (1), 19-31. Jaitner, T., Schinz, F. (2012) 17th Annual Congress of the ECSS, 562.

#### **DISRUPTING SWARMING BEHAVIOUR AMONGST JUNIOR FOOTBALL PLAYERS**

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Introduction: Swarming is a collective behaviour exhibited by groups of biological organisms manifested in many species in nature (Camazine et al., 2001). Swarms display structural order, with the behaviour of individual members integrated on the basis of simple interactional 'rules', such that they can appear to move as a single coherent entity (Merrifield, Myerscough, & Weber, 2006). In this explorative study we aimed to quantify and potentially disrupt the swarming phenomenon in children's soccer. Methods: Three junior (5-6 years old) football teams participated. One team received a constraints-informed training intervention designed to increase skills and tactical awareness. Each team (n=5) completed pre and post skills tests and also two 16 minute games against each other. Overhead

video footage was collected from the games, to measure the players' spatio-temporal distribution on the pitch (15 x 25 m). Swarm variables included interpersonal distance (IPD), surface area of team, stretch index about the team centroid and coherence of velocity profiles. Results: There were soccer skill (i.e., passing, dribbling, shooting) improvements after 8 weeks of training for all three teams. Before the training period there was strong evidence of swarming tendencies as expressed through low IPD ( $3.2 \pm 0.8$  m) and surface area ( $13.6 \pm 5$  m<sup>2</sup>). After targeted training, the swarming behaviour was partially disrupted (i.e., intervention team IPD =  $3.9 \pm 0.7$  m, surface area =  $18.1 \pm 7$  m<sup>2</sup>). Discussion: The behavioural phenomenon of swarming common to socio-biological groups in nature also appears to exist in junior soccer. Groups of players tend to bunch close together and align their heading direction toward the ball as individuals jostle to get close enough to gain ball possession. We are currently comparing real player positional data with simulated soccer data (constructed with NetLogo 5.0: <http://ccl.northwestern.edu/netlogo/>) to ascertain the extent to which children's soccer games adhere to common swarming principles. Future research may compare swarming in different age groups across adolescence to determine when and how this behaviour changes to more sophisticated patterns of play. References: Camazine, S., Deneubourg, J.-L., Franks, N. R., Sneyd, J., Theraulaz, G., & Bonabeau, E. (2001). *Self-organisation in biological systems*. Oxford: Princetown University Press. Merrifield, A., Myerscough, M. R., & Weber, N. (2006). Statistical tests for analysing directed movement of self-organising animal groups. *Math Biosci*, 203(1), 64-78.

### **SELF-CONTROLLED LEARNING OF MOTOR SKILLS: IS THERE A TRADE-OFF BETWEEN COGNITION AND MOTIVATION?**

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Introduction Studies have shown that self-control over (at least) one aspect of the practice situation results in a more effective motor learning (e.g., Post et al., 2011). However, this "self-control effect" consistently occurs delayed, i.e. in the retention test. To explain this delay, a model was developed in which a trade-off between cognitive and motivational processes during acquisition is assumed: Compared to externally controlled learners, self-control learners are exposed to a higher cognitive load (due to the need of decision-making) but stronger intrinsically motivated (due to the perception of autonomy). The aim of the present study was to test this model. Methods A sample of 48 young adults (Mage = 23.5) were randomly assigned to one of four groups: 1. Self-control (SC), 2. Yoked (YO), 3. Self-control + Training (SC+T), 4. Yoked + Training (YO+T). Self-control was given over the frequency of augmented feedback. Prior to the experiment, subjects in the SC+T group took part in a training with the objective to reduce the cognitive load during self-controlled learning. Both SC groups were paired with yoked groups. The task was to throw a standard tennis ball to a 1x1m-target with the non-dominant hand. Participants completed two acquisition sessions and a no-treatment retention test 4 days later. Results Data were analyzed in two separate 2 (control of learning) x 2 (training) x 20 (blocks of 10 trials) MANOVAs with throwing accuracy and form as dependent variables. Accuracy: All groups enhanced throwing accuracy during acquisition,  $F(19,836) = 4.36, p < .05, \eta^2 = .06$ . However, the effects of control of learning and training were not significant, both  $F(1,44) < 1$ . Analysis of retention data yielded a significant effect of control,  $F(1,44) = 5.37, p < .05, \eta^2 = .08$ , with the SC groups showing more accurate throws than the YO groups. The effect of training was not significant,  $F(1,44) < 1$ . Form: All groups improved clearly their throwing form during acquisition,  $F(19,836) = 17.26, p < .001, \eta^2 = .21$ . Again, the main effects were not significant, both  $F(1,44) < 1$ . Across retention, the form scores were similar, i.e. the effects of control and training were not significant, both,  $F(1,44) < 1$ . Discussion In view of the fact that the SC groups were (partly) superior to the YO groups in the retention test but not during acquisition, the findings of this study confirm prior research on self-controlled motor learning. However, the SC+T group did not show better acquisition performance than the SC group, which is contradictory to our model. Possible theoretical and methodological reasons are discussed in the poster. References Post, P.G., Fairbrother, J.T. & Barros, J.A.C. (2011): Self controlled amount of practice benefits learning of a motor skill. *Research Quarterly for Exercise and Sport*, 82, 474-481.

### **FUNDAMENTAL MOVEMENT SKILLS AND DAILY PHYSICAL ACTIVITY LEVELS IN PRESCHOOL CHILDREN**

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Introduction: Preschool and the early elementary school years are critical to a child's development and mastery of fundamental movement skills (FMS). The process of acquiring FMS occurs through a range of active play experiences and structured activity programs. Recent research among preschoolers has shown that FMS are positively associated with habitual physical activity (2005, 2008). Moreover, FMS are generally not considered to develop naturally in children through a maturational process. As such, these skills need to be learned, practiced, and reinforced (2011). Moreover, the type of FMS acquired differs depending on the movement category (i.e., locomotion, manipulative movements). In this study, we investigated the relationship between FMS and the daily physical activity level of preschool children, and elucidated the status of this relationship in relation to the movement categories. Methods: One hundred forty Japanese preschool children aged 4-6 years participated in this study. Each child performed 5 FMS (25-m run, zigzag run, standing broad jump, overhand throw, and bouncing the ball), with quantitative data obtained for each of these movements. The amount of physical activity was assessed using a triaxial accelerometer (OMRON, HIJ-350IT), which each child wore for a week. We examined the time children spent engaged in moderate-to-vigorous activity (MVPA) and recorded the number of steps during everyday activities. We compared the measurement data between 2 age groups (2 school-year grades) and between genders (boys and girls). We also tested for associations between the MVPA levels and the total FMS score (z-score) or the individual FMS score. SPSS software was used for statistical analysis. Results: We found that FMS were greater among older children than in younger children. The degree of MVPA was slightly higher among boys versus girls. A statistically significant relationship was found between the total score of the 5 FMS and MVPA ( $p < 0.05$ ). However, when the relationship between MVPA and each movement item was assessed individually, some differences were observed. The 25-m run, zigzag run, and standing long jump were associated with the degree of MVPA ( $p < 0.01, 0.01, \text{ and } 0.05$ , respectively), whereas the overhand throw and ball bounce were not associated with MVPA. Discussion: These results suggest that not only sufficient total daily activities but also practical movement experiences are needed to enhance every category of movement skill in children. Each particular movement needs to be practiced to enable mastery of movement skills (Logan et al., 2011) according to the developmental stage, particularly with respect to manipulative movements. References: Fisher et al. (2005), *Med. Sci. Sports Exerc.*, 37,684-8 Williams et al. (2008), *Obesity*, 16,1421-6. Logan et al. (2011), *Child Care Health Dev.*, 38,305-15

## THE VARIETY AND DEFINITION OF FUNDAMENTAL MOVEMENTS IN PRESCHOOLER'S SPONTANEOUS ACTIVITY

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**Introduction** Children should experience various movements to make the base of motor skill and the future sports habit. Physical activity guideline for young children in Japan indicates the importance to make movements variedly in many plays. We need to evaluate the diversity of children's movements accurately. Japan Sports Science Center (JSSC) (1980) introduced 84 movements such as "climbing" and "rolling", which are fundamental movements of preschoolers. They were ambiguous because JSSC collected only the terms of fundamental movements without field work evidence. Both researchers and practitioners couldn't understand many of the terms which correspond with actual motion of children. The purpose of this study was to ameliorate the concept of fundamental movements of JSSC based on the feature of action and field observations. **Methods** The subjects were 5-year old children who attend a kindergarten in Kobe City, Japan. We took movies of their spontaneous activity and categorized their motion to fundamental movements using the JSSC list. At first we picked out terms which could express observed motions the most accurately from the list. Then we re-categorized the motions into 8 domains, which included "up-and-down movement", "horizontal movement" "posture change" and so on. When the list couldn't express or correspond observed motions accurately, the terms were changed, removed, integrated or divided. Additionally new motions were added to the list. **Results and Discussion** In eighty-four movements of the list, four motions, "cross", "run away", "be carried one's back" and "stamp", were re-categorized into other domains. Seven motions were changed their names, integrated or divided, e.g. "skip / pop" were divided into "skip" and "pop". Ten motions, "ride", "hide", "stop" etc., were removed from the list since they were difficult to define as a single motion. Twelve motions, "jump and down", "running up", "cartwheel" etc., were added newly. Seventy-four motions were defined. For example, "climb" and "shin up", this deference was ambiguity in the list, were distinguished from perspectives whether children intended to support their action by using hands or not. As a result, eighty-two motions were proposed as fundamental movements. Eighteen motions weren't defined because they weren't observed in this study. Moreover very complicate actions that we couldn't express definitely by only the fundamental movements were also observed.

## TASK- AND DIFFICULTY-RELATED ARC EXPRESSION IN THE PRIMARY MOTOR CORTEX AFTER MOTOR SKILL LEARNING

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**Introduction** Transfer of motor learning represents that previously learned motor skill can provide beneficial effects on the acquisition of a more difficult, and related motor skill. The primary motor cortex plays a key role in this transfer of previously acquired experience. However, the alteration of neuronal substrates for this transfer of acquired experience is still unknown. Because immediate-early genes are closely associated with neuronal activities, therefore, the purpose of this study is to investigate the expression of immediate-early genes in the primary motor cortex during the transfer of motor skill learning. **Methods** Male Sprague-Dawley rats were trained on a runway apparatus to acquire the motor skill needed to complete the acrobatic motor skill learning. According to the difficulties to complete the task, the training protocols were defined into easy acrobatic and difficult acrobatic tasks. Animals were divided in 4 groups: control sedentary (C), easy (E), difficult (D), and easy + difficult training (E+D), and were trained to traverse the runway for seven days. At the last day of training, animals were sacrificed and their primary motor cortices were isolated for subsequent analysis of western blot and immunohistochemistry. **Results** The results demonstrated that previously acquired motor skill in the E group may improve the performance of motor skill in the difficult task. Additionally, the expression of activity-related cytoskeleton associated protein (Arc) in the primary motor cortex was significantly different among groups. Expression of Arc was significantly increased in E group compared to C group, whereas no significant changes in Arc level in D and E+D groups compared to C group. The immunohistochemical observation also showed an increase in Arc immuno-positive signals in the primary motor cortex from E group. **Discussion** Arc protein, as an immediate-early gene, has been reported that involved in modulating the consolidation of memory. The expression of Arc protein was increased in primary motor cortex after easy acrobatic training indicates that Arc plays a role in easy acrobatic training. Moreover, the increase of Arc expression was not observed in the motor cortex of rats from D and E+D groups, indicating the difficulty of motor skill has an effect on the expression of Arc. Because the expression of Arc was not significantly different between C and E+D group, indicating Arc protein could not involved in the transfer of previously acquired motor skill.

## GOAL ORIENTATIONS AND SHORT-TERM PERFORMANCE DEVELOPMENT OF PASSING SKILLS IN YOUNG TALENTED SOCCER PLAYERS

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**HAN**, Nijmegen, The Netherlands, 2UMCG, University of Groningen, the Netherlands **Introduction** In soccer the skill of passing the ball under constraints of time and space is fundamental (Ali, 2011). Being able to develop this skill as a talented soccer player to elite level is key. The players development might be affected by dispositional goal orientations, these predict and explain in which manner players engage in both training and competition (Duda, 1992). It is known that players who are highly task oriented show great persistence to master challenging tasks (Van-Yperen & Duda, 1999). Therefore, task orientation might assist in predicting the potential a talented player has to reach elite level. The goal was to examine whether task orientation discriminates talented soccer players in their passing skill development over a short time frame. **Method** Task orientation of 40 youth players (14,3± 1,1yrs) of a national Dutch soccer club was assessed with the Dutch version of the TEOSQ (Van-Yperen & Duda, 1999). Median split of the task orientation scores resulted in two groups: higher task oriented (HT, n=19, 4,5±0,2s) and lower task oriented (LT, n=21, 3,7±0,4s) (p<.05). The two groups were compared on their development on three performance variables (execution, penalty and performance times) on two consecutive trials with 5 minutes in between (T1 and T2) of the Loughborough Soccer Passing Test (LSPT)(Ali et al., 2007). In addition a questionnaire was administered to investigate persistence (range 1 through 6) as a psychological variable. **Results** No significant differences were found in the development of execution (HT=-4,1±3,9s vs. LT=-3,56±3,92, d=0,33), penalty (HT=-6,3±9,7s vs. LT=-1,2±14,3s, d=0,44) and performance times (HT=-10,4±12,7s vs. LT=-4,8±15,2, d=0,44) between groups (p>.05). Scores of persistence were significantly higher in the HT-group (M=5,4±0,4) than the LT-group (M=4,8±0,3)(p<.05). **Discussion** Although the potential of players to develop the skill of passing did not differ between groups, the HT-group tended to outscore the LT-group on all developmental performance variables. In order to differentiate talented soccer players on their potential to develop passing skills over a short time frame future research could focus on the minimum number of repetitions needed to elicit differences. **References** Ali, A., Williams, C., Hulse, M., Strudwick, A., Reddin, J., Howarth, L., Eldred, J., Hirst,

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### **INCREASED EEG THETA AND ALPHA ACTIVITY INDICATE SOMATOSENSORY WORKING MEMORY PROCESSES IN DIFFERENTIAL BADMINTON SERVE TRAINING**

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**Introduction** Several studies demonstrate higher learning rates in differential compared to classical repetition oriented training (e.g. Schöllhorn, Hegen & Davids, 2012; Schöllhorn, Michelbrink, Welmski & Davids, 2009). To our knowledge this is the first study that addresses the question of the underlying neuronal mechanisms in differential training. In the present study we measured EEG brain activation patterns after differential and classical repetition oriented badminton serve training. **Methods** Eight semi-professional badminton players were asked to perform differential and traditional badminton training in a within-subjects design. Electroencephalographic activity was recorded from nineteen electrodes according to the 10-20 system before and immediately after each 20-minute exercise. Analyses of variance were performed for the data of power density at the theta (4-7.5), alpha (8-13 Hz), and beta (13-30 Hz) band. Results Increased theta and alpha activity was obtained in contralateral parieto-occipital regions in the differential compared to the classical training condition. Beta activity was increased in the classical training condition in prefrontal areas. **Discussion** Results indicate different underlying neuronal processes in differential and classical repetition oriented training with a higher involvement of frontal areas in classical training, and parieto-occipital areas in differential training. While classical training seems to rely on a rather cognitively controlled processing, brain activation patterns indicate somatosensory working memory processes where visual attentional resources are allocated in processing of somatosensory information (Haegens, Händel & Jensen, 2011) in differential training. **References** Haegens, S., Händel, B.F. & Jensen, O. (2011). Top-down controlled alpha band activity in somatosensory areas determines behavioral performance in a discrimination task. *Journal of Neuroscience*, 31, 5197-5204. Schöllhorn, W.I., Hegen, P. & Davids, K. (2012). The Nonlinear Nature of Learning - A Differential Learning Approach. *The Open Sport Science Journal*, 5, 100-112. Schöllhorn, W.I., Michelbrink, M., Welmski, D. & Davids, D. (2009). Increasing stochastic perturbations enhance skill acquisition and learning of complex sport movements. In D. Araujo, H. Ripoll & M. Raab (eds.), *Perspectives on Cognition and Action in Sport* (pp. 59-73). Hauppauge, NY, United States: Nova Science.

### **PRELIMINARY STUDY ABOUT THE VOLLEYBALL TEACHING IN A YOUNG FEMALE TEAM**

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**Introduction** Traditionally Volleyball teaching is given by a coach through drills with a theoretical basis in cognitive approach. The drills are Partial, Varied, Randomized and Mental training and they are described in detail by the coach. They apply to models of Open circuit and Closed circuit motor control and Generalized motor program. In the teaching of physical activities, there is also another approach called "Dynamic-Ecological" where the coach doesn't prescribe exercises but builds a learning setting aimed at the variety of learning (Raiola 2008). It refers to the motor control of the imagination models and the Theory of Freedom Degrees: Reduction, Exploration and Accumulation of freedom degrees (Bernstein, 1967). The objective is testing the learning of certain basic technical skills of volleyball through training based on different scientific paradigms, and comparing the results of different exercises. **Methods** The method is experimental. The work is done with a team of eighteen athletes female under thirteen and it is divided into: PHASE I) Giving exercises for half an hour in each training session. The team is divided into two groups of nine, diversifying roles. The athletes will be evaluated either incoming and outgoing calls through Accuracy Tests about three technical skills: Shot with one hand, Dribble and Bagher. The variation of precision will be evaluated by the coach during the race with descriptors defined for the specific purpose. PHASE II: A) monitoring through detection cards regarding the three technical skills. B) introduction of new exercises related to the three technical skills. C) changing of setting. D) cooperative learning. E) locking exercises and symmetrization of some general movements in order to reduce the wide range of the movement excursions. At the end there is the comparison between the results of the final and intermediate tests. **Results** It is expected that the Dynamic-Ecological approach can find more educational implications than the cognitive one. **Discussion** The Dynamical Systems approach sees the 'human system' as a reality that can self-organize through a 'circular causality'. A body, left to itself, will be able to produce appropriate movements also without practice (Raiola 2008). Finding a positive result in Dynamic-Ecological approach compared to the cognitive one, should be further investigated for the accuracy of the data. **References** Raiola G (2008) Il ruolo della didattica negli ambienti di apprendimento educativo sportivo, Aracne, Roma, Italy Schmidt, R.A., Wrisberg, G., A. (2008), *Motor Learning and Performance*, Human Kinetics, Champaign IL, USA Bernstein, N.A. (1967). *The co-ordination and regulation of movements*. Oxford: Pergamon Press, USA

### **THE RELATIONSHIP BETWEEN VELOCITY AND ACCURACY IN HIGH PERFORMANCE TENNIS PLAYERS RELATED TO AGE AND GENDER.**

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**Introduction** Recent studies report that velocity and accuracy are the most important variables to motor performance (Van den Tillaar & Ettema, 2003). Both variables have been analyzed in different sports (Gorostiaga, Granados, Ibáñez & Izquierdo, 2005). Traditionally, higher velocity has been related with lower accuracy. Nowadays, recent works have shown that increases in velocity are not involved in accuracy losses (Van den Tillaar & Ettema, 2006). The aim of this study was to analyze the relationship between velocity and accuracy in elite players with different age range. **Methods** Fifty five elite tennis players (49 male 6 female) took part in this study. The participants were distributed in four groups: 10-12 years (n=21); 14-16 years (n=22); male +18 (n=6) and female +18 (n=6). All participants carried out thirty services towards a target located in the service box. Ball speed (Stalker Pro) and radial error of ball bounces (video digitized) were recorded to assess service performance. One-way Anova and correlation analysis were carried out to analyze the relationship between velocity and accuracy in each group. **Results** Ball velocity did not show clear correlation with accuracy within subjects (only four participants showed a relation, and only two of them in an inverse relation, none from the 18+ group). Players with higher values in velocity showed better results in accuracy in groups 10-12 yr. ( $r = -.512$   $p < .05$ ) and 14-16 yr. ( $r = -.693$   $p < .01$ ). Regarding group analysis, we have not found differences in accuracy between 10-12 yr. and 14-16 yr. groups, but there were differences in ball velocity ( $p < 0.01$ ). Both +18 yr. groups, male and female, showed better accuracy than the other two groups ( $p < 0.05$ ). Ball velocity showed by +18 yr. female group was

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similar to 14-15 yr. group, and their results were higher in velocity than 10-12 yr. group ( $p < 0.01$ ) and lower than +18 yr. group ( $p > 0.01$ ). Discussion and conclusions We have not found support to the inverse relation between velocity and accuracy. Three of the participants showed better performance with higher velocities, but none of them were from +18 elite group. Player age and gender seems to affect to velocity of services, but this is not that clear regarding accuracy of the services. References Gorostiaga, E.M., Granados, C., Ibañez, J. & Izquierdo, M. (2005). Differences in physical fitness and throwing velocity among elite and amateur male handball players. *International Journal of Sports Medicine*, 26(3), 225-232. Van den Tillaar, R., & Ettema, G. (2003a). Influence of instruction on velocity and accuracy of overarm throwing. *Perceptual and Motor Skills*, 96, 423-434. Van den Tillaar, R., & Ettema, G. (2006). Comparison between novices and experts of the velocity accuracy trade off in overarm throwing. *Perceptual and Motor Skills*, 103, 503-514.

## **GENDER DIFFERENCES IN VISUOMOTOR ADAPTATION**

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Introduction: It is well documented that gender differences exist for performance and learning across different cognitive domains. However, the relationship between gender and the acquisition of sensorimotor skills is poorly investigated. Therefore, the present study aimed to identify the effect of gender on visuomotor adaptation and intermanual transfer in a tracking task (main experiment). In addition, data from previous adaptation experiments using pointing movements were reanalysed with regard to gender differences (supplemental experiments). Methods: 59 male ( $23.2 \pm 2.1$  years) and 40 female ( $21.9 \pm 1.8$  years) right-handed university students without overt sensorimotor disorders participated in the main experiment. The subjects' task was to track a visual target on a computer screen with their right dominant hand while the visual feedback was first veridical (baseline) and then right-left reversed (adaptation). After the adaptation phase has ended, subjects were asked to switch the hand and to perform the task with their left, non-dominant hand while the visual feedback was still disturbed (transfer). The nature of the supplemental experiments was comparable to the main experiment but pointing was used instead of tracking. Results: An ANOVA with the tracking error as a dependent variable, the within-factor "EPISODE" and the between-factor "GENDER" revealed significant main effects for EPISODE ( $F_{19, 1805} = 111.75, p < 0.001$ ) and for GENDER ( $F_{1, 95} = 4.25, p < 0.05$ ) during adaptation indicating that subject's tracking error decreased with ongoing practice and, more importantly, that men had significantly lower tracking errors than women. The interaction term however, was not significant ( $F_{19, 1805} = 1.11, p > 0.05$ ) indicating that the time-course of adaptation did not differ between men and women. There were no significant effects of gender during baseline and transfer episodes. A similar pattern of results was obtained in the supplemental pointing experiments. Discussion: The results of the present study suggest that different mechanisms are involved during visuomotor adaptation in males compared to females with males probably using more strategic control and thus, adapting faster to the distortion than females. However, men's advantage during adaptation was not retained during intermanual transfer suggesting that the modification of the internal model and thus, visuomotor learning, did not significantly differ between genders.

## **Neuromuscular Physiology**

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### **THE RELATIONSHIP BETWEEN FOOT GRIP STRENGTH AND SPRINTING.**

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[Introduction] 'How to run fast' is the interest to many people. It has been shown that there is a strong correlation between maximal strength in half squats and sprint performance (Wisloff U et al., 2004). It is known that plantar flexor force is significantly higher in forefoot striking in running (Peal DP et al., 2012). The function of foot strength seems to be important for the sprinting movement during the contact of ground; however, there are no studies about relationships between sprinting and foot grip strength. [Purpose] The purpose of this study was to investigate the relationship between foot grip strength and sprinting. [Methods] Fifty five healthy subjects (age,  $19.2 \pm 1.9$  years; height,  $165.6 \pm 8.5$  cm; weight,  $57.0 \pm 8.8$  kg; BMI,  $20.6 \pm 2.0$  kg/m<sup>2</sup>; body fat percentage,  $18.3 \pm 6.7$ %; mean  $\pm$  SD) were tested for sprinting time and foot grip strength. Sprinting time was measured between 0m and 20m by photocells and analysed in three different distances (0-20m, 0-10m and 10-20m). After the self-paced warm-up, subjects set standing position with barefoot and their supportive leg was on the pressure mat. After the verbal signal, subjects began to run as fast as possible. The maximum voluntary isometric strength of foot grip was measured with by the foot grip dynamometer. Subjects were instructed to place their barefoot with heel stopper on the dynamometer. in standing position. The first proximal phalanx was positioned on the grip bar and the bar was gripped with maximal effort using all toes. [Result and Discussion] The absolute value of foot grip strength correlated with the speed of 0-20m ( $p < 0.01$ ), the speed of 0-10m ( $p < 0.01$ ), the speed of 10-20m ( $p < 0.01$ ). On the other hands, foot grip strength per weight correlated with the speed of 0-20m ( $p < 0.01$ ) and 10-20m ( $p < 0.01$ ), but not with 0-10m. This study suggested that foot grip strength may be important for sprinting, especially in acceleration phase. [Reference] 1. Wisloff U, Castagna C, Helgerud J, Jones R, Hoff J (2004) Strong correlation of maximal squat strength with sprint performance and vertical jump height in elite soccer players. *Br J Sports Med*;38(3):285-288. 2. Daniel P. Peal, Adam I. Daoud, Daniel E. Lieberman (2012) Effects of footwear and strike type on running economy. *Med Sci Sports Exerc.* 2012 Jul ; 44(7):1335-43.

### **PHYSICAL EXERCISE INDUCES AN INCREASE IN ELECTROENCEPHALOGRAPHIC ALPHA PEAK FREQUENCY**

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Introduction: The beneficial effects of exercise on cognitive performance are frequently reported in the literature, while its effects on neural parameters as the individual alpha peak frequency (iAPF), that is positively related to cognitive performance remain largely unknown. Therefore the aim of the present study was to evaluate the effects of different physical exercise protocols on the iAPF. Methods: Electroencephalographic activity was recorded in 12 healthy males before, directly after and 10 minutes after an incremental cycling test (ramp test) until subjective exhaustion and a 30 minutes lasting cycling protocol at 50% of the maximum power output (MPO), respectively. Electrical power values were calculated in the occipital region using fast fourier transformation. The iAPF was determined as the frequency indicating the highest power between 7 and 13 Hz. Results: After the incremental test the iAPF was significantly increased and remained elevated 10 minutes after exercise. In the 50% MPO protocol the iAPF was consistent throughout the measurements. Conclusion: The different

effects of the two exercise protocols on the iAPF might be best explained by their discrepancy in intensity probably indicating the necessity for high intensity exercise to increase the iAPF.

### **THE EFFECT OF FATIGUE ON EMG ACTIVITY OF THE ANKLE PLANTAR-FLEXORS DURING A 30-S CYCLING SPRINT**

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**Introduction** Fatigue-induced decrements in mean power of up to 58% have been reported during a 30-s maximal cycle sprint [1]. Martin and Brown [2] showed the highest reduction of relative power production (-63%) occurred at the ankle joint during this type of effort. This suggests that fatigue is manifested by a decreased ability of the ankle plantar flexors to directly generate and/or transfer power from proximal muscles [3]. The aim of this study was to manipulate the amount of fatigue during a 30-s sprint and to investigate its effect on the activation of plantar flexor muscles, the co-activation of these muscles with knee and hip extensors, and power output. **Methods** On separate days ten male participants randomly performed a 30-s cycling sprint in a fatigue-free state (SCTL) or after cycling for 10min at  $224 \pm 26$ W (SFAT). Mean power output (MPO), normalized integrated electromyography of the gastrocnemius medialis and lateralis (iEMGGAS), and co-contraction indices of the plantar flexors with vastii (CCIV-PF) and gluteus maximus (CCIGMAX-PF) were calculated for both sprints at 5-s intervals. Results MPO declined from 823W to 326W during SCTL and from 705W to 248W during SFAT between the first and last 5-s interval ( $p < 0.05$ ). MPO was lower during SFAT for the last three intervals (-25%, -27%, and -23% respectively). During SCTL and SFAT iEMGGAS (-23 and -25%), CCIV-PF (-45 and -49%) and CCIGMAX-PF (-41 and -44%) decreased over time ( $p < 0.05$ ). iEMGGAS (86 vs. 67%) and CCIV-PF (18 vs. 15%) were lower during SFAT ( $p < 0.05$ ). **Discussion** Decrements in mean power observed in both sprints, were similar with those previously reported [1]. The reduced power output caused by fatigue coincided with a decrease in plantar flexors activation and a lower co-activation between these muscles and both knee and hip extensors. The alterations in plantar flexors recruitment observed in this study can reduce the power generated and transferred by the plantar flexors during a 30-s cycling sprint, as reported by Martin and Brown [2]. **References** 1. McCartney, N., G. Heigenhauser, and N.L. Jones, Power output and fatigue of human muscle in maximal cycling exercise. *Journal of Applied Physiology*, 1983. 55(1): 218-224. 2. Martin, J.C. and N.A. Brown, Joint-specific power production and fatigue during maximal cycling. *Journal of Biomechanics*, 2009. 42(4): 474-479. 3. Raasch, C.C., F.E. Zajac, B. Ma, and W.S. Levine, Muscle coordination of maximum-speed pedaling. *Journal of Biomechanics*, 1997. 30(6): 595.

### **IMPAIRED RAPID MUSCLE FORCE CHARACTERISTICS FOLLOWING PLAYING TENNIS IN THE HEAT**

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**Introduction:** Studies on fatigue in tennis have primarily focused on the contribution of neural and muscular factors as measured from maximal isometric voluntary contractions of lower limb muscles. However, it remains unknown whether match-play tennis results in impaired neuromuscular function during "explosive" muscle actions and to which extent playing in a hot environment may exacerbate this phenomenon. The aim of this study was to assess the time course of changes in rapid muscle force characteristics in response to match-play tennis under severe heat stress. **Methods:** Two experimental tennis matches that consisted of 20 min of effective playing time - separated in two 10 min segments - were played in cool ( $\sim 22^\circ\text{C}$  and 70%RH) and hot ( $\sim 36^\circ\text{C}$  and 35%RH) environments by twelve competitive players (ITF rank 2-3). Maximal explosive force (i.e., with instructions of "hard and fast") and electromyographical (EMG) activity of the vastus lateralis and rectus femoris muscles were measured during brief (5 s) maximal voluntary isometric contractions (MVC) of the knee extensors before, immediately after, 24 h and 48 h after each game. Rates of force development (RFD) and EMG (i.e., Root Mean Square) rise were recorded at time intervals of 0-30, 0-50 and 0-100, 0-150 and 0-200 ms relative to force onset, and were also normalized to maximal force and EMG values, respectively. **Results:** From pre- to post-match, reductions occurred in the peak RFD within the first 200 ms (5 and 21%), MVC force (-9 and -19%) and the accompanying maximal EMG activity in cool and hot conditions ( $P < 0.05$ ). Similarly, absolute RFD at all time intervals was reduced (Cool: -6 to -9% and Hot: -12 to -16%;  $P < 0.05$ ) after both matches, while the rate of EMG rise did not change ( $P > 0.05$ ). MVC force and RFD returned to baseline levels within 24 h and 48 h after match-play in cool and hot conditions, respectively. Normalized RFD and EMG rise remained unchanged ( $P > 0.05$ ) throughout the protocol. **Conclusions:** In competitive players, rapid muscle force capacity (i.e. within the initial 200 ms of the contraction) is impaired after match-play tennis, which might affect functional performance in actions like sprinting and rapid changes in movement direction. In general, larger reductions in muscle force characteristics occurred after competing in the heat, and were accompanied by a slower recovery time course. However, all of the fatigue-induced changes could not be explained by reductions in agonist muscle activation. Additionally, when differences in maximal strength and activation capacity were accounted for, RFD and EMG rise were comparable across conditions.

### **COOLING INDUCED PLANTAR DESENSITIZATION AND POSTURAL CONTROL**

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**Cooling induced plantar desensitization and postural control** [Introduction] Cutaneous sensation on the plantar sole plays an important role in postural control. It has been reported that loss of plantar cutaneous sensation induced by ischemic blocking of afferent conduction below the ankle is related to loss of postural control (Wang and Lin 2008). Also, cooling the skin is often used to induce anesthesia. It has been shown that the cooling of plantar sole mechanoreceptors through ice immersion effects to balance control and lower leg muscle activity (Billot et al. 2013). This impairment of postural stability might be related to the decrease in muscle force production of foot after desensitization if foot muscle strength is also required to maintain a whole body balance. However, there are no studies how cooling induced plantar desensitization affects to the double and single leg quiet standing and it is related to the force generating capacity of foot muscle. [Purpose] The aim of the present study was to determine the role of skin in motor and balance control induced by cooling the skin of the foot. [Methods] Twenty young healthy individuals were participated. Postural control was measured with Kistler force plate before and after the 20 minutes of cold water immersion (0 degree). Postural control was assessed during double and single leg quiet standing in open eyes condition for 30 seconds, using force plate to quantify center of pressure (COP) dynamics. The total locus length(LL), area of body sway(ABS) and total locus length per area(LLA) were calculated using the software to analyze the body sway. The room temperature was maintained at 20 degrees. [Results and Discussion] After the cold water immersion, Medial-lateral COP of double and single legs quiet standing and ABS were significantly increased, and LLA was significantly decreased. Impairment of balance control after a desensitization of foot induced by cold water immersion may be also due to the decreased force generating capacity of foot muscle (Horiuchi

and Yamauchi ECSS2013). [Reference] Wang TY and Lin SI, Sensitivity of plantar cutaneous sensation and postural stability. *Gait Posture* 2008; 23(4):493-499. Billot M, Handrigan GA, Simoneau M, Corbeil P, Teasdale N. Short term alteration of balance control after a reduction of plantar mechanoreceptor sensation through cooling. *Neurosci Lett*. 2013 Feb 22;535:40-4. Lowrey CR, Strzalkowski ND, Bent LR. Cooling reduces the cutaneous afferent firing response to vibratory stimuli in glabrous skin of the human foot sole. *J Neurophysiol*. 2013 Feb;109(3):839-50.

## **SURFACE EMG DECOMPOSITION OF VASTUS MEDIALIS AND VASTUS LATERALIS IN TRAINED VERSUS UNTRAINED SUBJECTS**

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**Introduction** Much has been published on the functional differences between Vastus Medialis (VM) and Vastus Lateralis (VL) between trained and untrained individuals with work mainly focussed on muscular onset timings using surface electromyography (sEMG). Further exploration of the neuromuscular system can now be achieved by studying large yields of concurrently active motor unit action potential trains (MUAPT's) and their characteristics (De Luca, 2006), using surface decomposition. This study aims to provide insight into the neuromuscular system's mechanism of controlling Motor Units (MU's) in trained and untrained individuals during a fatiguing protocol. **Methods** Trained and untrained individuals were asked to perform a 40 second trapezoid isometric knee extension task at 40% MVC, which was repeated until volitional exhaustion. Surface EMG (sEMG) signals were recorded from VM and VL using five pin surface array sensors. The raw sEMG signals were then inputted into the Precision Decomposition (PD) algorithm (Nawab et al. 2010) which decomposed the sEMG signals into their constituent motor unit action potential trains (MUAPT's). The mean firing rate (MFR) for each detected motor unit was calculated and smoothed using a 3-s Hanning filter. **Results and Discussion** The untrained subject showed an increase in the VM MU firing rates during the isometric knee extension when compared to its synergistic partner VL. The trained subject did not show differences between the synergistic pair of VM and VL, instead exhibited similar MU firing rates for both muscles. The VL behaviour did not significantly differ between the fatigued and non-fatigued state or between the subjects. These findings could infer the VM is an important modifiable factor associated with training. These results, although exploratory, offer insight into the benefits of training and the effect on the neuromuscular control of synergistic muscles at the knee. The ability to conduct surface EMG decomposition is a recent technological advancement that is still being explored. However, these preliminary findings show that the application of this technology to exploring training differences can offer insight into individuals' neuromuscular control. **Conclusions** The study provides some tantalizing findings and thoughts for progression with regards to the differences in neuromuscular control in training. Although exploratory at this time, the reported differences in motor unit firing rates offer some explanation to knee control during fatiguing muscles and the differences between differently trained individuals. Further investigations among individuals with various levels of training could offer further insight into the mechanisms involved

## **THE RELATION BETWEEN MUSCLE LENGTH AND DURATION OF THE M-WAVE**

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**Introduction** During locomotion, the muscle length changes due to changes in force and joint angle. It was shown that there is a relationship between muscle length and spectral parameters of the surface EMG signal (Inbar et al., 1987, Okada, 1987). In this study, we tested effects of change in the muscle length due to joint rotation or voluntary contraction, on the compound muscle action potential (m-wave). **Methods** Subjects performed isometric knee extensions or plantar flexions of different force (10 to 100 % of maximum voluntary contraction (MVC)) and at different joint angles. EMG and m-waves were recorded in m. gastrocnemius medialis (GM) and m. vastus lateralis (VL). **Results** In both muscles we found a relation between changes in the joint angle and the duration of the m-wave. Knee extension from 90 to 70 degrees led to 4.1% decrease in the m-wave duration (n=10, P<0.05) and to 50 degrees – to 8% decrease (n=2). Plantar flexion of 20 degrees resulted in 5.6% decrease in the m-wave duration (n=8, P<0.05). In both muscles the duration of the m-wave positively correlated with the muscle length. Also an increase of the muscle force from 10 to 90% of the MVC led to a 15% shortening of the m-wave. During MVC, the median power frequency of the EMG spectrum (MF) increased in the VL from 80.3 Hz at 90 degrees to 85.1 Hz at 70 degrees but in the GM the passive muscle shortening led to about 15 Hz decrease in the MF. **Discussion** In both muscles, VL and GM, muscle shortening due to passive changes in the joint angle or active isometric contraction led to decrease in the m-wave duration. This findings confirm the results of Arendt-Nielsen et al. (1992) about relationships between muscle length and muscle fibre conduction velocity. In contrast, the decrease in the MF during the muscle shortening in GM contradicts the linearity between mean power frequency and fibre velocity (Arendt-Nielsen et al., 1985). **References** Inbar GF, Allin J, Kranz H. (1987). *Med Biol Eng Comput*, 25, 683-689. Okada M. (1987). *Eur J Appl Physiol*, 56, 482-486. Arendt-Nielsen L, Gantchev N, Sinkjaer T. (1992) *Electroencephalogr Clin Neurophysiol*, 85(3),166-72. Arendt-Nielsen L, Mills KR. (1985) *Electroencephalogr Clin Neurophysiol*, 60(2),130-4. **Acknowledgment.** This study is supported with funds of the Bundesministerium für Wirtschaft und Technologie managed by the Space Administration of the German Aerospace Center (grant 50WB0831).

## **THE RELATIONSHIP BETWEEN FOOT GRIP STRENGTH PLANTAR PRESSURE DURING SPRINTING.**

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**[Introduction]** We have found the significant correlation between foot grip strength and sprinting speed (Maruyama and Yamauchi ECSS2013). It has suggested that greater toe grip and gentler heel strike are the strategies to catch the ground in walking (Fong DT et al., 2007). Also, it can be speculated that foot strength may be related to the plantar pressure in sprinting. However, there is still unknown the relationship between foot grip strength and plantar pressure in sprinting. **[Purpose]** The purpose of this study was to investigate the relationship between foot grip strength and plantar pressure in sprinting. **[Method]** Thirteen male subjects( age,19.5±1.2 years; height, 170.9±8.0cm; weight, 64.3±5.9kg; BMI, 22.0±0.8kg/m<sup>2</sup>; body fat percentage, 14.0±3.9%; mean±SD) were tested for sprinting time, foot grip strength and plantar pressure in jogging and sprinting. Sprinting time was measured between 0m and 20m by photocells and analysed in three different distances (0-20m, 0-10m and 10-20m). After the self-paced warm-up, subjects set standing position with barefoot and their supportive leg was on the pressure mat. After the verbal signal, subjects began to run as fast as possible. The maximum voluntary isometric strength of foot grip was measured with by the foot grip dynamometer. Subjects were instructed to place their

barefoot with heel stopper on the dynamometer in standing position. The first proximal phalanx was positioned on the grip bar and the bar was gripped with maximal effort using all toes. Plantar pressure in jogging and sprinting were measured by a pressure insole system (Novel pedar-x, Germany). Jogging was self-paced running. The plantar pressure data were evaluated in 8 regions. [Result and Discussion] Significant higher pressure at hallux, lateral toes, 1st metatarsal head and 4th and 5th metatarsal head regions were found in sprinting as compared with jogging ( $p < 0.05$ ), on the other hands, medial mid-foot and heel pressures were significantly lower in sprinting than in jogging ( $p < 0.05$ ). Foot grip strength was significantly correlated with plantar pressure of hallux and lateral toes in sprinting ( $p < 0.05$ ), while no significant correlation was found between foot grip strength and plantar pressure of hallux and lateral toes in jogging. This study suggests that muscle strength of forefoot region can be an important role in sprinting performance. [Referencel 1. Daniel Tik-Pui Fong, De-Wei Mao, Jing-Xian Li, Youlian Hong. (2008) Greater toe grip and gentler heel strike are the strategies to adapt to slippery surface. *J Biomech.* 2008;41(4):838-44.

## **MAXIMUM ISOMETRIC FOOT GRIP FORCE AND MAXIMUM ISOMETRIC FORCE OF KNEE AND LEG EXTENSION MOVEMENT**

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[Introduction] Many physical activities are performed with a standing position on the foot and foot bears body weight as it carry the body through daily or sports activities. There are numerous studies on muscle functions of lower limbs; however, only few studies have demonstrated how foot grip force is associated with the force generating capacity of leg. Therefore, the present study was to investigate how isometric foot grip force generation was related to the force generating capacity of leg in middle aged and elderly individuals. [Methods] Thirty-one healthy individuals (63+/-9 years old) were measured the maximum foot grip, knee extension and leg extension forces. For MVC measurement of foot grip force, subjects exerted maximum force for ~3 seconds on a foot grip dynamometer with either sitting or standing position. Subjects also performed the maximum isometric knee extension and leg extension forces. Measurements were repeated three times with at least one-minute rest period between bouts, and the highest value among the measurements was used. [Results and Discussion] Foot grip forces both at the sitting and standing position were positively correlated with both the maximum isometric knee extension and leg extension forces, respectively. Foot grip force at the standing position was a higher correlation with the force generating capacity of leg as compared with foot grip force at the sitting position. The present results indicate that the ability to generate higher foot grip force is associated with a strong leg muscle force. Also, the measurement of foot grip force at standing position is more useful when evaluating the lower limb muscle functions with other leg force measurements.

## **PERFORMANCE AND RECOVERY DURING REPEATED CYCLING SPRINTS: EFFECT OF HYPOXIA SEVERITY**

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The aim of this study was to examine the effect of hypoxia severity on an initial bout of short (4-s) repeated cycling sprints and the subsequent recovery of performance during an additional bout of repeated cycling sprints. On separate days, 8 healthy males performed 2 sets of maximal isokinetic cycling sprints (lasting 4-s) at  $120.7 \pm 5.6$  RPM (26 s of passive rest between sprints and 8 minutes of passive recovery under normoxic conditions between sets). The first set consisted of 10 sprints and was completed under normoxia (simulated altitude: 0m), mild (2000m), and severe normobaric hypoxia (4000m). The second set consisted of 5 sprints and was completed under normoxia in all trials. There was a main effect of condition on the mean power output during the first sprint in set 1 (normoxia:  $1205.5 \pm 127.4$  W, mild hypoxia:  $1170.4 \pm 147.6$  W, severe hypoxia:  $1151.1 \pm 123.9$  W,  $p = 0.049$ ). During set 1 both the reduction in total mean power for the 10 sprints ( $959.5 \pm 101.1$  vs.  $1072.3 \pm 137.0$  and  $1046.7 \pm 135.7$ W,  $p = 0.000$ ) and the percentage decrement score ( $16.3 \pm 8.0\%$  vs.  $11.0 \pm 6.9\%$  and  $10.4 \pm 5.2\%$ ,  $p = 0.001$ ) were larger in severe hypoxia compared to normoxia and mild hypoxia, respectively. During sprint 1 in set 2 the mean power output recovered to  $96.3 \pm 5.9\%$  (all conditions compounded) of the mean power achieved during sprint 1 in set 1 with no difference observed between conditions ( $p = 0.811$ ). There was a main effect of condition when comparing the mean power achieved during sprint 1 in set 2 vs. sprint 10 in set 1 ( $119.3 \pm 11.5\%$ ,  $119.9 \pm 15.8\%$  and  $130.2 \pm 10.3\%$  for normoxia, mild and severe hypoxia respectively,  $p = 0.044$ ). During set 2 there was no difference between conditions in the mean power achieved during sprint 1 ( $p = 0.093$ ). During set 2 the mean power for the 5 sprints was reduced in severe hypoxia ( $p = 0.017$ ) compared to normoxia but not mild hypoxia ( $1021.7 \pm 127.4$  vs.  $1079.7 \pm 140.1$  and  $1068.4 \pm 137.5$  W) with a main effect of condition on the percentage decrement score ( $7.2 \pm 4.0\%$ ,  $7.3 \pm 3.3\%$  and  $5.2 \pm 4.2\%$ ,  $P < 0.05$ ). Despite the inability to repeat very short (4-s) cycling sprints being exacerbated during severe hypoxia compared to normoxia (the performance loss was not different between normoxia and a simulated normobaric altitude of 2000m), following 8 minutes of recovery, the initial sprint during a subsequent bout of repeated sprint exercise was not different and recovered to the same level among conditions. However, performance during 5 additional cycling sprints (completed in normoxia) was impaired when the first bout was completed in severe hypoxia compared to normoxia.

## **Nutrition**

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### **EFFECTS OF ILEX PARAGUARIENSIS INGESTION ON FAT METABOLISM DURING EXERCISE**

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Introduction The positive thermogenic and lipid-lowering effects of Yerba Mate (YM), an infusion made from the leaves of the tree *Ilex paraguariensis* are well documented (Bastos et al. 2007). Commonly reported chronic effects of introducing YM into the diet include the reduction in body fat percentage, and the acute effects include increased fatty utilisation in resting conditions (Martinet et al. 1999). However, no study has yet investigated whether and how YM ingestion affects fat utilisation during exercise. This study investigates the acute effects of YM on fatty acid oxidation at different exercise intensities. Methods: Following the institutional ethical approval, thirteen healthy participants (mean + SD: age =  $20.8 \pm 3.4$  yr, height =  $171.8 \pm 10.0$  cm, body mass =  $70.4 \pm 11.3$  kg) gave written consent, and were randomly assigned to exercise in two experimental conditions over a period of two weeks, in double-blind design. During each visit participants ingested either a placebo of hydroxypropyl methylcellulose capsules or 1000 mg capsule of YM. Participants then rested for 60 minutes before completing a cycling ergometer incremental exercise until volitional exhaustion, with power output initiated and in-

creased by 0.5 w.kg<sup>-1</sup> every 3 minutes. Cardiorespiratory gases of oxygen uptake (VO<sub>2</sub>), carbon dioxide production (VCO<sub>2</sub>) and respiratory exchange ratio (RER) were continuously measured, and were used to estimate fatty acid oxidation (FAO) using stoichiometric indirect calorimetry technique (Peronnet and Massicott 1991). A repeated measure ANOVA was applied to detect the effects of YM ingestion on FAO, and paired t-test was applied to detect the effects on maximal exercise performance, significance levels were set at (p<0.05). Results: RER was significantly reduced at all power outputs (p<0.05). FAO was significantly increased (main effect, P<0.05), at all light to moderate exercise power outputs corresponding to RER < 1, in the YM condition compared with placebo condition (0.26 ± 0.09 vs. 0.34 ± 0.10, 0.25 ± 0.12 vs. 0.33 ± 0.11, and 0.16 ± 0.15 g.min<sup>-1</sup> at 36.5, 73.0 and 110.0 W respectively, p<0.05). This increase in FAO was despite no difference in peak VO<sub>2</sub> (38.8±8.4 vs. 38.1±8.7 ml.kg<sup>-1</sup>.min<sup>-1</sup>) or maximal power output (222.3 ± 59.8 vs. 221.8 ± 66.8 W). Discussion and Conclusion: Acute ingestion of YM before exercise enhances fat metabolism during light and moderate exercise intensities, without negatively affecting peak power or peak VO<sub>2</sub>. This is the first study to have demonstrated the YM metabolic effects during exercise. The combined ingestion of YM with exercise may be an effective strategy for optimising fat metabolism during exercise, known to play a role in metabolic weight management. References: Bastos DHM, de oliveira DM, Matsumoto RLT et al. (2007) *Med Arom Plant Sci Biotech.* 1(1), 37-46. Martinet A Hostettmann K Schutz Y (1999) *Phytomed.* 6, 231-238 Péronnet F, Massicotte D (1991) *Can J Sports Sci.* 16:23-29

## FLUID BALANCE OF WELL-TRAINED SWIMMERS DURING VARYING INTENSITY EXERCISE IN AN OUTDOOR ENVIRONMENT

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**Introduction** The current hydration recommendations for aquatic sports are based mainly on those for 'land-based' sports, despite the different methods of heat loss (i.e. conduction and convection) and the immersion of the body in water<sup>1-2</sup>. Currently, limited research exists on the sweat loss of aquatic athletes in outdoor environments across multiple training sessions within a day (i.e. morning and afternoon training) and of varying exercise intensities. It is thought the level of dehydration is not as severe in aquatic sports as in 'land-based' sports<sup>1</sup>, and therefore the fluid intake guidelines may differ for aquatic athletes. The purpose of the present study was to investigate the individual sweat loss of elite swimmers training twice per day in sessions of varying exercise intensity in an outdoor environment. **Methods** Twelve nationally and internationally competitive male swimmers volunteered to participate in this study (mean ± SD age 16.9 ± 2.7 years, mass 71.0 ± 7.8 kg). Data was collected over two days during a two-week training camp in an outdoor 50 m pool prior to a national competition. Each day consisted of two training sessions resulting in two different training conditions: Day 1 (easy-moderate) and Day 2 (easy-hard). Standard fluid balance measurement procedures were followed, and individual fluid intake and sweat loss was calculated. **Results** The 'moderate' and 'hard' sessions elicited body mass losses of 0.24 kg and 0.30 kg, which was significantly greater than the 'easy' sessions (p = 0.01 and p = 0.003, respectively) in which gains in body mass (0.17 kg) were observed. Sweat loss and sweat rate were significantly higher in the 'moderate' session (0.74 L and 0.43 L/h) compared to the 'easy' (0.30 L and 0.17 L/h) session (p = 0.02 and p = 0.02, respectively), neither of which were different to the 'hard' session. Sweat loss and sweat rate were moderately correlated with fluid intake in the 'easy' training condition only. There were no differences between training days in body mass loss or total sweat loss (i.e. Easy-Moderate p = 0.08; Easy-Hard p = 0.52). **Discussion** Overall, athletes were better able to match fluid intake with sweat loss in the 'easy' sessions, resulting in a net gain in body mass. The lack of differences in daily body mass change and daily sweat loss may be due to the large individual variation in fluid intake and sweat loss among athletes, which likely impacted upon the calculations in this study. Nevertheless, sweat rates for swimmers are substantially lower than those reported for 'land-based' athletes, suggesting the need for more specific hydration guidelines for aquatic athletes. **References** 1. Maughan, R.J., Dargavel, L.a., Hares, R. & Shirreffs, S.M. (2009). *Int J Sport Nutr Ex Metab*, 19, 598-606. 2. Cox, G.R., Broad, E.M., Riley, M.D. & Burke, L.M. (2002). *J Sci Med Sport*, 5, 183-193.

## MICRONUTRIENT INTAKE OF TOP LEVEL MALE AND FEMALE HIGH JUMPERS

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**Introduction** Elite male and female high jumpers have a low body mass index (BMI) that would place them at the lower quarter of the general population percentile curve. To maintain a low body mass, high jumpers may consume relatively low energy diets and this may lead to inadequate intake of vitamins and minerals that are important for energy metabolism, hemoglobin synthesis, bone health and immune function. The aim of the present study was to investigate and compare micronutrient intake of top-level male and female high jumpers during the general preparation phase of their training. **Methods** Fourteen elite male and female high jumpers took part in the study (7 males: 1.86±0.03 m, 75.4±1.7 kg, BMI: 21.9±0.7 kg/m<sup>2</sup>, personal best: 2.09±0.08 m and 7 females: 1.77±0.03 m, 58.7±2.1 kg, BMI: 18.7±0.8 kg/m<sup>2</sup>, personal best: 1.68±0.06 m). Participants weighed and recorded their diet for 3 days (2 weekdays and 1 weekend day), during the general preparation phase. Nutrient intake was analyzed using custom-made software based on a standard nutritional database (Food Standards Agency, 2002). Statistical comparisons between male and female jumpers were made using independent t-tests (p<0.05). **Results** Average daily energy intake was higher in male than in female jumpers was 2673±445 and 1984±262 kcal (p<0.05). A low intake (below 50% of daily reference intake-DRI) was found for both male and female jumpers for vitamin D (12% of DRI), vitamin E (34% of DRI) and folate (46% of DRI). Female jumpers had a low iron intake compared with DRI (55% of DRI) and low vitamin B12 intake (~60% DRI). A relatively low intake for both genders was also found for calcium (78% of DRI), magnesium (66% of DRI), zinc (84% of DRI) and selenium (83% of DRI). **Discussion** Exercise training may lead to increased micronutrient needs and thus athletes should consume diets that provide at least the recommended daily reference intakes (DRI) for all micronutrients (ACSM, 2009). In the present study, both male and female jumpers had intakes of vitamins D and E and folate that were all lower than 50% of DRI. Also, iron intake in female jumpers was 55% of DRI and this was combined with low folate (<50% DRI) and low vitamin B12 intake (~60% DRI). These micronutrient deficiencies may be due to the low energy intake and suboptimal diet composition. **References** Food Standards Agency (2002). McCance and Widdowson's *The Composition of Foods*. Cambridge: Royal Society of Chemistry. ACSM (2009). *Med Sci Sports Exercise*, 41(3), 709-731.

## EFFECTS OF A TRANSDERMAL APPLICABLE ARGININE SUPPLEMENT ON THE MAXIMAL AND SUBMAXIMAL BENCH-PRESS PERFORMANCE.

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Arginin is a common supplement in weightlifting and bodybuilding. Supplements are usually taken by oral application and therefore have to pass the gastrointestinal tract to be absorbed into the cardiovascular system. The aim of the present study was to determine the potential ergogenic effects of the new transdermally applied arginine supplement AminoSkin Power on maximal and submaximal bench-press performance. 15 sports students with a 1-year minimum of resistance training attended 2 sessions. In a double-blind, crossover design the subjects were randomly assigned to using the placebo in the first and AminoSkin in the second session or counterwise. In each session they had to apply the given unguent on their chest and arms and perform the 1-RM test protocol of the National Strength and Conditioning Association (NSCA) and one set at 80 % 1-RM for maximum repetitions. To maintain high objectivity, specific technical instructions regarding the bench press were given. The achieved weights and correspondent repetitions were protocolled as well as the heart rate was monitored through the whole session. In addition the subjective sensation of a potentially positive effect was obtained. Differences between the placebo and AminoSkin Power were analyzed by dependent T-tests. Neither in maximal performance (difference  $0,89 \pm 4,18$  kg) nor in submaximal performance (difference  $0,64 \pm ,72$  reps) could be found any ergogenic effect of AminoSkin Power compared to the placebo. The heart rate also didn't show any significant difference throughout the whole session and in the 80 % 1-RM set. There is no proof for an ergogenic effect of the transdermal applied arginine supplement, but the obtained data suggests that there might be a positive effect on submaximal bench-press performance. Therefore future studies should focus on the submaximal performance and the effectiveness of transdermal application in general.

## CAFFEINE INGESTION PARTIALLY COMPENSATES THE MORNING REDUCTIONS IN UPPER AND LOWER BODY MUSCLE POWER

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Purpose: To investigate whether caffeine ingestion counteracts the morning reduction in neuromuscular performance associated with circadian rhythm. Methods: Thirteen highly resistance-trained men underwent a battery of neuromuscular tests under three different conditions; i) morning (8:00 a.m.) with 6 mg kg<sup>-1</sup> of caffeine ingestion (i.e., AMCAFF); ii) morning (8:00 a.m.) with placebo ingestion (AMPLAC); iii) afternoon (18:00 p.m.) with 6 mg kg<sup>-1</sup> of caffeine ingestion (PMCAFF) and iv) afternoon (18:00 p.m.) with placebo ingestion (PMPLAC). A randomized, double blind, crossover, placebo controlled experimental design was used, with caffeine ingestion 90 min prior to the test. Body weight, bioelectrical impedance analysis, blood hematocrit and tympanic temperature were measured before a neuromuscular test battery and after a standardized warm-up. The test battery consisted in the measurement of bar displacement velocity during free-weight full-squat (SQ) and bench press (BP) exercises against loads that elicit 25%, 50%, 75% and 90% 1RM load. After recovery cycling peak power was measured during an all-out 4s cycling sprint (1). Results: Before the neuromuscular performance test, body weight, impedance and hematocrit were not significantly affected by time of day. However, body temperature was 0.4°C lower in the morning than in the afternoon despite the standardized warm-up ( $P < 0.05$ ). In the PMPLAC trial, muscle power was similar to the PMCAFF trial in all loads except in 90% 1RM load where caffeine ingestion increase 8% BP and 5% SQ power ( $P < 0.05$ ). In the AMPLAC trial, muscle power was lower than in the AMCAFF trial, at all loads (25%, 50%, 75% and 90% 1RM) in BP and SQ exercises (5.5-9.5%;  $P < 0.05$ ). Similar difference was found between AMPLAC and PMPLAC (5-8.5%;  $P < 0.05$ ). Peak cycling power was not improved by this dose of caffeine ingestion (6 mg kg<sup>-1</sup>) neither in the morning nor in the afternoon. Conclusions: Caffeine ingestion at a dose of 6 mg kg<sup>-1</sup> body weight in the morning (i.e., AM trials) improves upper and lower body muscle power at all loads (i.e., 25-90% 1RM). In the afternoon (PM trials) caffeine has no effect on muscle power, except when working against a high resistance (90% 1RM). Caffeine ingestion in the morning partially reverses the circadian reduction in muscle power. 1. Martin JC, Wagner BM, and Coyle EF. Inertial-load method determines maximal cycling power in a single exercise bout. *Medicine and Science in Sports and Exercise*. 1997;29(11):1505-12.

## A CASE STUDY: NUTRITIONAL INTERVENTION AND BODY HYDRATION/COMPOSITION ASSESSMENT IN ULTRA-ENDURANCE CYCLING EVENT

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Introduction The training and competition alter the metabolism and body composition greatly, especially those of long duration in one or several stages, where the energy becomes to be deficient (Weitkunat et al., 2012). There is little research, and this is the aim of this study, focusing on analyzing the effects of a cycling test (1000km non-stop) with an individualized nutritional intervention to assess the hydration and body composition as a response of the organism. Methods A well-trained ultra-endurance athlete developed 1000km non-stop of cycling in a road circuit (4.7km) with a 40-hours of time limit. The nutritional and fluid intake was registered, during the entire test (pre, during -6 measures- and at the end) anthropometry and bioimpedance analysis -BIA- (Z-Metrix®, Bioparhom) were used to determine changes in body mass, skeletal muscle mass and fat mass. In order to quantify hydration status we measured intracellular water volume and urinary specific gravity. Results The athlete consumed a total of 49.6 MJ of energy, 2781 mg of caffeine and 17.3 L of fluids (water, supplements and food contain), equal to 0.44 L/h. The body mass decreased as well as fat mass a 2.2%. The skeletal muscle mass and intracellular water volume decreased until the end too. These changes in body composition by anthropometry and BIA were changed in the same way that urine specific gravity (1005 g/mL to maximum of 1030 g/mL and 1020g/mL at the end). Discussion Our data suggest that is important to consider a nutritional intervention to modulate the body composition to secure physical performance in endurance exercise, decreasing the obvious changes that occur in the body of the athlete in these special events (Knechtle et al., 2009; Rehrer NJ., 2001). References Weitkunat T, Knechtle B, Knechtle P, Rüst CA, Rosemann T. (2012). *J Sports Sci*. 30(10):1003-1013. Knechtle B, Wirth A, Knechtle P, Rosemann T. (2009). *Int J Sports Med*. 30(3):163-167. Rehrer NJ. (2001). *Sports Med*. 31(10):701-715.

## LIPID STATUS IN A YOUNG MALE POPULATION WITH HIGH-INTENSITY TRAINING

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**Introduction** Fat is a highly concentrated energy source and the major source of energy, both resting and during low intensity physical activity. Muscle is the main tissue that burn (oxidizes) fat. Higher rates of fat oxidation occur during aerobic exercise, and using fat for exercise can spare muscle glycogen. Adaptation to aerobic exercise improves fat utilization as an energetic source. The long and short-term unbalanced diet could lead on nutritional deficiencies that alter performance and the optimization of results in high intensity training. Bad eating habits in the studied collective could cause adverse effects, so adequate nutrition is important to control high intensity athletes because their increased energy expenditure requires a huge intake. The aim of this study was to evaluate the nutritional fat status in a young male adult collective trained with high intensity tests. **Methods** This is a cross-sectional study. Twelve men, aged 25.8 ±4.2 years, participated in the study voluntarily. Real nutritional intake was measured with Nutriber software, the anthropometry with bioimpedance TANITA equipment and specific methodology, and the physical condition was tested with practical exercises (2000m run, high jump, a circuit and pull-ups). SPSS 17.0 program was used to determine the bivariate Pearson's correlation between vitamins and other parameters. The aim of this study was to evaluate the nutritional status focused on fat intake in a young male adult collective trained with high intensity tests. **Results** The adequacy (%RDAs) of Energy, Lipid, Protein and Carbohydrates were 76.1%, 80.8%, 219.9%, 63.1%, respectively. Energy and fat intake were significantly correlated with the intake of saturated fatty acids ( $r=0.97$ ;  $p<0.001$  and  $r=0.84$ ;  $p=0.001$ , respectively). The intake of chicken was correlated with the intake of saturated fatty acids ( $r=0.64$ ;  $p=0.026$ ). The intake of butter is directly correlated with saturated fatty acids, cholesterol and the energy intake ( $r=0.60$ ;  $p=0.042$ ,  $r=0.78$ ;  $p=0.003$  and  $r=0.80$ ;  $p=0.002$ , respectively). Chickpeas are directly correlated with saturated fatty acids, fat and energy intake ( $r=0.66$ ;  $p=0.020$ ,  $r=0.61$ ;  $p=0.036$  and  $r=0.73$ ;  $p=0.007$ , respectively). The intake of olive oil is inversely correlated with the lipid profile (saturated, monounsaturated and polyunsaturated fatty acids) **Conclusions** Our results show imbalances in recommended fat intake that could alter lipid status in young athletes and the expected results of high-intensity training. Nutritional assessment as well as monitoring these collectives is necessary to prevent possible negative long term and to further the acquisition of healthy habits **References** Trushina ÉN, Gapparova KM, Mustafina OK, Chekhonina luG, Nikitiuk DB, Kuznetsov VD. *Vopr Pitan.* 2012;81(3):92-6. Russian. Elikov AV, Tsapok PI. *Gig Sanit.* 2012 Jan-Feb;(1):84-7. Russian. Murakami I, Sakuragi T, Uemura H, Menda H, Shindo M, Tanaka H. *Nutrients.* 2012 Jul;4(7):625-37. doi: 10.3390/nu4070625. Epub 2012 Jun 27.

## DOPING AND SUPPLEMENT: THE ATTITUDE OF IRANIAN NATIONAL TEAM DOCTORS

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**BACKGROUND:** Supplement use is common in sport. Burns (2004), reported that 88.0% of the questions athletes used at least one supplements and 58% admitted using more than one type (1). Besides their cost, use of supplements may have side effects on general health and sports performance. Nobody cannot ignore role of team physician in athletes sport achievement. **METHODS** This studies utilized a cross-sectional survey design and cluster sampling. 60 validated questionnaires were distributed among team physicians in 30 different fields of sports. A questionnaire designed to explore physicians' attitude to supplement consumption by athletes, beliefs and knowledge regarding dietary supplements. Mean age of participants was 30 years. **RESULTS** The knowledge of team physician about supplements was good in 79.3%, fair in 65.1%, and poor in 2.3%; whilst 24.7% felt that they have little knowledge. 78.6% stated that supplements are unavoidable part of competitive sports. They thought over than 70% of elite athletes use supplements. Most of them they had experience of inadvertent doping due to supplement contamination with prohibited substances. They expressed athletes like have a recommendation of sport supplements use by nutritionists (27%), team physicians (38.1%), coaches (18%), fitness trainers (16.3%) and pharmacists (12.6%). They cited athletes using supplements based on recommendation (54.7%), brand (24.8%), advertising claims (23%), availability (14%) and price (16%). **DISCUSSION** Our study revealed that many team physicians mentioned that athletes should acquire information from nutritionists, team physicians, coaches, fitness trainers and pharmacists. Whilst, Malinauskas et al. in their study found that 71% of athletes considered coaches the best consultants regarding sports supplements (3). It is evident that team physicians so far can be a reliable information source. So that, sport organizations can schedule educational sessions for team doctors to update their nutrition and supplement information. Subsequently they can transfer the information to athletes for best practice. **REFERENCES** 1- Burns, RD. et al. (2004). Intercollegiate student athlete use of nutritional supplements and the role of athletic trainers and dietitian in nutrition consulting. *Journal of American Dietetic Association.* 104, pp.246-249. 2- Fung L & Yuan Y. Performance Enhancement Drugs: Knowledge, Attitude, and Intended Behavior among Community Coaches in Hong Kong. *Sport Journal* 2006, 9(3). 3- Malinauskas, BM. et al, Supplement of interest for sport-related injury and sources of supplement information among college athletes. *Advanced Medical Science.*2007; 52, pp.50-54.

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reliable information source. So that, sport organizations can schedule educational sessions for team doctors to update their nutrition and supplement information. Subsequently they can transfer the information to athletes for best practice. REFERENCES 1- Burns, RD. et al. (2004). Intercollegiate student athlete use of nutritional supplements and the role of athletic trainers and dietitian in nutrition consulting. Journal of American Dietetic Association. 104, pp.246-249. 2- Fung L & Yuan Y. Performance Enhancement Drugs: Knowledge, Attitude, and Intended Behavior among Community Coaches in Hong Kong. Sport Journal 2006, 9(3). 3- Malinauskas, BM. et al, Supplement of interest for sport-related injury and sources of supplement information among college athletes. Advanced Medical Science.2007; 52, pp.50-54.

### **NO CUMULATIVE EFFECT OF GRAPE POLYPHENOL WITH EXERCISE ON INSULIN SENSITIVITY IN HIGH FAT FED RATS**

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Improvement of insulin sensitivity has been found in rodent and in obese human with polyphenol such as resveratrol. Exercise training is also a well-known therapeutic for insulin resistance. The purpose of our study was to investigate the association of grape polyphenol (PP) with exercise training on the mechanisms of insulin resistance in high fat diet fed rats. We chose a grape seed polyphenol supplementation with a mix of polyphenol in order to be closed to the French nutritional recommendation of eating fruits and vegetables. 40 male Sprague-Dawley rats were used. During 4 weeks they were fed ad libitum with a high-fat diet (HFD) (58% kcal from fat, D12330 Research Diet). Then rats continued the HFD for 8 weeks but they were included in one of 4 groups of 10 rats: HF rats with only the diet, PP rats with a supplementation of PP in drinking water (50mg/g), EXO rats submitted to exercise training on treadmill (1h/day; 5days/week, 10% slope at 30m/min) and EXO+PP rats with exercise training and PP supplementation. Glucose tolerance tests were performed: at rats arrival, after the 4 weeks of HFD and after the 8 weeks of treatments. After sacrifice, soleus muscles and epididymal adipose tissue were incubated with insulin or PBS for 15 minutes at 37°C. Compared to HF rats, exercised rats presented a significant decrease in adiposity illustrated by a significant decrease in leptin. On insulin sensitivity, HF rats presented a higher glycemia compared to trained rats with a significant increase at 90 minutes after glucose injection. The area under the curve for glycemia was significantly increase after 4 weeks of HFD and present a significant decrease only in exercise animals when analyzed by ANOVA, there was no effect of PP alone or in combination with exercise. On soleus, the ratio Akt phosphorylated on Akt on tubulin present an increase only in exercised animals. On adipose tissue, this ratio at this time of analysis was not affected by exercise or PP. Moreover, on muscle, a decrease of inflammation was detected in exercise animals without effects of PP. Training is able to counteract the insulin resistance due to the high fat diet with no benefit of grape polyphenol supplementation on this alteration, at this time of analysis.

### **VITAMIN D STATUS, LEAN MASS AND MUSCULAR STRENGTH IN SEDENTARY SUBJECTS SUPPLEMENTED WITH LEUCINE FOLLOWING A 16 WEEKS EXERCISE PROGRAMME**

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1; UB (Barcelona, Spain) 2; INEFC (Barcelona, Spain) 3; CIBERDEM (Barcelona, Spain) 4; UPN (Pamplona, Spain); 5; SportVital (Andorra la Vella, Andorra)

Introduction Loss of lean mass and muscular function associated with aging increases with sedentarism and nutritional imbalance. Exercise stimulates muscular protein synthesis and increases muscular strength. On the other hand, an adequate protein intake is necessary for achieving an optimal muscle mass (Solerte et al., 2008). Recently, some evidence has emerged suggesting that vitamin D deficiency increases muscle weakness (Fuller et al., 2011). The objective of this study was to evaluate the effect of a combined routine that included strength and endurance exercises and a post-exercise supplementation with leucine-enriched milk whey protein on lean mass, muscular strength and inflammatory markers in healthy and DM2 sedentary subjects. Methods We performed a clinical, randomized, double-blind study with 35 healthy volunteers (n = 17) and DM2 volunteers (n = 18) that underwent a 16 weeks training program. A subgroup of healthy volunteers received a supplement or a placebo 30 minutes after performing exercises. Each individual was clinically assessed at the beginning and at the end of the exercise programme, including muscular strength, body composition, diet and muscular strength tests. Results and discussion First results obtained to the date showed that all the groups slightly increased their lean mass (between 0,3% and 2,1%) and the leg muscular strength measured with a 1RM test increased (p<0,05) in subjects that received the protein supplement (41,7%), placebo (44,5%) and controls (13,7%). Vitamin D plasma concentration in subjects at baseline was generally quite low, showing levels <30 nmol / L indicative of insufficiency (82% of subjects) or even <20 nmol / L indicative of deficiency (32% of subjects). According to the observations made by other authors (Fuller et al., 2011), these really low plasma concentrations could attenuate the increases in muscle mass. References Fuller JC, Baier S, Flakoll P et al. (2011). JPEN, 35(6), 757-62. Solerte SB, Gazzaruso C, Bonacasa R et al. (2008). Am J Cardiol Jun 2;101(11A):69E-77E.

### **DIETARY HABITS OF JUNIOR RECREATIONAL GYMNASTS**

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Introduction Adherence to Mediterranean diet seems to positively affect components of health-related quality of life in adolescents (Costarelli et al., 2012) and significantly reduce the risk of obesity and arterial stiffness (Lydakis et al., 2012). The purpose of the present study was to assess dietary habits of Greek junior recreational gymnasts. Methods 89 junior recreational (3-4 days/week) gymnasts (age: 8.7 ± 0.2 yrs, body height: 129.5 ± 1.5cm and body weight: 30.4 ± 1.1kg) answered the Mediterranean Diet Quality Index (KIDMED) questionnaire. The questionnaire consisted of 16 questions that assess the adherence to the Mediterranean diet pattern. For each question, the positive answer was rated as +1 and the negative as -1. The total score varies between 0 and 12 and scores between 0-3 are considered poor (low quality diet), scores between 4-7 are considered of medium quality and scores ≥ 8 are considered optimal (high quality diet). Results are presented as mean ± SE. Results According to the Mediterranean Diet Quality Index participants scored 8.3 ± 0.2 and therefore their diet was classified as of an optimal quality. More specifically most of the children (≥ 88%) consume every day breakfast with milk or/and yogurt and serials. In a daily basis they also consume vegetables and fruits, while fish is consumed at least twice a week. Discussion The results of the present study indicate that Greek recreational gymnasts still follow the Mediterranean Diet pattern that is considered to be the best diet pattern in order to maintain a healthy living and promote longevity. References Costarelli V., Koretsi E.,

## ANTIOXIDATIVE CAPACITY AND OXIDATIVE STRESS AFTER THREE WEEKS OF STRENUOUS EXERCISE IN YOUNG ADULTS

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**Introduction:** Acute strenuous exercise increases the level of reactive oxygen (ROS) and at the same time eventually decreases the levels of plasma antioxidants. Athletes have an increased production of ROS but they also have an up-regulated antioxidative capacity (AOC). **Aim:** To test the hypothesis that AOC is up-regulated even after a short period of strenuous endurance training. **Methods:** 15 healthy (medium 26 year old) volunteers participated in 3 weeks endurance intensive training with 2 sessions per day, six days a week; intensity targeted to the lactate threshold. After the last training session the participants were asked to refrain from any sport activity during a subsequent 4-weeks post-exercise recovery period. The AOC and the indirect determination of the concentration of ROS were measured at baseline, after training-, and detraining period. **Results:** The total plasma AOC levels decreased significantly during the three weeks of exercise compared to baseline. After four weeks of recovery, the levels had increased but were still lower than baseline. There were no significant changes in oxidative stress after three weeks of training. At baseline oxidative stress was inversely related to fat free mass ( $r = -0.65$ ,  $P = 0.01$ ), hemoglobin ( $r = -0.89$ ,  $P < 0.001$ ), leucocyte count ( $r = -0.66$ ,  $P = 0.01$ ), oxygen uptake ( $r = -0.55$ ,  $P = 0.04$ ) and directly to respiratory quotient ( $r = 0.68$ ,  $P = 0.007$ ). AOC correlated to neither hs C-reactive protein ( $r = 0.64$ ,  $P = 0.02$ ) and the respiratory quotient ( $r = 0.59$ ,  $P = 0.03$ ) were positively related to the relative amount of body fat, while oxidative stress and AOC were not. Oxygen uptake increased, but body fat was not altered during the exercise period, neither was oxidative stress. However, AOC decreased ( $P = 0.004$ ) as did hemoglobin ( $P = 0.006$ ). **Discussion:** Short term high intensity endurance training decreases AOC. The decreased AOC did not fully recover after a detraining period. It seems that AOC rather decreases than increases after a short period of strenuous exercise. Whether the reduction of AOC is due to limited availability of antioxidants or increased consumption induced by ROS remains to be proven. **References:** Davies KJ, Quintanilha A, Brooks GA, Packer L (1982) *Biochem and Biophys Commun*, 107 (4), 1198-205 Chevion S†, Moran DS, Heled Y, Shani Y, Regev G, Abbou B, Berenshtein E, Stadman ER, Yoram, Epstein Y. (2008) *PNAS*, 100 (9), 5119-5123 Radak Z, Chung HY, Goto S. (2008) *Free Radical Biology & Medicine* 44 153-159 Do not insert authors here

## THE INFLUENCE OF MASTIC AND PHYSICAL ACTIVITY AS A FACTOR RELATED TO LIPID METABOLISM, GLUCOSE METABOLISM AND BODY COMPOSITION

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Fukazawa, T.I, Smyrnioudis, I. 2, Konishi, M.I, Takahashi, M.I, Kim, H.I, Sakamoto, S. 1 1:Waseda University (Japan) 2:The Chios Gum Mastic Growers Association (Greece) **Introduction:**In the past several years, mastic gum from Chios-island of Greece has been a very popular and widely used functional food, which has important roles in the treatment of several modern lifestyle-related diseases in Western countries. This study aims at exploring ways in introducing mastic-gum from Chios Island in Greece to Japan with focus on its therapeutic-effect on lipid metabolism, glucose metabolism and body composition. **Methods:**We studied 21 healthy male subjects. Group A ( $n = 7$ ) received mastic powder 5g/day. Group B ( $n = 7$ ) received placebo powder 5g/day. Group C ( $n = 7$ ) received mastic powder 5g/day and additionally, participated in 30-min of walking, 3 times per week as physical activity. The period of the experiment is six months for all groups with an intervention of 3 months. We carried out the following blood test and physical measurement twice, before the intervention of three months and after the completion of the six months experiment. **Blood test:** group of lipid metabolism consists of cholesterol, low density lipoprotein, high density lipoprotein, triglycerides and lecithin-cholesterol acyltransferase. Group of hepatic function consists of serum glutamic oxaloacetic transaminase, serum glutamate pyruvate transaminase and gamma-glutamyl transpeptidase. Group of glucose metabolism consists of insulin and glucose. Group of body composition consists of body mass index, waist circumference, body fat, subcutaneous fat ratio and rate of skeletal muscle. **Results:**Comparing the differences among three Groups: A, B and C and between the two experimental periods: first period (3 months) and second period (3 months). At this stage of our experiment, we focus on the changes observed in the first period before the intervention of 3 months. Concerning Groups A and B, the changes are not greatly seen. However, after comparing group A with group C, there are more changes to be observed. The blood-test indicates that the combination of mastic-gum and 3 times of walking per week has a positive effect on lipid metabolism, glucose metabolism and body composition. **Conclusion:**At the end of the first period of three months, we only observe some slight positive effects of combining mastic intake and physical exercise. Continuing our examination, the data will be compared with those extracted at the end of the second period, six months later (including the intervention period). According to previous studies, we expect that Chios mastic powder could have at least a hepatoprotective role in vivo in humans (Triantafyllou et al., 2007). As this study is still in progress, we aim to observe clear results after the completion of the second period and to examine the functional and medical efficacy of mastic in Japan. **References:**Triantafyllou A., Chaviaras N., Sergentanis T.N., Protopapa E., Tsaknis J. (2007). *Journal of Ethnopharmacology*, 3, 43-49.

## Philosophy and Ethics

### EVALUATION OF WEST-AUSTRIAN COACHES' AND SPORT TEACHERS' KNOWLEDGE REGARDING DOPING IN SPORT

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**Introduction:** Athletes are surrounded by a network of relationships and dependencies. This network has the power to influence the athlete, both, in a positive as well as in a negative way. Important are the right attitudes towards, and qualified education in the field of doping. The aim of the current study was to evaluate the knowledge and attitudes of West-Austrian coaches and sport teachers regarding anti-doping issues and to assess their role in educating athletes/students. **Methods:** An anonymous questionnaire was distributed to coaches and sport teachers of five Tyrolean sport schools ( $n=135$ ). The questionnaire was structured into ten areas of interest, dealing with socio-demographics, knowledge about prohibited substances, attitudes towards doping, own sporting career as well as the contact to athletes. To define the level of knowledge a cut-of point at 80% (retrieved from the literature) of correct answered was set, indicating

good knowledge. Chi-Square tests, student t-Test as well as descriptive statistics were used to analyze the data. Results: 62 respondents returned the questionnaire (response rate 45.9%). 93.5% showed a good knowledge of the World Anti-Doping Agency (WADA) prohibited list. Uncertainties occurred with respect to the side effects of stimulants and anabolic steroids (40.3% bad knowledge each). 58.1% felt well informed about doping matters, mostly through primary and secondary education. Over 97% of the respondents showed a critical attitude against doping and 53.2% discussed the topic with their athletes during training. Yet, for 69.4% doping was not a relevant topic during everyday training even though 48.4% reported a high interest in the topic aside their athletes. 6.5% of the coaches and teachers felt tempted to use prohibited substances during their active career themselves. No significant differences were found with respect to gender, age, years of profession and/or own professional sporting career. Discussion: Findings show a slightly better knowledge of the Tyrolean coaches and sport teachers in regard to doping substances when compared to the studies by Peters et al (2009) and Laure et al (2001). Yet, there are still some gaps in the knowledge especially regarding side effects of anabolic steroids and stimulants as well as nutritional supplements. Although athletes show an interest in the topic by addressing their coaches for information and coaches articulate a strong wish to integrate the topic into the education of their students, only 69.4% consider the topic as relevant in everyday training. References: Laure P, Thouvenin F, Lecerf T (2001). *J Sports Med Phys Fitness*, 41, 132-136. Peters C, Schulz T, Oberhoffer R, Michna H (2009). *Dtsch Z Sportmed*, 60(3), 73-79.

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## **Physical Education and Pedagogics**

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### **RELATIONSHIPS BETWEEN FITNESS AND GUIDANCE OF ATTENTION IN SPORTS INVOLVED AND SPORTS NON-INVOLVED CHILDREN**

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**Introduction** The study intended to assess the relationships of fitness – motor and anthropometric measures and some indicators of attention and whether there are differences regarding guidance of attention between children athlete's and non-athlete's. **Methods** The sample of 56 children (35 athletes) aged 8-11 was assessed. Fitness was measured using the EUROFIT battery comprised from 8 motor tests: hand grip, sit ups, flamingo balance test, sit and reach, standing broad jump, bent arm hang, plate tapping, shuttle run. Body weight and height were also assessed and BMI was calculated. The skinfolds were taken at triceps, biceps, subscapular and abdominal sites and sum of skinfolds was calculated. Guidance of attention was established by questionnaire based on DSM-IV classification (APA, 1996) with ten items included. Items in the questionnaire were like the following: "It is hard to me to maintain the attention when I am doing homework or playing some game." Children answered on Likert scale from 1 – 5 ("never" – "very often"). Results There was no differences in body measures between boys and girls but in motor test boys outperformed girls in sit-ups ( $p=.00$ ) and standing broad jump ( $p=.00$ ), while the girls were better in shuttle run ( $p=.00$ ). Children athletes were significantly better from non-athletes in all motor test and also in sum of attention items. There were no differences in BMI and sum of skinfolds. Mann Whitney U test showed that there was statistically significant differences in 7 of 10 item, favoring children athletes in guidance in attention. Motor tasks were further standardized and summarized in overall motor score. After the same was done with attention items the correlation between motor and guidance of attention scores was computed. Negative but significant value of  $-.43$  was obtained, suggesting the higher the motor scores the lower the attention problems. **Discussion** Similar findings are presented in Adsiz et al. (2012), which proved that children which were more physically active also had higher level of concentration. The same was established by Hillman and others (2009), they found that moderate aerobic exercise could enhance cognitive attention control in period of young adolescence. Akcmlı (2005) also showed that movement exercises positively influence on the development attention and memory. Özdemir (1990) found that children involved in sport have higher level of attention than sports non-involved children. It could be concluded that children sport engagement could lead to increased level of attention as well as possible expansion of academic achievements and learning skills. References Hillman, C.H., et al. (2009). The effect of acute treadmill walking on cognitive control and academic achievement in preadolescent children, *Neuroscience*. 159:1044-1054

### **THE INFLUENCE OF AN ALTERNATIVE EDUCATION PROGRAM UPON STUDENTS' TENNIS LEARNING PROCESSES**

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**Introduction** One of the ways to overcome the label of elite sport of tennis is to show the possibility of its practice adapted to different spaces, alternative materials and participation of a greater number of players in each learning group. Therefore, the aim of the present study was to investigate the effects of teaching tennis, considering the application of the Recreational Game method, on learning of mid-school children during physical education classes. **Methods** The study investigated the effects of an alternative education tennis program upon the learning process of school children between the ages of 11 and 13 years old, at a public school in the city of Rio de Janeiro. Twelve school children with no previous experience of the game participated in 38 lessons aimed at teaching the basic Forehand, Backhand and Serving movements, methodologically worked according to Method of Recreational Sports Game. For the purposes of data collection, a Lawn Tennis Specific Motor Skills Test was developed, validated and applied. The results were analyzed by means of descriptive statistical work and the Student's t-Test was used for dependent samples. **Results** The results indicated that the method employed was effective for the functional acquisition of motor skills and those of the game itself, as well as being an important factor in the motivation of the students. **Discussion** Our results are in accordance with others authors such as Leonardo et al. (2009) and Faria et al. (2006), indicating that learning of team sports can be facilitated through the experience of the pre-sports games, as well as those of Matthiesen et al. (2008) and Matthiesen and Fioravanti (2008), which from experience with track and field modalities, suggest that learning this modalities may have basis in recreational activities, leading to development of basic motor skills. The similarity found in student performance during the game and Skill Specific Tennis Tests suggests that the use of Recreational Game Method in the process of teaching and learning, with application of activities that preserve the characteristics of the end-game, can be an important factor contributing to the acquisition of basic skills, the functionality of the game and motivation for learning. References Faria, E. R.; Nazari, J.; Brunelli, P. F.; Silva, S. M. F. M.; Alves, T. S. (2006). Entre o "esporte institucionalizado" e o "esporte convivência": uma estratégia para o handebol. *Revista Especial de Educação Física, Edição Digital*, 3. Leonardo, L.; Scaglia, A. J.; Reverdito, R. S. (2009). O ensino dos esportes coletivos: metodologia pautada na família dos jogos. *Motriz*, 15, 236-246. Matthiesen, S. Q.; Carvalho, J.; Prado, S. R. (2008). Atletismo para

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### THE EFFECT OF PHYSICAL ACTIVITY HABITS AND PHYSICAL FITNESS ON ACADEMIC PERFORMANCE IN ADOLESCENTS STUDENTS

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**Introduction** Physical activity (PA) was found to improve cognitive functions in the brain but there is weak evidence of PA habits, fitness levels and academic performance association (Chaddock et al., 2011). The aim of the study was to expand the current existing research on academic and physical education in order to effectively determine the influence PA habits and fitness on academic performance (AP) has among high school students. **Methods** The sample comprised 1,326 subjects, both male and female, between fourteen and eighteen years old ( $15'12 \pm 0'99$ ), enrolled in their second cycle in 13 schools in Leganés (Madrid). We administered fitness test based on FITNESSGRAM: cardiorespiratory fitness by the Shuttle Run test, hamstring flexibility by the Sit & Reach test, and prehensile strength of their forearm flexors by the use of a manual dynamometer. We assessed PA habits with the Assessment of Physical Activity Level Questionnaire (APALQ) (Ledent, Cloes, & Piéron, 1997), and AP based on the number of failed subjects in their most recent scholastic trimester. **Results** Due to weak statistical correlation, the findings must be interpreted cautiously; however, there was found to be a statistically positive but weak correlation between the academic performance and the level of cardiorespiratory resistance ( $r=-0,107$ ;  $p=0,00$ ), and between the academic performance and the level of hamstring flexibility ( $r=0,080$ ;  $p=0,00$ ). These results allow us to infer that a greater number of failed subjects will lower a student's score obtained in both physical tests. **Discussion** Cardiorespiratory fitness results are consistent with previous research on academic performance in children (London & Castrechini, 2011). The findings of the current study showed that cardiorespiratory fitness and hamstring flexibility may have a positive influence on academic performance in adolescent students. **References** Chaddock, L., Pontifex, M. B., Hillman, C. H., & Kramer, A. F. (2011). A review of the relation of aerobic fitness and physical activity to brain structure and function in children. *J Int Neuropsychol Soc*, 17(6), 975-985. London, R. A., & Castrechini, S. (2011). A longitudinal examination of the link between youth physical fitness and academic achievement. *J Sch Health*, 81(7), 400-408. Ledent, M., Cloes, M., & Piéron, M. (1997). Les jeunes, leur activité physique et leurs perceptions de la santé, de la forme, des capacités athlétiques et de l'apparence. *Sport*(159/160), 5-90.

### DOES PHYSICAL OUT OF SCHOOL ACTIVITY COMPROMISE THE ACADEMIC PERFORMANCE OF YOUTH PEOPLE?

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**Introduction:** As the focus on academic achievement has increased, the hours of physical education in the school have decreased in Spain. In an attempt to discover how the decline in PA may affect academic achievement, researchers have been studying the effects of PA on cognition and academic achievement in children for more than 50 years (see review of Howie & Pate, 2012). Some studies have found strong, positive relationships between physical activity and cognitive outcomes, while other studies have reported small, negative associations (Fedewa & Soyeon, 2011) Recommendations for appropriate amounts of physical activity for the youth population, have been developed by several organizations and agencies around the world. Although recent reviews have summarized the benefits of regular physical activity on the health of youth and its benefits a more specific approach is indicated. **Method:** The objective of this study was to examine whether there is any relation between the systematic practice of a sport measured with the PAQ-A and the academic achievement in children aged 12-13 years. The sample was composed by children from the lower leagues of a first division team and students from the scholar context,  $n=72$ . **Results:** Our study has found positive relationships between physical activity levels and academic achievement. **Discussion:** This study presents results dealing with the effects of regular physical activity on several health and behavioural outcomes in Spanish school-age youth, with the goal of developing a recommendation for the amount of physical activity deemed appropriate to yield beneficial health and behavioural outcomes. **References:** Fedewa, A.L., & Soyeon, A. (2011). The Effects of Physical Activity and Physical Fitness on Children's Achievement and Cognitive Outcomes: A Meta-Analysis. *Research Quarterly For Exercise & Sport*, 82(3), 521-535. Howie, E., Pate R.(2012). Physical activity and academic achievement in children: A historical perspective. *Journal of Sport and Health Science*, 1, 160-169.

### ECOLOGICAL-DYNAMIC APPROACH IN PHYSICAL EDUCATION ACCORDING TO BERTHOZ THEORIES

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In Italy, the school document on physical education (PE) has been changing continuously by the Minister of Education and its last updated (G.U. 2013) is a new educational and didactics model for PE, as well as it happens for the other subjects. New discoveries about the mechanisms of learning skills are highlighting in opposite way to the traditional vision and so a new question on teaching method emerges. Actually, there is not an accurate study about the content of motor control, learning and development in PE, to verify if they are applied teaching method and if these aspects are in current ministerial document for first cycle of education. In this way it needs to integrate psychology and pedagogic aspects in PE according to the body, corporeality theory. Natural sciences and its approach of the physiology of perception offer the educational epistemology on the moving body a description of the functions of specific properties of human beings who can face up the complexity and transfer it to other contexts. Original PE research is carried out by the study of Alain Berthoz, who step by steps, offers a thorough analysis of the concepts of Le Sense du mouvement (Berthoz, 1997) with proactive idea of action, Le decision (Berthoz 2003) with a decision making in movement and Simplexity (Berthoz, 2009) with a mix between complex and simplex. He offers a new vision to help an educational epistemology. The principle of differentiation, anticipation, forecasting, reliability, flexibility are in the dynamics, the expressiveness and the emotional potential of PE. It is a very complex phenomenon which includes corporeity, affectivity and witness and it requires a dynamic vision and multidimensional too. **Methods** is to analyze the documents and to evaluate if the new paradigm is included in document. An integrated method that joins a historical and documentary approach to describe the evolution steps and then to argument and deduct on new discoveries on PE. **Results** do not carry out any particular aspects connected to the new theories. All ministerial documents do not provide any reference of specificity of motor control system and its classification. Furthermore, there are not any innovative elements on didactics and teaching methods. It appears a repetitively traditional corpus of documents updated with general scientific idea that must be changed. PE documents need a changing vision to address a

new approach to didactics according to ecological-dynamic approach (Raiola 2012). References: G U (2013) Indicazioni nazionali curricolo, Poligrafico stato, Roma, Berthoz, A. (2009) La complexité, Odile Jacob, Paris Berthoz, A. (2003) La décision, Odile Jacob, Paris Berthoz, A. (1997), Le Sens du Mouvement, Odile Jacob, Paris Raiola G., (2012) La complessità dello studio in ambito educativo sportivo, Pensa, Lecce

## Physiology

### THE EFFECTS OF EXERCISE-INDUCED CHANGES IN CEREBRAL OXYGENATION ON COGNITION IN THE HUMAN PREFRONTAL CORTEX

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[Background] An increasing number of human studies have suggested a beneficial influence of aerobic exercise on blood concentrations in the motor region of the brain (Ide et al., 2000, Bhambhani et al., 2007). We have also reported that exercise with moderate intensity increases cerebral oxygenation in the PFC. This increase may be related to an improvement in cognitive performance; however, it is still unclear whether exercise-induced oxygenation hemodynamics affects the cognitive function during and after exercise. [Purpose] The purpose of this study was to investigate the effect of exercise-induced changes in cerebral oxygenation on cognition in the human prefrontal cortex. [Methods] Five healthy individual performed a 9 min modified Flanker test (FT) and a 15 min serial calculation test (UKT) before, during and after exercise. The exercise condition was set at 55% of VO<sub>2</sub>max. During exercise, the participants took the Flanker test 20 min after the start of exercise. Haemoglobin concentration changes such as oxyHb, deoxyHb and totalHb were measured in the prefrontal cortex (PFC) using a multichannel functional optical topography. The number of calculations were counted from the UKT. The reaction time (RT) and the number of errors were analyzed in the FT. [Results and discussion] The oxyHb increased during UKT and exercise, while deoxyHb decreased during UKT. The number of calculations in the UKT increased after exercise. In the FT, the RT decreased during exercise and the number of errors did not change. This indicated that either psychological or physical stress causes an increase in oxygenated haemoglobin in the PFC. It is still unclear how an increase of oxyHb after exercise is related to an improved cognitive performance during and after exercise with moderate exercise intensity. [Reference] Bhambhani Y, Malik R, Mookerjee S. (2007). Cerebral oxygenation declines at exercise intensities above the respiratory compensation threshold. *Respiratory Physiology & Neurobiology*, 156(2):196-202. Ide K, Secher NH. (2000a). Cerebral blood flow and metabolism during exercise. *Progress in Neurobiology*. 61(4):397-414.

### RELATIONSHIP BETWEEN DAILY SPONTANEOUS RUNNING DISTANCE AND BRAIN MONOAMINE LEVELS IN RATS

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Introduction Spontaneous wheel running is common physical exercise model to enhance physiological and psychological health in rodents. It is well known that daily spontaneous wheel running distance gradually increases over several weeks from starting day of running. Remarkably, it is also known that there is considerable individual variability in the amount of daily spontaneous running distance in the running wheel. Because the amount of physical exercise is an important factor to obtain beneficial effects of exercise, individual differences of daily spontaneous running distance may influence outcome of exercise training. In this study, we examined the effects of difference of daily spontaneous running distance on brain monoamine levels which have crucial role for physiological and psychological benefits in rats. Materials and Methods Male Wistar rats were used in this study. The rats were housed individually in plastic cages with or without an attached running wheel and were randomly assigned to either physically active or sedentary conditions. Physically active rats were allowed voluntary access to their wheels for 4 weeks. Daily wheel revolutions were recorded digitally, and running distance was calculated by multiplying wheel circumference by the number of revolutions. The rats were screened into high runner (HR) or low runner (LR) based on the calculated daily running distance. Furthermore, locomotor activities in the housing space in cages (i.e. activity of other than running wheel) were analyzed using infrared system. We assessed the levels of brain dopamine, serotonin, noradrenaline, and its metabolite using high-performance liquid chromatography (HPLC). This assessment was performed in various brain regions, such as the prefrontal cortex, striatum, nucleus accumbens, paraventricular nucleus of the hypothalamus, hippocampus and central nucleus of the amygdala. We also examine the creatine synthase activity in the soleus muscle, and blood glucose levels to estimate individual training status. Results Four weeks of spontaneous wheel running made the predominant individual variability in daily spontaneous running distance, but not locomotor activities. Brain monoamine levels in HR remarkably differed from that of LR in the several brain regions. Discussion The results of the present study showed that difference in the amount of daily spontaneous running distance influenced monoamine levels in several brain regions related to physiological and psychological benefits. The results of the present study, taken together with numerous studies that have shown that spontaneous wheel running has excellent effects on the maintenance of physical and mental functions, suggest that it is necessary to enhance the ability to engage in spontaneous physical activity in their daily lives.

### EFFECT OF COMBINED TRAINING ON PLASMA VOLUME VARIATION IN RESPONSE TO SUPRAMAXIMAL EXERCISE: EFFECT OF ADVANCED AGE

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Introduction Plasma volume variations are known to be affected by several factors such as age (Berthoin et al 2003), physical training (Zouhal et al 2007) and exercise intensity (El Sayed et al 1990). The purpose of this study was to investigate the effect of 13 weeks of high intensity sprint and strength training (HISST) on plasma volume variation (PVV) in response to supramaximal exercise in young and older (middle age) adults male athletes. Methods Twenty-eight male subjects, moderately trained (21.3±1.2 and 40.6±1.9 years) participated on this study. They were divided in four groups as follow: young male experimental group (YE, 21.3±1.1 yr., n= 7), young male control group (YC, 21.9±1.06 yr., n= 7), aged male experimental group (AE, 40.3±1.8 yr., n= 7) and aged male control group (AC, 40.9±1.8 yr., n= 7). Experimental groups performed a HISST two to three times a week during 13 weeks. Before and after the training program, all participants performed a Wingate-test (WT). The hematocrit (Ht) and hemoglobin (Hb) were measured at rest, after a warm-up (15 min, 50% VO<sub>2</sub>max), immediately after WT and after 10 min of recovery. The PVV was calculated using Ht and Hb (Dill and Costill 1974). Results

Before and after HISST, the warm-up induced no significant differences in PVV between AE and YE. However, a significant decrease ( $p < 0.05$ ) in PVV was observed in all groups before and after HISST at the end of the WT. The maximal values registered were  $-12.7 \pm 7.4\%$  in AE and  $-10.8 \pm 3.3\%$  in YE after HISST. Hence, the degree of regression between test and re-test was much more pronounced in YE with a percentage of about  $-2\%$  suggesting the age effect in response to WT. During recovery after HISST, PVV increased in all groups, this increase was significantly high in YE ( $p < 0.05$ ) compared to the other groups. Discussion The similarity of results between YE and AE in PVV after warm-up and after HISST is due probably to the benefit effect of the training program among experimental groups. The higher decrease of PVV in AE observed at the end of WT could mainly be explained by the age effect. The higher increase in PVV during recovery in YE seems to be the result of a metabolic adaptations related to sprint and strength training (Zouhal et al 2007). However, this hypothesis remains to be explained. References Berthoin S, Allender H, Baquet G, Dupont G, Matran R, Pelayo P, and Robin H (2003). *Acta Paediatrica*. 92: 283-290. Dill, DB, Costill, DL. (1974) *J Appl Physiol*. 37(2): 247-248. El-Sayed MS, Davies B, Morgan DB (1990). *J Sports Med Phys Fitness*. 4:420-5. Zouhal H, Moussa E, Jacob C, Groussard C, Delamarque P, Gratas-Delamarque A (2007). *Biology of sports*. 24:4.

## EFFECTS OF A 25 KM ULTRA OPEN WATER SEA SWIMMING TEST ON SALIVARY LEVELS OF HORMONES AND IMMUNITY MARKERS

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Introduction Several hormones and inflammatory and immunological markers, which are usually determined in blood, can be also measured, in a non-invasive way, in saliva. The aim of this study was to determine the effect of an open water sea swimming ultra exercise test on hormone, C-reactive protein (CRP) and immunoglobulin A (IgA) levels in saliva. Methods Saliva samples were taken from 43 swimmers (32 men and 11 women) participating in the "25 km Cabrera Open Water Race". The race (25 km) was performed between the islands of Cabrera and Mallorca at a constant pace of 3 km per hour. Unstimulated saliva samples were taken before and after the exercise test. Cortisol, testosterone, dehydroepiandrosterone (DHEA), CRP and Ig A were measured in these saliva samples using commercially available ELISA kits (Salimetrics, Newmarket Suffolk, UK). Mean age ( $\pm$ s.e.m.) of participants in the study was  $38.2 \pm 1.4$  years, weight  $74.2 \pm 1.8$  kg and height  $175.3 \pm 1.2$  cm. Participants lost about 3 kg weight during the exercise test. Results Salivary flow rate increased significantly after the exercise ( $p < 0.001$ ). The swimming race induced a significant increase in cortisol levels ( $p < 0.001$ ). However, testosterone concentration decreased after the exercise ( $p = 0.006$ ) and DHEA levels did not change along the study. On the other hand, the competition induced a decrease in both Ig A levels ( $p < 0.001$ ) and Ig A secretion rate ( $p = 0.023$ ). However, no changes were observed in CRP levels. Discussion A decrease in saliva production after exercise is commonly observed due to dehydration. The increase in the salivary flow rate after exercise in the present study could be produced by the marine salt, which is one of the most important stimuli for increased salivation. Increased cortisol levels, together with the reduction of testosterone, reflect the high physical stress and the catabolic environment induced by the high demanding exercise performed. Increased cortisol could result in decreased production of Ig A, inducing a situation of partial immunosuppression. Low levels of IgA after exercise may be responsible, at least in part, for the increased incidence of upper respiratory tract infections which has been observed after several endurance competitions or high intensity training programs. It is noteworthy that the ultra-endurance exercise performed did not induce changes in CRP levels as a component of the habitual inflammatory response to exhaustive exercise. In conclusion, salivary testing allows a non invasive measurement of physical stress and immunosuppression induced by an ultra-endurance exercise test.

## CROSS-VALIDATION OF DIFFERENT PREDICTIVE EQUATIONS FOR AEROBIC CAPACITY BY SHUTTLE RUN 20M IN BRAZILIAN YOUNG MEN.

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1: Curso de Educação Física, Universidade Católica de Brasília (UCB), Brasília, Brazil, 2: Laboratório de Avaliação Física e Treinamento (LAFIT), UCB, Brasília, Brazil, 3: Programa de Pós Graduação em Educação Física, UCB, Brasília, Brazil. INTRODUCTION Cardiorespiratory fitness (CF) makes up the main physical fitness health-related component, also been associated with cardiovascular profiling and used for health promotion policies in different countries. Moreover, CF can be predicting by maximum oxygen uptake ( $VO_{2max}$ ). Indirect tests (IT) provide the possibility of assessment in multiple subjects at the same time at low costs. One of the feasible IT is Shuttle Run 20m (SR20m). However, SR20m uses equations from specific population as proposed by Léger; Léger with velocity adjusted by Kuipers; Barnett. The first two equations are constantly used in Brazil due to be easy to memorize and Barnett's for been recommended recently (Ruiz et al, 2009). So, even with frequent use of SR20m, at this moment, no study has investigated the validity of these equations in Brazilian young men. Thus, the aim of this study was to determinate the validity of three different SR20m equations for estimating  $VO_{2max}$  in Brazilian young men. METHODS To assess aerobic capacity 21 Brazilian young men ( $13.6 \pm 1.0$  years;  $46.3 \pm 8.4$  kg;  $1.6 \pm 0.1$  m) performed SR20m until volitional fatigue. Prior to the test, anthropometric data were collected. During the entire SR20m subjects wore a portable gas analyzer that measure breath-by-breath oxygen uptake. ANOVA for repeated measured was performed to detect differences between measured and estimated  $VO_{2max}$  and the agreement between them by Bland Altman method. RESULTS Only Barnett's equation didn't differ from measured  $VO_{2max}$  ( $p < 0.05$ ). Moreover, the prediction errors (SEE and E) ranged from 4.54 (Léger) to 0.4 ml/kg/min (Barnett). The agreement between measured and estimated was Barnett 0.1, Kuipers 4.6 and Léger -5.3. DISCUSSION Only Barnett's equation estimated  $VO_{2max}$  equal than measured. All the others equations underestimated average  $VO_{2max}$ . Our results are similar than performed with European youths (Ruiz et al, 2009). According to our results, we recommend using the Barnett's equation for the better agreement with gold standard in Brazilian young men. REFERENCES BARNETT, A., CHAN, LYS., BRUCE, IC. (1993) *Pediatric Exercise Science*. 5, 42-50. KUIPERS, H., VERSTAPPEN, FTJ., KEIZER, HA., GUERTEN, P., Van KRANENBURG, G. (1985) *International Journal of Sports Medicine*. v.6, 1985. LÉGER, IA., LAMBERT, A., GOULET, A., ROWAN, C., DINELLE, Y. (1984) *Canadian of Applied Sport Sciences*. 9, 64-69. RUIZ, JR., SILVA, G., NORTON, O., RIBEIRO, JC., OLIVEIRA, JF., MOTA, J. (2009) *Journal of Sports Sciences*. 27(0),1-8.

## **RUNNING A 100 KM ULTRA-MARATHON INDUCES AN INFLAMMATORY RESPONSE BUT DOES NOT RAISE THE LEVEL OF THE PLASMA IRON-REGULATORY PROTEIN HEPcidIN**

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Exercise may induce an inflammatory response that may lead to changes in iron metabolism. The aim of this study was to examine the relationship between the inflammation induced by a 100 km run and the level of hepcidin, which is a hormone regulating iron metabolism. Six males, age  $44.5 \pm 13.5$  years, running 100 km. The concentration of the CRP protein, IL-6 and leucocyte count were measured as an index of inflammation. A 100 km run caused a progressive increase in blood IL-6 concentration, which reached the highest values after 75 km. Furthermore, an increase in levels of CRP, a marker of inflammation, was observed after the 100 km run and continued to increase after a 14 h recovery period. Leucocyte number and markers of muscle damage were significantly elevated after the 100 km run. This was accompanied by a decrease in transferrin saturation and an increase in blood haemoglobin and ferritin. Despite all these changes, the 100 km race did not affect blood hepcidin concentration either during the run or after a 14 h recovery period. The study shows that a 100 km run induces an inflammatory response but does not trigger changes in the blood hepcidin level. Thus it can be concluded that changes in IL-6 are not sufficient to increase the blood hepcidin level in runners.

## **RELATIONSHIP BETWEEN FINGERTIP SWEAT AMMONIA CONCENTRATIONS AND POWER FOLLOWING SHORT-TERM SPRINT CYCLE EXERCISE**

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**Introduction** During short-term sprint exercise, the accumulation of ammonia in working skeletal muscles increases, and effluxes into the blood. Previously, we (Itoh & Ohkuwa 1991) have confirmed that the peak value of blood ammonia concentrations appears in sprints within 15-s. Increasing sweat ammonia excretion have also reported during cycle exercise (Czarnowski & Gorski 1991). However, no one has confirmed changes in the sweat ammonia concentrations after short-term sprint exercise. Therefore, we determined changes in sweat ammonia concentrations after the 10-s supramaximal cycle exercise. Furthermore, we examined whether peak sweat ammonia concentrations would relate with power following the short-term sprint exercise or not. **Methods** Ten healthy male students ( $21.6 \pm 0.2$  years; mean  $\pm$  SE) volunteered as the subjects. The subjects performed 10-s sprint cycle exercise as fast as they could using a Power max-V (Combi wellness Co., Ltd., Japan). Sweat ammonia samples were obtained from the surface of fingertip (forefinger) with a sampling tube containing 5% ethanol. Sweat samples were collected before and 0, 1, 2, 3, 4, 5, 6, 9, 15 min after the 10-s sprint exercise. Sweat ammonia and sodium concentrations were measured by the ion chromatographic analysis. **Results** The peak power and the exercise load of the subjects were  $836.0 \pm 39.9$  watt and  $6.3 \pm 0.3$  kp, respectively. Sweat ammonia ( $\text{NH}_4^+$ ) concentrations increased after the exercise compared to pre-exercise values, and then returned to pre-exercise levels. Similar changes in the ratio of  $\text{NH}_4^+$  to sodium ( $\text{Na}^+$ ) ( $\text{NH}_4^+ / \text{Na}^+$ ) were observed. There was a significant relationship between the peak  $\text{NH}_4^+$  and the power after the exercise ( $r=0.848$ ,  $p<0.001$ ). A significant relationship was also observed between  $\text{NH}_4^+ / \text{Na}^+$  and the power ( $r=0.756$ ,  $p<0.01$ ). **Discussion and Conclusions** The ammonia that appears in the blood during short-term exercise originates from the deamination of adenosine 5'-monophosphate (AMP) to inosine 5'-monophosphate (IMP) in the muscle. This reaction occurs via the purine nucleotide cycle (PNC) and is catalyzed by AMP deaminase (Lowenstein 1972). Ammonia production via the PNC in contracting muscle depends on exercise intensity, and occurs predominantly in fast-twitch muscle fibers (Dudley et al. 1983). On the other hand, previous studies have suggested that part of ammonia formed during exercise was lost with sweat (Czarnowski & Gorski 1991). Thus, in this study, excessive energy demands during the sprint cycle exercise increased the blood ammonia concentrations, and these increased blood ammonia levels might reflect the sweat  $\text{NH}_4^+$  concentrations. Therefore, peak sweat  $\text{NH}_4^+$  and  $\text{NH}_4^+ / \text{Na}^+$  would relate the power after short-term sprint exercise. **References** Itoh H and Ohkuwa T (1991). *Eur J Appl Physiol*, 62, 23-25. Czarnowski & Gorski (1991). *J Appl Physiol*, 70, 371-4. Lowenstein JM (1972). *Physiol Rev*, 52, 382-414. Dudley GA et al. (1983). *J Appl Physiol*, 54, 582-586.

## **EXERCISE IMPROVES POSTMENOPAUSAL DEPENDENT VASCULAR ACTIVITY**

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**Introduction** The risk of developing cardiovascular disease is well known to rise in women following menopause, and is associated with sedentary lifestyle and reduced cardiorespiratory exercise tolerance. The age-related deterioration in the vasculature integrity has been suggested to accelerate post menopause, and the effects on the vascular endothelial function have been linked with age and menopausal changes (Kirwan et al. 2004, Klonizakis et al. 2013). Recent studies have recommended regular exercise to reduce postmenopausal-related CVD risks including vasomotor and arterial stiffness (Figueroa et al. 2012), and cardiorespiratory exercise tolerance (Earnest et al. 2010). However, no study has yet investigated whether the exercise dependent increase in cardiorespiratory capacity is combined with improvement in endothelial microvascular function. This study aims to test whether and regular aerobic exercise training increase microvascular activity and cardiorespiratory exercise tolerance in postmenopausal women. **Methods** Following obtaining the institutional approval, fifteen postmenopausal women (age =  $53.3 \pm 2.9$ , body mass  $74.4 \pm 15.0$ , height =  $164.9 \pm 5.3$ ) participated in this study and were interviewed about their menopausal status. Participants then completed a cardiorespiratory tolerance test, and were assessed for their upper- and lower-limb vascular endothelial cutaneous vascular conductance (CVC) test using Laser Doppler Fluximetry (LDF), with endothelium-dependent Acetylcholine (ACh) and -independent Sodium nitroprusside (SNP) vasodilation. The exercise training involved eight weeks of discontinuous treadmill running based on each individual's perceived exertion twice per week. **Results** Exercise training improved CVC (e.g. ACh at  $2000 \mu\text{C}_b$  in the forearm  $0.9 \pm 0.4$  PU/mmHg compared with  $2.2 \pm 1.6$  PU/mmHg post-operatively). This was combined with improvement in participants' cardiorespiratory exercise tolerance as indicated by a significant increase in their ventilatory threshold (VT) ( $11.5 \pm 2.1$  vs.  $14.0 \pm 3.0$ ) and the corresponding VT speed ( $4.4 \pm 1.0$  vs.  $5.0 \pm 0.8$ ), all are  $P<0.05$ . **Conclusion** The present study suggests that regular moderate exercise improves menopausal related microcirculatory endothelial function and increases exercise tolerance in postmenopausal women, both are responsible for reducing cardiovascular risk in this high-risk group. **References** Earnest CP, Blair SN, Church TS. (2010) *Eur J Appl Physiol*. 2010 Sep;110(1):75-82. Figueroa A, Vicil F, Sanchez-Gonzalez MA, et al. (2013) *Am J Hypertens*. 26(3):416-23 Kirwan LD, Maculsky NJ, Shapiro HM et al. (2004) *J Clin Endo Metab*. 89(4):1618-1629 Klonizakis M, Alkhatib A, Middleton G et al. (2013) *Clin Sci*. 1;124(9):579-87

## MUSCLE FUNCTION & PERFORMANCE AFTER MANIPULATION WITH BLOOD METABOLITES IN HIGHLY TRAINED CYCLISTS

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**Introduction** Intense exercise with one muscle group compromises subsequent intense exercise performance engaging another muscle group. In the present study it is investigated if the detrimental effects of previous arm-exercise can be localized to the engaged muscle group or if the experienced fatigue is of more central origin. Further, it was investigated if protection from systemic metabolic acidosis would counteract exercise induced deterioration of muscle function and performance in highly trained cyclists. **Methods** On three separate days, cycling performance was evaluated in eight highly trained cyclists (VO<sub>2</sub>max: 70.0±8 ml O<sub>2</sub>/min/kg; Age 30±5 years; Weight 74±10 kg). Randomized manipulations were placebo treatment (PLA), bicarbonate ingestion (NaHCO<sub>3</sub>, 0.2 g/kg) and prior intense arm exercise (ARM). Two exercise bouts were performed (EX1 and EX2). EX1 consisted of 3 min cycling at 85 % aerobic peak power (367±19 W). EX2 was identical to EX1 but followed by a 2 min performance test (PT). EX1 and EX2 were separated by 75min rest. Blood samples were taken from an arm vein at rest as well as 1 min prior to and after each bout. In a subgroup (n=5), quadriceps maximal voluntary contraction (Q-MVC), voluntary activation degree (VAD) and twitch force (TF) was evaluated pre-exercise as well as 1 min after EX1 and EX2. Immediately after, maximal voluntary handgrip force (H-MVC) was determined. **Results** Mean power during PT was less (P<0.001) in ARM (377±39 W) relative to HCO<sub>3</sub> (412±39 W) and PLA (410±41W) with no difference between the latter two. Blood pH were lower (P<0.01) in ARM and higher (P<0.01) in HCO<sub>3</sub> compared to PLA (P<0.001) prior to both EX1 (7.19±0.05 and 7.41±0.01 vs. 7.36±0.02) and EX2 (7.23±0.04 and 7.42±0.02 vs. 7.37±0.02), respectively. Venous blood lactate was elevated (P<0.001) in ARM compared to both HCO<sub>3</sub> and PLA prior to EX1 (14.2±3.3 vs. 0.9±0.2 and 1.0±0.3) and EX2 (10.7±3.8 vs. 1.2±1.4 and 1.2±0.4 mM), respectively. After EX1 blood pH was lower in ARM (7.18±0.05) compared to HCO<sub>3</sub> (7.28±0.02) and PLA (7.24±0.05) (p<0.001). Furthermore in HCO<sub>3</sub> blood pH levels were higher after EX1 compared to PLA (p<0.05). After EX2 no difference in blood pH were observed among trials. Q-MVC performance was lower after EX2 in ARM compared to values at rest. Otherwise, no differences were observed in Q-MVC, VAD, TF or H-MVC for any of the trials after EX1 and EX2 compared to values at rest. No differences were found among PLA, HCO<sub>3</sub> and ARM. **Discussion** As expected ARM had negative effects on PT performance. This could be ascribed to inhibited muscle function since Q-MVC was lower after EX2. Central activation appeared unaffected as illustrated by the unaltered VAD and H-MVC. An increase in blood pH during HCO<sub>3</sub> did not improve PT performance. Thus, blood pH appears to be of limited importance for intense short-term exercise like PT.

## RED BLOOD CELL MORPHOLOGY ADAPTS TO INTENSE, ENDURANCE TYPE EXERCISE

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**Purpose:** Through the transport of oxygen, red blood cells play a key role in defining the body's endurance capacity. As an adaptation to endurance training, red blood cell mass and plasma volume are increased in trained individuals compared to untrained subjects. However, only little data is available on the adaptation of the morphology of red blood cells to intense endurance training. **Methods:** 15 highly trained endurance athletes underwent 9 days of 3-6 hours of outdoor cycling exercise in a temperate climate (~25°C). Fluid intake was not restricted and carefully monitored. In the morning and the evening of each day, athletes were weighed and standardized venous blood samples were obtained, hematological variables (Hemoglobin concentration (Hb), hematocrit (Hct), red blood cell count, MCV, MCHC, MCH) were determined on an automated cell counter, protein concentration was measured in serum. **Results:** Athlete's weight did not show any alterations, the fluid balance was stable throughout the study period. Hb and Hct decreased significantly over the first 3 days of exercise to remain stable thereafter. MCV increased from the first to the last day of racing (meanΔMCV Day1-Day9 2.3fl, p<0.05), MCHC decreased accordingly (meanΔMCHC Day1-Day9 -2.1mg/dl, p<0.01). The magnitude of the variations was similar in morning an evening samples. Serum protein showed no significant change. **Conclusion:** Our data show a significant, persisting increase in MCV and a decrease in MCHC associated with several days of endurance-type training. This pattern accompanies the exercise induced plasma volume expansion, illustrated by decreased Hb and Hct. Previous research has focused on changes in MCV and MCHC during or shortly after high intensity exercise assuming that an exercise induced increase in osmolality would lead to cell swelling. However, these studies failed to demonstrate any long-term effect. In our investigation, osmolality was not measured, but the literature suggests unaltered osmolality after multi-day endurance exercise, which is confirmed by our observations of stable weight and unaltered protein concentration. Therefore, the physiological mechanisms triggering the sustained changes in MCV and MCHC remain to be explored. The altered MCV after several days of endurance training should be considered when using indirect models for the calculation of plasma volume changes based on Hct. In this context, the stability of MCV might also be used as a tool to assess potentially confounding plasma volume shifts in research settings.

## EFFECTS OF LIPOSUCTION AND EXERCISE TRAINING ON SELECTIVE INFLAMMATION-RELATED ADIPOSE TISSUE CYTOKINES.

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**Introduction** It has been speculated that the immediate liposuction-induced increase in the ratio of visceral to subcutaneous fat could lead to an increased metabolic risk. The beneficial effects of exercise on adipokine metabolism and the metabolic profile have been well described. Therefore, exercise training could positively impact adipokine metabolism following the surgical procedure. **Objective** To investigate the effects of liposuction on selective inflammation-related adipokines and insulin sensitivity in women (20-35 years; BMI: 23.8 ± 2.2 Kg/m<sup>2</sup>) who were either exercise-trained or not after surgery. **Methods** Thirty-six women underwent a small-volume abdominal liposuction (mean fat aspirate supernatant: 1240.3 ± 363.6 ml). Two months after surgery they were randomly divided into two groups: trained (n=18) and non-trained (n=18). The four-month exercise program consisted of aerobic plus resistance training, thrice a week. Body fat distribution and abdominal visceral to subcutaneous fat ratio (V-S ratio - determined by computer tomography), plasma levels of inflammation-related adipokines, and insulin were assessed at baseline (PRE), two (POST2) and six months after surgery (POST6). Adipose tissue gene expression of inflammation-related adipokines and physical capacity were assessed at PRE and POST6. **Results** V-S ratio equally increased in both groups from PRE to POST2 and POST6 (TR PRE: 0.18±0.04, POST6: 0.27 ± 0.10, p=0.0001; NT PRE: 0.18±0.08, POST6: 0.29±0.13, p=0.0001; within-group comparisons). Adiponectin plasma levels were markedly decreased (TR PRE: 19.3±7.3, POST6: 12.5±4.1, p=0.001; NT PRE: 19.4±8.0, POST6: 12.8±3.9, p=0.001; within-group comparisons) and a small but significant decrement in

adiponectin gene expression in subcutaneous abdominal and thigh adipose tissue was also observed ( $p < 0.05$ , within-group comparisons). Plasma levels of IL-6, TNF- $\alpha$  and IL-10 were unchanged throughout the study in both groups. In contrast, the inflammation-related cytokines' gene expression was significantly increased by 3 to 12 fold in both subcutaneous abdominal and thigh adipose tissue ( $p < 0.05$ , within-group comparisons). Finally, insulin sensitivity and physical capacity were unchanged in the non-trained group whereas it was significantly improved in the trained group at POST6 (data previously published). Conclusion These results indicated that a small-volume liposuction markedly down-regulated the secretion of adiponectin by the adipose tissue whereas it up-regulated the expression of inflammation-related genes six months after surgery in both exercise-trained and untrained women. These findings demonstrated that liposuction may not be free of long-term adverse metabolic effects. Additionally and importantly, although exercise training was incapable of counteracting these potential associated risks as consequence of a liposuction procedure, it improved insulin sensitivity and physical capacity. Thus, health professionals should strongly recommend exercise training as a mandatory intervention following liposuction surgery.

### **NORMALISED METHOD TO QUANTIFY THE OXYGENATION PROFILE OF SKELETAL MUSCLE WITH REAL TIME NIRS MEASUREMENT.**

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**Introduction:** The real time Near-Infrared Spectroscopy (NIRS) measurement is widely used to monitor the oxygenation profile of an exercising skeletal muscle. The measurement is based on two traces: the concentration of oxyhaemoglobin (O<sub>2</sub>Hb) and deoxyhaemoglobin (HHb). These can simultaneously allow the calculation of the sum (tHb=O<sub>2</sub>Hb+HHb) and the difference (HbDiff=O<sub>2</sub>Hb-HHb). With the minimum of two measuring channels, an absolute value of the tissue oxygen saturation (StO<sub>2</sub>) can be obtained via the Tissue Saturation Index (TSI) (Myers et al., 2009). The main technical limitation of this in vivo measurement is the difficulty in obtaining a calibrated scale. Recommended quantification methods focus on blood flow and volume and oxygen consumption (Van Beekvelt et al., 2002). We want to go further and focus on the quantification of the O<sub>2</sub>Hb and HHb, looking for a reliable correlation between the lowest TSI% obtainable and the lowest O<sub>2</sub>Hb measurable. **Methods:** 11 healthy subjects (9 males and 2 females, aged 27 $\pm$ 8 years) participated in the study. The NIRS instrument (PortaMon, Artinis Medical Systems) was placed on the forearm's m. extensor digitorum. Pressure cuff was placed around the upper arm, and ischemia was induced (240 mmHg), until the decreasing O<sub>2</sub>Hb concentration reached a plateau, and the pressure was relieved. Previous to this a short boot of forearm exercise with (1-3 kg) was performed with isometric muscle concentration during the ischemic application. **Results:** The decrease in TSI and O<sub>2</sub>Hb with arterial occlusion was about 35 AU and 40  $\mu$ M, respectively. The TSI at the ischemic level reaches down to about 30% independent of initial resting TSI level. Although the O<sub>2</sub>Hb concentration reaches plateau at the same time, we cannot assume that actual concentration level has reached 0  $\mu$ M, rather, that the level of available O<sub>2</sub>Hb has. We simplify by using the 40- $\mu$ M decrease and the resting TSI value to estimate the concentration of O<sub>2</sub>Hb and HHb. **Discussion:** The actual O<sub>2</sub>Hb level will never reach zero due to residual critical Mb O<sub>2</sub> partial pressure about 2.75 torr (Bekedam et al., 2009). But the NIRS measurement does not distinguish between Mb and Hb. The 30% TSI value occurs due to; (1) the physical behaviour of microcirculation, capillaries will not be all closed simultaneously; and (2) the affinity of O<sub>2</sub>Hb to haemoglobin maintains residual O<sub>2</sub>Hb. The consistency of this model needs to be tested under distinct conditions, e.g., hypoxic vs normoxic environments, anaerobic vs aerobic exercises. The ischemic arrest is not a new method to evaluate the lowest O<sub>2</sub>Hb concentration, but we propose the above mentioned modifications for a more detailed profiling. **References:** Bekedam, M.A., van Beek-Harmsen, B.J., van Mechelen, W., Boonstra, A., and van der Laarse, W.J. (2009). *J Appl Physiology*, 107, 1138-1143. Myers, D., McGraw, M., George, M., Mulier, K., and Beilman, G. (2009). *Crit Care*, 13(Suppl. 5), S2-S14. Van Beekvelt, M.C.P., Van Engelen, B.G.M., Wevers, R.A., and Colier, W.N.J.M. (2002). *Clin Physiol & Func Im*, 22, 210-217.

### **VARIATION OF THE MEDIAL GASTROCNEMIUS PENNATION ANGLE AND TORQUE BETWEEN GENDERS**

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**Introduction** Muscle pennation angle and fiber length are important parameters of muscle strength. These characteristics of the muscle are changeable according to the functional requirements. Some studies have shown that several factors, like physical activity, gender, age and morphology, can influence the muscle pennation angle. The purpose of this study is to compare the variation of the pennation angle in two conditions, relaxed and maximal contraction of gastrocnemius, a fundamental muscle to the gait, in a sample of man and women. It was also our goal to verify the influence of factors like height, weight and BMI in the variation of the pennation angle. **Methods** The medial gastrocnemius pennation angle was assessed by ultrasound with a 12 MHz linear probe, in rest and in maximal contraction. The evaluation of the gastrocnemius was done in two planes: longitudinal and transversal. The image of the medial gastrocnemius was acquired only in longitudinal plane, to allow the evaluation of the angle between two lines, the fascicle and the deep aponeurosis. Muscle strength was evaluated using an isokinetic dynamometer, BiodexSystem3. 60 subjects, 50% of female and 50% agreed to participate voluntarily on this experiment. Both groups had a similar level of physical activity and subjects with muscle injury were excluded. After a warm up, subjects were asked to remain at rest for a first measurement of the pennation angle. After that the same measurement was performed during a maximal contraction and the torque value was recorded. In both measurements, rest and maximal voluntary contraction, the lower limb was fixed in the same position in order to maintain the same degree of gastrocnemius extensibility. Both limbs for each subject were assessed **Results** Our results showed that the variation of the pennation angle is influenced by gender. Overall, females were found to have lower angles of pennation and force values than males. To find predictors of the difference angle pennate angle of the right leg and the left, we used a linear regression analysis in which prediction model we included the independent variables gender, lower limb pre-existing injury, sport activity, age, height and weight. **Discussion** As expected males present higher values in all variables, with significant differences between the two groups in both states. However, the pennation angle in rest even though remaining higher in males, showed no significant differences when compared to the female rest pennation angle. The differences in morphology by the pennation angle variation between men and women are confirmed in our experiment.

## THE CAPACITY AND HYPOXIC RESPONSE OF SUBCUTANEOUS ADIPOSE TISSUE BLOOD FLOW IN HUMANS

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**Introduction** We have recently shown that blood flow in subcutaneous adipose tissue of the leg increases from rest to exercise in an exercise intensity-dependent manner, but only in the vicinity of working muscle (Heinonen et al. 2012). Furthermore, we also showed that adenosine receptor antagonism attenuates this blood flow enhancement at the highest exercise intensity (Heinonen et al. 2012). Here we studied the effects of exogenously infused adenosine on adipose tissue blood flow (ATBF) in order to estimate the blood flow capacity in the adipose tissue. Further, we also wanted to investigate how acute systemic hypoxia affects ATBF at rest or during exercise. **Methods** We measured ATBF in nine healthy young men by positron emission tomography using radiowater tracer. ATBF was measured adjacent to the knee extensors at rest and during dynamic knee extensor exercise, and during two physiological perturbations: while breathing moderate systemic hypoxia (14 % of O<sub>2</sub>) at rest and during exercise, and during intra-arterial (a. femoralis) infusion of adenosine, with a dose which has previously been shown to induce maximal femoral artery blood flow. **Results** Adipose tissue blood flow was  $1.3 \pm 0.6$  ml/100g/min at rest and increased by exercise ( $8.0 \pm 3.0$  ml/100g/min,  $p < 0.001$ ) and adenosine infusion ( $10.5 \pm 4.9$  ml/100g/min,  $p = 0.001$ ), but not by breathing of moderate systemic hypoxic air at rest ( $1.5 \pm 0.4$  ml/100g/min,  $p = 0.16$ ). Adipose tissue blood flow was similar during exercise and adenosine infusion ( $p = 0.23$ ), but vascular conductance was higher during adenosine than exercise. Finally, adipose tissue blood flow during exercise in moderate systemic hypoxia was reduced ( $6.3 \pm 2.2$  ml/100g/min) compared to normoxic exercise ( $p = 0.004$ ). **Discussion** In conclusion, the vasodilatation capacity of human subcutaneous adipose blood flow to exogenous adenosine appears to be at least comparable to that induced by moderate intensity exercise. In addition, reduced blood flow in adipose tissue during exercise in systemic hypoxia is likely a result of sympathetic nervous vasoconstriction activation that works to redistribute blood flow to exercising muscle in a condition of reduced oxygen availability. **References** Heinonen IH, Bucci M, Kemppainen J, Knuuti J, Nuutila P, Boushel R, Kalliokoski KK. (2012) *J Appl Physiol*, 112, 1059-1063.

## EFFECTS OF PEDAL RATE ON PEDAL FORCE AND MUSCLE ACTIVITY DURING CYCLING

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**Introduction** The exercise stress in physiological experiment using cycle ergometer was determined by pedal load and pedal rate namely muscle force and contraction velocity. However, the relationship among friction-braked pedal load, pedal force exerted by foot and lower limb muscle activities was unclear. Therefore, the aim of this study was to investigate the effect of pedal rate on pedal force and electromyographic (EMG) activities in thigh muscles during constant load cycling stress tests. **Methods** Ten healthy male volunteers (age,  $21.1 \pm 0.3$  yr; height,  $169.6 \pm 3.9$  cm; weight,  $66.7 \pm 8.4$  kg) were evaluated on a friction-braked cycle ergometer. The subjects performed constant load (1.0 kp) cycling stress tests for 6min in three different pedal rates (40, 80 and 120 rpm) on different days in randomized order. Pedal force and pedal frequency were measured throughout all tests and averaged for 30 sec (from 5 min to 5 min 30 sec). EMG signals of 5 thigh muscles (vastus lateralis, vastus medialis, rectus femoris, biceps femoris, and semitendinosus) were measured similarly. Integrated EMG value (iEMG) of each muscle was normalized by the value at maximal voluntary contraction (%iEMG) and totaled up (total %iEMG). External power was calculated as power to rotate flywheel from pedal load and pedal frequency. Internal power was estimated as power exerted in exercising muscle (Minetti et al., 2001). Total power was evaluated as sum of external and internal power. **Results and Discussions** Despite the fact that pedal load was set in 1 kp on all stress tests, as pedal rate was increased, pedal force and external power were increased. Consequently, even if same pedal load is set, it was revealed that pedal force shows different value if pedal rate is changed in cycling stress test. Total %iEMG was increased with increasing pedal rate, particularly remarkable in 80 to 120 rpm, which was similar to change of internal and total power. In total %iEMG and pedal force relationship, the increasing rate of total %iEMG was greater than that of pedal force. It was therefore shown that the muscle activities would be distributed to power output for faster lower limb rotation in higher pedal rate. Present results suggest that pedal rate could affect muscle force as well as contraction velocity or muscle power output, indicating that setting of exercise stress should be established carefully in cycling experiment. **Acknowledgement** This study was partly supported by a Grant-in-Aid for Scientific Research from The Ministry of Education, Sports, Science and Technology in Japan (# 23570287 to K. Hirakoba). **Reference** Minetti AE, Pinkerton J, Zamparo P. (2001) *Proc R Soc Lond B* 268, 1351-1360

## EFFECTS OF CARBOHYDRATE SUPPLEMENTATION ON VENTILATORY RESPONSE DURING REPETITIVE INTENSE EXERCISE

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**Introduction** Decrease in blood pH is known to be one of the factors driving breathing. On the other hand, the effects of blood pH on the ventilatory response during intense exercise (IE) still remain to be investigated in detail. In the previous study (Yamanaka et al., 2012), we examined the effects of blood pH on the ventilatory response during IE, by using repetitive protocol in which the increase in blood lactate concentration ([La-]) and the decrease in blood pH are attenuated with decrease in muscle glycogen content. As a result, since ventilation (VE) and effort sense during IE was increased by the repetition of IE, it was suggested that ventilatory response during IE is independent of blood pH and at least partly associated with effort sense elicited by recruitment of type II fibers in the working muscle. In the present study, we therefore examined the relationship between recruitment of type II fibers, effort sense and ventilatory response by preventing the rise in the recruitment of type II fibers via carbohydrate supplementation. **Methods** Seven subjects performed an IE test in which IE (2 min,  $99 \pm 5\%$  of VO<sub>2</sub>max) was repeated three times (IE1st, IE2nd and IE3rd) using a cycle ergometer at 120-min intervals. Each interval consisted of a 20-min recovery, 40-min submaximal exercise ( $50 \pm 5\%$  of VO<sub>2</sub>max), and a further recovery for 60 min. Each subject ingested carbohydrate (maltodextrin, 1g/kg) after the IE1st and IE2nd. This carbohydrate supplementation was provided in five divided doses at intervals of 20 min with a total of 500 ml of water during the 40-min submaximal exercise and the 60-min recovery before IE2nd and IE3rd. **Results** There were no significant differences in [La-], blood pH, ventilatory response, effort sense, and mean power frequency (MPF) of the EMG measured in the vastus lateralis during IE between the three conditions. **Discussion** It is thought that similar levels of [La-] and blood pH between the three conditions is a consequence of effective carbohydrate supplementation. In addition, unchanged MPF through the three IEs suggests that rise in the recruitment of type II fibers by the repetition of IE, which had been observed in our previous study (Yamanaka et al., 2012), was prevented by carbohydrate supplementation. Although VE during IE was increased by the repetition of IE in our previous study, VE and effort sense in the present study were the same levels in the three IEs. These results reinforce our hypothesis that ventilatory response during IE is associated with effort sense elicited by recruitment of type II fibers. **Reference** Yamanaka R, Yunoki T, Arimitsu T, Lian CS, Afroundeh R, Matsuura R, Yano T (2012). *Eur J Appl Physiol*, 112, 2149-2162.

## BODY HEIGHT OF BASKETBALL PLAYERS IN THE LAST 15 YEARS

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**Introduction** In basketball the main objective is to score by putting a ball into the basket that is in the hoop with the regular rim height of 305 cm. As early as in 1976 Alexander found that body height is significantly related to success in the game of basketball which means that it is a good predictor for the number of points a player can score, number of rebounds after shot attempts and generally for successful playing. The aim of this study was to analyze changes in body height of basketball players in the period from the year 1995 to 2010. **Methods** According to data from official FIBA webpages body height of players from the first eight ranked teams in European and World championships and Olympic Games from 1995 till 2010 was assessed. The average height was calculated for every team, and number of players taller than 200 cm was evaluated. **Results and discussion** Almost all studies related to body height of both male and female basketball players confirmed the fact that basketball players are on average significantly taller than non-selected population and mostly taller than athletes who compete in other sports. It can also be observed that over years mean values increased, that is, that basketball players today are taller than basketball players who played ten years ago or even before that. Hence, we can conclude that there has been a long-term trend of body height increase in basketball which in recent years partly slowed down. This can be attributed not only to the omnipresent process of acceleration, but also to the process of selection. Namely, it can be seen in youngest players in basketball schools that players who are selected are of above average body height. Malina (1994) in his study concludes that basketball players are in childhood about or above 90 percentiles of population height and are also biologically older. Some 20 or 30 years ago a certain body height of basketball team corresponded to a certain result in a competition (Furukawa, 1974). By analyzing results obtained in European and World championships as well as in the Olympics in the last fifteen years it can be seen that such a trend does not exist today. Nonetheless, it can be seen that there is over 60% of players of a mean body height over 200 cm among the top eight teams while the others mainly ranged between 198 and 200 cm. Furthermore, most teams have 7 to 8 players who are above 2 meters and among winning teams there is rarely a team with less than 6 players above 2 meters. **References** Alexander MJL. (1976). *Res Quart*, 47, 575-585. Furukawa M. (1974). *Res J Physical Education*, 18, 351-366. Malina RM. (1994). In: Bouchard C, Shepard RJ, Stephens T (ed) *Physical activity, fitness and health*. Champaign, Illinois: Human Kinetics Publ, pp. 918-930. Matković B. (2010). *Anthropological analysis of basketball*. KIF, Zagreb.

## SCALING RUNNING EFFICIENCY IN RECREATIONAL AND HIGH-LEVEL ENDURANCE RUNNERS: EFFECT ON PERFORMANCE PREDICTION

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**Introduction** Among factors affecting the relationship between running efficiency (REff) and middle- or long-distance running performance, some authors have investigated the way by which an athlete's body size affects performance, demonstrating that an indiscriminate use of the unit ml.kg<sup>-1</sup>.min<sup>-1</sup> is inappropriate to compare oxygen consumption between subjects with different body characteristics or performance level. Therefore, the aim of this study was to examine the effect of allometric scaling on the relationship between REff and middle-distance running performance according to performance level. **Methods** The relationship ( $\log y = b \cdot \log x + \log a$ ) between human maximal metabolic rate ( $y$ ) and body mass ( $x$ ) was used for determination of  $b$  (allometric scaling). Thirteen recreational middle-distance runners (male, mean  $\pm$  SD – age: 33.31  $\pm$  8.48 years; body mass: 76.41  $\pm$  8.57 kg; maximal oxygen uptake – VO<sub>2</sub>max: 52.87  $\pm$  4.60 ml.kg<sup>-1</sup>.min<sup>-1</sup>) (G1) and thirteen high-level middle-distance runners (male, age: 25.46  $\pm$  4.23 years; body mass: 62.85  $\pm$  2.67 kg; VO<sub>2</sub>max: 70.41  $\pm$  1.92 ml.kg<sup>-1</sup>.min<sup>-1</sup>) (G2) performed a continuous incremental test to determine VO<sub>2</sub>max and a 6-min running submaximal test at 70% of VO<sub>2</sub>max to assess REff. The performance was assessed from the best performance in middle-distance events. **Results** Significant correlation between REff and performance were found for both groups, however, strongest correlations were observed in the recreational runners, especially when using the allometric exponent (respectively for G1; non allometric vs. allometric scaling ( $b = 0.75$ ):  $r = 0.80$  vs.  $r = 0.86$ ; and for G2; non allometric vs. allometric scaling ( $b = 0.75$ ):  $r = 0.55$  vs.  $r = 0.50$ ), demonstrating that REff could be an important factor to predict middle-distance running performance. **Discussion** These results corroborate with previous studies indicating the role of REff in endurance performance and the interest to identify strategies to improve REff (Daniels, 1985; Bailey and Pate, 1991; Morgan and Craib, 1992; Saunders et al., 2004; Foster and Lucia, 2007). However, in this study, the strongest correlations were observed in the recreational runners, especially when using the allometric exponent, demonstrating the interest of allometric scaling to express efficiency or oxygen consumption in such population. According to Markovic et al. (2007), the recently proposed allometric cascade model by Darveau et al. (2002) may be valid in describing the scaling behavior of metabolic rate in untrained individuals, but not in athletes. **References** Bailey SP, Pate RR. (1991). *Sports Med*. 12, 228-236. Daniels JT. (1985). *Med Sci Sports Exerc*. 17, 332-338. Darveau CA, Suarez RK, Andrews RD, Hochachka PW. (2002). *Nature*. 417, 166-170. Foster C, Lucia A. (2007). *Sports Med*. 37, 316-319. Markovic G, Vucetic V, Nevill AM. (2007). *Ann Hum Biol*. 34, 315-328. Morgan DW, Craib M. (1992). *Med Sci Sports Exerc*. 24, 456-461. Saunders PU, Pyne DB, Telford RD, Hawley JA. (2004). *Sports Med*. 34, 465-485. CAPES/Brazil supported this study (N° 7136/12-9).

## EFFECT OF ORAL CONTRACEPTIVES ON ADAPTATION TO STRENGTH TRAINING

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**Introduction** The majority of young women use oral contraceptives (OC). Use of OC has been reported to be associated with lower synthesis rates of myofibrillar and tendon collagen proteins. Therefore, we in the present study aimed to investigate whether the adaptive response to regular strength training in muscle and tendon differentiate between OC-users and controls. **Methods** Fourteen healthy young OC-users (24 $\pm$ 1 yrs, fat% 32 $\pm$ 1, 35 $\pm$ 2 O<sub>2</sub>/min/kg) and 14 controls (24 $\pm$ 1 yrs, fat% 32 $\pm$ 2, 34 $\pm$ 2 O<sub>2</sub>/min/kg) performed a 10-week supervised progressive resistance training program (leg extension and leg press). Participation in regular strength training within the last six months was an exclusion criterion. Before and after the intervention period a muscle biopsy was obtained from m. vastus lateralis. Furthermore, muscle and tendon cross-sectional area (CSA) was determined by MR-scans. Maximal isokinetic strength was measured in a dynamometer and 1 RM was determined during leg extension. **Results** Training enhanced muscle CSA ( $p < 0.001$ ) and tendon CSA ( $p < 0.01$ ). A tendency towards a greater increase in muscle CSA was observed in the OC-group than in controls (interaction  $p = 0.066$ ). Analysis of mean muscle fiber type CSA show a tendency towards an increase in type II muscle fiber area ( $p = 0.10$ ), whereas type I muscle

CSA increased in the OC-group ( $3821 \pm 557$  to  $4470 \pm 475$  mm<sup>2</sup>,  $p=0.05$ ), but not in controls ( $3822 \pm 822$  to  $3893 \pm 779$  mm<sup>2</sup>,  $p=0.20$ ) (interaction  $p<0.05$ ). Post hoc analysis indicated that the effect of OC on muscle mass was induced by the OC-users ( $n=7$ ) who use OC containing 30 µg ethinyl estradiol, whereas the response in OC-users taking pills with 20 µg ethinyl estradiol did not differentiate from controls. Both OC and controls experienced an increase in maximal isokinetic strength ( $p<0.001$ ) and 1RM leg extension ( $p<0.001$ ) after the training period. The response in the strength parameters did not differentiate between groups. Conclusion Use of OC during a 10-week supervised, progressive strength training program was associated with a tendency towards a greater increase in muscle mass and a significantly greater increase in type I muscle fiber area compared to controls. Nevertheless, use of OC was not accompanied by a significantly greater increase in muscle strength

### CHANGES IN THE WHOLE-BODY BIOELECTRICAL IMPEDANCE VECTOR INDUCED BY TRAINING IN YOUNG ELITE SYNCHRONIZED SWIMMERS: PRELIMINARY RESULTS

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Introduction Synchronized swimming (SS) requires high-volume and high-intensity training that is assumed by young swimmers from an early age. A typical training session may include specific drills, choreography, and physical conditioning exercises, imposing complex physiological demands (Rodríguez-Zamora et al., 2012). Bioelectrical impedance vector analysis (BIVA) is a non-invasive and safe technique for assessing hydration and body composition changes (Lukaski & Piccoli, 2012). This study applied BIVA to the assessment of hydration changes evoked by training sessions in swimmers of different age and competitive level. Method 59 swimmers were divided into 1) pre-juniors (pre-JR): mean age 13.9 (SD 0.9) y, body mass (BM) 47.0 (7.2) kg, height 161.8 (8.2) cm, fat mass 15.1 (4.8) %BM, muscle mass 37.6 (5.0) %BM; and 2) juniors (JR): 16.7 (0.9) y, BM 53.7 (4.9) kg, height 165.8 (5.2) cm, fat mass 18.6 (2.6) %BM, muscle mass 38.8 (3.7) %BM. Anthropometric assessment (ISAK) and BIVA analysis were conducted PRE and POST a typical training session (p-JR 2.5 (0.1) h, JR 4.0 (0.2) h). A multi-frequency wrist-to-ankle BIA meter device (Z-Metrix®, BioparHom Co, France) was used and 50 kHz whole-body BIA vectors were analyzed by the resistance-reactance (R/Xc) graphic method, and Z mean values plotted (Piccoli et al., 1994). Hotelling's T2 test determined differences in the complex localized vector through the 95% confidence and tolerance intervals. Results Changes ( $p<0.005$ ) were observed between PRE and POST in BM (pre-JR: 47.0 (7.2) kg vs. 46.7 (7.3) kg; JR: 53.7 (4.9) kg vs. 53.4 (4.9) kg), R (pre-JR: 530 (46) Ohms vs. 548 (45) Ohms; JR: 503 (33) Ohms vs. 524 (45) Ohms), and Xc (pre-JR: 64.4 (5.4) Ohms vs. 66.6 (4.8) Ohms; JR: 66.0 (2.9) Ohms vs. 70.3 (4.3) Ohms). BIVA showed vector migration from PRE to POST ( $T^2=8.99$ ;  $p<0.05$ ) in JR, whereas no changes were found in pre-JR ( $T^2=1.92$ ;  $p>0.05$ ). Discussion JR swimmers showed a migration of the BIA vector characterized by an increase in length (R) and a decrease in the dielectric mass of soft tissues (Xc), likely as a result of moderate dehydration. In turn, pre-JR showed the maintenance of a good hydration status without significant bioelectrical changes. These preliminary results should be considered by coaches, nutritionists and physicians in order to ensure adequate fluid intake during training in these young athletes. References Lukaski HC, Piccoli A (2012). Handbook of Anthropometry. Springer, 287-305. Rodríguez-Zamora L, Iglesias X, Barrero A, Chaverri D, Erola P, Rodríguez, FA. (2012). PLoS One 7(11), e49098.

### SOCCER REFEREES REPEATED SPRINT ABILITIES

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Introduction Soccer referees are an integral part of the soccer game. Their job is to regulate the behavior of players and other participants through the implementation of soccer rules. In addition to the principal referee who makes the final decision on the ground, there are 3 assistant referees that may assist in game regulation. To make the most correct decision, the referee must be at the right place and have an overview of the situation which requires excellent physical condition, visual perception, mental ability, focus, willingness and ability to make quick decisions. The aim of this study was to evaluate sprint abilities of soccer referees and assistant referees. Methods The sample consisted of 83 soccer referees, international ( $N=15$ ) and national ( $N=68$ ). On average referees were  $35.5 \pm 3.2$  years old,  $183.1 \pm 6.2$  cm tall and weighted  $83.6 \pm 6.4$  kg. All of the referees were tested with the FIFA High-Intensity Fitness Test that involves 6 x 40m sprints followed by a maximum of 1 minute and 30 seconds recovery after each sprint. Results The average values of all six trials for referees was  $5.75 \pm 0.19$  s (range 5.3-6.1), and significantly better for assistant referees  $5.63 \pm 0.15$  s (5.1-5.9). The average best trial for referees was  $5.58 \pm 0.24$  s, and for assistants  $5.59 \pm 0.11$  s. Discussion During competitive games, referees pass a total of 9-13 km with varying levels of intensity, but approximately at the level of 85 to 90% of the maximal heart rate and respectively 70 to 80% of the maximal oxygen consumption (Weston et al., 2012). Blood lactate concentration was between 4 and 5 mmol/l, but the recorded values were as high as 14 mmol/l. All this leads to the fact that they are subjected to high levels of exertion that can sometimes even exceed those that the players endure. It is also important that they can not be replaced like players so they have to keep pace with the match from the beginning till the end. The results for both referees and assistants are within the FIFA required values. The better results of assistants are in correspondence with the demands of their role – they have to be in line with the ball whenever it is possible to avoid wrong offside judgments due to poor positioning. Krstrup and his colleagues (2002) stated that assistant referees' performance of repeated sprints correlates with the high-intensity players' performance in a soccer game. The differences between the six trials in the sense of fatigue were not noticed. References Krstrup P, Mohr M, Bangsbo J. (2002). JSports Sci, 20(11), 861-871. Matkovic BR, Nedic A. (2012). Croat Sports Medicine J, 27(2), 59-67. Rontoyannis GP, Stalikas A, Sarros G et al. (1998). J Sports Med Phys Fit, 38, 208-214. Weston M, Castagna C, Impellizzeri FM, Bizzini M, Williams AM, Gregson W. (2012). Sports Med, 42(7), 615-631.

### CHANGES OF THE PERFORMANCES FOR HIGH INTENSITY INTERVAL TRAINING BETWEEN PRE AND POST HEME-IRON INTAKE PERIOD OF THE HIGH SCHOOL SWIMMERS

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This research focused on the examination using high school swimmers as subjects as follows: First, what influence heme-iron intake and training for a short term (for four weeks) would have on high-intensity interval training performance. Second, what affects they would have on lactate level after a cool-down and the change of mood condition before and after training. And the research also centered on what influence the intake of heme-iron brings about to blood constituent including Hb (hemoglobin) and also studied the degree of

changes in swimming records in the competition before and after the period. The result was as follows: 1) The swimming speeds significantly increased in the competition at post-intake heme-iron compared with the ones of the previous competition ( $p < 0.001$ ). 2) The intake of heme-iron significantly increased average swimming speeds at the first and second round lactate tolerance set (LTS, 1 R:  $p < 0.001$ , 2 R:  $p < 0.001$ ). The HR (heart rate), RPE (Rate of Perceived Exertion), and lactate level ( $\Delta$ La after 1 R- before LTS) at the first round were significantly increased, too. 3) Each item of POMS (Profile of Mood States) (Tension-Anxiety: T-A, Depression, Anger-Hostility: A-H, Vigor, Fatigue, and Confuse) significantly decreased in T-A ( $p < 0.001$ ) and D ( $p < 0.05$ ) after training at pre-intake of heme-iron compared with before LTS. Likewise, at post-intake of heme-iron each item of POMS significantly decreased in T-A ( $p < 0.001$ ) and D ( $p < 0.001$ ). This showed that test subjects came to endure more severe training than ever at post-intake of heme-iron. But it was found that psychological condition was kept intact. 4) Hb were significantly increased at post-intake of heme-iron ( $p < 0.001$ ). No significant difference was noted on Hb on blood constituent inspection but, in contrast, PLT (Platelet) ( $p < 0.01$ ) and TIBC (Total Iron Binding Capacity) ( $p < 0.001$ ) significantly decreased at post-intake of heme-iron. This was apparently because the decrease of the training opportunities caused by the conflict of the intake at the latter half with the competition period didn't stimulate red blood cell production. However, conversely, the increase of ferritin was noted in many test subjects, so the further extension of intake period was thought necessary for additional examination in the future. From the above mentioned results, the followings became clear. The high school swimmers who went for the training at post-intake of heme-iron could increase swimming speed through high-intensity interval training even in the short period of 4 weeks. As a result, they could improve their swimming speed in the competition. References Noguchi T, Suzuki J, Shinya K, Takamura A, Sekiguchi K (2009). Final Reports for Research Grants for Meat and Meat Products, 27, 53-60. Noguchi T, Suzuki J, Matsumoto M, Meguro T, Sakai M, Hasegawa T, Katsumata M (2010). Final Reports for Research Grants for Meat and Meat Products, 28, 61-69. Marray-Kolb LE, Beard JL (2007). *Am J Clin Nutritions*, 85(3).

### ESTIMATION OF VO<sub>2</sub> KINETICS FROM GRADED EXERCISE TESTS IN SPRIINTERERS

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**INTRODUCTION** Oxygen uptake kinetics are determined by computation of the time constant, or 'τ' ('tau'), from VO<sub>2</sub> data during square-wave work. In an incremental (ramp) test, presuming a linear increase of VO<sub>2</sub> with increasing intensity ( $dVO_2 / dt = \text{const}$ , for the intensity range below the anaerobic threshold), tau can be estimated from the time delay ( $\tau = \Delta t$ ) needed to reach the VO<sub>2</sub> that corresponds to the steady-state VO<sub>2</sub> (VO<sub>2</sub>ss) at the same intensity (Whipp et al., 1981). Accordingly, we estimated tau in trained sprinters from: 1) single treadmill step tests (with no steady-state) and VO<sub>2</sub>ss, and 2) two step tests with different speed increments, without utilization of VO<sub>2</sub>ss. **METHODS** 24 sprint runners (100-400m) completed 3 incremental treadmill tests to exhaustion with increase in running speed of: 1 km/h each ½ min (T05), 1 km/h each min (T1), and 2 km/h each 4 min (SS). Breath-by-breath VO<sub>2</sub> data were averaged to 30 s, and centered to the corresponding running speeds for T05 and T1. The VO<sub>2</sub>ss values at 8, 10 and 12 km/h were defined as the average VO<sub>2</sub> values in the 4th minute of respective stages in the SS test, and were corrected to account for the VO<sub>2</sub> difference between ramp and step protocols. The time constants ( $\Delta t$ ) were determined from linear regression parameters derived from the VO<sub>2</sub>/running speed relationship in SS, T05 and T1. The analysis was performed within the aerobic speed range (8-12 km/h). The significance of differences between  $\Delta t$  were determined from 1) SS-T1, 2) SS-T05, and 3) T1-T05 test data ( $p < .05$ ). **RESULTS AND DISCUSSION** The VO<sub>2</sub> kinetics, as estimated from  $\Delta t$  determined from SS-T05, SS-T1 and T1-T05 data did not differ significantly ( $49.2 \pm 21.0$  s,  $51.7 \pm 37.1$  s, and  $46.7 \pm 29.1$  s, respectively;  $p > 0.05$ ), and were somewhat slower in T1 and T05 with increasing speed. The per step increase of intensity in T05 (1kmh/30s) is twofold the increase in T1 (1kmh/60s). Therefore, for a certain VO<sub>2</sub>, the  $\Delta t$  between T1 and T05 tests should be equal to  $\Delta t$  between T1 and SS, enabling estimation of  $\tau$  and VO<sub>2</sub>ss. Indeed, the average error of VO<sub>2</sub>ss and  $\Delta t$  estimated from the time delay between T1 and T05 was practically irrelevant (0.1-0.3 ml/min/kg, or 3-5 s). The average  $\Delta t$  values of sprint runners were significantly higher compared to tau values measured directly from square-wave tests in previous studies, and approx. 15-20 s higher than the values determined with the same methodology in endurance runners (Sentija et al, 2012). The high  $\Delta t$  values as measures of VO<sub>2</sub> kinetics of both studies, may be explained by the delay time needed for transportation of blood from working muscles to the lungs (~ 10-20 s). As in endurance runners, high individual variability (many values outside of the physiological range for  $\tau$ , reflecting accumulated effects of high biological variability and technical errors for repeated measurements), precludes the use of this methodology as a reliable procedure for individual determination of VO<sub>2</sub> kinetics. **REFERENCES** Whipp BJ et al (1981). *J Appl Physiol* 50(1):217-21 Sentija D, Vucetic V (2012). *ECSS*, 556-7

### EXHAUSTED EXERCISE PRECONDITIONING MAY CAUSE PLASMA TO PREVENT LIPID PEROXIDATION OF RBC IN VITRO

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**Purpose:** Exercise preconditioning has been known to reduce strenuous exercise-induced oxidative damages. To understand the underlying mechanisms, plasma samples isolated from exhausted exercises were used to investigate the possible protection effect on RBC with or without following hypoxia/reoxygenation. **Methods:** Eight healthy male participants were recruited voluntarily (age:  $28.9 \pm 8.3$  yr, height:  $170.1 \pm 5.9$  cm, weight:  $68.9 \pm 7.4$  kg). Blood samples were collected before (resting, r) and after (post exercise, e) running by Bruce graded exercise testing (GXT). Plasma and RBC were separated and then recombined again into 4 groups: rWB (rWhole Blood), rRrP (rRBC + rPlasma), rReP (rRBC + ePlasma), rRs (rRBC + PBS). All groups were then treated with hypobaric hypoxia at PO<sub>2</sub> = 45 mmHg (H/N) or normbaric normoxia at PO<sub>2</sub> = 152 mmHg (N/N) for 1 hr and then recovered by N/N for 5 min. Data were to compare differences among the groups at indicators including antioxidant enzyme activities, peroxidized lipid (TBARS), lactate, glucose and uric acid. **Results:** As compared to the control group, plasma with exercise preconditioning had significantly increased levels of lactate ( $15.26 \pm 0.73$  mM vs.  $2.88 \pm 0.19$  mM,  $p < .05$ ), glucose ( $120.18 \pm 6.40$  mg/dL vs.  $98.12 \pm 5.09$  mg/dL,  $p < .05$ ) and uric acid ( $5.64 \pm 0.53$  mg/dL vs.  $4.56 \pm 0.48$  mg/dL,  $p < .05$ ). Except for eReP, RBC's TBARS level was significantly elevated in rWB, rRrP, rRs after N/N treatment as compared to rP ( $146.35 \pm 32.48$  nmol/gHb,  $141.97 \pm 34.4$  nmol/gHb,  $148.42 \pm 29.8$  nmol/g Hb vs.  $59.72 \pm 16.31$  nmol/gHb,  $p < .05$ ) or eP along ( $146.35 \pm 32.48$  nmol/gHb,  $141.97 \pm 34.4$  nmol/gHb,  $148.42 \pm 29.8$  nmol/gHb, vs.  $50.53 \pm 21.33$  nmol/gHb,  $p < .05$ ). However, this protection effect contributed to eP cannot be observed in groups after H/N treatment. All antioxidant enzyme activities among the groups were not different in both N/N and H/N treatments. **Conclusion:** Plasma with exhausted exercise preconditioning may reduce RBC peroxidized lipid damages but may not in hypoxia and reoxygenation. Further studies are needed to explore the role of uric acid in this reaction.

## THE ABILITY OF LOG-LINEAR ANCOVA TO DETECT CARDIORESPIRATORY DEFICIT IN OVERWEIGHT SUBJECTS

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**Introduction** There has been much debate over how to most appropriately scale peak aerobic power (VO<sub>2</sub>peak) in groups of subjects differing in body size. This issue is particularly pertinent when seeking to determine relative cardiorespiratory (CR) fitness in overweight (OW) subjects. The problems associated with assessing CR fitness in OW subjects was highlighted recently by Potter et al. (2013), who showed that a group of OW children could be considered to exhibit either superior (absolute VO<sub>2</sub>peak), similar (VO<sub>2</sub>peak divided by mass raised to the power 0.67) or reduced (scaling VO<sub>2</sub>peak in direct proportion to body mass) fitness when compared to non-overweight (NO) subjects depending on the scaling approach taken, despite the VO<sub>2</sub> kinetics data indicating a clear CR impairment in the OW subjects (mean response time [MRT] was significantly longer in the OW subjects). However, these authors did not attempt to compare VO<sub>2</sub>peak data between NO and OW subjects using log-linear analysis of covariance (log-ANCOVA). The aim of this study was to investigate the ability of log-ANCOVA to detect VO<sub>2</sub>peak differences in OW and NO children. **Method** Eleven OW (age 11.8 (0.4) y; BMI 25.8 (3.4) kg.m<sup>-2</sup>) and 12 NO (age 11.8 (0.4) y; BMI 25.8 (3.4) kg.m<sup>-2</sup>) participated. These groups differed significantly in MRT to moderate intensity exercise (43.5 (10.7) vs. 36.3 (5.3) s) and subjects completed a cycle ramp test (12 W.min<sup>-1</sup>) to ascertain VO<sub>2</sub>peak (ml.min<sup>-1</sup>). The VO<sub>2</sub>peak data were first log transformed and then adjusted VO<sub>2</sub>peak values were compared using ANCOVA (having ensured the regression slopes were not significantly different,  $p=0.529$ ). Results Log-ANCOVA revealed a non-significant VO<sub>2</sub>peak difference between groups ( $p=0.629$ ). **Discussion** Despite the presence of a CR deficit in the OW subjects (as evidenced by their slower VO<sub>2</sub> kinetics), log-ANCOVA suggested similar cardiorespiratory function in both groups. As has been previously demonstrated with alternative scaling methods (Potter et al. 2013), the use of VO<sub>2</sub>peak to assess CR fitness in OW subjects, even using log-ANCOVA, may be misleading and actually disguise CR impairment in OW subjects. **References** Potter CP, Zakrzewski JK, Draper SB, Unnihan VB. (2013). *Int J Obesity* 37,101-106

## MAXIMUM LACTATE STEADY STATE AND 4 MMOL/L LACTATE THRESHOLD IN ROWING

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**Introduction** Maximum lactate steady state (MLSS) during a longer lasting load (30 min) characterizes the load threshold that is covered mainly by aerobic energy supply. The individual MLSS can be determined by a series of repeated tests at different load levels. Hence, these procedures are very time consuming and need normally several days for testing. In the past many concepts and corresponding tests have been developed which propose to estimate the MLSS by using just a single test (Heck, 1990; Marees de, 2003). This study compares the MLSS test with a multiple step test on a rowing ergometer. **Methods** 11 top elite rowers (age 20.1 ± 1.9 years, height 189.7 ± 9.6 cm, weight 86.7 ± 9.8 kg) of national level participated in this study. Submaximal three step tests (step duration 8 min, resting time between each step 30 s) were performed on a Concept II rowing ergometer (type C) with slides at the beginning and six weeks later at the end of the study. Average power output (P (W)), average stroke rate (SR (1/min)), heart rate (HR (1/min)) and post exercise ear capillary blood lactate (LA (mmol/l)) were measured. By interpolation the power output at 4 mmol/l LA (P<sub>4</sub>) was calculated. Between this two step tests - with a delay of one week - a second test series with gradually adapted load was performed to determine the MLSS on identical ergometers (duration 30 min at constant load; LA samples at 2nd, 4th, 8th, 10th, 14th, 18th, 22nd, 26th and 30th min). In accordance to Beneke (1995) the first 30 min load was recommended in the range of 3 mmol/l LA. In case of an equilibrium of the MLSS the given load was increased of 10 W (3-4% of P), in case of a non equilibrium respectively an increase of the LA the load was decreased of about 10 W. **Results and Conclusions** P<sub>4</sub> was in the range of 289 ± 35.2 W in average, P at MLSS reached a mean of 264 ± 32.6 W in average. Corresponding LA was 2.3 ± 0.6 mmol/l after 8 min (MIN = 1.5, MAX = 3.4 mmol/l) and at the end after 30 min at 2.7 ± 0.7 mmol/l (MIN = 2.2, MAX = 3.7 mmol/l). Lactate values at MLSS were without exception lower than 4 mmol/l, however between both values a high significant correlation was found ( $R^2=0.90$ ). By regression analysis, MLSS could be estimated from P<sub>4</sub> using the following formula:  $MLSS = 0,88 \times P_4 + 10$ . The standard estimation error was 10.0 W (3,8%), and therefore within the range of precision of measurements for the estimation of MLSS. Hence, with regard to the small sample size the lactate threshold at P<sub>4</sub> seems to allow a precise estimation of the MLSS in elite rowing. **References** Beneke R. (1995). *Medicine and science in sports and exercise*, 6, 863-867. Heck H. (1990). *Laktat in der Leistungsdiagnostik*. Hofmann, Schorndorf. Marees de H. (2003). *Sportphysiologie*. Sportverlag Strauss, Köln.

## AEROBIC CAPACITY AND INCREASE IN BODY CORE TEMPERATURE DURING GRADED EXERCISE TESTING

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**Introduction** Persons with higher aerobic capacity were shown to have a greater increase in body core temperature than persons with low aerobic capacity during sustained submaximal exercise at similar relative intensities (Mora-Rodriguez et al, 2010). The aim of this study was to determine the relationship between some indicators of aerobic capacity (maximal oxygen uptake (VO<sub>2</sub>max), maximum speed (V<sub>max</sub>), speed at the ventilatory anaerobic threshold (VT<sub>2</sub>), as well as heart rate at VT<sub>2</sub> (HRVT<sub>2</sub>)) and the rate of temperature rise (Tr, delta temp/delta t) in different intensity zones during a graded treadmill exercise test. **Methods** The participants were 32 physically active males (age (mean±SD) 26.5±6.6 years; height 179.2±5.0 cm; body mass 76.8±8.1 kg). Graded treadmill exercise test with speed increments of 0.5 km/h each 30 sec was performed, in controlled thermoneutral conditions, until volitional exhaustion. Ventilatory parameters, heart rate and rectal temperature (measured at 8 cm from anal sphincter) were registered throughout the test. The first and the second ventilatory thresholds (VT<sub>1</sub> and VT<sub>2</sub>), delimiting three intensity zones (low, moderate, and high intensity), were determined by the V-slope method. Tr was calculated for each intensity zone (Tr<sub>1</sub> below VT<sub>1</sub>, Tr<sub>2</sub> between VT<sub>1</sub> and VT<sub>2</sub>, Tr<sub>3</sub> above VT<sub>2</sub>). Pearson product-moment correlation coefficients were used to determine the relationship between zone specific Trs and indicators of aerobic capacity (VO<sub>2</sub>max, V<sub>max</sub>, VT<sub>2</sub>, HRVT<sub>2</sub>). **Results** Tr<sub>1</sub> was significantly related to HRVT<sub>2</sub> ( $r=0.48$ ,  $p<0.01$ ). Tr<sub>2</sub> was related to V<sub>max</sub> and VT<sub>2</sub> ( $r=0.40$  and  $0.45$ , respectively,  $p<0.05$ ) and HRVT<sub>2</sub> ( $r=0.61$ ,  $p<0.01$ ). Tr<sub>3</sub> was related to VT<sub>2</sub> and HRVT<sub>2</sub> ( $r=0.38$  and  $0.39$ ,  $p<0.05$ ). The direction of all correlations was positive, except for correlations between Tr<sub>1</sub> and VO<sub>2</sub>max, V<sub>max</sub> and VT<sub>2</sub>, which showed a negative trend. **Discussion** In all three intensity zones Tr was significantly positively related to some of the aerobic capacity indicators. The positive direction of correlations is congruent with previous findings of a greater activity-related Tr in highly fit than in moderately fit persons (Cheung & McLellan, 1998). The trend of negative correlations between Tr<sub>1</sub> and indicators of aerobic capacity suggests a possible fitness-related thermoregulatory differentiation across intensity zones. Aerobically fitter subjects show a slower Tr in the low intensity zone, and a higher one at intensities above VT<sub>1</sub>, as opposed to persons with lower aerobic capacity. Slower Tr<sub>1</sub> could result from a higher mechanical efficiency and/or lower

heat production in fitter subjects, or a local-core temperature discrepancy, at intensities below VT1. References Mora-Rodriguez et al. (2010). *Eur J Appl Physiol*;109:973-81. Cheung & McLellan (1998). *J Appl Physiol*;84:1731-9.

### THE LEVEL OF IMMUNOGLOBULIN AND BLOOD MORPHOLOGICAL INDICES AFTER SINGLE AND REPEATED WHOLE-BODY CRYOTHERAPY

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**Introduction:** During the recent decade the interest in whole-body cryotherapy (WBC) has significantly increased. The application of it has become more common and the benefits of using cold as a treatment are observed not only in patients with different afflictions but also in athletes i.e. treatment of overuse and post traumatic injuries as well as for enhancing post effort recovery. **Objective:** To examine the influence of a single and repeated WBC on chosen immunoglobulin (IgG, IgM, IgA) and blood morphological indices (white blood cells, red blood cells, platelets, neutrophils, lymphocytes, monocytes, eosinophils, basophils, hemoglobin, hematocrit and reticulocytes). **Methods:** The study was carried out on ten athletes and ten non-athletes, young and healthy men (aged  $22 \pm 1.56$ , with a body mass index of  $21.71 \pm 2.44$  kg/m<sup>2</sup>). The participants were subjected to 12 whole-body cryostimulations (at temperatures of  $-130^\circ\text{C}$ ) in a special cryogenic chamber for 3 minutes, 3 times a week. Blood samples were collected four times - before cryostimulation and 30 minutes after the first and twelfth WBC. The subjects were asked to avoid physical exercise 48 hours before blood sampling. **Results:** Before the 1st WBC session, the level of hematocrit was significantly higher in the non-athletes group. As a result of a single exposure to cryogenic temperatures, a significant increase in the level of neutrophils was observed ( $p < 0.05$ ). Furthermore, a minor increase in the numbers of white blood cells, red blood cells and the percentage of reticulocytes was observed. However, as a result of repeating 12 WBC sessions, significant decreases in white blood cells, neutrophils, red blood cells, hemoglobin and hematocrit in athletes were noted. There was also a significant decrease in the levels of IgG and IgM after 11 treatments compared to the baseline value and before 12 treatment sessions compared to the first WBC ( $p < 0.05$ ) in athletes, but still within the normal range. RBC count was significantly lower in the non-athletes group after the 12 WBC sessions when compare to non-athletes, whereas platelets count, lymphocytes, monocytes, eosynophils, and basophils remained unchanged in this group. **Conclusion:** The observed changes could be a result of more sensitive immune systems in athletes. Therefore, it can be concluded that repeated whole-body cryostimulation could not be recommended to athletes. **Key words:** cryostimulation, athletes, non-athletes, immune system The study was financed by NCN; project No UMO-2011/01/N/NZ7/00652

### INFLUENCE OF TART CHERRY JUICE ON INDICES OF MUCOSAL IMMUNITY, SALIVARY CORTISOL, INFLAMMATION AND UPPER RESPIRATORY TRACT SYMPTOMS FOLLOWING MARATHON RUNNING

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**Introduction** This study's aim was to examine the effects of tart cherry juice on markers of stress, mucosal immunity, inflammation and respiratory tract symptoms following a marathon. **Methods** Twenty recreational Marathon runners assigned to either tart cherry juice (CJ) or placebo (PL) consumption for 5 days prior to, the day of, and for 48 h following a Marathon race. Markers of mucosal immunity (secretory immunoglobulin A (sIgA), immunoglobulin (IgG)), stress (salivary cortisol), inflammation (plasma interleukin-6 (IL-6) and C-reactive protein (CRP)) and self-reported incidence and severity of upper respiratory tract symptoms (URTS) were measured before and following the race. Data were analysed using a mixed model analyses of variance ANOVA with two between-participants factors (treatment: CJ versus PL) and four within participants factors (time: day before the race, immediately post-race, 24 h and 48 h post-race). **Results** All variables except mucosal immunity showed a significant time effect ( $P < 0.01$ ). Serum IL-6 showed a significant treatment effect ( $F(1,18)=12.920$ ,  $P=0.002$ ) and treatment by time interaction ( $F(3,54)=8.675$ ,  $P=0.009$ ) and was elevated immediately post-race, with a smaller elevation in the CJ group vs PL ( $38.98$  vs  $82.1$  pg/mL,  $P=0.009$ ). Serum CRP had a significant treatment effect ( $F(1,18)=12.920$ ,  $P=0.002$ ) and treatment by time ( $F(4,54)=10.667$ ,  $P=0.002$ ) and increased at 24 and 48 h post-Marathon with significantly smaller elevation in the CJ group vs PL ( $P=0.002$ ). The salivary cortisol and mucosal immune response (sIgA and IgG) to the Marathon revealed no significant differences between groups and no significant treatment by time interaction effect. The incidence and severity of URTS showed a significant treatment effect ( $F(1,18)=5.879$ ,  $P=0.026$ ) and treatment by time interaction effect ( $F(3,54)=5.242$ ,  $P=0.014$ ). URTS were higher at 24 h ( $P=0.022$ ) and 48 h post race ( $P>0.05$ ) in the PG compared to CG group. **Discussion** Cherry juice appears to provide a potential supplement to protect the upper respiratory tract from inflammatory symptoms caused by infectious and non-infectious agents (Spence et al., 2007, Robson-Ansley, et al, 2012), by potentially reducing exercise-induced pulmonary inflammation. Spence L, Brown WJ, Pyne DB, et al. (2007). *Med Sci Sports Exerc*, (39) 4, 577-86. Robson-Ansley P, Howatson G, Tallent J. et al. (2012). *Med Sci Sports Exerc*, 44 (6), 999-1004.

### NO CHANGE IN HEMOGLOBIN MASS AFTER 12 WEEKS OF INTENSIVE ENDURANCE TRAINING AT SEA LEVEL

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**Introduction** Hemoglobin mass (Hbmass) is associated with the maximal oxygen uptake (VO<sub>2</sub>max). A comprehensive review concluded that the variation in VO<sub>2</sub>max can be explained by Hbmass: an increased VO<sub>2</sub>max by  $4 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  were correlated to an increase of 1g of hemoglobin (Schmidt & Prommer, 2010). Despite the relationship between VO<sub>2</sub>max and Hbmass a recent study found that increased VO<sub>2</sub>max was not accompanied by changes in Hbmass after 40 days of sea level endurance training (Eastwood et al., 2012). The aim of this study was to investigate the effects of a 12 week intensive endurance training regime at sea level on VO<sub>2</sub>max and Hbmass. **Methods** Thirty-one participants (19 females and 12 males; age:  $26 \pm 6$  yrs, VO<sub>2</sub>max  $53.5 \pm 7.6$  ( $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ), Hbmass  $10.8 \pm 1.6$  (g/kg)) were recruited. The training protocol consisted of 3-4 endurance training sessions every week for 12 weeks, combining interval ( $4 \times 4$  min up to  $6 \times 6$  min;  $> 90\%$  HRmax) and continuous running sessions (30 and 60 min;  $\sim 85\%$  HRmax and  $\sim 75\%$  HRmax), respectively. VO<sub>2</sub>max was determined by an incremental running exercise until exhaustion on a treadmill. Hbmass was assessed by using a optimized version of the CO-rebreathing method (Schmidt & Prommer, 2005). All participants performed a familiarization test, and were tested before and after 5-6 and 12 weeks of training. **Results** After 12 weeks of intensive endurance training VO<sub>2</sub>max increased by  $10.1 \pm 5.2\%$  ( $p < 0.01$ ). However, no significant changes were observed for Hbmass. The non-significant change in Hbmass was  $-1.1 \pm 3.4\%$  (also no change after 5-6 weeks). The correlation between VO<sub>2</sub>max and Hbmass was at baseline  $r = 0.89$  ( $p < 0.0001$ ) in absolute values, and when adjusted for bodyweight  $r = 0.73$  ( $p < 0.0001$ ). The correlation between the percent change in VO<sub>2</sub>max and Hbmass was  $r = 0.34$  ( $p = 0.06$ )

in absolute values, but only  $r = 0.14$  ( $p=0.46$ ) when adjusted for bodyweight. Discussion Twelve weeks of endurance training increased  $VO_{2max}$ , while Hbmass did not change. This is in accordance with Eastwood et al (2012). The lack of change in Hbmass indicates that augmented  $VO_{2max}$  was due to other factors, such as improved cardiac output and improved oxygen extraction. References Eastwood, A., Bourdon, P. C., Norton, K. I., Lewis, N. R., Snowden, K. R., & Gore, C. J. (2012). No change in hemoglobin mass after 40 days of physical activity in previously untrained adults. *Scand J Med Sci Sports*, 22(6), 722-728. Schmidt, W., & Prommer, N. (2005). The optimised CO-rebreathing method: a new tool to determine total haemoglobin mass routinely. *Eur J Appl Physiol*, 95(5-6), 486-495. Schmidt, W., & Prommer, N. (2010). Impact of alterations in total hemoglobin mass on  $VO_{2max}$ . *Exerc Sport Sci Rev*, 38(2), 68-75.

### CHANGES IN THE WHOLE-BODY BIOELECTRICAL IMPEDANCE VECTOR INDUCED BY TRAINING IN AMATEUR FOOTBALL PLAYERS: PRELIMINARY RESULTS

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**Introduction** Football is a team sport that incorporates frequent fluctuations between high and low exercise intensities. Rating of perceived exertion (RPE) is a valid, simple and cheap method for monitoring exercise intensity in football. Despite there is extensive information about physiological demands during a football match, less information is on the training sessions (Bangsbo et al., 2006) and in particular about the possible hydration changes generated. Bioelectrical impedance vector analysis (BIVA) is a non-invasive and safe technique for assessing hydration and body composition changes (Lukaski & Piccoli, 2012). This study applied BIVA to assess possible hydration changes evoked by one high intensity training session in a group of amateur football players (FP). Method 10 amateur FP completed anthropometric (ISAK) and bioelectrical assessments (BIVA) PRE and POST a high intensity training session ( $1.5 \pm 0.2$  h). Borg 15-point rating of perceived exertion scale was assessed to determinate the training session intensity. A tetra-polar phase-sensitive BIA (BIA-101; AKERN-Srl, Florence, ITALY) was used to measure resistance (R), reactance (Xc) and phase angle (PA). 50 kHz whole-body BIA vectors were analyzed by the R/Xc graphic method, and Z mean values plotted (Piccoli et al., 1994). Hotelling's T2 test determined differences in the complex localized vector through the 95% confidence and tolerance intervals. Results The FP registered the following anthropometric profile: age: 19,5 (1,3) years; height: 175,2 (5,4) cm; weight: 65,8 (6,8) kg; BMI: 21,4 (1,9) kg/m<sup>2</sup>; fat mass: 7,6 (1,6) %; muscle mass; 48,2 (2,6) %; bone mass: 16,5 (2,1) %; somatotype: 2,5-3,5-3,3. Borg's scale response following the training session was 14,5 (1,3) RPE. Significant changes were observed between PRE and POST training session in body mass: 65,8 (6,8) kg vs. 65,0 (6,7) kg ( $\Delta -1,23\%$ ,  $p=0,005$ ); R: 552,7 (59,3) ohms vs. 563,5 (65,5) ohms ( $\Delta 1,89\%$ ,  $p=0,037$ ); Xc: 67,9 (7,3) ohms vs. 69,8 (7,2) ohms ( $\Delta 2,89\%$ ,  $p=0,008$ ). BIVA showed no significant whole-body vector migration from PRE to POST training session ( $T2=0,33$ ;  $p>0,05$ ). Discussion Despite the significant differences in R and Xc, the BIA vector shows no significant displacement between PRE and POST conducted football training session. The sample characteristics, the workload type and the total time of the training session, could have influenced these results. However, the significance changes in body mass and bioelectrical variables, invite us to interpret these results with caution. Further research is needed in order to analyze the relationship between specific designs of football training sessions, and their effects in the hydration status of football players. References Bangsbo J, Mohr M & Krstrup P (2006). *J of Sports Sci*, 24(7):665–674. Lukaski HC, Piccoli A (2012). *Handbook of Anthropometry*. Springer, 287-305.

### ABDOMINAL TO LOWER BODY FAT MASS RATIO IMPACTS ON LIPOXMAX IN NORMAL WEIGHT WOMEN

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### GAIT SPEED AND HAND GRIP STRENGTH – MORE USEFUL THAN MUSCLE MASS TO ESTIMATE SARCOPENIA IN ELDERLY WOMEN?

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**Introduction** According to the European Working Group on Sarcopenia in Older People (EWGSOP) diagnosis of sarcopenia requires documentation of low muscle mass plus either low muscle strength or low physical performance [1]. The aim of the current study was to investigate (a) the prevalence of sarcopenia with or without obesity and (b) its association with frequently used sports motoric tests in elderly.

Methods Bioimpedance analysis was used to predict muscle mass of 102 institutionalized women aged  $82.6 \pm 5.9$  years. Skeletal muscle mass index (SMI) was calculated by body cell mass and height. Subjects having a SMI  $< 6.75$  kg/m<sup>2</sup> in addition to either showing a walking speed  $< 1$  m/s or a handgrip strength  $< 20$  kg were considered as sarcopenic [2]. Obesity was determined by a BMI  $\geq 30$  kg/m<sup>2</sup> [2]. In addition, participants completed functional tests to assess strength as well as aerobic capacity. These tests include isokinetic torque measurements of knee extensors - and flexors (Lido Loredan), 6-minute walking distance, functional reach, 30 second chair raise and arm lifting test. Results Out of 102 women 40 (39%) subjects were of normal weight without signs of sarcopenia, 35 (34%) were obese, 10 (10%) were sarcopenic and only 1 subject (1%) could be defined as having sarcopenic obesity. We did not detect any difference between these groups according to the measured functional tests (Kruskal Wallis test,  $p > 0.05$ ). Interestingly, a SMI  $< 6.75$  kg/m<sup>2</sup> did not describe differences in motor skills as compared by Mann-Whitney U test ( $p > 0.05$ ). This was in contrast to comparisons using gait speed. Differences between groups in the isokinetic peak torque of knee extension and flexion, chair raise test and 6-minute walking distance were detected (all  $p < 0.05$ ). The best discriminator was found to be hand grip test (76% of subjects below cut-off value). Women with reduced handgrip strength showed a significantly reduced outcome in all other functional tests (all  $p < 0.05$ ). Discussion The results of our study imply that only a small proportion of elderly institutionalized women are actually defined as being sarcopenic using the criteria of the EWGSOP. Especially, handgrip strength  $< 20$  kg resulted in weaker outcomes in all relevant functional tests. Handgrip strength was efficiently used to predict morbidity and mortality [3,4]. As this is a cheap test which can be used in a high number of subjects we suggest its broader use in studies for the screening of functional limitations. References [1] Cruz-Jentoft, A, et al. (2010) Age Ageing, 39, 412-423. [2] Stenholm, S, et al. (2008) Curr Opin Clin Nutr Metab Care, 11 (6), 693-700. [3] Norman, K, et al. (2011) Clin Nutr, 30(2),135-142. [4] Bohannon RW. (2008) J Geriatr Phys Ther, 31(1),3-10.

### SPRINT INTERVAL TRAINING ON THE VERTICAL TREADMILL

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Introduction Over a third of injuries throughout the soccer season are related to repetitive impacts on joints during running (1). Recumbent exercise modes have been employed to reduce impact on joints during training (2). A vertical treadmill (VerT), which requires a running action in a recumbent posture on a vertically hung, non-motorised treadmill whilst the limbs are supported with overhanging resistance cables, was designed for the physical conditioning of athletes. It has not been established if there are any physiological adaptations or performance benefits of training using a VerT. The aim of this study was to determine the effects of sprint interval training (SIT) on the VerT compared with over ground sprint training on aerobic and anaerobic power. Methods With institutional ethics approval, twenty active males aged 23 (3) years, stature 1.79 (7.35) m, body mass 77.6 (12.6) kg volunteered for this study. Participants' aerobic and anaerobic running power were determined by incremental VO<sub>2</sub>max treadmill test and a maximum anaerobic running test (MART) respectively. Participants were pair matched, based upon their aerobic and anaerobic power, and assigned to VerT or 20 m shuttle sprint group (SG). SIT consisted of 4-6, 30 s all-out efforts with 4 minutes recovery between bouts, 3 days a week for 6 weeks. Results SIT increased VO<sub>2</sub>max from 46.8 (5.4) to 49.9 (4.9) ml/kg/min in the VerT ( $p = 0.00$ ) and from 46.1 (4.4) to 49.1 (5.2) ml/kg/min in the SG ( $p = 0.00$ ). MART score (O<sub>2</sub> equivalents) also increased from 105.2 (8.6) to 109.7 (8.7) ml/kg/min in the VerT ( $p = 0.00$ ) and from 104.8 (9.3) to 108.9 (9.2) ml/kg/min in the SG ( $p = 0.00$ ). There were no group x time interactions. Discussion The improvement in aerobic and anaerobic power for SG was similar to that reported previously (3). The findings of this study suggest that 6 weeks of SIT on the VerT results in similar improvements in aerobic and anaerobic running power to those from over ground sprint training. Therefore, the VerT could be used as a low-impact conditioning tool and might be a substitute for exercise involving prolonged over ground running. References 1. Engström, B. Forsblad, M. Johansson, C. Törnkvist, H. (1990). Does a major knee injury definitely sideline an elite soccer player? Am J Sports Med. 18(1):101-5. 2. Billinger, S. Loudon, J. Gajewski, B. (2008). Validity of a Total Body Recumbent Stepper Exercise Test to Assess Cardiorespiratory Fitness. J Strength and Cond Res. 22(5):1556-1562. 3. Hazell, T. Macpherson, R. Gravelle, B. Lemon, P. (2010). 10 or 30-s sprint interval training bouts enhance both aerobic and anaerobic performance. Eur J Appl Physiol. 110(1):153-60.

### NONINVASIVE METHOD FOR EVALUATING SKELETAL MUSCLE OXIDATIVE CAPACITY WITH NEAR INFRARED SPECTROSCOPY IN VARIOUS SUBJECTS

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Introduction Near infrared spectroscopy (NIRS) devices can noninvasively provide information about the changes in tissue oxygenation. Thus, it is expected for NIRS to be further used in clinical or field setup. Time constant for recovery of muscle oxygen consumption (TcVO<sub>2</sub>mus) after submaximal exercise is an index of muscle oxidative function (Motobe et al., 2003). However, only a few studies have investigated a usefulness of TcVO<sub>2</sub>mus. Therefore, the purpose of this study was to examine whether TcVO<sub>2</sub>mus was altered qualitatively in various subjects with differing conditioning. Methods Fourteen healthy men participated in this study. The subjects divided into two groups, a 21-d non-dominant arm immobilization group [19.5 $\pm$ 0.9 years, (mean $\pm$ SD) maximal voluntary contraction(MVC) for non-dominant arm 415.5 $\pm$ 72.4 N, dominant arm 413.3 $\pm$ 71.4 N] (n=8; IMM) (Kitahara et al., 2003) or training group (25.1 $\pm$ 0.9 years, MVC for non-dominant arm 409.3 $\pm$ 28.5 N, dominant arm 479.9 $\pm$ 54.7 N) (n=6; TRN). The TRN group conducted muscle endurance handgrip training (dynamic handgrip exercise at 30 % of MVC, 1 Hz until exhaustion) 5 times weekly and muscle strength handgrip training (70 % MVC for 2 seconds with 2 second rest interval, repeated 10 times) in the non-dominant arm 3 times weekly. We measured the following parameters for participant pre- and post- intervention on the non-dominant arm and dominant arm: MVC of the grip, forearm cross-sectional area (CSA), work capacity per CSA (dynamic handgrip exercise at 30 % of MVC, 1 Hz until exhaustion). The oxidative capacity was evaluated by the TcVO<sub>2</sub>mus using NIRS. Results There was no change for all parameters in the dominant arm. In the non-dominant arm there is no significant change in CSA in the IMM (pre 3604 $\pm$ 662 mm<sup>2</sup>, post 3568 $\pm$ 607 mm<sup>2</sup>) and TRN (pre 4015 $\pm$ 526 mm<sup>2</sup>, post 3988 $\pm$ 511 mm<sup>2</sup>), respectively. The MVC significantly decreased in the IMM (20.2%) and tended to improve in the TRN (4.5%) ( $p = 0.08$ ). The work capacity per CSA in the IMM significantly decreased (22.2%) and improved in the TRN (90.7%). The TcVO<sub>2</sub>mus significantly prolonged in the IMM (pre 46.0 $\pm$ 6.9 s, post 62.1 $\pm$ 17.3 s), and improved in the TRN (pre 65.7 $\pm$ 6.4 s, post 51.7 $\pm$ 3.67 s). Discussion The TcVO<sub>2</sub>mus decreased in the IMM (25.9 %) and improved in the TRN (20.9 %). These values are in accordance with the data reported in previous studies (Motobe et al., 2003, Hamaoka et al., 1998). The TcVO<sub>2</sub>mus is reported to be altered by the changes in the muscle oxidative capacity, such as the changes in mitochondrial volume and numbers, and oxidative enzyme activity (Motobe et al., 2003). Conclusion The TcVO<sub>2</sub>mus was altered with differing muscle conditioning. This result provides a qualitative, but reasonable evidence indicating that the TcVO<sub>2</sub>mus is useful index for evaluating muscle oxidative capacity. References Motobe M, et al., (2004). Dyn Med. 3:2. Hamaoka T, et al., (1998). Jpn J Appl Physiol. 28:1-9. Kitahara A, et al., (2003). Med Sci Sports Exerc. 35: 1697-1702.

## EFFECT OF HYPEROXIC RECOVERY ON OXIDATIVE STRESS DURING A SIMULATED CROSS-COUNTRY SKIING TEAM SPRINT

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**Introduction:** As the use of breathing oxygen-enriched air (hyperoxia) is no longer prohibited by the World Anti-Doping Agency, the question for elite athletes arises, whether the use of hyperoxia could be beneficial for improving competition performance. In competitive events its application is only practical during the recovery periods due to technical and heavy assemblies. There is evidence that hyperoxic recovery between bouts of high-intensity exercise has positive influence on key physiological variables of endurance performance (Nummela et al., 2002; Sperlich et al., 2011). However, it is still unclear whether acute exposure to hyperoxic air may produce additional reactive oxygen species (ROS). Therefore, the aim of the study was to evaluate the acute effects of hyperoxic recovery on oxidative stress during a simulated cross-country skiing team sprint competition. **Methods:** Seven well-trained male endurance athletes performed two 3 x 3-min all-out sprint intervals on a double-poling ergometer at simulated moderate altitude (~1800 m). During the 3-min recovery periods between the 3 x 3-min sprints, all athletes inhaled either hyperoxic (FIO<sub>2</sub> = 1.00) or hypoxic (FIO<sub>2</sub> ~0.165) air in a randomized and single-blind order. The level of ROS was measured prior the warm-up and directly after the exercise protocol, using the free oxygen radical test (FORT) (Callegari, Parma, Italy). The results are expressed as FORT units (FORT U), where one FORT U corresponds to 0.26 mg/L of H<sub>2</sub>O<sub>2</sub>. Oxidative stress is defined as values > 310 FORT U. **Results:** No differences between post-exercise level of ROS for hyperoxic (259.7 ± 29.8 FORT U) and hypoxic (283.6 ± 56.5 FORT U) trial were obtained (P = 0.28; effect size = 0.53). Pre- to post-exercise FORT values were the same with hyperoxic (262.3 ± 32.2 to 259.7 ± 29.8 FORT U; P = 0.69) and with hypoxic (268.4 ± 48.4 to 283.6 ± 56.5 FORT U; P = 0.21) recovery. **Discussion:** Hyperoxic recovery appeared to have no additional oxidative risk for athletes performing 3 x 3-min maximal interval workouts at moderate altitude compared to hypoxic recovery. Furthermore, with hyperoxic recovery FORT levels were for all athletes at all time-points below the normal range for healthy individuals (< 310 FORT U). However, it remains unclear whether a longer period of exposure to hyperoxic air during exercise may enhance ROS production and could lead to oxidative damage. **References:** Nummela A, Hamalainen I, Rusko H. (2002). *Scand J Med Sci Sports*, 12(5), 309-15. Sperlich B, Zinner C, Krueger M, Wegryk J, Mester J, Holmberg HC. (2011). *Scand J Med Sci Sports*, 21(6), e421-9.

## HEART RATE HYSTERESIS IN TRIATHLETES DURING CYCLING AND RUNNING

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**Introduction** In complex biological systems the hysteresis phenomenon explains the co-existence of different states for the same parameter value and informs about the nonlinearity of the phenomena under consideration. Heart rate (HR) features are especially important because the parameter is widely used in exercise monitoring and assessment. The purpose of this study was to reveal the existence of the hysteresis phenomenon in the evolution of HR during progressive loading/unloading cycling and running tests. **Methods** Twenty trained triathletes, M=24,17; SD=9,31 years old, previously familiarized with the experimental procedures performed 2 progressive loading/unloading tests (cycling and running, respectively) in two different days. HR and rate of perceived exertion (Borg's RPE 6-20 scale) were recorded and reported during the trials. In the loading phase triathletes started pedaling (70 rpm) at 100W (with increments of 30W .min<sup>-1</sup>) and running at 10km .h<sup>-1</sup> (with increments of 1km.h<sup>-1</sup> per minute), until they reached a RPE ≥ 18. The load was then progressively decreased (30W.min<sup>-1</sup> and 1km.h<sup>-1</sup>, respectively) like a mirror. The differences of HR median values for the same load intensities in the loading and unloading phases, respectively, were compared using non-parametric Wilcoxon matched pairs test. **Results** Results showed a clear HR hysteresis phenomenon between the loading and unloading phases of both tests. In the cycling test significant differences (p < 0.001) were found for all pair of loads (n= 6, loading/unloading, respectively). In the running task, the differences were higher for the 3 loads close to the maximum (p<0.001) and lower for the 3 loads close to the minimum (p<0.002; p<0.005; p<0.016, respectively). HR Median values of unloading phases were always larger than HR median values of loading phases in all participants. **Discussion** HR followed a different path during the loading and unloading phases although the external loads were the same. The HR hysteresis effect seems to be more pronounced in cycling than in running. Further research should investigate if this is related to the different demands of both types of exercise or the different training status of participants in both disciplines. The results point to the existence of hysteresis HR effects in trained triathletes during both cycling and running exercises. This feature should be taken into account for an accurate monitoring and training assessment.

## EFFECT OF THE EXERCISE MODE ORDER ON ARTERIAL STIFFNESS IN NORMOTENSIVE MEN

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**Introduction** Increased arterial stiffness (AS) of elastic vessels is considered an important cardiovascular risk factor and is associated with cardiovascular morbidity and mortality. Studies have showed that a single session of aerobic or resistance exercise promotes important hemodynamic changes. However, less is known about the acute effect of a single session combining resistance and aerobic exercise, and their order within the session on AS. **Methods** Six young healthy male participants (24.5±2.7 yrs) were submitted to two exercise sessions in which the exercise order was randomized to start with aerobic followed by resistance exercises (AR) or the reverse (RA). Each exercise session last approximately 1h. Aerobic exercise performed at 75-80% VO<sub>2</sub>peak for 35 min. Resistance exercises encompassed 3 sets of 8-10 RM for upper and lower body segments. Carotid-femoral pulse wave velocity (cf-PWV) was assessed through applanation tonometry by a single investigator at rest and after exercise session (2, 10, 20 and 30 min). **Results** For the AR session the cf-PWV (m/s) were: rest (5.8±1.1) and after exercise (2 min 5.9±0.7; 10 min 5.7±1.1; 20 min 5.9±1.4; and 30 min 5.5±0.8). For the RA session the cf-PWV (m/s) were: rest (5.6±1.0) and after exercise (2 min 5.8±0.9; 10 min 5.6±0.7; 20 min 5.8±0.9; and 30 min 5.3±0.5). There was no significant main effect of time or session x time interaction. **Discussion** The results of the present study indicate that exercise mode order within exercise sessions do not acutely influence the cf-PWV. Moreover, we did not found a main effect of time on cf-PWV, which is in disagreement with previous published data (Naka et al., 2003; DeVan et al., 2005) even though those studies did not use the combination of exercise modes on the same session. It is possible that the reduced sample size of this pilot study preclude the achievement of any significant main effect of the exercise order in the main outcome. Therefore, further studies with a large sample size are needed to ascertain if the exercise mode order within the exercise session is an explanatory factor of acute variation of AS. **References** DeVan, A. E.,

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### **NUMBER OF MICTURITIONS AS A HYDRATION MARKER FOR KIDS**

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Hydration status, due to the dynamic nature and the constant turnover of body water, is not easily assessed. A valid estimation can be achieved with the use of various indices in the laboratory. Nonetheless methods that can be used easily in the field could be valuable tools for hydration assessment. Study Objective: To examine whether the number of bathroom visits could predict hypohydration in kids aged 8-14 years. Methods: 128 Greek healthy boys (n=75) and girls (n=53) aged 8-14 years (Height: 1.47±0.13 m, Weight: 42±12 kg, Fat: 25.1±7.7%, Total Body Water (TBW): 25.5±6.5 L) were asked to collect their urine for 24 hours while conducting normal daily activities. They were also instructed to record the times they visited the bathroom and to mark the volume and the time of each void on the urine container. 24h urine was analyzed for osmolality (Uosm) via freezing point depression osmometry. Results: Sensitivity analysis showed that the overall accuracy of the number of micturitions as compared with Uosm was 64.8±4.9%. Specifically, the sensitivity of a positive number of micturitions test (i.e., ≤5) was 54.8% and the specificity was 68.2% for detecting hypohydrated persons (i.e., Uosm>700). The threshold used (i.e., 5) was also the optimal cut-off point for number of micturitions according to the performed ROC (Receiver Operating Curve) analysis. Conclusions: According to our data less than or equal to 5 visits in the bathroom could lead to 24h urine Osmolality of >700mOsm/kg. These data suggest that the number of micturitions might provide an indication about hydration status of children aged 8-14 years.

### **BEHAVIOR OF HYPERTENSIVE BLOOD PRESSURE DURING RECOVERY IN INTERVAL TEST 10 RM**

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Introduction Application protocol testing with hypertensive people are not fully elucidated and specific yet, following the principles to people who aren't suffering HAS, scientific investigations are presented scarce in relation to appropriate recovery interval between attempts at strength test for hypertensive patients. Therefore, the aim of this study was to evaluate the behavior of the hypotensive effect in components of blood pressure in two different post-test of 10 maximum repetitions (10 RM). Methods 20 hypertensive on medication, 18 women and 2 men, with no experience on strength training, were subject an adaptation of 6 sessions and remained without training at the 72 hours before evaluation. A test of 10RM evaluated the strength of the arms (MS) in bench press and legs (MI) in leg extension. The interval between each set was 5 minutes. Trying to find the average of arterial pressure (MAP) before each attempt of 10RM (PRÉ), at intervals of 2 (2PÓS) and 4 (4PÓS) minutes, was measured systolic and diastolic pressures by auscultation. Data were expressed with values of central tendency (mean) and dispersion (standard deviation). Results The MAP not presented significant differences between periods analyzed when done for MI test, PRE (97,1±5,04); 2PÓS (97,7±6,57) and 4POS (95,8±5,48), p=0,56, like for MS, PRE (94,9±6,28); 2PÓS (96,8±7,17) and 4POS (95,1±6,33), p=0,62. Discussion The results of the present study identified no significant differences in the periods analyzed (POS2) and (POS4) in MAP. Whereas the 10RM test requires the subject intensities increasing as we approach the end of the test, and that the SBP and DBP rise progressively reaching the highest values in the last repetitions (MACDOUGALL et al., 1985), the ranges proposed in this study were insufficient to promote significant reduction in the values of MAP. Regarding the acute effects of resistance exercise highlights the post-exercise hypotension after exercise (BRUM et al., 2004), which was most evident in the hypertensive than normotensive (FORJAZ et al., 2000). References Brum PC, Forjaz CLM, Tinucci T, Negrão CE. (2004). *Rev Paulista de Educação Física*, 18, 21-31. Forjaz CLM, Tinucci TA, Ortega KC, Santaella DF, Mion DJ, Negrão CE. (2000). *Blood Pressure Monitoring*. 5, 255-262. MacDougall JD, Tuxen D, Sale DG, Moroz JR, Sutton JR. (1985). *J Appl Physio*, 58,785-790.

### **THE POWER DOPPLER ANALYSIS OF VASTUS LATERALIS MUSCLE VASCULARITY IN EXERCISE**

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INTRODUCTION Muscle structure and morphology can change with workout or physical exercise (1). During the exercise metabolic changes occur and blood flow within the muscle changes (2). Ultrasonography is an imaging technique useful to study the muscle morphology in physiological and pathological conditions (3). Power Doppler (PD) is a relatively new technique that significantly improves the sensitivity of ultrasound B-mode and reflects the blood flow in the tissues (4). PD provides a sensitive indication of muscle activity even with low contraction levels (5). The main goal of this study is to analyze if there is any flow blood alteration within the vastus lateralis muscle. METHODS Forty two healthy males volunteers (mean age 21±3 years) performed isometric and isokinetic contractions in different angles, with an isokinetic dynamometer. Ultrasound images in transverse plane of vastus lateralis muscle were acquired, before and after exercise, using PD to evaluate blood flow and quantified using MATLAB software. RESULTS With exercise, all 42 vastus lateralis muscles showed a significant subjective increase in apparent vascularity (p < .005). CONCLUSION Some studies showed changes in gastrocnemius muscle vascularity with Exercise-induced (2;6). This study, also, presents that PDS revealed marked increases in vascularity intramuscular after exercise. References 1. Ghamkhar, L. et al; Application of Rehabilitative Ultrasound Assessment of Low Back Pain: A Literature Review; *Journal of Bodywork and Movement Therapies*; N° 14; 2011 2. Newman, J., et al; Power Doppler Sonography: Use in Measuring Alterations in Muscle Blood Volume After Exercise; *AJR*:168; 1997 3. Vlychou, M. et al; Ultrasound of Muscle; *Curr Probl Diagn Radiol*; September 2008 4. Hodges P., et al; Inefficient Muscular Stabilization of the Lumbar Spine Associated with Low Back Pain. A Motor Control Evaluation of Transversus Abdominis; *Spine*, N°21; 1996 5. Gubler, D., et al; Ultrasound Tissue Doppler Imaging Reveals No Delay in Abdominal Muscle Feed-Forward Activity During Rapid Arm Movements in Patients With Chronic Low Back Pain; *SPINE* V.35, N°16, 2010 6. Hirsch W, et al; Colour Doppler imaging analysis for tissue vascularity and perfusion: a preliminary clinical evaluation; *Ultrasound Med Biol*; 1995

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## MYOCELLULAR ADAPTATIONS TO STRENGTH TRAINING IN POSTMENOPAUSAL OSTEOPOROTIC WOMEN

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**Introduction** Osteoporosis is associated with reduced muscle strength and muscle mass, and genetically predispositions may be involved in the accelerated decline in bone mass and muscle strength in some women (1). Nevertheless, we have earlier reported that postmenopausal osteoporotic women respond normally to heavy load strength training with increases in muscle strength of 30-40% and increased cross sectional area of thigh muscles of 7-8% after 15 weeks of training (2). However, the muscle cellular adaptation to strength training is so far not investigated in this patient population. Consequently, the aim of this study was to investigate changes in muscle fiber area, fiber distribution and the satellite cell response to 15 weeks of heavy load strength training in postmenopausal women. **Methods** A total of 22 osteoporotic women between 56 and 80 years of age were recruited from an earlier cross sectional study (1). The strength training was conducted three times per week for 15 weeks. After an initial familiarization to training over 2 weeks, strength training was performed with one to three 4-12 RM sets in squats, standing calf rise, leg press, rowing, chest press and shoulder press. Biopsies were collected from m. vastus lateralis before and after the training period. Muscle cross sections were analyzed for fiber types, fiber area and number of satellite cells and myonuclei using standard immunohistological techniques. **Results** There were no significant changes in muscle fiber area from pre to post training for neither type I fibers ( $4175 \pm 947$  vs.  $3942 \pm 1133 \mu\text{m}^2$ ) nor type II fibers ( $2829 \pm 847$  vs.  $2966 \pm 1105 \mu\text{m}^2$ ). Furthermore, there was no change in fiber type distribution from pre to post training (52% type I fibers and 48% type II fibers). The number of satellite cells and myonuclei is currently under investigation. **Discussion** Surprisingly, we did not observe any increase in fiber area despite a significant increase in m. quadriceps cross sectional area of 7-8% as previously reported (2). Interestingly, the frequency distribution of fiber areas shifted towards a higher number of fibers with small to moderate areas. Further analysis will show whether there were any changes in the number of satellite cells or myonuclei. **References** 1. Reppe et al. Bone 2010 Mar;46(3):604-12. 2. Raastad et al. ECSS, book of abstract 2010.

## EFFECT OF CAFFEINE INGESTION ON PERCEPTUAL AND PHYSIOLOGICAL RESPONSES TO PROLONGED MODERATE-INTENSITY ARM CRANKING

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**Introduction** Caffeine's metabolic and performance effects have been widely reported. However, caffeine's effects on affective states during exercise are unknown. Therefore, the aim of this study is to investigate the effects of caffeine on the perception of effort and fatigue during prolonged upper limb exercise. **Methods** A randomised double blind placebo controlled crossover design was used to compare the effects of caffeine at 7.5 mg/kg and a placebo of starch at the same dose. The caffeine was consumed in gelatine capsules 45 minutes before the start of the exercise test. Fifteen Healthy young males performed 20 min of arm exercise at an intensity equivalent to 90% of individual lactate threshold, determined from a standard ramp-incremental exercise protocol. Physiological as well as rates of perceived exertion using Borg (0-10) RPE scale and Visual Analogue Scales (VAS) were assessed during the last 20 seconds of each 5 minutes of the test and during three stages of post exercise. A 2-way repeated measures ANOVA was used to test the differences between the caffeine and the placebo responses. **Results** Caffeine ingestion produced no significant effect on RPE, (VAS), blood lactate concentration, peak oxygen uptake or peak minute ventilation. However, heart rate (HR) levels (mean +/- SD) were significantly higher after caffeine consumption than after placebo use at 15 min:  $144 \pm 4 \text{ b} \cdot \text{min}^{-1}$  vs  $134 \pm 4 \text{ b} \cdot \text{min}^{-1}$ , at 20 min:  $149 \pm 4 \text{ b} \cdot \text{min}^{-1}$  vs  $136 \pm 4 \text{ b} \cdot \text{min}^{-1}$ , at 2 min post exercise:  $116 \pm 4 \text{ b} \cdot \text{min}^{-1}$  vs  $106 \pm 3 \text{ b} \cdot \text{min}^{-1}$ , at 4 min post exercise:  $110 \pm 3 \text{ b} \cdot \text{min}^{-1}$  vs  $102 \pm 3 \text{ b} \cdot \text{min}^{-1}$ , and at 6 min post exercise  $106 \pm 3 \text{ b} \cdot \text{min}^{-1}$  vs  $100 \pm 3 \text{ b} \cdot \text{min}^{-1}$ . **Conclusion** Our findings indicated that except for the significant differences in HR responses, no noticeable variations were found in gas exchange, blood lactate or RPE responses between caffeine and placebo arm exercise trials.

## Physiotherapy

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## ACUTE EFFECT OF PELVIC PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUES IN CHRONIC LOW BACK PAIN

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**Introduction** Chronic low back pain (CLBP) constitutes a major proportion of disabling musculoskeletal conditions. Exercise is one of the most frequently used modalities in the rehabilitation of subjects with low back pain (Kofotolis et al., 2005; Malkia E et al., 1996). Proprioceptive neuromuscular facilitation (PNF) exercises are designed to enhance the response of neuromuscular mechanisms by stimulating proprioceptors (Voss et al, 1985). The aim of this study is to examine the acute effect of pelvic PNF exercises on pain, functional mobility, lumbar mobility, sacroiliac joint mobility in patients with CLBP. **Methods** Eleven participants with CLBP were participated (age= $58.36 \pm 13.07$  years). Pain intensity was evaluated with Visual Analog Scale (VAS) (Dickson et al., 1981). Functional mobility was assessed with Timed up Go Test (Podsiadlo et al., 1991) and Step-Up Tests (Jacobson et al., 2011). Lumbar mobility was assessed with trunk forward flexion, trunk lateral flexion, trunk rotation and trunk hyperextension tests (Mitchell et al., 1979). Sacroiliac joint mobility was evaluated with Gillet Test (Potter et al., 1985). All evaluations were performed before and after treatment. Treatment program including conventional physiotherapy consist of hotpack, ultrasound and TENS and pelvic PNF exercises. **Results** Significant differences were found in Timed Up and Go Test, Gillet Test on right side, Gillet Test on left side, trunk forward flexion, trunk right lateral flexion, trunk left lateral flexion, trunk hyperextension tests, step-up test with left leg, VAS ( $p < 0.05$ ). No significant difference was found in trunk rotation and step-up test with right leg ( $p > 0.05$ ) before and after treatment. **Discussion** According to our results pelvic PNF exercises enhance functional mobility, lumbar and sacroiliac joint mobility and decrease pain. Pelvic PNF exercises should be used in CLBP in physiotherapy programmes. Further studies are needed to conduct with larger sample size and investigate long-term effects of PNF exercises in CLBP. **References** Jacobson BH, Thompson B, Wallace I, Braun L, Rial C. (2011). Clin Rehabil, 25(6), 549-556. Kofotolis N, Sambanis M. (2005). J Sports Med Phys Fitness, 45, 84-92. Malkia E, Ljunggren AE. (1996). Scand J Med Sci Sports, 6, 73-81. Mitchell FL, Moran PS and Pruzzo NA. (1979). An Evaluation and Treatment Manual of Osteopathic Muscle Energy Procedures, Valley Park, Missouri. Podsiadlo D, Richardson S. (1991). J Am Geriatr

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### **ACUTE EFFECTS OF SCAPULAR PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUES IN FROZEN SHOULDER**

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**Introduction:** Frozen shoulder is a common problem in general practice (Hand et al., 2008; Hannafi et al., 2000). The scapula plays several roles in facilitating optimal shoulder function (Paine et al., 1993). Use of the scapular component of the traditional proprioceptive neuromuscular facilitation (PNF) provides useful information on the kinaesthetic awareness of the scapula (Magarey et al., 2003). The aim of our study is to analyse acute effects of scapular PNF techniques on pain, shoulder functionality, scapular dyskinesia and shoulder range of motion in patients with frozen shoulder. **Methods:** Twenty patients with frozen shoulder were randomly assigned in PNF group (PG) (n=10, age=58.10±8.03 years) and to normal physiotherapy group (NG) (n=10, age=60.00±5.81 years). Visual Analog Scale (VAS) was used to assess pain intensity (Dixon et al., 1981). Shoulder flexion and abduction were assessed with Universal goniometer (Boone et al., 1978). Simple Shoulder Test (SST) was used to measure functional limitations (Ayhan et al., 2010). Scapular dyskinesia was evaluated with Lateral Scapular Slide Test (LSST) (Kibler et al., 1998). All evaluations were done before and after interventions in two groups. NG were received wand exercises and passive stretching exercises besides conventional physiotherapy including hotpack, ultrasound and TENS. PG were performed scapular PNF exercises addition to conventional physiotherapy. **Results:** Significant differences were found in LSST (1st test position) and in active range of motion of shoulder abduction after treatment between PG and NG. (p<0.05) NG gave better results than PG in LSST (1st test position) and active range of motion of shoulder abduction. No significant difference was found in LSST (2nd and 3rd test positions), VAS, SST and active range of motion of shoulder flexion after treatment between PG and NG (p>0.05). **Discussion:** According to our results; not only scapular PNF exercises but also other physiotherapy exercise approaches besides conventional therapy can be more effective on shoulder functions. Further studies are needed to conduct with larger sample size, perform with upper extremity PNF techniques and investigate long-term effects of PNF exercises. **Reference:** Ayhan C, Unal E, Yakut Y. (2010). *Fizyoter Rehabil*, 21(2): 68-74. Boone DC, Azen SP, Lin C, Spence C, Baron C and Lee L. (1978). *Phys Ther*, 58, 1355-1360. Dixon JS, Bird HA. (1981). *Ann Rheum Dis*, 40, 87-89. Hand C, Clipsham K, Rees JL, et al. (2008). *J Shoulder Elbow Surg*, 17, 231-6. Hannafi n JA, Chiaia TA. (2000). *Clin Orthop Relat Res*, 95-109. Kibler WB. (1998). *Am J Sports Med*, 26(2), 325-337. Magarey ME, Jones MA. (2003). *Man Ther*, 8, 195-206. Paine RM, Voight ML. (1993). *J Orthop Sports Phys Ther*, 18, 386-391

### **EFFECTS OF A PREVENTIVE PROGRAM ON OPTIMUM ANGLE OF KNEE FLEXORS IN SOCCER PLAYERS**

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**Introduction** The incidence of hamstring injuries is high in soccer. A strategy commonly used to their prevention is eccentric strengthening of hamstring muscles. This exercise type has shown to increase the optimum angle of peak torque, which may result in greater structural stability at longer muscle lengths 1. Thus, the objective of this study was to assess the effects of a preventive eccentric and plyometric program on optimum angle of the knee flexors in soccer players. **Methods** Fifty male players were assigned to an intervention group (EG, n=27) or a control group (CG, n=23) in according to position and starting or substitute condition. Over the seven-week period of preventive training, two players from the EG suffered an anterior cruciate ligament and ankle sprain injury and two athletes from the CG suffered a low back and shoulder injury. Others were excluded by leaving their club or personal reasons. After these exclusions, 25 (22.8 ± 5.0 years, 174.8 ± 5.5 cm and 70.6 ± 8.3 kg) and 19 (22.1 ± 2.7 years, 176.8 ± 6.3 cm and 70.7 ± 6.8 kg) players constituted the EG and CG, respectively. Both groups performed regular soccer training during the seven-week period. The hamstring strength was assessed through an isokinetic concentric test in sitting position at velocity of 60°/s, 6 maximal contractions were measured. The second, third, fourth and fifth contractions were averaged for the determination of the optimum angle by fitting a 4th order polynomial curve 2. These measurements were repeated before and after of the intervention period for both groups. Data was analyzed with general linear model of repeated-measures, the priori level of statistical significance was set at p≤0.05. **Results** Significant different were observed in the optimum angles of knee flexors of the non-dominant leg of the EG (EG: 41.46 ± 2.2° pre-test and vs 36.13±2.4° post-test; p=0.030). Secondly, also were found significant different for non-dominant leg between both groups (EG: 36.13 ± 2.4° vs CG: 42.7 ± 2.4°; p=0.40). **Discussion** As claimed other authors 2, a preventive program of eccentric strengthening increases the optimum angles of the knee flexors. However, in our study such differences only were observed in the non-dominant leg of the EG, due to a difference in the optimum angle of knee flexors of each leg in pre-test. **References** 1. Brughelli, M. & Cronin, J. *Sports Med*, 37(9). 2. Brughelli, M., Mendiguchia, J., Nosaka, K., Idoate, F., Los Arcos, A., Cronin, J. *Phys Ther Sport*, 11.

## **Psychology**

### **INFLUENCE OF PSYCHOLOGICAL FACTORS ON FOOTBALL INJURIES**

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**INTRODUCTION:** Current literature demonstrates that injury may have important psychological implications for competitive athletes including disruptions in mood state, a loss of positive social identity and uncertainties regarding the prospects of a return to pre-injury competitive levels. However, there is limited knowledge on the influence of psychological factors on football injuries. The aim of this study was to examine how much an injury-prone personality profile and symptoms of generalized anxiety disorder can influence the risk of injury in adult football players. A self-administered questionnaire inquired about the anxiety disorders as well as personality traits. **METHOD:** a population of 100 football players was divided into 3 groups: 52 players aged 18-25 yrs, 32 players aged 26-35 yrs, 16 players aged 36-45 yrs. Data gathering was based on an epidemiological questionnaire, the Big Five Questionnaire (Caprara, et al, 1993) and the Stai - Trait Anxiety Inventory with subscales Y-1 and Y-2 (Spielberger, et al, 1968). The participants were asked to rate questions using test-specific scales. Factor analysis of the data was performed and the matrices of correlation were tested with Principal Components (Oblimin Rotation) using SPSS software (Statistical Package for Social Sciences). Factor analysis simplified the variables, and the most

significant ones were interpreted. The Big Five broad factors (dimensions) of personality traits are: Extraversion -Agreeableness - Conscientiousness – Neuroticism-Openness to Experience The STAI Form Y measures anxiety and clearly differentiates between the temporary condition of “state anxiety” and the more general and long-standing quality of “trait anxiety”. RESULTS: Our football players were mainly midfielders (39) and defenders (31), with most active for > 10 yrs. Clinical examination revealed that most prevalent injuries were muscle and ankle strains (68%) and most injured anatomical structures were ligaments followed by tendons. Big Five factors and Stai were significantly correlated ( $R = 0.58, P < 0.01$ ) and also muscle-tendon strains with Stai Trait Inventory. DISCUSSION: There is a growing realisation that psychological factors, such as stress and anxiety, may also play a role in the frequency and extent of injury. The findings support suggestions that psychological measures have utility in predicting football injuries, as confirmed also for their validity in predicting injuries in elite athletes (Ivarsson et al. 2010). References: A. Holme, et al.: Risk factors for injuries in football. *Am J Sports Med*, 2004 Ivarsson A., Johnson U.: Psychological factors as predictors of injuries among senior soccer players. A prospective study. *JSSM*, 2010

### **THE EFFECT OF MENTAL TRAINING IN COLLEGIATE WOMEN'S FOOTBALL PLAYERS. : AN EXAMINATION OF PSYCHOLOGICAL COMPETITIVE ABILITY.**

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Introduction Psychological skills are very important factor in football games. And Psychological competitive ability is one of important factors in perform peak performance in football games, too. The purpose of this study was to examine the effect of mental training in collegiate women's football players. Methods Twenty-one female players (age:  $19.4 \pm 0.9$  years, 5 forwards, 6 midfielders, 8 defenders, 2 goalkeepers), who belong to the Aichi women's football division I league, participated in this study. They provided mental training program at 20 weeks. The effects of mental training were investigated using DIPCA 3. Results 8 factors of Psychological competitive abilities were increased after mental training program. Especially, they are significant increased Patience and Volition for self-realization ability. Discussion This mental training program was effectiveness for Collegiate Women's Football players. But all factors weren't increased after mental training program. Furthermore, it is necessary to improve this mental training program. References Otake M (2006) An Examination of Psychological Competitive Ability in Soccer Players-A Comparison between the Universiade Soccer Players of Japan and Korea-Football Science (3)9-14.

### **DECISION MAKING AND PERFORMANCE IN VOLLEYBALL. A STUDY IN TRAINING STAGES.**

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Introduction In the study of the decisional process in sport there are variables that interact to result in a specific decision in a game situation (Garcia et al., 2011). In this sense, the relationship between performance and cognitive variables was studied in various sports, such that players who showed a higher success in the decision reached a higher level of performance (Nielsen & McPherson, 2001). The goal of the study was to analyze decision-making and performance, depending on the role of game play volleyball players in action defense. Methods The sample was composed of 10 Under-16 players. The independent variable was game function, differentiating between defense specialists and non-specialists. The dependent variables were decision making, evaluated by the GPAI of Oslin et al. (1998) adapted for defense in volleyball, and performance in the defense action, measured by the statistical system FIVB (Coleman, 1975). Results No significant differences were found, based on the function involved nor in decision-making ( $F_{1,8} = 2.02, p = .193; \eta^2 = .202$ ), or performance in the defense action ( $F_{1,8} = .39, p = .548; \eta^2 = .047$ ). Discussion The results show that in formative stages, specializing in defense is not a determinant factor for sports performance in this action game. Thus, players who are at the beginning of sports training should conduct a comprehensive training in the different roles involved in volleyball. Subsequently, in a progressive manner, functional specialization will be structured, first defining the setter, and finally, the defense specialists, such as the libero (Mesquita et al., 2001). References Coleman, J.E. (1975). A statistical evaluation of selected volleyball techniques at the 1974 World's Volleyball Championships. Thesis Physical Education. Brigham Young University. García, L., Araújo, D., Carvalho, J., & Del Villar, F. (2011). Panorámicas de las teorías y métodos de investigación en torno a la toma de decisiones en tenis. *Revista de Psicología del Deporte*, 20(2), 645-666. Mesquita, I., Marques, A., & Maia, J. (2001). Relação entre a eficiência e a eficácia no domínio das habilidades técnicas em voleibol. *Revista Portuguesa de Ciências do Desporto*, 3(1), 33-39. Nielsen, T.M. & McPherson, S.L. (2001). Response selection and execution skills of professionals and novices during singles tennis competition. *Perceptual and Motor Skills* 93, 541-555.

### **TRACING THE PERSONOLOGICAL PROFILE OF INJURY-PRONE SOCCER PLAYERS**

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INTRODUCTION In recent years a new line of research studies confirmed the relationship between the main personality traits and the injury risk, especially among soccer players (Johnson and Ivarsson, 2013). In addition, findings from other studies, including soccer players as participant, suggest that psychological factors such as competitive stress, anxiety and daily hassles are associated with increase injury risk (Adie, Duda et al., 2010). The aim of this study was to trace an early personological profile of the male soccer players who are prone to injuries. METHOD: The participants of the study were 100 soccer male players (aged 18 to 45 years), 37 defenders, 39 midfielders, 24 strikers. Each player filled in a qualitative questionnaire about his personal characteristics and sport practice (trainings, matches, etc.) and any previous injury. The participants also completed the Big Five Questionnaire (Caprara et al, 1993), that studies the big personality traits (open-mindedness, conscientiousness, energy, agreeableness, neuroticism/emotional stability). RESULTS: The data were tested for correlations between personality traits and number of injuries (divided in specific types). Meniscal injuries were positively correlated with conscientiousness ( $\rho = 0.209, p < 0.05$ ); tendinopathies were negatively correlated with agreeableness ( $\rho = -0.223, p < 0.05$ ), emotional stability ( $\rho = -0.280, p < 0.05$ ) and open-mindedness ( $\rho = -0.200, p < 0.05$ ). Fractures were also negatively related with agreeableness ( $\rho = -0.255, p < 0.05$ ) and emotional stability ( $\rho = -0.376, p < 0.01$ ). Personality differences between subjects who reported injuries and those that did not were also explored. Players with past meniscal injuries were found to be also more conscientious (Mann-Whitney's Test,  $p < 0.05$ ); players with past tendinopathies had lower values of agreeableness (T test,  $p < 0.05$ ), emotional stability and open-mindedness (T test,  $p < 0.05$ ); finally players with past microfractures (tiny breaks) had lower values of agreeableness and emotional stability (Mann-Whitney's Test,  $p < 0.05$ ). DISCUSSION: Soccer players with past injuries tend to show a more neurotic profile (less emotionally stable), but also other personality traits tied to specific types of accidents which warrant further investigation. REFERENCES Ivarsson

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### **SOCIAL ENVIRONMENT, NEED SATISFACTION AND WELL-BEING IN HIGH-PERFORMANCE ATHLETES**

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**Introduction** The Basic Need Theory, a sub-theory in the self-determination theory framework (SDT; Deci & Ryan, 2000) has postulated that an autonomy supportive environment should promote athletes' well-being and these associations will be mediated by the satisfaction of the three psychological needs (autonomy, competence and relatedness). In this study a model was proposed testing the hypothesized associations between athletes' perceptions of coach autonomy support, need satisfaction, and three indicators of well-being. It was hypothesized that as more autonomy support the athletes perceive more needs satisfaction will be informed and in turn more well-being will be perceived. **Methods** A total of 137 athletes (male = 51 and female = 86) from different sports training at the Centre de Tecnificació Esportiva de Esplugues de Llobregat (Barcelona, Spain), ranging in age from 14 to 18 years ( $M = 15.6$ ;  $SD = 1.02$ ), participated in this study. All participants had been practicing sport 4 days per week ( $M = 4.36$ ;  $SD = 0.65$ ), for over 4 hours per day ( $M = 3.80$ ;  $SD = 1.04$ ) and had worked with their coach for 2 years ( $M = 2.26$ ;  $SD = 1.12$ ). Participants completed a multi-section inventory including the Spanish adaptations of: Sport Climate Questionnaire (SDTwebsite; Balaguer et al., 2009; Subscale of Perceived competence from the Intrinsic Motivation Questionnaire (McAuley et al., 1989; Balaguer et al., 2008); The scale of the need for autonomy (Reinboth and Duda, 2006; Balaguer et al., 2008); The acceptance subscale of the need for relatedness scale (Richer and Vallerand, 1998; Balaguer et al., 2008). The subjective vitality scale (Ryan and Frederick, 1997; Balaguer et al., 2005) Subscale of Self-esteem of Self-Description Questionnaire III (SDQ-III, Marsh et al., 1994; Balaguer, Castillo, & Duda, 2008); and Satisfaction with life scale (Diener et al., 1985; Aienza et al., 2000). **Results** Structural Equation Modeling analyses showed athletes' perceptions of coaches' autonomy support positively predicted their psychological need satisfaction ( $B=0.40$ ). Finally, subjective vitality ( $B=0.58$ ), life satisfaction ( $B=0.41$ ) and self-esteem ( $B=0.49$ ) were positively predicted by the psychological needs satisfaction. **Discussion** Overall, findings support the importance of social psychological atmosphere in order to predict well-being via psychological need satisfaction. **References** Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227-268.

### **TESTING THE MULTI-ACTION PLAN INTERVENTION MODEL: A MULTI-METHOD ASSESSMENT WITH ELITE SHOOTERS**

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**Do not insert authors here** **Introduction** The multi-action plan (MAP) model reflects the notion that different psycho-bio-social states underlie distinct performance-related experiences. Previous empirical evidence suggests that attentional focus, affective states, and psychophysiological patterns differ among optimal-automatic (type 1), optimal-controlled (type 2), suboptimal-controlled (type 3), and suboptimal-automatic (type 4) performance experiences (Bortoli et al., 2012; Bertollo et al., in press). The aim of this study was to test the cortical pattern underpinning the performance categories conceptualized in the MAP model. **Methods** Five elite pistol shooters, members of the Italian Shooting Team, participated in the study. They ranged in age from 16 to 30 years and had extensive international experience. Participants performed 120 air-pistol shots at 10 meters from an official target. Following each shot, they reported perceived control and accuracy levels on a 0-11 scale. Objective performance scores were also gathered. Electroencephalogram (EEG) activity was recorded through a 32 channel system Advanced Neuro Technology (ANT). Alpha ERD/ERS analysis was performed. **Results** MANOVA analysis (2 performance  $\times$  2 control level) was conducted on the amplitude of alpha ERD/ERS assessed during the second preceding each shot. Findings revealed differences in cortical activity as related to performance categories ( $p < .001$ ). Specifically, type 1 performance (optimal-automatic) was characterized by clear ERS in the bilateral centro-parieto-occipital areas. The opposite effect was observed for type 3 performance, with clear ERD in the occipital area. Variations of this pattern were noticed for type 2 (optimal-controlled) and type 4 performance experiences. **Discussion** Overall, findings showed that lower cortical activation was associated with type 1 performance (optimal-automatic), thereby lending support to the well-established "neural efficiency hypothesis". Additionally, results confirmed that athletes may attain a good level of performance, even in conditions of low level of cortical arousal, when exerting control of idiosyncratic core components of action. These findings are congruent with the MAP framework, in which unique psycho-bio-social states underlie distinct performance-related experiences. **References** Bertollo, M., Bortoli, L., Gramaccioni, G., Hanin, Y., Comani, S., and Robazza, C. (In press). Behavioural and psychophysiological correlates of athletic performance: A test of the multi-action plan model. *Applied Psychophysiology and Biofeedback*. Bortoli, L., Bertollo, M., Hanin, Y., and Robazza, C. (2012). Striving for excellence: A multi-action plan intervention model for shooters. *Psychology of Sport and Exercise*, 13, 693-701.

### **EFFECTS OF SPORTS CLUB MEMBERSHIP, SEX, AND AGE ON PHYSICAL SELF-CONCEPT AND GOAL ORIENTATION IN GERMAN PRIMARY SCHOOL CHILDREN**

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**Introduction** The development of both a positive self-concept and an adequate goal-orientation is generally seen as a crucial factor in childhood and adolescence (e.g., Harter, 2007). Due to its social and performance-orientated structure, sport acts a socializing agent and plays an important role for the setting of these individual attributes (e.g., Conzelmann et al., 2011). However, little is known about the status quo of physical self-concept and goal-orientation in children of primary school age and in which extent it is affected by sports club membership, sex, and age. The aim of the present study was to analyze these relationships. **Methods** A sample of 365 primary school children of second ( $n = 176$ ,  $Age = 7.5$ ) and fourth grade ( $n = 189$ ,  $Age = 9.5$ ) completed questionnaires of physical self-concept and goal-orientation (see Lohbeck et al., under review). Items were reduced and linguistical simplified to be suitable for primary school children; in case of lack of understanding they were explained by the first author. Overall, the validation of modified questionnaires led to satisfying results (see Lohbeck et al., under review). **Results** Data were analyzed in separate  $2 \times 2 \times 2$ -ANOVAs with physical self-concept and goal-orientation as dependent variables. With regard to the physical self-concept, children belonging to a sports club reported significantly higher values than non-involved children,  $F(1,357) = 54.51$ ,  $p < .001$ ,  $\eta^2 = .13$ , as well as boys than girls,  $F(1,357) = 9.93$ ,  $54.51$ ,  $p < .01$ ,  $\eta^2 = .03$ . Age had no effect,  $F(1,357) = 1.56$ ,  $p > .2$ . Relating to goal-orientation, sports club membership and sex had

effects only on some subscales, however, second graders generally scored higher values than fourth graders, e.g.,  $F(1,357) = 22.64, p < .001, \eta^2 = .06$ . Discussion Findings show that yet in primary school age being in a sports club has a positive effect on the physical self-concept. The difference between boys and girls was found in prior studies too and has to be considered as a gender effect. Surprisingly, 7-year-old children demonstrated stronger achievement goals and motivation than 9-year-old children. Further studies should include motor performance tests to assess not only the level of physical self-concept but also its veridicality. References Conzelmann, A., Schmidt, A. & Valkanover, S. (2011). *Persönlichkeitsentwicklung durch Schulsport*. Huber: Bern. Harter, S. (2007). The self. In N. Eisenberg (Ed.), *Handbook of child psychology* (pp. 505-570). New York: Wiley. Lohbeck, A., Tietjens, M. & Bund, A. (under review). Das physische Selbstkonzept, die Bezugsnormorientierung und die Zielorientierung bei Grundschulkindern. *Zeitschrift für Sportpsychologie*.

## OPTIMIZING SELF-EFFICACY AND ANXIETY THROUGH COMPREHENSIVE COMPETITION PLANS IN CYCLING

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**Introduction** A common issue for athletes is the effect of pre-competitive anxiety on performance. This includes both the intensity and direction (interpretation) of anxiety. Self-efficacy is thought to be an important antecedent and mediator of anxiety (Hall et al., 1998) in that high efficacy individuals may view anxiety as a sign of psychological readiness whereas low efficacy competitors are more likely to perceive it as a sign of stress. To address athletes' psychological preparation, Arruza et al. (2009) noted that pre-competition plans can have a positive effect on perceived performance and anxiety, and that more emphasis should be placed on the development of such plans. Therefore, the aim of this study was to examine the effect of comprehensive competition plans on anxiety and self-efficacy among competitive cyclists in Barbados. **Methods** Eight competitive cyclists (aged 15-28 years) took part in a four-week program in which they learned to formulate and follow several pre-race plans during training. The plans were broken down into race segments and included imagery as well as mood-related cue words. At the end of this education period, the athletes developed similar plans for a competitive event. Data on four anxiety measures (cognitive and somatic anxiety intensity and direction) and self-efficacy were collected before and after the program via the CSAI-2 (Martens et al., 1990) and a two-item self-efficacy measure, respectively. Changes in the dependent variables were assessed through paired samples t tests while regression analyses were used to test whether self-efficacy could predict participants' scores on the four anxiety measures. **Results** After the program, there were significant decreases in cognitive and somatic anxiety intensity as well as more positive interpretations of somatic anxiety. However, there were no significant differences in self-efficacy. Of the eight regression analyses conducted, self-efficacy emerged as a predictor of cognitive anxiety intensity and somatic anxiety direction. **Discussion** The findings suggest that competition plans can decrease cyclists' anxiety intensity, likely through the knowledge of what needs to be done and what their abilities will allow them to do at different stages of a race. It is also possible that reductions in somatic (or bodily) anxiety intensity can lead to more facilitative somatic interpretations through a sense that physical symptoms are indicative of an excitement and confidence about taking on the various race segments as practised in the competition plans. Current evidence suggests that to reduce or optimize anxiety, competition plans should be developed for specific phases of races and sports competitions. **References** Arruza JA, Tellechea S, Gil de Montes L, Arribas S (2009). *Per & Mot Skills*, 109, 304-314. Hall HK, Kerr AW, Matthews J (1998). *J Sport & Exer Psych*, 20, 194-217. Martens R, Burton D, Vealey RS, Bump LA, Smith DE (1990). *Competitive anxiety in sport*, 117-213. *Human Kinetics, Champaign IL*.

## CORRELATION BETWEEN BMI AND COGNITIVE FUNCTIONING IN SCHOOL PUPILS IN TIRANA ALBANIA

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**CORRELATION BETWEEN BMI AND COGNITIVE FUNCTIONING IN SCHOOL PUPILS IN TIRANA ALBANIA** **Introduction** The study tested the effect of physical development on executive functions in (7 to 14 years age) children. Pupils in this age represent a wide diversity of their development profile which differs in the terms of physical and cognitive parameters. Pupils have a great need for physical activity that comes out through the leisure time games they play or improvise. **Cog. funct. & executive funct.** in pupils may be particularly sensitive under the influence of increased physical activity, related to BMI changes. But how is the correlation between the physical development (BMI) and executive functions in inactive and active pupils, or in those who become active by increasing physical activity. **Methods** In this study participated 187 children (91 m. & 96 f.) from 1st to 7th grade. Conducted tests were: 1) RT to simple acoustic stimuli 9.86ms ( $\pm 1.92$ ), RT to simple visual stimuli 326.8 ( $\pm 1.11$ ), Attention control test 0.60 ( $\pm 1.18$ ). **Correl. analysis** was applied using P. **Correl.** if there is any correlation between the test scores and the child ability to these cognitive redevelopment parameters. **The Results of P. correlation coeff. and p-values (2-tailed) between BMI and cogn. tests revealed:** a) a significant positive correlation between scores of RT to simple visual and acoustic stimuli. ( $p=.78$ ). b) a significant positive correl. between BMI and balance test ( $p=0.21$ ). **One-way ANOVA** was used to evaluate diff. based on gender and age, **And pointed out:** a) no significant differences between males and females. b) **Signif.diff.** between grades. **Results** The results of Pearson correlation coeff. and p-values (2-tail.) between BMI and the cognitive tests revealed: a) there was a significant positive correlation between scores of RT to simple visual and acoustic stimuli  $p=.78$  related to BMI. b) There was a significant positive correlation between BMI and balance test  $p=0.21$  related to BMI. **One-way ANOVA** was used to evaluate diff. based on gender and age. **ANOVA results pointed out:** a) there were no significant diff. between m&f. b) There was significant diff. between grades (from 1 to 7). **References** Bouchard, C. 1994. Genetic of Obesity; CRC Pres. Bouchard, C...1993. Genetic and non genetic determinants of regional fat distribution. *Endocrinology Review* 14. Carlson S. M. Development. sensitive measures of executive function in preschool children. *Develop. Neuropsych.* 2005. Deurenberg, P.1991. BMI as a measure of body fatness: age and sex specific prediction formulas. *British Journal of Nutrition* 65 Engeland A... BMI in adolesc. in relation to total mortality: 32year followup of 227,000 Norw. m & f. 2003. Hillman CH,... Aerobic fitness and neurocog. funct. in healthy preadolescent children. *Med. & Sci. in Sp. & Exer.* 2005. Welsh M. C, ... Executive functions in developing children: ..In: McCartney Handb. of Early Childhood Development. Blackwell Pub. 2006

## STRUCTURAL EQUATION MODELING OF THE EFFECT OF COACH LEADERSHIP STYLE ON TEAM COHESION OF HIGH PERFORMANCE INDOOR SOCCER TEAMS

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**Introduction** The development of sports group is characterized by being a dynamic process with constant changes in the processes of interaction and comprises a system of mutual connections of roles and relationships among group members (TRNINIC et al., 2008). In

this context, leadership style is considered a crucial factor for the development of group cohesion, cohesion being a psychological variable critical to the performance and success of a sports team (CARRON; HAUSENBLASS; EYS, 2005). Therefore, this study aimed to validate a predictive model concerning Coach Leadership and Group Cohesion in indoor soccer teams. Methods Participants included 120 male adult indoor soccer athletes from eight teams competing in the Brazilian Professional League, Brazil. Instruments for data collection were the Leadership in Sport Scale (LSS) and the Group Environment Questionnaire (GEQ). Data analysis was conducted through Structural Equation Modeling ( $p < 0.05$ ). Results Results evidenced a good model fit indicators for the proposed model (effect of coach leadership in social and task cohesion) and significant trajectories between all the variables ( $CF > 0.50$ ); the coach leadership style characterized as democratic and based on social support, reinforcement and training-instruction influenced positively task cohesion ( $CF = 0.70$ ) and moderately social cohesion ( $CF = 0.37$ ). Discussion For the indoor soccer from the state of Parana, the coach's leadership style based on democratic, reinforcement, social support and training-instruction behaviors is determinant to the development of task cohesion; however, it doesn't have the same importance for social cohesion. Carron, Eys and Hausenblass (2005) suggest that the higher the competitive level of the team is the smallest is the influence of the coach in social aspects of cohesion. Jowett and Chaundy (2004) emphasize that the leadership behaviors of training, education, democratic leader, support and feedback predict more task than social cohesion. Moreover, this study allows us to have a better understanding about the relationship between the variables and the importance of the coach to the development of team cohesion. References Carron AV, Hausenblass AA, Eys MA. (2005). *Group Dynamics in Sport*. Morgantown, WV: Fitness Information Technology. Jowett S, Chaundy V. (2004). An investigation into the impact of coach leadership and coach-athlete relationship on group cohesion. *Group Dynamics: theory, research and practice*, 8(4), 302-311. Trninic V, Papic V, Dimec T. (2008). Concepts of developing groups in sports games. *Acta Kines*, 2(2), 85-92.

### **LEADERSHIP STYLE OF COACHES OF HIGH PERFORMANCE BRAZILIAN INDOOR SOCCER TEAMS**

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Introduction The literature has pointed out that a great sports coach is one that offers good support to the athletes, providing strategies and resources for developing athletes' performance and achieving the goals of the team. Thus, he may be considered a key factor for the athlete's performance in games and competitions (CHELLADURAI, 2007). Therefore, the goal of this study was to analyze the leadership style of coaches of high performance Brazilian indoor soccer teams. Methods The study included 122 athletes - members of eight indoor soccer teams participating in a Brazilian Professional League and their respective coaches, totaling 130 subjects. The instruments used were the Leadership Scale for Sports and a semi structured interview. For data analysis, it was applied the Kolmogorov-Smirnov, the Mann-Whitney ( $p < 0.05$ ) and Content Analysis. Results Athletes perceived that their coaches behavior is based mainly on training-instruction ( $Md = 4.2$ ), reinforcement ( $Md = 4.1$ ) and social support ( $Md = 3.7$ ); by comparing the coaches' self-perception, the perception and preference of athletes, it was found significant difference between athletes perception and preference in "training-instruction" "reinforcement" and "autocratic" dimensions. This finding shows that athletes would like their coaches provide further instruction and reinforcement during training and more autocratic in their decisions; in the analysis of the interviews it was found that athletes realize that their coaches are participatory during training and games, however, that such participation could be more intense, with more demonstration of authority. Discussion Our results indicate that there is a strong tendency for coaches to value more the behavior of training-instruction, reinforcement and social support, and the preference of athletes by autocratic style, which is confirmed by the literature (Chelladurai, 1990; Vincer and Loughhead, 2010). Thus, for the sporting context of high performance Brazilian indoor soccer, the leadership style is more oriented to optimize the athletes performance, emphasizing the instructions about the skills, techniques and strategies, which enables a positive feedback (reinforcement) regarding performance. References Chelladurai P. Leadership in sports: a review of relevant research. *Int J Sport Psych* 1990; 21:328-354. Chelladurai P. Handbook of Sport Psychology. In Tenenbaum G, Eklund R. (ed). *Leadership in Sports*. New Jersey, 2007, 113-135. Vincer DJE, Loughhead TM. The relationship among athlete leadership behaviors and cohesion in team sports. *The Sport Psychologist* 2010; 24(4):48-67.

### **MOTIVATIONAL CLIMATE GENERATED BY SIGNIFICANT OTHERS AND LIFE SKILLS IN YOUTHS**

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Introduction The situational differences created by significant others, such as teachers, parents, coaches are reflected in the motivational climate perceived by youths and affecting their individual characteristics, such as achievement goals, self-determination, self-efficacy, skills and adaptive/maladaptive behaviors. However, there still is scarce evidence on the potential associations between a mastery vs. performance oriented climate generated by PE teachers, parents, and coaches and youths' self-perceptions in life skills which are considered protecting factors against maladaptive behaviours (WHO, 2003). Thus, this study examines if the motivational climate created by significant others (parents, coaches and teachers) and the individual motivational orientation in sports are associated with youths' self-awareness in setting goals and self-efficacy in intra- and interpersonal life skills. Methods Hundred and seventy-three junior-high school students were administered questionnaires evaluating their: (1) achievement goal orientation in sport and PE (Duda & Nicholls, 1992); (2) teacher-, parents-, and coach-initiated motivational climate (White et al., 1996; Whitehead et al., 2004; Papaioannou et al., 2007); (3) Self-efficacy in and knowledge of life skills (Caprara, 2001; Danish, 2000). Total scores for task vs. ego, mastery vs. performance, learning/enjoyment vs. worry conducive/success-without-effort scales were computed and submitted to bivariate correlation analyses. Results Pupils' task orientation and perception of mastery and learning/enjoyment climate were positively correlated with their perception of self-efficacy in positive emotion, school achievement, and social relations. Conversely, the latter except for the emotional skill were negatively correlated with a worry conducive climate generated by parents. Also, a positive correlation emerged between parents-initiated learning/enjoyment climate and pupils' self-efficacy in self-regulation and between mastery oriented climate in PE/sport and pupils' goal setting knowledge. In contrast, the latter was negatively correlated with a performance oriented, worry conducive and success-without-effort climate. Discussion Results, even though correlational in nature, highlight the role played by significant others in the development of youths' life skills, suggesting that a mastery, learning and enjoyment climate may positively contribute to it, while a climate that is performance oriented, worry conducive and reinforces success without effort may be detrimental. References Caprara, G.V. (2001). Trento, Erickson. Duda JL, Nicholls J. (1992). *J Educ Psychol*, 84, 290-299. Papaioannou, A.G., Kosmidou, E., Tsigilis, N. (2007). Champaign, IL, Human Kinetics, 35-35-56. White, S.A., Duda, J., & Hart, S. (1992). *Perc Motor Skills*, 75, 875-880. Whitehead, J., Andr e, K.V., & Lee, M.J. (2004). *Psychol Sport Exerc*, 5, 291-317. World Health Organization (2003). WHO Information Series on School Health.

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## DOES FITNESS LEVEL MODULATE VIGILANCE OF YOUTH PEOPLE?

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**Introduction:** The study of the effects of physical exercise on cognitive processing is increasing in recent years. Many studies show how physical exercise modulates cognitive processes in different population groups (see review of Hillman, Erickson, & Kramer, 2008). Vigilance is very important in sport since it regulates the ability of the athlete to maintain the attention that allows him to capture and interpret information about the context. Previous studies carried out by our research group with children from 10 to 12 years found that those who practiced a sport (football) systematically (more than 5 h/week) had better attentional performance than those who are not practicing exercise in a systematic way (less than 2 h/week). However, the design employed in the experiment refused to clarify if this effect was due to the regular practice of a sport with high cognitive load or the level of fitness of the participants. **Method:** The objective of this study was to examine whether there is any relation between the systematic practice of a sport predominantly perceptual (football), the fitness level (VO<sub>2</sub> max through the Test Course Navette and recovery of the heart rate) and the vigilance (reaction time in psychomotor vigilance task) in children aged 12-13 years (children with a level of less than 2 hrs/week practice vs footballers from lower levels of a 1st division team). **Results:** Our study has found positive relationships between fitness level and vigilance measured by a psychomotor vigilance task. **Discussion:** Our results indicate that, at least in the early ages, attentional performance seems to be more modulated by variables associated with the physical condition of the participants than the experience which could result of the systematic practice of a particular sport predominantly perceptual. **References:** Hillman CH, Erickson KI, Kramer AF: Be smart, exercise your heart: exercise effects on brain and cognition. *Nature*. 2008; 9:58-65. Tomporowski P, Ellis N. Effects of exercise on cognitive processes: A review. *Psychological Bulletin*. 1986;99(3):338-346.

## PSYCHOMETRIC PROPERTIES OF THE BASIC PSYCHOLOGICAL NEED SATISFACTION SCALE IN SPANISH YOUNG FOOTBALL PLAYERS

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Self-determination theory (SDT; Deci & Ryan, 2002) suggests that the satisfaction of the basic psychological needs for autonomy, competence and relatedness are important predictors of optimal functioning in different contexts including sport. The purpose of this study was to analyze the psychometric properties of the Spanish version of the Basic Psychological Need Satisfaction Scale in sport. The participants in the study were 2245 grassroots football players (2041 males, 201 females, and 3 did not report gender) between the ages of 9 to 16 years old ( $M = 11.49$ ;  $SD = 1.19$ ) from 188 youth football teams corresponding to 39 football clubs in four regions in Spain (Barcelona, Castellón, Lleida and Valencia) pertaining to the European Project PAPA (Promoting Adolescent Physical Activity). On average, participants had played competitively for 3 years or more and they train with their respective teams 4.66 hours per week ( $SD = 1.19$ ). The participants completed a questionnaire package which included Basic Psychological Need Satisfaction Scale in football (i.e., autonomy, competence and relatedness), and Subjective Vitality Scale. Exploratory factor analysis, Cronbach's alphas and Pearson's correlations were employed to examine scale validity and reliability. The exploratory factor analysis showed a three-factor solution: competence (6 items), relatedness (4 items) and autonomy (4 items) accounting for 52.6% of the variance, with eigenvalues after rotation of 4.7, 1.5 and 1.1 respectively. Factor correlations ranged from .30 to .56. The reliability analysis showed good internal consistency (competence  $\alpha = .79$ , relatedness  $\alpha = .76$ , autonomy  $\alpha = .60$ ). Satisfaction of the basic psychological needs in young football players maintained a significant relationship in expected accordance with subjective vitality (competence and vitality = .46; relatedness and vitality = .50; autonomy and vitality = .22), which showed evidence of the construct validity and was consistent with the theoretical predictions. In sum, the results provided evidence of construct validity of the Basic Psychological Need Satisfaction Scale in Spanish young football players. This research was funded by the European Commission under the Seventh Framework Program - Health - 223600 - as part of the Project PAPA ([www.projectpapa.org](http://www.projectpapa.org)).

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## Rehabilitation

### THE USE OF OBSERVATION IN REHABILITATION SETTINGS: APPLICATION OF AN APPLIED MODEL

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**Introduction** Over the last one hundred years there have been a variety of theoretical explanations to explain how one learns or changes behavior as a result of watching others. These theoretical orientations tended to parallel paradigms of the era and ranged from instinctual (Tarde, 1903), associative (Allport, 1924), reinforcement (Miller & Dollard, 1941), social-cognitive (Bandura, 1965-1997, Zimmerman, 2000), direct perception (Scully & Newell, 1985), and recently neurophysiological explanations (diPellegrino, Fadiga, Fogassi, Gallese, & Rizzolatti, 1992). Despite the varied theoretical orientations, little attention has been paid to how demonstrations can be used in practical settings. **Method/Results** This presentation will focus on the where, what, who, when, where, why, and how of using demonstration as suggested in a recent review that developed a model to be used by practitioners when using demonstrations (Ste-Marie, Law, Rymal, O, Hall, & McCullagh, 2012). Ninety one research papers were reviewed in developing the model. In addition observer characteristics as well as task characteristics were examined to determine the influence of all these variables on motor, cognitive, and affective outcomes. **Discussion** The model will be used as the basis for suggesting how to use demonstrations in rehabilitation settings. For example, when individuals are progressing through the rehabilitation process would it be better to show them a mastery model (someone who have already overcome the injury and is performing optimally) or a coping model (someone who is progressing through the rehabilitation process similar to your client). Other examples will be provided. **Selected References:** Ste-Marie, D.M., Law, B., Rymal, A.M., O. J., Hall, C., McCullagh, P. (2012). Observation interventions for motor skill learning and performance: An applied model for the use of observation. *International Review of Sport & Exercise Psychology*, 2012, 1-32.

## **EFFECT OF EXERCISE ON MUSCULAR STRENGTH AND QUALITY OF LIFE IN WOMEN AFTER BREAST CANCER TREATMENT**

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**Introduction** Participation in exercise program after breast cancer treatment has been significantly associated with a reduction in the risk of death and an improvement in quality of life (Holmes et al., 2005, Schneider et al., 2007). The aim of this study was to investigate the training and detraining effects of a combined resistance and aerobic training program in muscular strength and quality of life in women who have completed breast cancer treatment. **Methods** Ten women (age: 44.0±5.2 yrs) participated in a combined aerobic and resistance exercise program for 16 weeks. Training was supervised and lasted 16 weeks with a weekly frequency of 3 days per week. Muscular strength of lower limbs (10 RM) was measured at baseline, after 5 and 16 weeks of training as well as after 8 weeks of detraining. Finally quality of life was assessed with the Eortc QLQ-C30 questionnaire (ver. 3.0) at the beginning, at 16 and 24 weeks (Cull et al., 1998). **Results** The exercise training programme resulted in a significant strength improvement (leg extension: +53.1%, p<0.05, leg press: +59.9%, p<0.05) after 16 weeks. However 8 weeks of detraining, resulted in a significant reduction of muscular strength (leg extension: -20.4%, leg press: -15.3%, p<0.05). In quality of life feelings of weakness and tiredness significantly decreased by 45% and by 39% respectively while the feelings of sadness and easily anger decreased 33% (p<0.05). Finally the overall health and quality of life score was statistically improved at the end of the intervention period. **Discussion** Results of the present study indicate that combined exercise is an effective way to increase muscular strength and promote quality of life in women after breast cancer, highlighting the need for uninterrupted exercise throughout life. **References** Holmes M, Chen W, Feskanich D, Kroenke C., Colditz G. (2005). *JAMA*, 293:2479–86 Schneider C., Hsieh C., Sprod L., Carter S., Hayward R. (2007). *Annals of Oncology* 18: 1957. Cull A., Sprangers M., Bjordal K., Aaronson N. (1998). ISBN: 2-930064-15-3.

## **AQUATIC PULMONARY REHABILITATION: A PROPOSAL FOR THE PROMOTION OF HEALTH AND QUALITY OF LIFE IN PATIENTS WITH COPD.**

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**Introduction** COPD is a disease that causes changes in lung function, dyspnea and peripheral skeletal muscle dysfunction. These factors lead to exercise intolerance and progressive worsening of fitness, with the consequence of social isolation, anxiety and addiction. Hydrotherapy can be used as a treatment for being a physiotherapy technique that provides an effective systemic improvements to these individuals, improving their quality of life. The objective of present study was to evaluate the impact and effectiveness of an aquatic therapy program in patients with COPD on improving the quality of life and evaluate this process in the context of health promotion. **Methods** The methods used were the following tools for data collection, evaluation form containing patient's medical history; manometer test, peak flow test; six-minute walk, quality of life questionnaire (SGRQ). We performed an initial assessment, the volunteers were treated from the intervention of an aquatic exercise program for 12 weeks and then reassessed. **Results** According to the results we are seeing an improvement in the PI Max. and PE.Max in 75% of the participants. Yet they're significant differences between the mean values of the phases before and after 12 weeks of hydrotherapy. We can also observe that the results related to PEAK FLOW for PFE pointed out an improvement until 61% for patients after 8 weeks of training, but there were no differences between 8th and 12th weeks. For the TC6 test we can identify a little but significant improvement after 12 weeks in 75% of the subjects. Finally, from the results obtained, we observed that the study participants had an improvement in physical functional capacity, ventilatory muscle strength and the degree of airway obstruction, having a positive effect on quality of life of these people, as observed data in the questionnaire SGRQ. **Discussion** Considering that this is a cases study due to the low number of subjects studied, we believe that the hydrotherapy to patients suffering from COPD was effective in promoting improvement over expiratory muscle strength as well as functional capabilities and also in general health and quality of life assessed by SGRQ. This, together with issues of low cost, easy applicability and good acceptance of the Protocol, allows us to suggest that the adoption of hydrotherapy as a alternative practice in processes and public policies aimed at promoting the health of the population, should be strongly encouraged. **THE AUTHORS THANKS TO** Mr. JOSÉ ROBERTO JARDIM, Ph.D. ASSOCIATED PROFESSOR OF UNIFESP (BRAZIL) BY CEDING THE CEDING THE RIGHTS TO USE THE SGRQ FOR RESEARCHS IN BRAZIL. **References** CASANOVA, C, COTE, C.G; MARIN, J.M; DE TORRES, J.P; AGUIRRE-JAIME, A; MENDEZ, R. et al. The 6-min walking distance: long-term follow up in patients with COPD *Eur Respir J.* 2007;29(3):535-40. MIRANDA, E.F; MALAGUTI, C; CORSO, S.D. Disfunção muscular periférica em DPOC: membros inferiores versus membros superiores. *J Bras Pneumol.* 2011;37(3):380-388

## **THE EFFECT OF ENDURANCE AND STRENGTH TRAINING ON CHRONIC FATIGUE SYNDROME FOR WOMEN WHO HAVE COMPLETED TREATMENT FOR GYNAECOLOGICAL CANCER - A RANDOMIZED CONTROLLED TRIAL.**

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**Introduction:** Previous studies have shown that participation in physical training and educational and counselling groups may have positive effects on fatigue syndrome in the rehabilitation of cancer patients (1, 3). However, more research is demanded regarding the effects of physical training on chronic fatigue syndrome focusing on women treated for gynaecological cancer (2). The purpose of this study is to evaluate the effect of endurance and strength training on chronic fatigue syndrome for women treated for gynaecological cancer. **Methods:** Subjects: Approximately 600 women who completed curative treatment for gynaecological cancer at Haukeland University Hospital Bergen, Stavanger University Hospital and Sørlandet Hospital Kristiansand, Norway, between January 2007 and December 2011 received a request to participate, 120 accepted. A randomized controlled design was applied in this study: 1) Physical training in group, 2) Education and counselling groups, 3) Control group. The physical training group participated in two sessions per week (90 min) in a total of 16 weeks. The group training was carried out in a gym as follows; warm-up (15 min), endurance training (25 min) moderate to hard intensity, strength training (25 min), stretching and relaxation with focus on body awareness (25 min). The strength training part was performed using simple tools such as elastic bands and weights. All participants performed the same tests pre- and post-intervention and after 1 year. **Tests;** VO<sub>2</sub>peak was measured as a graded exercise test on a treadmill (Woodway, Germany) and maximal strength was measured in leg press, leg extension and chest press. Oxygen consumption was measured using a Jaeger Oxycon Pro in mixing chamber mode (Jaeger, Germany). Strength tests were performed in apparatus (Cybex International UK Ltd). The

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women were also measured for chronic fatigue syndrome. The Fatigue Questionnaire (FQ) measures the presence and intensity of fatigue symptoms and contains 11 questions where 3 items are used in this context. The total fatigue score is the sum of physical and mental fatigue. Results: Collecting data will be accomplished April 2013 and the results will be fully analysed May 2013. Discussion: The study will indicate if physical exercise, here presented as endurance training and strength training in group sessions, will have significant effects on fatigue syndrome for women treated for gynaecological cancer. References: 1. Courneya KS, Friedenrich CM et al. (2003). *Psycho-Oncology*, Vol. 12, Issue 4, pages 357-374 2. Donnelly CM, Blaney JM et al. (2011). *Gynecol Oncol*, Sep; 122(3):618-24 3. Kampshoff CS, Buffart LM et al. (2010). *BioMed Central*, 10:658

## Sociology

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### **OWNERSHIP AND GOVERNANCE OF SPANISH FOOTBALL CLUBS FROM THE FANS' PERSPECTIVE: AN EMPIRICAL EXAMINATION OF THE CONSEQUENCES OF THE COMMODIFICATION PROCESSES**

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**Introduction** During the past twenty years, Spanish football has witnessed an intense change process that has transformed some of its main structural characteristics in an extraordinary way. This process has been directly related to the commodification tendencies that have also affected other aspects of social and economic life, and it has had a strong influence on the recent evolution of football, determining aspects as varied as the greater professionalization of players, the corporatization of clubs, the proliferation of merchandising, rule-changes to draw in new customers, and a general redefinition of the competitive structures and ethos of the sport (Walsh and Giulianotti, 2001: 53). This study has set out to examine, from an empirical perspective, the social consequences of the commodification processes of football in the discourse of the sport's fans. **Methods** The analysis was based on interviews with 19 fans, 6 sport journalists and 3 professional sport managers. The fans were supporters of Valencia CF and Levante UD, two clubs with very different characteristics whose fans can be considered to represent the most frequent experiences, opinions and attitudes in Spanish football. **Results** The study has shown, in the first place, that the process of commodification has not affected the fans' feelings of identification with their clubs, although it has affected their repertoire of behaviours. A situation of hyper-consumption has been produced, which explains the growing personalization of football consumption and an intensification of the entertainment-festive dimension of attending matches at the stadiums. Secondly, the study has shown the existence of a sense of symbolic ownership of the club among Spanish fans that explains why the majority of them continue to consider themselves 'members', even though the transformation of the clubs into Limited Liability Sports Companies has turned these fans into shareholders or season ticket holders. **Discussion** This study has proposed the existence of a paradox of football, where fans' fascination with football co-exists with the feeling that the clubs are poorly managed and economically unsustainable. The tension created by these two extremes is resolved by fans distancing themselves from the club in anything not related to strictly sports-related aspects. A transformation occurs, then, of fans into hyper-spectators: consumers of the football show who voluntarily remove from the social dimension of the club. They go to the stadium looking for a psychologically pleasurable experience and only react in a critical way when their team accumulates periods of bad sports results, especially when, in addition, the playing style is not aesthetically pleasing to them. **References** Walsh, A. & Giulianotti, R.: (2001): 'This sporting mammon: a normative analysis of the commodification of sport'. *Journal of the Philosophy of Sport*, 28, 53-77

### **EVALUATION OF BODY MOVEMENTS PRESENT IN TRADITIONAL CHILDREN'S GAMES FROM THE PERSPECTIVE OF THE SOCIOLOGY OF CHILDHOOD**

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**Introduction** The field of the Sociology of Childhood changed the theoretical and methodological referential in the research on aspects of child culture (Corsaro, 2005). Part of the children's culture, the game is the child social activity and must be learned in the children's sociality context (Brougère, 1995). The traditional games occur in the interaction among peers and are practiced freely by children in different countries in accordance with rules accepted by the groups they belong to. They provide moments of physical activity, discoveries and social interaction. They stimulate basic motor skills like walking, running, throwing, jumping, swinging and such. These skills are formed by the coordinated action of moves that will serve as a basis for more complex learning. They also stimulate psychomotor functions like body scheme, tonus, coordination, spatial and temporal organization, rhythm, fine motor skills, laterality and balance (Mello, 2006). The objective of this study was to conduct a survey of children's traditional games in Brazil to investigate their characteristics as an integral social practice of child culture and to evaluate the bodily movements present in their practice. **Methods** We adopted the qualitative approach (Graton and Jones, 2010) and the methodological referential of the sociology of childhood (Corsaro, 2005; Sirota, 2006) that proposes children should be investigated as actors and subjects of their practices. In different regions of Brazil, 54 teachers, participants in the research as collaborators, observed games, heard the children's reports, developed a dialogue and recorded data on specific sheets. **Results and Discussion** The research recorded 72 traditional children's games in Brazil. Depending on the geographical area, they had different designations and suffered variations on the ways they were performed (examples: hide and seek, kite, goat-blind, marbles, jump rope, hopscotch). They were practiced in squares, streets, backyards and schools courtyards (outside the curriculum). During the games, intense social interaction occurred; 57% were practiced by boys and girls together; the ages ranged from 6 to 12; the predominant age range was 9 to 10 years (89%); on average, the groups had 6 to 10 participants simultaneously (43%). The research confirmed the presence of basic motor skills and psychomotor functions in different body movements recorded during the traditional games. **References** Brougère G (1995). *Jeu et éducation*. L'Harmattan, Paris. Corsaro W. (2005). *The sociology of childhood*. Sage, Thousand Oaks, CA. Graton C, Jones I. (2010). *Research methods for sports studies*. Routledge, London. Mello A.M. (2006). *Psicomotricidade, educação física e jogos infantis*. Ibrasa, São Paulo. Sirota R. (2006). *Éléments pour une sociologie de l'enfance*. PUR, Rennes

## **AN INVESTIGATION OF LIFESTYLE AND PERCEIVED WELLNESS LEVEL IN JAPANESE COLLEGE FRESHMAN**

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Introduction "Wellness" is "an active process of becoming aware of and making choices toward a more successful existence" by National Wellness Institute (1). It is apparent that the concept of wellness is not widely spread throughout Japan. The authors believe that college students should be familiar with the concept before they graduate (2). Therefore, it is very important to research on parameters of wellness for college students. In the present study, we investigated the scores of the "wellness check test" which can evaluate the degree of lifestyle for wellness, the degree of perceived wellness and relationships between them. Materials & Methods A total of 767 Japanese college freshmen (360 female and 407 male) were surveyed in the present study. They answered the Wellness Check Test that consists of thirty questions divided by six factors as follows: 1) enjoying fitness, 2) eating well, 3) taking care of ourselves, 4) enjoying life, 5) relating to others and 6) being part of the world according to the six-grade system in each question. They also evaluated the degree of their perceived wellness according to the five-grade system. Results & Discussion Our main findings were that 1) the score of "enjoying fitness" of the wellness check test in male students was significantly higher than that in female students while female students scored significantly higher in the other 4 factors, 2) the degree of perceived wellness did not show significant difference between male and female, and 3) the students with higher degrees of perceived wellness showed higher scores of almost all the factors in the Wellness Check Test. Conclusion Our findings suggest that when we lecture on wellness to college freshmen, we should take into account both sexual differences in the scores of the wellness check test and differences of degree in perceived wellness. References (1) National Wellness Institute. <http://www.nationalwellness.org> (2) Mizumura, S. (2009). An investigative study of wellness education in Japanese universities and colleges. *Wellness Journal*, 5 (1), 38-45.

## **ANALYSIS OF A PHYSICAL ACTIVITY IN A SPANISH PRISON**

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INTRODUCTION Sport in prisons in Spain is part of the activities that the current legislation provides. There are several investigations which conclude that sport can contribute to increase the socialization (Castillo, 2004), the compensation of the subculture in prison (Arribas et al., 2001; Castillo, 2004; Chamarro, 1997; Ríos, 1986) or to improve the physical and psychological well-being (Ríos, 1986). The main objective of this study is to determine whether a particular sport physical activity has an effect on the participants and to evaluate the attendance to the activity, in order to determine the convenience of programming these activities. METHODS The study was performed in a football school located in a prison. An adapted questionnaire from Castillo (2004) was provided at the beginning and at the end of the investigation, and an attendance record was used and filled in every session. RESULTS The average of students who attended at the sessions was 24, which makes an average in percentage (over total enrollment) of 83%. The largest reason for not attending at the activity was injury or illness (50%), followed by permits (17%) or performing other activities (17%). In the provided questionnaires, the satisfaction with the coach was good evaluated and most of them asked for an increase in the frequency of the activity. DISCUSSION The high turnover of participants in the activity (because of dropouts) has been a major factor in the study. The main dropouts were due to transfer or release, as Chamarro said (1997). Control of any of these factors would help to this data to be different. Regarding the socialization factor, satisfaction with the coach or with the frequency of the activity, similar data have been obtained to Castillo in 2004, and it can be concluded that physical activity is clearly attractive in a prison environment. REFERENCES Arribas, H., Mantecón, L., Rodríguez, R. y Sánchez, I. (2001). Exclusión social y actividad física: propuestas de intervención educativa a través de contenidos sociomotrices, en dos contextos diferentes. En Latiesa, M.; Martos, P. y Paniza, J.L. (eds.) *Deporte y cambio social en el siglo XXI* (pp. 367-382). Madrid: Esteban Sanz. Chamarro, A. (1997). *Determinantes psicosociales de la práctica de ejercicio físico en un centro penitenciario*. Tesis doctoral. Universidad de Salamanca. Castillo, J. (2004). *Deporte y reinserción penitenciaria*. Madrid: Consejo Superior de Deportes. Ríos, M. (1986). *L'activitat físico-esportiva en una presó de dones*. *Apunts*, 4, 52-59.

## **Sport Management**

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### **EVIDENCE-BASED POLICY-MAKING: IMPLEMENTING EU SPORT POLICY IN HUNGARY**

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In 2007 the Hungarian Parliament unanimously passed the bill on the Sport Strategy of Hungary. It was progressive, but was not followed by the Action Plan including identifying the financial resources. Not surprisingly, the Strategy has not referred to the White Paper on Sport document of the European Union, which was accepted by the European Commission in 2007 as well. Since that time two other EU-level key policy documents have been issued (Communication on the European Dimensions of Sport in January 2011 and the Work Plan on Sport for 2011-2014 in June 2011) and Hungary, as one of the 27 members States actively participates in the implementation of the EU Work Plan on Sport via the active members of the Expert Groups. Nevertheless, still, national level implementation activities were not initiated via sustainable, purposely funded cross-sectoral cooperations and projects. There is a major development takes place in these weeks when a 18-month long national project begins with the financial support of the European Union's Social Fund, Social Renewal Operative Programme. The objective is to prepare a first ever white paper on sport in Hungary, which serves as one of the most significant inputs for a new policy paper and strategy for sport for the Hungarian member state. The call for proposal followed the structure of the White Paper on Sport and requested the applicant organisations to structure their research activities in the tender document along that structure. The authors aim to analyse the objectives and process of this important element of evidence-based policy-making in the field of sport, as one of the possible methods to successfully implement the community-level policy in one of the member states.

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## PROBLEMS OF PROFESSIONAL BASKETBALL IN RUSSIA

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**Introduction.** Recently Russia started to build modern marketing relations in almost all including sports. All regions of Russia are facing absolutely new problems, highly connected with creation of stable middle and long-term financial systems of professional sport clubs. **Methods.** Initial information as social survey has been gathered during the Russian national championship in 2012/2013. The survey was direct and individual, with the questionnaire of 19 questions with the range of 4-8 possible answers. 36 coaches of professional basketball clubs have taken part in the research. **Results.** The table of problems has been formed and rated due to the remarks of coaches. To their point the solution of the problems mentioned should influence deeply the development of Russian basketball. First problem is the lack of financing of professional clubs. Second problem is the lack of legislative basis regulating the commercial activity in sports. The third place was occupied by the infrastructural problem – the absence of necessary sport halls with enough places and conveniences. The 4th problem lies in the level of basketball mastery of Russian basketball players which is in many cases lower than the skill level of European players. And the 5th problem found is the absence of professional sport managers with the work experience in basketball. **Discussion.** All problems mentioned had the highest priority for all the coaches interviewed. It has to be mentioned that almost none of them mentioned the problem of state financing – which could be easily explained by their professional orientation. It is more important for the coach or the athlete to receive money than to think where to get it. It makes no difference for them if financing comes from the state, sponsor or the ticket program. But this remains the major problem for Russia which could influence the future development of Russian basketball.

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## Sport Statistics and Analyses

### OXYGEN UPTAKE RESPONSES DURING CYCLING AT MAXIMAL LACTATE STEADY-STATE AND CRITICAL POWER

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**Introduction** Comparisons between the CP and power associated to MLSS suggest that both are different and should not be used interchangeably (Jones et al., 2010). However, a complete physiological steady-state has been recognized up to the boundary circumvented by PC (Jones et al, 2008), which has been either considered to MLSS (Baron et al., 2003). This study aimed to analyze the profile of VO<sub>2</sub> response at CP and MLSS, during cycling exercise. **Methods** Eight active male cyclists (28.1 (3.6) years, 78.5 (12.5) kg, 176.0 (0.09) cm, and 2934.1 (587.3) mlO<sub>2</sub>.min<sup>-1</sup> VO<sub>2</sub>max) did perform, the following tests on different days: incremental exercise until exhaustion to determine peak oxygen consumption (VO<sub>2</sub>peak); 2-4 tests to determine the MLSS; 3 predictive tests (95, 100 and 110% IVO<sub>2</sub>max) for PC estimative; and one to test exhaustion at 100% of CP. The breath-by-breath VO<sub>2</sub> data was used to analyze the VO<sub>2</sub> responses during all tests performed. The VO<sub>2</sub> responses were time aligned, outlier were excluded, and interpolated second-a-second to be analyzed from punctual method. The analyzed parameters were: VO<sub>2</sub> end (mean 30s VO<sub>2</sub> at the end of exercise), and slow component (SC, the difference between mean 20s VO<sub>2</sub> around the 120s and 600s of VO<sub>2</sub> response). Differences between the parameters of VO<sub>2</sub> response were analyzed by independent T-test, with significance level set at 0.05. **Results** The VO<sub>2</sub> end (30th minute) value at MLSS (2420.6 (533.7) ml O<sub>2</sub>.min<sup>-1</sup>) did elicit 82.6 (7.6) %VO<sub>2</sub>peak, whereas VO<sub>2</sub> end values at PC (2898.6 (576.6) mlO<sub>2</sub>.min<sup>-1</sup>) did reach VO<sub>2</sub> peak value (99.3 (9.6) %VO<sub>2</sub>peak). Both responses (absolute and relative values of VO<sub>2</sub>end) were different between MLSS and PC. The SC was observed while cycling at MLSS (339.5 (238.7) ml.minO<sub>2</sub>-1) and PC (566.5 (287.9) ml.minO<sub>2</sub>-1), but they did not differ from each other, neither when expressed relative to VO<sub>2</sub> increment during exercise (16.6 (10.6)% and 23.0 (10.0)%, respectively). **Discussion** While delayed VO<sub>2</sub> steady-state was observed during cycling at MLSS and PC, it was truncated at VO<sub>2</sub>peak at PC for seven of eight subjects analyzed. On this base, PC differs substantially from MLSS. Despite the lack of metabolic correspondence has been extensively discussed (Jones et al., 2010), the noticeable difference in VO<sub>2</sub> response between both would probably reflect on the events leading to exhaustion (Baron et al, 2003), and must be carefully weighted when evaluate endurance capacity and plan training. **References** Baron, B., Dekkerle, J., Robin, S., Neviere, R., Dupont, L., Matran, R., y col. (2003). *Int J Sports Med*, 24(8), 582-587. Jones AM, Wilkerson DP, DiMenna F, Fulford J, Poole DC. (2008). *Am J Physiol Regul Integr Comp Physiol*. 294, R585-93. Jones AM, Vanhatalo A, Burnley M, Morton RH, Poole DC. (2010). *Med Sci Sports Exercise*, 42 (10), 1876-1890.

### USING SPATIAL METRICS TO CHARACTERIZE TACTICAL BEHAVIOUR IN A BASKETBALL GAME

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Lopes, A.1,2, Fonseca, S.1, Paulo, A.1, Leser, R.3, Baca, A.3 1: FEFD-Universidade Lusófona (Lisboa, Portugal), 2: CIDESD (Portugal), 3: Centre for Sport Science and University Sports, University of Vienna, (Vienna, Austria) **Introduction:** Tactical behaviour usually refers to the players' actions, meaning that the position of every player is influenced by the tactical concepts (Jäger, Perl, & Schöhlhorn, 2007). A method for assessing tactical team performance is the observation of spatial patterns. Various spatial constructions have been used: convex hull (CH), bounding rectangle (BR), voronoi diagrams (VD) (Bourbosson, Sève, & McGarry, 2010; Fonseca, et al., 2012a). The purpose of this work is to identify the best candidate to describe team tactical behaviour. **Methods:** A training match of the talent Austrian's basketball team played in a 28x15m field was considered. Positional data of all players was collected using Ubisense Location System (Leser, Baca, & Ogris, 2011). The area of each spatial metric defined above was calculated for each team, using routines implemented in Matlab R2008a software. To quantify the teams' regularity of the spatial behaviour, the normalised measure of approximate entropy (Fonseca, et al., 2012b) was calculated for each metrics' time series. The Pearson correlation coefficient was used to evaluate the inter-team spatial relationship. **Discussion:** The used spatial metrics provided similar, but different, information about how teams used space by means of tactics. The analysis of this measures showed that the dispersion of the teams in the field tend to follow a dynamical teams' counter-phase (Yue et al., 2008), the area or dominant region of a team tends to contract when the opposite team area expands (Frencken, et al., 2011), and this was best reported by the VD. These kind of patterns' behaviour seem to be associated with the ball possession changes and/or disputes, following the results of Bourbosson et al. (2010), when they used similar spatial metrics (stretch index). VDs seem to overcome some limitations of other spatial metrics (Fonseca et al., 2012a). **References** Bourbosson, J., Sève, C. and McGarry, T. (2010). Space-time coordination dynamics in basketball: Part 2. The interaction between the two teams. *Journal of Sports Sciences*, 28, 349-358. Fonseca, S., Milho, J., Travassos, B., and Araújo, D. (2012a). Spatial dynamics of team sports exposed by Voronoi diagrams. *Human*

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### **ANXIETY, DECISION-MAKING AND PERFORMANCE IN VOLLEYBALL TRAINING STAGES. DIFFERENCES BETWEEN WINNER AND LOSER TEAMS**

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Introduction Volleyball is a sport with high technical, tactical, physical and psychological demands. In recent years, researchers had tried to discover the key factors related to the victory. (Kugler et al., 1996). The main objective of this study was to identify differences in cognitive (decision-making), emotional (anxiety) and performance variables between winning and loser teams in a sample of young volleyball players. Methods The study sample was composed of the 173 participants (74 males, 99 females) who belong to all the Under-16 teams (M: 14.63, SD: 1.05) which compete in the 'Extremadura Volleyball League'. The research followed the standards of the research ethics committee of the University of Extremadura (2010). The dependent variable was the match outcome. The independent variables were state anxiety (CSAI-2R), decision-making (GPAI) and performance (FIVB observation system). Results A T-test for independent samples was performed to check the differences between winner and loser teams in the studied variables. Results showed statistically significant differences in decision making, self-confidence and performance between players from winner and loser teams. Discussion With regard to decision-making, players of winner teams showed significant higher values than players from loser teams. In this regard, some studies have shown that experts take better decisions than novice players (Moreno et al., 2008). As for the anxiety variable, we found significant differences in self-confidence (the positive factor of anxiety), with values consistently higher in winners than in losers. Our results coincide with previous studies that found higher self-confidence scores in winner teams and no differences in cognitive and somatic anxiety (Tsopani et al., 2011). As for performance (in game actions), players from winner teams showed higher performance scores than losers. Our results coincide with previous studies that emphasize the importance of game actions in volleyball (Asterios et al., 2009). References Asterios, P., Kostantinos, C., Athanasios, M. & Dimitrios, K., (2009). Comparison of technical skills effectiveness of men's National Volleyball teams. *International Journal of Performance Analysis of Sport*, 9, 1-7. Moreno, M. P., Moreno, A., Ureña, A., Iglesias, D., Del Villar, F., (2008). Application of mentoring through reflection in female setters of the Spanish national volleyball team. A case study. *International Journal of Sport Psychology* 39 (1) 59-76. Tsopani D., Dallas, G., & Skordilis, E. (2011). Competitive state anxiety and performance in young female rhythmic gymnasts. *Perceptual and Motor Skills*, 112 (2), 549-560.

### **HOW DOES MODIFYING COMPETITIVE OPPORTUNITIES AFFECT THE EXPERIENCES OF CHILDREN PLAYING RUGBY LEAGUE?**

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HOW DOES MODIFYING COMPETITIVE OPPORTUNITIES AFFECT THE EXPERIENCES OF CHILDREN PLAYING RUGBY LEAGUE? Morley, D. 1, Ogilvie, P.1 & Rothwell, M.2 1 Institute of Sport, Physical Activity and Leisure, Leeds Metropolitan University, Leeds, UK; 2 Rugby Football League, Leeds, UK Introduction The Rugby Football League (RFL) in England has embarked on a review of their game as played by children. The 'traditional' game established for children was introduced some 20 years ago (Rothwell, 2012) and was designed to provide an 'enjoyable fun activity and a marked all round improvement in the technical abilities and awareness of those playing the game' (RFL, 2012, p.4). The RFL were keen to explore a 'modified' game that would encourage a higher frequency of skills being used as a result of changing the number of players, size of the pitch and rules. The aim of this study was to assess the attitudes of players and parents towards this 'modified' game and to understand the impact of these modifications on the frequency of skills being used. Methods An average of 60 players per week, aged 6-10, and 40 parents attended a 'competition festival' on four consecutive Saturdays, where they played both the traditional and modified versions of the game appropriate to their age. We employed a number of research techniques within a 'mosaic' approach (Clark & Moss, 2001). The techniques used within this approach consisted of 'tagging' the frequency of skills, surveys, graffiti boards, focus group interviews, role-play and video footage to stimulate discussion. Results Some modifications to the rules in the modified game had negligible impact on increasing participation through a higher frequency of skills in the game, particularly in terms of tackling and the fluency of passing. However, the modified game provided some positive outcomes, particularly in terms of the increase in scoring and passing, although the exact nature of these incidents within the game requires further exploration. The majority of parents refused to accept that the modification of the traditional game is necessary for their child's development, although the majority of children eventually preferred the modified game to the traditional one and recognised the benefits this could bring. Discussion With an increase in skill development opportunities, some children began to explore new roles within the game that they enjoyed. The lack of impact on skill frequency in some areas could be explained by the lack of time for the new rules to be interpreted by the players. If the game is to be modified it is vital that an effective communication strategy is employed to impart the rationale for this approach to the parents of all players. References Clark, A. & Moss, P. (2001). *Listening to young children: The Mosaic approach*. London: National Children's Bureau. Rothwell, M. (2012) *Primary Rugby League Review*. Leeds:RFL. Rugby Football League, (2012) *Modified Games rule book*. Leeds: RFL.

### **EVOLUTION OF THE EFFICACY OF GAME PHASES IN U-14, U-16, U-19, NATIONAL LEVEL, AND INTERNATIONAL MEN'S VOLLEYBALL TEAMS**

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INTRODUCTION In volleyball, teams can play in two different phases: a) side-out or complex 1 (receiving team), or b) complex 2 (serving team). The efficacy of these phases depends on the players and teams ability to execute the actions that involve the game phases. No studies have been found in the reviewed done about the level of efficacy of the games phases in the different age groups. Performance of these phases may vary depending on training years and/or players maturity (Malina & Bouchard, 1991). The aim of this study was to analyse the efficacy of game phases in U-14, U-16, U-19, national level, and international men's volleyball teams METHOD A stratified random sample of 300 sets (60 sets per category) was selected according to performance level. The sample was taken from teams

playing Spanish National Men's Volleyball championships (2009) in under-14, under-16, and under-19 categories, senior national (A1-league 2008-09-10 sessions), and senior international categories (Olympic Games 2008). A correlational intergroup design was used. The variables of this study were: a) competition category, and b) efficacy game phases (percentage of points obtained being in reception and in serving). Match observation was carried out by an experienced observer, using Data Volley® software. Reliability was .93 with Cohen Kappa test. Kruskal-Wallis test ( $p < .05$ ) and Bonferroni Procedure for post hoc analysis were calculated using statistical package SPSS 15.0. RESULTS In the formation categories (U-14 to U-19), the efficacy of the receiving team improved from 48.37% to 55.20%. Teams from national and international level had an efficacy in reception phase close to 70% and a Kill efficacy of 30% approximately. The efficacy of the receiving team improved statistically significant through the different age groups ( $p = .000$ ) and decrease the efficacy of serving team ( $p = .000$ ). The most remarkable change of the efficacy was observed between the under-19 and national category. DISCUSSION AND CONCLUSIONS The efficacy of reception phase increase and the serving phase decreased through the competition groups studied. These results highlight the need to establish specific normative profile for the different level of performance (category groups of competition) and to adapt the training methodology to the peculiarities of each level of competition. REFERENCES Malina, R. M., & Bouchard, C. (1991). Growth, maturation, and physical activity. Champaign: Human Kinetics.

### T-PATTERN ANALYSIS IN SOCCER: DETECTING REGULARITIES IN ATTACK PLAYS

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**Introduction** The dynamics of play during a match between opposing teams are clearly complex phenomena that traditional approaches to the quantification of team sports are not able to identify. The aim of this study was to describe a method for detecting the dynamics of play in professional soccer through an analysis of temporal patterns (Camerino et al., 2011; Fernández et al., 2009). In particular, the objective was to reveal the hidden yet stable structures which underlie the interactive situations that determine the attack actions of play in soccer. **Method** The methodological approach is based on observational design, supported by digital recordings and computer analysis. The observational design (Anguera et al., 2011) was nomothetic, point and multidimensional. **Participants** The study is part of a broader research project involving the analysis of all games played by AC Milan (Italy) during the 2012-2013 national League Championship; the matches here considered are those played during the first leg. **Instruments** The matches were recorded with LINCE software (Gabin et al., 2012). The variables considered in this study, that fulfill the conditions of exhaustiveness and mutual exclusivity, are: lateral position, zone, lateral passing, zone passing, ball recovery and loss, ball out of play. Data were analyzed with Theme 6 beta. This software detects the temporal and sequential structure of data sets, revealing repeated patterns that may regularly or irregularly occur within a period of observation (T-patterns). A T-pattern is essentially a combination of events where the events occur in the same order with the consecutive time distances between consecutive pattern components remaining relatively invariant (Magnusson, 2005). **Data analysis** Ongoing work **References** Anguera, M.T., Blanco-Villaseñor, A., Hernández-Mendo, A., Losada, J.L. (2011). Diseños Observacionales: Ajuste y Aplicación en Psicología del Deporte. Cuadernos de Psicología del Deporte, 11 (2), 63-76. Camerino, O.F., Chaverri, J., Anguera, M.T., & Jonsson, G.K. (2011). Dynamics of the game in soccer: Detection of T-patterns. European Journal of Sport Science, 12, 216-224. Fernández, J., Camerino, O., Anguera, M.T., & Jonsson, G.K. (2009). Identifying and analyzing the construction and effectiveness of offensive plays in basketball by using systematic observation. Behavior Research Methods, 41, 719-730. Gabin, B., Camerino, O., Anguera, M.T. & Castañer, M. (2012). Lince: multiplatform sport analysis software. Procedia Computer Science Technology.46. 4692-4694. Magnusson, M.S. (2005). Understanding social interaction: Discovering hidden structure with model and algorithms. In L. Anolli, S. Duncan, Jr., M.S. Magnusson, & G. Riva (Eds.), The hidden structure of interaction. From neurons to culture patterns (pp. 3-22). Amsterdam: IOS Press.

### DOES OUTPERFORMING AN OPPONENT ON SELECTED ACTION VARIABLES LEAD TO WINNING THE MATCH IN ENGLISH CHAMPIONSHIP SOCCER?

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**Introduction** Contemporary empirical research has attempted to describe differences between soccer teams that are deemed as successful and unsuccessful using frequencies of action variables, frequently labelled performance indicators (e.g. Lago-Ballesteros and Lago-Penas 2010; Lago-Penas et al., 2010). It is suggested that coaches could design training practices to control such variables in future competition (Lago-Penas et al., 2010). This current investigation attempts to identify whether outperforming the opposition on an action variable relates to winning matches in the English Championship. **Methods** Nineteen action variables were collected from 277 English Championship matches (2010-11 season) using the Amisco Pro analysis system (Amisco Pro, Sport-Universal, Nice, France). Chi-square analyses were used to discriminate match outcomes using the IBM SPSS statistics package (v19, SPSS Inc., 2010). Results When the home team scored first they won 70.6% of matches compared to 67.8% for the away team (Chi-square= 119.86,  $df = 2$ ,  $p < 0.05$ ,  $\Phi = 0.68$ ). The only other variables that resulted in a greater than 50% chance of winning the match were receiving less red cards (home 57.1%; away 62.5%) and having more shots on target (home 54.0%; away 54.0%). All other variables (in order of magnitude for the home team: greater percentage of first time passes, less time in possession (2nd half), more shots, less yellow cards, more time in possession (1st half), more forward pass completions, more offside decisions, more pass completions, more time in opposition territory, more final third entries, less fouls, more corners, greater average number of touches per possession, more individual ball possessions, more passes, more forward passes) produced greater likelihoods of winning for the home team compared to the away team. These ranged between 34.8% and 48.4% (home team) and 22.0% and 40.2% (away team). **Discussion** Performing better on the action variables used in this study; and routinely collected by professional soccer teams; did not in the majority of instances, predict match outcomes particularly well. This suggests that their value as performance indicators is dubious. However a lack of sophistication in the analysis techniques may have contributed to this finding. For example, soccer is a multi-faceted sport whereby unsuccessful performance on one action variable may be counteracted by successful performance on another variable. Hence some teams may perform well on one combination of variables whereas another on an entirely different set of variables. It is therefore suggested that more complex analysis procedures e.g. logistic regression or multilevel linear models should be used to determine the extent to which these action variables counteract each other for individual teams. **References** Lago-Ballesteros, J. & Lago-Penas, C. (2010). J Hum Kinet, 25, 85-91. Lago-Penas, C., Lago-Ballesteros, J., Dellal, A. & Gomez, M. (2010). J Sports Sci and Med, 9, 288-293.

## RELATIONSHIP AMONG THROWING VELOCITY, GRIP STRENGTH, AND ANTHROPOMETRIC PARAMETERS IN TOP CLASS FEMALE WATER POLO PLAYERS

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**Introduction** Throwing velocity of the ball is an important skill in water polo and a very important aspect for success (Bloomfield et al, 1990). The velocity of a water polo throw is not only dependent on the muscular strength, but others aspects like body segments coordination, technical skills and anthropometric characteristics (Van der Wende, 2005). The aim of this work is to establish the importance of the anthropometric factors in the throwing velocity. **Methods** Twelve elite trained female water polo players participated in this study. International Society for the Advancement of Kinanthropometry (ISAK) protocol was used to determine the anthropometric profile of the water polo players. In order to assess their specific explosive strength production, a radar gun (StalkerPro Inc., Plano), with 100 Hz frequency of record and with sensibility 0,045 m•s<sup>-1</sup> was used. The radar was placed behind the goal post and in a perpendicular direction to the player. The players were instructed to perform 6 maximal throws under 3 different conditions from the 5 m penalty line (1.- no defender or goalkeeper; 2.- goalkeeper only; 3.- with goalkeeper and previous displacement). Additionally, Maximal isometric hand-grip force was recorded using a handheld hand-grip dynamometry (T.K.K. 5401, Japan), with a sensitivity of 1 N. The players performed 2 repetitions at maximum intensity with the dominant hand. **Results** Only the condition 2 shows a significant correlation with grip strength ( $r = 0.607$ ;  $p = 0.036$ ), biacromial breadth ( $r = 0.714$ ;  $p = 0.0089$ ) and muscle mass (by Lee) ( $r = 0.579$ ;  $p = 0.048$ ). **Discussion** The positive correlations of throwing velocity (in the throwing with goalkeeper condition) with the breadths and maximal grip, show that the muscle mass and the strength levels are another component that influences decisively the ability to throw fast, in line with those reported by Van der Wende (2005). The grasp of the ball is essential in water polo. A good grasp is related to the ball's velocity when throwing (Visnapuu and Jurimae, 2007). The dependence of the throwing velocity of the biacromial breadth is confirmed in the present study, with particular relevance to the wings; the importance of this parameter, particularly in the rotation of the trunk and shoulders during the throw, was highlighted before (Elliott and Armour, 1988; Van der Wende, 2005). The different lengths studied were not correlated with the throwing velocity, as suggested before (Bloomfield et al. 1990; Van der Wende, 2005). **References** Bloomfield J., Blanksby BA, Ackland TR, Allison GT. (1990). Australian Journal of Science and Medicine in Sport 22(3), 63-67. Elliott BC, Armour J. (1988). J Sports Sci 6(2), 103-114. Van der Wende K. (2005). Auckland University of Technology, New Zeland. Visnapuu, M, Jurimae, T. (2007). J Strength Cond Res 21, 923-929.

## EVOLUTION OF INJURY INCIDENCE DURING A SEASON IN SPANISH SOCCER FIRST-DIVISION

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**Introduction** There is a lack of epidemiological data on injuries in Spanish male professional soccer Leagues. The purpose of this study was to examine the evolution of injury incidence throughout a season of the Spanish soccer First-Division and to analyse differences between competition and training. **Methods** During the season 2008/2009, 16 out of 20 clubs competing in Spanish Soccer First-Division were involved in the study. Competition and training exposure were weekly estimated in a team basis. Injuries during training and competition were prospectively collected using a specific web survey based on the Fédération Internationale de Football Association (FIFA) Consensus Statement (Fuller et al. 2006). Injury incidence during training and competition was calculated per 1000 hours of exposure. Chi-square tests were used to analyse differences in injury incidences between training and competition and also to analyse differences in injury incidence according to the periods of the season. **Results** A total of 1293 injuries were identified among the 427 analysed players (524 competition injuries vs. 769 training injuries). The total exposure was 228,742.7 h (12,038h of competition exposure vs. 216,704.7h of training exposure). The injury incidence was higher in competition than training (43.5 vs. 3.5;  $p < 0.001$ ). The training injury incidence in the pre-season (July and August) was higher than the incidence in the rest of the season (all  $p < 0.001$ ). In addition, competitive period I (from September 2008 to January 2009) was more injurious than competitive period II (from February to June 2009;  $p < 0.001$ ). The injury incidence during training tended to decrease throughout the season, especially since November. The competition injury incidence in competitive period II was higher than the incidence in competitive period I ( $p < 0.001$ ). Injury incidence peaks in May after a progressive increase from the beginning of the season. **Discussion** The results showed a high injury incidence in Spanish Soccer First-Division, indicating that competition was much more injurious than training. Training injury incidence was higher during the pre-season and tended to decrease throughout the season, while competition injury incidence increased progressively throughout the season. These differences between injury incidences in competition and training according to the period of the season suggest the need of specific injury prevention protocols in the Spanish soccer First-Division. **References** Fuller CW, Ekstrand J, Junge A, Andersen TE, Bahr R, Dvorak J, Hagglund M, McCrory P, Meeuwisse WH. (2006). Br J Sports Med, 40(3),193-201.

## ANALYSIS OF RECURRENCE INJURIES IN SPANISH SOCCER FIRST-DIVISION

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**Introduction** There is a lack of epidemiological data on injuries in Spanish male professional soccer Leagues. The purpose of this study was to examine the incidence of recurrence injuries throughout a season of the Spanish soccer First-Division and to analyse differences between competition and training. **Methods** During the season 2008/2009, 16 out of 20 clubs competing in Spanish Soccer First-Division were involved in the study (427 players). Incidence on recurrence injuries and injury severity during training and competition were prospectively collected using a specific web survey based on the Fédération Internationale de Football Association (FIFA) Consensus Statement (Fuller et al. 2006). Competition and training exposure were weekly estimated in a team basis. Recurrence injuries were defined as injuries of the same type and location occurred after the player's recovery and return to full participation. The severity of recurrence injuries was based on the following scale: minor, equal or major; in comparison with the prior injury severity. Injury incidence during training and competition was calculated per 1000 hours of exposure. Chi-square tests were used to analyse differences in injury incidences between training and competition. **Results** A total of 145 out of 1293 injuries (57 competition injuries vs. 88 training injuries) were considered as recurrence injuries during 228,742.7 hours of exposure (12,038h of competition vs. 216,704.7h of training). Incidence of recurrence injuries was 0.63 per 1000h of exposure (4.73 during competition vs. 0.41 during training;  $P < 0.001$ ). The 72.4% of recurrence injuries were of equal or major severity than the original injury. In addition, equal and major recurrence injuries (2.2 and 1.6) showed higher incidence than minor injuries (0.8). **Discussion** Our results agree with previous studies in European teams and competitions, (Walden,

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Hagglund et al. 2005; Ekstrand, Hagglund et al. 2011) showing that the 11% of the injuries were recurrence injuries, and the 30% of these injuries cause longer absences than do non-recurrence injuries. These results suggest that additional efforts improving rehabilitation processes in Spanish Soccer First-Division are needed in order to reduce the risk of recurrence injuries. (Fuller and Walker 2006) References Ekstrand J, Hagglund M, Walden M. (2011). *Br J Sports Med*, 45(7), 553-558. Fuller CW, Ekstrand J, Junge A, Andersen TE, Bahr R, Dvorak J, Hagglund M, McCrory P, Meeuwisse WH. (2006). *Br J Sports Med*, 40(3), 193-201. Walden M, Hagglund M, Ekstrand J. (2005). *Br J Sports Med*, 39(8), 542-546.

## **BALL PASSING FLOW PATTERNS IN BASKETBALL REVEAL DIFFERENT SETS OF CONSTRAINTS**

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Introduction Team invasion games are characterized by emerging patterns of ball passes as a result of confluence of two major classes of constraints: Task instructional constraints and immediate informational constraints occurring in local interactions between players of both teams. The aim of this investigation was to analyze the ball passing patterns during attack of the two high performance basketball teams: Igokea and Olympia competing in the Adriatic League. Methods The observational data collection was conducted by the Tacto software (Duarte et al. 2010). 325 attacking passes performed during the whole match were analyzed. The attacked area was divided in 9 quadrants of equal size. The absolute probabilities of ball allocation within the quadrants were calculated as relative frequencies. Conditional probabilities of passes among quadrants were also calculated. Then the most probable sequences of passes among quadrants were estimated to detect the characteristic channels of ball flow during the attack of both teams. Results The stochastic process analysis showed different ball passing flow patterns. The preferred ball flow of Igokea was located in the left side of the attacked area with only one high probability flow loop to and from the outer zone. It was also characterized with directed flows toward the central zone of the attacked area. On the contrary, Olympia's emergent actions preferably were dispersed at the right hand side of the attacked area with 3 flow loops to and from the outer zones. Discussion The spatial patterns of passing revealed in this study show different structure of play that emerged as a consequence of the confluence of tactical task and immediate informational constraints impinging on the attacking team. Whereas attacking patterns of Igokea as a host team were characterized by more direct flows into the defense area of the opposing team with only one loop circulating toward the outer area, the team of the guest team Olympia showed several looping flows of passes mainly located in the outer areas. This loop patterning was mainly a consequence of the task instructional constraints where patiently conducted attack i.e. 'laying on the ball' was an imperative. The team of Igokea also possessed more concentrated ball positions in contrast to Olympia who manifested more dispersed ball allocation as a consequence of the previously mentioned task constraints. References Duarte, R., Araújo, D., Fernandes, O., et al. (2010). *Medicina*, 46, 6, 408-416.

## **Sports Medicine**

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### **PHYSICAL ACTIVITY AND BODY MASS INDEX IN A SAMPLE OF ELDERLY PEOPLE**

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INTRODUCTION The benefits of physical activity (PA) on the prevention of obesity are well known (Warburton et al. 2006). However, there are few studies analyzing the relation between objectively measured PA in elderly people and health parameters. Therefore, this study aimed to examine the association between objectively measured PA and obesity related parameters by gender. MATERIAL AND METHODS Participants were 100 elderly people aged  $\geq 60$  years old who were all capable of performing basic daily activities by themselves and who lived on their own. PA was assessed by Actigraph GT3X accelerometer. Examined variables were: counts per minute (CPM), steps per day (SPD), minutes of sedentary (0-99 CPM), light (100-1951 CPM,  $< 3$  METs) or moderate-to-vigorous PA (MVPA) ( $\geq 1952$  CPM,  $> 3$  METs) (Freedson, 1998). Body Mass Index (BMI) was calculated and classified as normal weight, overweight, and obese (NHLBI 1998). Waist (WC) and hip circumferences were measured and waist-to-hip ratio calculated (WHR). Data were analyzed by: t-test, ANOVA (post-hoc Scheffe test) and Pearson's correlation coefficients. RESULTS Participants were 65% women (70.1  $\pm$  6.60 yrs; BMI 27.3  $\pm$  3.72 kg·m<sup>-2</sup>; WC 87.7  $\pm$  9.14 cm; WHR 0.83  $\pm$  0.05) and 35% men (70.6  $\pm$  7.37 yrs; BMI 27.5  $\pm$  2.76 kg·m<sup>-2</sup>; WC 98.1  $\pm$  9.11 cm; WHR 0.94  $\pm$  0.05). Daily CPM were 262 for both genders and the SPD were 11,742 and 11,849 in male and female respectively. Mean values of PA in the normal weight group were 312 CPM and 13,522 SPD; in the overweight group 259 CPM and 11,784 SPD; in the obese group 208 CPM and 9,793 SPD. Differences between the values of the normoweight and the obese group were significant; both in CPM and in the SPD ( $P < 0.05$ ). PA measurements, both CPM and SPD, correlated inversely with BMI ( $P < 0.01$ ), WC ( $P < 0.01$ ) and WHR ( $P < 0.05$ ). MVPA also correlated inversely with BMI ( $P < 0.001$ ), WC ( $P < 0.001$ ) and WHR ( $P < 0.05$ ). DISCUSSION The finding that men and women are similar regarding average CPM and SPD sheds new light on earlier findings. This finding does not meet with those of other studies, where men achieve more steps per day (Colley et al. 2011). In this study the more active participants were associated with healthier BMI values, as described previously by others (Davis et al., 2011). Moderate-to vigorous PA is more closely related with lower BMI values than less intense PA. REFERENCES Colley, R.C. et al. (2011). Health reports / Statistics Canada, Canadian Centre for Health Information, 22: 7-14. Davis M.G. et al. (2011). *Med Sci Sports Exerc*, 43: 647-54. Freedson et al. (1998), *Med Sci Sports Exerc*, 30:777-81. NHLBI (1998). *Obes Res*, 6: 551-209. Warburton, D.E. et al. (2006). *CMAJ*, 174: 801-9.

### **INJURIES IN GERMAN PROFESSIONAL MEN'S ICE HOCKEY - VIDEO ANALYSIS OF MATCH INJURIES**

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Introduction: Because of its speed, equipment and body contact ice hockey is probably more dynamic and physical than most other team sports. This is certainly one main reason why ice hockey is so popular in Germany. But what is attractive to the audience might also bear a certain injury risk. With 40.1 time-loss injuries per 1000 match hours ice hockey has indeed the highest match injury incidences among German professional team sports. This fact is endangering game operations of the clubs through steadily increasing insurance rates. Methodology: Two consecutive first and second league seasons (2010-2012) were analyzed with regard to registered injuries, resulting costs and disabilities. National ice hockey journals were consulted to describe the sample of all professional hockey players that played at least once in a competitive match. Injury data including information about nature and severity of the injury were provided by the Ger-

man accident insurance of the athletes (VBG). Moreover, identifiable match injuries were assessed through video analysis to objectify the circumstances and situations that frequently lead to injuries. The gathered information was used to reveal key areas for prevention and to tailor targeted counter-strategies for elite clubs, coaches, athletes and referees. Results: During the two seasons 2,594 injuries were registered causing direct medical costs of 4.4 million and 31,000 days of disability. 60 % of injuries needed medical treatment only, 40 % caused time-loss (disability). Each player sustained 1.9 injuries per season (0.8 time-loss injuries/season). Head injuries (20.9 %), knee injuries (12.4 %) and shoulder injuries (11.1 %) were observed most often. Beside the aforementioned three body regions, ankle injuries, with regard to their severity, also appeared as another key region. In case of head injuries direct checks to the head as well as contact with sticks and boards were monitored as most frequent injury situations. Immediate contact with boards was also the predominant trigger for shoulder injuries. Concerning knee injuries pivoting or coordination deficits in non-contact skating situations were quite frequent, followed by knee-on-knee hits by opposing players. Most ankle injuries result from direct contact with the puck or from canting of the skate on the icy surface. Discussion: Fair-play and respect among ice hockey players is still of prime interest when it comes to decreasing the number of injuries, particularly as severe head injuries commonly result from irregular checking. Additionally, referees should receive more support in identifying and penalizing gross unsportsmanlike conduct. Furthermore, improving checking and skating technique, already in young ages, will help athletes to withstand crucial game situations that frequently lead to injuries.

### **EFFECTS OF RAPID WEIGHT LOSS AND RECOVERY ON MUSCLE SIZE, FORCE AND POWER GENERATION CAPACITY IN JAPANESE WRESTLERS**

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**Introduction** It is well known that wrestlers undergo rapid weight loss and recovery before competitions. Such rapid changes in the weight of wrestlers are likely to have a negative effect on the recovery of their physical fitness for competition. However, it is not been sufficiently studied whether the effects of rapid weight loss and recovery entail differences in muscle size and function. Therefore, this study investigated the effects of rapid weight loss and recovery on the muscle size, force and power generation capacity in Japanese wrestlers. **Methods** The participants were male wrestlers aged 19 to 21. All participants belonged to university wrestling teams and underwent wrestling training throughout the year. The participants lost 6% of their body weight in 56 h, and recovered in 15 h. The cross-sectional area (CSA) of the thigh and trunk muscles was determined using magnetic resonance imaging (MRI). Isometric maximal voluntary contraction during knee extension and flexion was measured using an isokinetic dynamometer. In addition, the power generation capacity of muscles was determined by 30-s maximal pedaling using a bicycle ergometer. Measurements were performed 1 week prior to weight loss (pre-WL), after the weight loss (WL), and after recovery of the body weight (post-WL). **Results** The body weight decreased significantly between the pre-WL and WL periods, and increased significantly between the WL and post-WL periods. Significant differences at all CSA measurement sites were observed for both the thigh and trunk muscles in the two periods. However, the CSA change ratio was almost the same for each site. The isometric knee extension and flexion torques also remained unchanged between the pre-WL and post-WL periods. However, the peak and mean power during the 30-s maximal pedaling decreased significantly between the pre-WL and post-WL periods. **Discussion** These results suggest that the CSA of trunk and thigh muscles are strongly affected by rapid weight loss and recovery, although differences in muscle size due to rapid weight change are not observed across CSA measurement sites. Isometric maximal voluntary contraction during knee extension and flexion remains unchanged, however, power generation capacity is markedly lower after weight recovery as compared with that prior to weight loss. The effects of rapid weight loss and recovery may differ between muscle force and power generation capacity. **References** Fogelholm GM, Koskinen R, Laakso J, Rankinen T, Ruokonen I. (1993). *Med Sci Sports Exerc*, 25(3), 371-377. Kukidome T, Shirai K, Kubo J, Matsushima Y, Yanagisawa O, Homma T, Aizawa K. (2008). *Br J Sports Med*, 42, 814-818.

### **THE INDUCED MUSCLES ACTIVATION IN WHOLE BODY VIBRATION TRAINING AT DIFFERENT VIBRATION EXPOSURE TIME**

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**Introduction** The effect of Whole body vibration (WBV) in neuromuscular system is through stimulates the receptors in muscles and tendons, and causes muscle stretch reflex (Cardinale, 2003). It has been broadly applied in the muscle strengthening (Adams, 2009). How much the muscles activation induced from the mechanical vibration and whether they are affected by the vibration exposure time are still rare discussed. The purpose of this study is to investigate the muscles activation differences and muscles activation change at different vibration exposure time during WBV training. **Methods** Five university students (20.2±0.5 years old) without any lower extremity musculo-skeletal injuries history and cardiovascular disease at least one year were participated in this study. The vertical vibration training was set at 2 mm amplitude and 35 Hz vibration frequency. The subject kept knee flexion at 145 degrees during WBV training. The electromyography was used to detect the muscles activation and the rectus and biceps femories were investigated. Five different training exposure time were tested in this study. They are continuous four minutes WBV without rest, one minute WBV with one minute rest for four, six, eight, and ten repetitions. The root mean squared of electrical potential of each muscle at every minute during the WBV were calculated. One sample t-test was used for test the statistical difference of muscle activation at different exposure vibration time in five training programs. **Results** The results found that during the WBV, the rectus femoris showed significant larger activation than the biceps femoris (30.45 •V vs. 11.35 •V). However, there was no significant difference in the muscle activation in between every minute in five training programs. **Discussion** The WBV induced different muscles activation for different muscles. In the knee flexion postures, WBV induce larger extensor (rectus femoris) contraction than in flexor (biceps femoris). With one minute vibration and one minute rest WBV training protocol, the induced muscle activation kept at the same level at least ten repetitions that represented muscles vibrated at this intensity were without any fatigue tendency. **References** Adams JB, Edwards D, Serravite DH, Bedient AM, Huntsman E, Jacobs KA, Del Rossi G, Roos BA, Signorile JF (2009). *J Strength Cond Res* 23, 237-245. Cardinale M and Bosco C. (2003). *Exerc Sport Sci Rev*, 31, 3-7.

## EFFECTS OF LOW-VOLUME EXERCISE TRAINING AND VITAMIN E SUPPLEMENTATION ON OXIDATIVE STRESS IN OLDER ADULTS

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**Introduction** Elevated oxidative stress leads to the development of cardiovascular diseases and atherosclerosis (Bjelakovic et al., 2007). On the other hand, many studies have shown that resting oxidative stress markers decrease after endurance exercise and vitamin E supplementation (Peternelj et al., 2012). However, the least amount of physical activity and the combined effects of antioxidant required to alter the levels of oxidative stress markers are unclear. Thus, the purpose of this study was to investigate the effects of a 12-week low-volume walking program below the current recommended amount of exercise (< 150 min/week) and vitamin E supplementation on oxidative stress markers in older adults. **Methods** The participants were non-randomly assigned to the following four groups: control (C, n=14), vitamin E (S, n=10), exercise (Ex, n=7), or vitamin E and exercise (S + Ex, n=7). The S and S + Ex groups were instructed to take vitamin E ( $\alpha$ -tocopherol, 300 mg/day) capsules for 12 weeks. The exercise program of Ex and S + Ex groups consisted of walking for 30-60 min/session 2 days per week for 12 weeks. Blood samples were taken at baseline and immediately after 12 weeks. **Results** The serum derivatives of reactive oxygen metabolites were significantly decreased in the S, Ex, and S + Ex groups after 12 weeks compared with the baseline values (three-factor ANOVA, main effects of exercise and time, and an interaction between exercise and time,  $P < 0.01$ ). Conversely, serum biological antioxidant potential concentrations in the S and Ex groups were significantly higher at 12 weeks than at the baseline (three-factor ANOVA, main effects of supplementation and time,  $P < 0.05$ ). Plasma thioredoxin concentrations in the S, Ex, and S + Ex groups were significantly higher at 12 weeks than at the baseline values (three-factor ANOVA, a main effect of time, and interactions between supplementation and time, and between exercise and time,  $P < 0.05$ ). **Discussion** Our findings will be of interests to sedentary older adults that even a low-volume exercise training (90 min/week) was effective in reducing resting oxidative stress in older adults. These findings might encourage more people to incorporate a small amount of physical activity into their lives. Moreover, our findings suggest that the daily recommended doses of vitamin E supplementation (300 mg/day) would be effective for improving oxidative stress status in elderly individuals. Thus, our findings may indicate that the benefits of the least amount of physical activity and vitamin E supplementation translate to reduced risks of cardiovascular disease and atherosclerosis related to oxidative stress in the long-term. **References** Bjelakovic G. et al. (2007). *JAMA*, 297, 842-857. Peternelj TT and Coombes JS. (2012). *Sports Med*, 41, 1043-1069

## INTRATENDINOUS INJECTIONS OF HYPEROSMOLAR DEXTROSE UNDER SONOGRAPHIC GUIDANCE IN THE TREATMENT OF LATERAL EPICONDYLITIS

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**Abstract** **OBJECTIVE:** Hyperosmolar dextrose is one of the most commonly used proliferants. When injected, it causes inflammation with the intent to induce a healing response. We aimed to study intratendinous injections of hyperosmolar dextrose by ultrasound guidance. **PATIENTS AND METHODS:** Thirty patients, 20 men and 10 women with clinically determined chronic (lasting 3 months or longer) lateral epicondylitis were recruited. All patients noted pain intensity levels significant enough to prevent the participation in activities, such as playing tennis sports or lifting heavy objects. All patients underwent sonography-guided intratendinous injection of 25% hyperosmolar dextrose every 4 weeks. At baseline and before each injection, clinical assessment was performed using a visual analogue scale (VAS) for pain at rest (VAS1), pain during normal daily activity (VAS2), and pain during or after sporting or other physical activity (VAS3). Sonographic parameters including tendon thickness, echogenicity, and neovascularity were also recorded. **RESULTS:** The mean percentage of reduction for VAS1 was 80.5% ( $p < 0.001$ ), for VAS2 of 81.0% ( $p < 0.0001$ ), and for VAS3 of 69.1% ( $p < 0.0001$ ). The mean tendon thickness decreased by 13%. The number of tendons with anechoic clefts or foci was reduced by 71%. Echogenicity improved in 40% but was unchanged in 30%. Neovascularity was decreased in (60%) but no neovascularity was present before or after treatment in (10%). **Conclusion:** Intratendinous injections of hyperosmolar dextrose by ultrasound guidance was effectively decreased elbow pain, and improved strength in subjects with chronic lateral epicondylitis.

## RESEARCH ON CONDITIONING AND MANAGEMENT FOR MENSTRUATION IN JAPANESE ELITE ATHLETES

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**Introduction** Many female athletes have suffered from menstrual problems, or have problems of conditioning concerned with menstrual cycle. However, in Japan, there were few data on menstrual status, management of menses and condition throughout menstrual cycle, especially at the national top level. Therefore, to assess exactly current status for these data, we conducted survey in the form of questionnaire targeting national elite athletes. **Methods** Subjects were 242 Japanese female athletes aged  $22.4 \pm 4.7$  yrs (from 14 to 42). They were certified reinforcement athletes from 24 sports, and had participated in international competitions such as the Olympic Games or world championships. They answered self-written questionnaire including menstrual status, subjective condition and symptoms throughout menstrual cycle, management of menses and so on. **Results** Ninety-six percent of subjects had undergone menstruation. Mean age at menarche was  $13.1 \pm 1.9$  yrs (from 9 to 20). Although many athletes had regularly menstruation (69%) judged from menstrual cycle, some athletes had problems with menstrual irregularities (14%), epimenorrhoea (6%) and amenorrhoea (3%). During menstruating and luteal phase, many athletes had menstrual pain, premenstrual syndrome such as lower abdomen, breast and back pain, weight gain and mental problems. Especially, for 40% of them, menstrual pain interfered with their daily life. Thus more than 30% of athletes answered that the condition during these phases was bad or worse, though they did not appeal bad condition during other phases. On the other hand, most athletes did not change their training menu, intensity and amount throughout cycle, and did not control the course of the menstrual cycle (not taking oral contraceptive pill), despite having various symptoms. In addition, whereas 40% of total athletes had anxieties about menses, consultation rate of gynecology and rate of recording basal body temperature (BBT) was low (respectively 30% and 24%). **Discussion** These results indicated that not so many Japanese top athletes took special cares for management of menses or conditioning throughout cycle, despite having various symptoms, anxieties and so on. Therefore, we needed to recommend BBT measurement for assessing menstrual status and conditioning, and to provide information on exercise and menses.

## ASSESSMENT OF ENERGY EXPENDITURE IN PREGNANT WOMEN

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**Introduction** There is a relationship between physical activity and health, and is evidenced in many studies; During gestation, a woman's natural phase, since it shows no pathology, may adopt an active style of life. Energy expenditure in physical activity is directly related to the frequency, duration and intensity of human movement developed in various tasks. The rating level of physical activity of the population has been the target of many studies worldwide as a way to identify the impact of sedentary lifestyle of the human being. With the aim to measure energy expenditure in pregnant women. **Methods** This study was quantitative character, cross-sectional, based on the study of (Chasan-Taber, 2004) being used after Transcultural Adaptation Process, resulting in the Physical Activity Questionnaire for Pregnant Women - QAFG (in Portuguese) (SILVA, 2007). The questionnaire captures energy expenditure in METs for both the intensity is classified as in 'light' (1.5 to <3.0 METs), 'sedentary' (<1.5 METs), 'moderate' (3.0 to 6.0 METs) and 'strong' (> 6.0 METs). The study was conducted in the city of Fortaleza, Ceara, Brazil, the sample consisted of 30 pregnant women with Social Class A and B. Seen in medical clinics private network, which had between 16 to 40 years. **Discussion** In the validation study conducted in Massachusetts the Pregnancy Physical Activity Questionnaire - PPAQ - shows that the first choice for pregnant women in activity energy expenditure was watching TV and video, followed by walking slowly, thus presenting level between 'light' to 'moderate' intensity (CHASAN-TABER 2004). Corroborating these data, a study performed by Silva et al. (2007) in Fortaleza, assessed 305 pregnant women, also noted a marked reduction in physical activity patterns in the evolution of pregnancy. **Conclusion** In the sample 36.6% of women were classified as 'moderate'. The study also showed a reduction in physical activity during the three trimesters of pregnancy. The socioeconomic characteristics, with high purchasing power, may indicate percentage of pregnant women with moderate physical activity considered since the first trimester, and was decreasing with the outcome of pregnancy. Another factor that deserves mention was the absence of practicing sports among these women. Therefore, activities that require greater energy expenditure were not practically performed by pregnant women. **References** CHASAN-TABER, L. et.al. Development and Validation of a Pregnancy Physical Activity Questionnaire – PPAQ *Medicine & Science in Sports & Exercise*. Vol. 36 N. 10, pp. 1750-1760, 2004. SILVA, F.T. Avaliação do nível de atividade física durante a gestação. *Rev. Bras. Ginecol. Obstet.* 2007; 29: 490-500.

## RESPIRATORY ADAPTATIONS AFTER COMPLETING THE SÃO PAULO INTERNATIONAL MARATHON 2012

Santos, J.M.B., Luna Jr, L.A., Sierra, A.P.R., Benetti, M., Bachi, A.L.L., Tubaldini, M., Rodrigues, B., Kiss, M.A.P.D., Gabriel, E.A., Vaisberg, M.

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**Introduction** Many physiological aspects should be considered in exercise training prescription, including musculoskeletal, cardiovascular and respiratory limitations related to overload imposed by the training itself. Many investigators have focused the cardiovascular and musculoskeletal systems, while respiratory responses remain unclear. The aim of this work was to investigate the respiratory responses presented by recreational runners after high intensity endurance exercise. **Methods** Twelve male subjects (age 34.5±8.12 years, height 176.46±5.21 cm, weight 73.3±8.47 kg, %fat 16.6±5.90) participating in the São Paulo International Marathon 2012 performed a pulmonary function test before and 0/5/10/15/20 minutes after a maximal progressive cardiopulmonary exercise test. Two different situations were compared: a week before the marathon and between 3rd and 15th day after the challenge. Additionally, blood samples were collected immediately and 72 hs after the marathon to analyse biochemical markers of stress and inflammation. Data are presented as difference mean±standard deviation and difference media and were compared with Wilcoxon test (p <0,05). **Results**

	Basal	After	p	Difference	Difference	Marathon	Mean	Media							
Pre	5.06	4.93	0.21	0.11	± 0.64	0.28	FVC T0	5.09	4.75	0.05*	0.32	± 0.50	0.40		
T5	5.13	5.08	0.14	0.16	± 0.60	0.32	FVC T10	5.16	4.95	0.02*	0.45	± 0.50	0.55		
T15	5.20	4.79	0.05*	0.38	± 0.63	0.52	FVC T20	5.11	4.74	0.09	0.27	± 0.53	0.43		
Pre	622.10	623.91	0.81	-27.19	± 144.59	25.62	PEFr T0	642.90	626.94	0.05*	39.73	± 57.36	59.25		
T5	629.90	606.48	0.02*	51.19	± 56.99	54.91	PEFr T10	640.70	569.19	0.00*	63.45	± 51.19	53.61		
T15	622.35	576.42	0.01*	38.63	± 45.98	27.54	PEFr T20	651.50	584.88	0.01*	72.73	± 49.95	62.73		
	Basal	Immediately after	72 hs after	Lactate	1.78 ± 0.52	4.98 ± 0.99#	2.37 ± 0.95#	hs-CRP	0.16 ± 0.19	0.18 ± 0.23	1.13 ± 0.53#	CPK	245.5 ± 150.67	558.75 ± 349.56#	1690.19 ± 2547.61#

Leuko-cytes 4.97 ± 1.09 12.52 ± 3.58# 4.86 ± 1.35 # different from basal (p<0.05) No correlations were found between ventilatory parameters and biochemical markers. **Conclusions** These results suggest that high intensity prolonged endurance exercise can elicit some pulmonary adaptations with respiratory limitations that increased during the first 10 minutes after maximal exercise. The biochemical markers confirmed the physiological stress and inflammatory responses presented after completing a marathon, but are not directed related to the observed pulmonary adaptations.

## BIOELECTRICAL IMPEDANCE VECTOR POSITION OF ITALIAN DIVISIONS SOCCER PLAYERS: REFERENCE VALUES FOR THE SOCCER POPULATION

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bioelectrical impedance vector analysis (BIVA) was performed. BIVA in contrast to the estimated masses does not depend on equations and displays differences in hydration, BCM and phase-angle. Furthermore BIVA allows establishing population specific 50%, 75% and 95% tolerance ellipses. Results In comparison to the other divisions and to the normal population, the vector and the tolerance ellipse of the elite-level showed a shift to the left ( $p < 0.001$ ). When compared to the elite-level, lower skilled players had lower phase-angles ( $7.7^\circ$  vs.  $7.2^\circ$ ), BCMs (40.5 kg vs. 37.2 kg) and fat-free masses (66.3 kg vs. 63.0 kg) ( $p < 0.05$ ). Discussion In conclusion, soccer players differ from the normal population in regard to BIVA. Muscle mass and function, as indicated by BCM and phase-angle, increase with increasing skill-level. The soccer specific tolerance ellipses might be used for classifying individual vectors and to define target regions for low level players. References Lukaski HC, Piccoli A (2012). Handbook of Anthropometry: Physical Measures of Human Form in Health and Disease, 287-305. Springer, London. Norman K, Stobäus N, Pirlich M, Bosy-Westphal A. (2012). Clin Nutr, 31(6), 854-861.

### SENSORIMOTOR CONTROL OF THE LUMBAR SPINE IN MALE COMPETITIVE WEIGHT-LIFTERS, SWIMMERS, SOCCER AND HOCKEY PLAYERS

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1: BG Rehabilitation Centre (Bremen, Germany), 2: Institute of Sports Science, University of Bremen (Germany) Introduction The efficiency of the proprioception of the joints determines the quality of co-ordinative control of the postural and motor apparatus and, hence, the physical performance in everyday life and sport. In addition, the kinaesthetic, articular receptors in muscle-tendon tissue, capsule and ligaments serve as prophylaxis against injury and premature degeneration (Richardson 1996). Most previous studies have been devoted to the joints of the extremities (Barrett 1991). Only a few investigations have been devoted to the proprioception of the spine or of the lumbar spine (Gill and Callaghan 1998; Packhurst and Burnett, 1994). So it was the aim of this study to quantify objectively spinal position sense and to evaluate the influence of sports and low back pain on the proprioception of the male lumbar spine. Methods In a controlled cross-sectional study 34 hockey players, 31 gymnasts, 38 swimmers and 54 non-athletes aged 16 to 33 years had to reproduce different defined joint positions in extension (10 degrees) and flexion (15, 30, 45 degrees) of the lumbar spine by means of an ultrasonic measuring system (20 Hz) as well in four-point kneeling as in standing when blindfolded. Results In general the accuracy of position sense was significantly greater in standing than in four-point kneeling ( $p = 0,002$ ), what indicated an intensified use of further mechanisms of control for protecting the erect position. Furthermore there was a tendency for extreme joint positions to be reproduced more exactly as compared with the medium positions ( $p = 0,034$ ). As a result of an increased nociception in subjects with low back pain the reproduction angles in the extreme positions were significantly less than intended ( $p = 0,004$ ). In comparison to the control group competitive weight-lifting did not influence the proprioception of the lumbar spine. However, there were appreciable different deviations from the defined joint positions in swimmers and gymnasts as well as in hockey players ( $p = 0,006$ ). Discussion Both perceived pain and especially the specific requirement profiles of gymnastics, hockey and swimming seemed to be responsible for the modification of the depth sensitivity of the lumbar spine (Byl and Sinnott 1991). References Barrett DS. (1991). J Bone Joint Surg, 73B, 833-837. Byl NN, Sinnott P. (1991). Spine, 16, 325-330. Gill KP, Callaghan MJ. (1998). Spine, 23, 371-377. Parkhurst TM, Burnett CN. (1994). J Orthop Sports Phys Ther, 19, 282-295. Richardson AB. (1996). Clin Sports Med, 2, 379-390.

### TRICHOPHYTON INFECTION IN JAPANESE FEMALE ATHLETIC STUDENTS

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TRICHOPHYTON INFECTION IN JAPANESE FEMALE ATHLETIC STUDENTS Maruo, A.1, Yamamoto, S.2, Tanaka, S.3 1Graduate School of Health and Sports Sciences, Mukogawa Women's University 2Institute for Health and Exercise Science, Mukogawa Women's University 3Department of Health and Sports Sciences, Mukogawa Women's University 【Introduction】 Tinea is a superficial type of dermatomycosis caused by trichophyton fungus present on dead layers of the skin, nails, and hair. Although it is the most common type of human mycosis, few reports have been presented. Since 2001, tinea capitis has become widespread among martial arts participants and the number of people with trichophyton fungus has increased, while infected judo wrestlers in high schools and universities in Japan have also been reported. It is considered important to investigate this disease, as it is increasing in young individuals. Here, we investigated the relationship between various types of trichophyton infection and sports participation. 【Methods】 A survey that included questions about club activities, acquaintances, and medical history of trichophyton infection was distributed to female university students. A total of 506 students with a mean age of 19.6 years completed the questionnaire, for a response rate of 100%. We compared athletic with non-athletic students using a chi-square test for statistical analysis. P values  $< 0.05$  were considered to be significant. 【Results】 There were 136 students (36.7%) with knowledge of trichophyton in the athletes group and 66 (43.7%) in the non-athletes group, which was not a significant difference. In the athletes group, 22 (6.0%) had a history of trichophyton, while 11 (7.3%) of the non-athletes noted such a history, which was not a significant difference. In addition, medical history of trichophyton among contact sports (3.4%,  $n=5$ ), ball sports (5.0%,  $n=14$ ) and barefoot sports (7.9%,  $n=5$ ) did not significantly differ. 【Discussion】 Recognition of and anamnesis for trichophyton infection vary, as the proportion of individuals who recognize athlete's foot is much higher than that of those who recognize tinea corporis. Reports have shown that athlete's foot is the most common type of dermatosis, thus it is reasonable that the proportion of individuals who recognize it is higher than that of those who recognize tinea of the head and body. In the present study, there were scant differences between athletes and non-athletes in regard to recognition of and anamnesis for each type of trichophyton infection. 【References】 Tatuya.U, Kazumi.T : supports and athlete's foot 『Clinical sports medicine』 1998;15-6 : 681,682 Nobuo.H : The history with athlete's foot and human 2010 ; 54-2 : 174

### THE USE OF TRANSCRANIAL ELECTRICAL STIMULATION TO RECOVERY ATHLETES

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INTRODUCTION Great psycho-emotional and physical stress that accompanies the participation of athletes in competition, raises the problem of finding the means and methods to improve the processes of recovery of physiological functions. Transcranial electrical stimulation of the brain (TES) is a non-invasive and drug-free methods, and is a weak current through electrodes placed on the scalp. This effect selectively activates defense mechanisms of the brain and causes increased release of endorphins and serotonin (Petersen N. T. et al., 2001; Markina L.D., 2004). METHODS The study involved 10 powerlifters aged from 18 to 24, high qualification. To study of mechanism

autonomic regulation analysis of heart rate variability (HRV) was used. Athletes were tested for a week before the competition (background), before and after the event and after the TES - an experimental group and the control group - 20 minutes after the competition. In the experimental group a session of TES, duration 20 min, pulse bipolar current, the maximum value of 3 mA was held. RESULTS HRV analysis has shown that the most significant changes occurred after the competition in terms of reflecting the voltage of the central mechanisms of heart rate regulation. After the competition, the athletes there is a decrease of the current functional status and the prevalence of sympathetic activity level to reduce the activity of background parasympathetic autonomic regulation. After the competition following indicators changed: Mo decreases to  $525 \pm 21$  ms, variation range (VR) decreases to  $112 \pm 20$  ms, increases the strain index (SI) to  $658 \pm 158$  and the index of vegetative balance (IVB)  $654 \pm 154$ . After TES session the following indicators changed: increased Mo on 13%, VR increased by 2 times, SI, heart vegetative indicator and the IVB decreased by 3 times. In the control group, HRV was not significantly changed. DISCUSSION Thus, transcranial electrical stimulation, based on the selective activation of endorphins and serotonin mechanisms of the brain, can accelerate recovery processes autonomic regulation of physiological functions powerlifters after load. REFERENCES Petersen, N.T., Butler, J.E. & Marchand-Pauvert, V. (2001). *J.Physiology* 537.2, 651-656. Markina, L.D. & E.A. Kratinova (2004). *Neuroscience and behavioral physiology*. 34:1, 101-104.

### **ANKLE JOINT KINEMATICS IN SUBJECTS WITH MEDIAL TIBIAL STRESS SYNDROME DURING SIMULATED RUNNING.**

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**Introduction** The ankle joint motion of subjects with medial tibial stress syndrome (MTSS) during sports performance is not understood. The purpose of this study was to investigate the in vivo kinematics of the ankle joints in subjects with MTSS during simulated running. **Methods** Five young volunteers with MTSS in their lower legs provided written informed consent to participate in the present study. Each running trial was recorded using cineradiography. Images were obtained cineradiography sampling at a 60 Hz. Geometric bone models of the tibia and talus/calcaneus were created from computed tomography scans of the distal part of one lower limb. Following a combination of approaches, anatomical coordinate systems were embedded in each bone model (Yamaguchi S, et al., 2009). After modelling of the tibia and talus/calcaneus, these models were matched with the orthogonal images. The in vivo ankle positions were then reproduced using the three-dimensional ankle model. The following two types of ankle joint motion were examined: talocrural joint motion (relative motion of the talus with respect to the tibia) and subtalar joint motion (relative motion of the calcaneus with respect to the talus). The ankle positions at different time intervals from heel strike to heel off during running were then reproduced from a series of three-dimensional ankle models. **Results** During simulated running, from heel strike to heel off, a significantly larger range of plantar flexion motion was observed in the talocrural joint than in the subtalar joint. During the stance phase, a larger range of the internal/external rotation and inversion/eversion angles were observed in the subtalar joint than in the talocrural joint, respectively. The contribution of the subtalar joint towards active supination/pronation motion was greater than that of the talocrural joint. **Discussion** The kinematic data obtained in this study may have important clinical implications. Knowledge of ankle joint kinematics in subjects with MTSS during normal closed kinematic chain motion (stance phase of running) is important. These results add quantitative data to an in vivo database of subjects with MTSS. **References** [1]. Yamaguchi S, et al., *Foot Ankle Int.* 30(4):361-366, 2009.

### **EVALUATION OF THE TRUNK AND LOWER-LIMB MUSCLE ACTIVITIES DURING LUMBAR STABILIZATION EXERCISES AFTER ELECTROACUPUNCTURE**

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**Introduction** Application of acupuncture results in a temporary decrease in muscle activity. The effect on the muscle that has not received the acupuncture is unclear. The present study investigated the immediate efficacy of electroacupuncture compared to no acupuncture on the muscles activities of the trunk and lower limb during lumbar stabilization exercises. **Methods** Eight healthy male subjects ( $19.5 \pm 0.7$  years) were randomized to receive either electroacupuncture or no acupuncture (remaining lying down) in a crossover fashion with 1 week between trials. Two exercises were performed on the floor: elbow-toe and back bridge. Electroacupuncture or no acupuncture was conducted for 10 min before the exercises. Electroacupuncture was applied at dachangshu (BL25; the muscles of the low back). Pairs of surface electrodes were used to record the electromyographic signal amplitude of the rectus abdominis, external oblique, internal oblique, erector spinae, lumbar multifidus, rectus femoris, gluteus medius, and biceps femoris muscles. The EMG data were normalized as the percentage of maximum voluntary contraction, and data between doing each exercise with or without electroacupuncture were compared using the Wilcoxon signed-rank test. **Results** With the elbow-toe exercise, the activity level of the rectus abdominis muscle was decreased with electroacupuncture ( $p = 0.08$ ). When performing the back bridge exercise, the activity level of the external oblique muscle was enhanced with electroacupuncture ( $p = 0.02$ ). **Discussion** This study indicates that the activity of the muscle that did not receive acupuncture is influenced by the activity of the opposing muscle that did receive the acupuncture. **References** Hübscher M, Vogt L, Ziebart, T, Banzer, W. (2010). *Euro J Appl Phys*, 110, 353. Imai A, Kaneoka K, Okubo Y, Shiina I, Tatsumura M, Izumi S, Shiraki H. (2010) *J Orthop Sports Phys Ther*, 40, 369-375.

### **AGEING COMPARATIVE STUDY BETWEEN DIFERENT CITIES IN BRAZIL AND PORTUGAL: A HEALTH ANALYSES, AGEING AND QUALITY OF LIFE**

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**Introduction** The population estimates in the studied countries show that Portugal is nowadays in the list of the oldest countries in the world and in Brazil the "ageing of the top" will occur up to 2025 occupying the 6th elderly population of the world, in absolute terms. **Methods** The aim of this study was to analyze comparatively Life Quality between the senior citizens who participate in the Public Physical Activity Programs at Nisa, Portugal (Program Activ Sénior) and Florianópolis, Brazil (Programa Floripa Ativa). A transversal descriptive study was carried out including 258 senior citizens, both genders, using the Brazilian and Portuguese versions of the Short Form 36 questionnaire. **Results** The global Cronbach's alpha was 0.72 for the Physical and 0.73 for the Mental Component. Descriptive analysis showed that the subjects' average age was 69,56 years old (PD: +/- 5,74 years) and that most of them were women (84,8%). The best scores for both cities/countries were obtained for the Mental Component. There were statistically significant differences for the following dimensions: Physical Pain, General Health and Vitality. **Discussion** Therefore, it was possible to conclude that the most significant percentage

belongs to the women. The feminization of ageing, estimates for average age and participation of women in studies related to ageing are always in greater numbers (Matsudo et al., 2011). The results of this study suggest that the collective health strategies that have been adopted in Nisa/Portugal and Florianópolis/Brazil through their Programs were able to establish social bonds and provide health gains, bringing benefits for active ageing. References Matsudo, SM, et al. (2001). *Braz. J Sport Med*, 7, 2-13.

### **SWEAT LOSS AND FLUID INTAKE DURING SWIMMING TRAINING IN SPRING AND SUMMER AT AN OUTDOOR SWIMMING POOL: A FIELD STUDY**

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**Introduction** Several papers have reported on sweat loss and fluid intake during swimming training at indoor pools (Taimura et al., 1997, 2006, 2008). The water temperature of indoor swimming pools is managed constantly, but, in the case of outdoor swimming pools, the water temperature depends on the temperature outside. This study clarified sweat loss and fluid intake during swimming training in spring and summer at an outdoor swimming pool. **Methods** The subjects were 18 male college swimmers. They were informed of the aims, risks, and benefits of this investigation both verbally and in writing prior to signing an informed consent document. The body weight before and after training, the volume and the frequency of fluid intake and urination during training were measured. The subjects were allowed to take fluid ad libitum during training. The sweat loss during exercise was calculated from the weight loss, the fluid intake and the volume of urination [(body weight before training - body weight after training) + fluid intake during exercise - the volume of urination]. **Results** The mean outdoor and water temperature during swimming training was  $25.0 \pm 0.9^\circ\text{C}$  and  $33.2 \pm 1.2^\circ\text{C}$ ,  $23.7 \pm 0.1^\circ\text{C}$  and  $32.0 \pm 0.3^\circ\text{C}$  in winter and summer, respectively. Sweat loss, fluid intake and fluid intake ratio (fluid intake / sweat loss  $\times$  100) were  $280.6 \pm 181.6$  g,  $153.4 \pm 122.9$  g,  $37.3 \pm 29.3\%$  in spring and  $610.5 \pm 281.7$  g,  $302.3 \pm 197.0$  g,  $33.1 \pm 21.8\%$  in summer, respectively. The sweat loss and fluid intake in summer were significantly greater than those in spring ( $P < 0.05$ ). The fluid intake ratio in spring was significantly greater than that in summer ( $P < 0.05$ ). **Discussion** Sweat loss and fluid intake during swimming training was related to pool conditions. However, there was no difference in the fluid intake ratio between summer and winter. Swimmers should have more fluid intake before/during swimming training to prevent dehydration, especially in summer. References Taimura A, Matsunami M, Nakagaichi M and Sugawara M (1997). *Med Sci Sports Exerc*, 29(5), s133. Taimura A, Matsunami M, Nakagaichi M and Sugawara M (2006). *Med Sci Sports Exerc*, 38(5), s356. Akihiro Taimura, Masaru Matsunami, Masashi Sugawara, Masahiro Taguchi and Shoichiro Taba (2008), Proc. of the 1st International Scientific Conference of Aquatic Space Activities, 227-232.

### **ETUDE DES EFFETS DE LA RÉADAPTATION CARDIAQUE PAR L'EXERCICE PHYSIQUE CHEZ LES CORONARIENS**

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**Résumé** La réadaptation cardiaque prend une part grandissante dans la prise en charge des coronariens. Il y a cependant une grande discordance entre son apport bénéfique certain chez ces patients, démontré par toutes les études et le peu de centres existants principalement dans les pays en voie de développement ; d'autant plus que ces effets sont obtenus avec un excellent rapport coût-bénéfice. Cette étude qui devait traiter, en principe, toutes les phases classiques de la réadaptation cardiaque, ne s'est intéressée qu'à la phase qui met en évidence les aspects du réentraînement à l'effort... A cet effet, nous considérons que l'entraînement physique est une partie clé de la réadaptation cardiaque. Les effets physiologiques obtenus par cet entraînement influencent la morbidité et la mortalité des patients de manière significative. Ces effets physiologiques sont accompagnés d'effets psychologiques favorables. A souligner que pour obtenir ces résultats, l'entraînement doit répondre à un certain nombre de critères : • être fondé sur l'entraînement dynamique, • être régulier, • calibré par une épreuve d'effort, • représenter un volume et une intensité de travail suffisants. Cette approche complète bien évidemment l'éducation à la prévention des différents facteurs de risque : • sevrage tabagique, • diététique, • lutte contre la sédentarité, • meilleure connaissance de la maladie, etc. Nous avons donc collaboré avec le service de médecine du sport qui a lancé cette discipline et nous rapportons notre première expérience en réadaptation cardiaque avec l'étude de 158 patients pris en ambulatoire. Les résultats ont montré l'amélioration fonctionnelle chez tous les patients avec une qualité de vie jugée meilleure par tous sur un questionnaire remis en fin de programme.

### **FUNCTIONAL INTEGRATED TRAINING: THE CONCEPTUAL FRAMEWORK APPLIED IN SPORTS CONDITION TRAINING, HEALTH-RELATED EXERCISE AND INJURIES PREVENTION**

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1: FCDEF-UC (Coimbra, Portugal), 2: FPE-URC (Iguatú, Brazil); 3: DPES-UV (Valencia, Spain); UNI-RIO (Rio de Janeiro, Brasil) **Introduction:** Several strategies for prescription physical exercise have emerged in recent years. For this reason, the term Functional Training (FT) is usually used to refer to a 'new' system of training that seeks to develop the physical fitness qualities (PFQ) of a more integrated one (King et al. 2000). Therefore, the aim of this study was to suggest a conceptual framework (CF) for the FT and to identify the main areas of application. **Procedure:** For this purpose was performed systematic review of the scientific literature. Our objective is to present a CF for FT as a complex and multidimensional system, emphasizing more specific approaches of the sciences of human movement to understand the real practical application of the FT in health-related exercise, sports condition training and injuries prevention. **Evidences:** Applied to the sport condition training, the goals are causing the individual to increase their performance and to prevent injuries. In the health-related exercise the applications of FT are to promote the improvement of PFQ, and create new practices in response to a low physical fitness of the population. **Discussion:** The development of a CF can provide a basic and standardized foundation, which definitions support a theoretical model and to assist in the practical application of scientific evidence support (Garber et al., 2011). In this proposal, was possible to develop a model to identify some specific approaches within each area of knowledge of the science of human movement applied to the FT. Therefore, what is proposed from the CF presented here is the understanding that FT consist as the improve PFQ (e.g. coordination, balance and strength) combining the core training and training in all plane of motion as well as development of energetic systems. (Clark et al, 2009). The strength workout is extensively revised in the literature it is associated with the increase of other indicators of PFQ and injuries prevention (Brent et al. 2009; Behm and Colado, 2012; Colado and García-Massó, 2009). The sport and exercise sciences have discovered new ways to enhance the performance of human and this has reflected in new forms of practical application in sport, health-related exercise and rehabilitation sciences as well. References: Behm, D and Colado, JC. (2012). *Int J Sports Phys Ther*.

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## **ASSOCIATION OF THIGH, CALF, AND ABDOMEN CIRCUMFERENCES AND ARTERIAL STIFFNESS IN MIDDLE-AGED MALES WITH METABOLIC SYNDROME**

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**Background and purpose:** Association of body circumference (CC) and atherosclerosis has been observed in recent studies. However, studies in such area are rarely conducted and poorly understood. Furthermore, mixed results have been reported. We aimed to test the cross-sectional association of arterial stiffness with calf, abdomen, and thigh circumferences (CC) to elucidate the association of CC to arterial stiffness in middle-aged males with metabolic syndrome. **Methods:** The study was performed on 143 males participants aged between 45 to 60 years who have visited A general hospital in Seoul, Korea for annual health examination. The participants were screened for metabolic syndrome with health questionnaire, 8 hr fasting blood tests, anthropometric measurements, and PWV. Blood tests included TC (total cholesterol), TG (triglyceride), HDL-C, LDL-C, glucose, insulin, and HbA1c. Subjects with metabolic syndrome were selected based on guidelines of NCEP-ATP III and WHO: TG > 150 mg/dl, HDL-C > 40 mg/dl, SBP > 130 mmHg, DBP > 85 mmHg, fasting glucose > 110 mg/dl, WC > 90 cm. Subjects with 3 or more were categorized as metabolic syndrome. **Results:** The present study showed that calf, abdomen, and thigh circumferences (CC) were significantly greater in those with metabolic syndrome (MS) than those without metabolic syndrome (NMS). However, when MS was divided in groups in quartile by circumferences, those with greater thigh and calf circumferences had significantly less baPWV. When odd ratios were calculated through logistic regression analysis based on 1400 cm/sec as atherosclerosis, those with less thigh and calf circumferences had greater risk for atherosclerosis in relationship to abdomen. **Conclusions:** The present study shows an inverse relationship between baPWV and thigh and calf circumferences in those with metabolic syndrome. Lower body musculature and sarcopenia may be related to risk for baPWV.

## **AN OXYGEN INHALATION TO IMPROVE FUNCTIONALITY AND RECOVERY OF SKIERS**

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**INTRODUCTION** In sports practice, there aids and methods increasing adaptive capacity of an athlete. Such means may be a breathing air mixtures (BAM) with high oxygen content (Han, Kim, Lim, & Kim, 2011). The aims of this study was to determine the effect of BAM containing 93% oxygen on the functional status and recovery skiers. **METHODS** The experiment was attended by 26 elite male skiers. The average age of athletes was  $20 \pm 1.79$  years old, the experience of sports activities is  $6.4 \pm 1.5$  years. To evaluate the performance of athletes the incremental exercise test on a treadmill was used. The test used a standard protocol (Power, Handrigan & Basset, 2011). In the process of the step test with the help of Polar heart rate monitor at each stage was recorded heart rate, defined anaerobic threshold (AT), was calculated power of the work performed (W), oxygen uptake (VO<sub>2</sub>). The research program included a two-fold tests with a break of at least 3 days. Before the second test athletes for 10 minutes BAM containing 93% oxygen with a portable oxygen concentrator Air Sep Life Style, performance 5 l/min. Before and after BAM with a high content of oxygen functional status was evaluated respiratory and cardiovascular systems of athletes. **RESULTS** Analysis of respiratory system parameters shows that breathing concentrated oxygen leads to an increase in vital capacity due to an increase in respiration volume ( $p < 0.001$ ). Analysis of the aerobic performance of athletes has shown that BAM containing 93% oxygen to the maximum load leads to an increase in VO<sub>2</sub> max, AT ( $p < 0.001$ ), oxygen uptake at AT ( $p < 0.001$ ), while the increase in the aerobic zone ( $p < 0.001$ ), aerobic threshold power ( $p < 0.001$ ), decrease value of time in the anaerobic zone and increase in total power test ( $p < 0.001$ ) compared to the level registered after the first load testing, in which athletes did not use BAM. Analysis of heart rate variability and circulation shows increasing efficiency of functioning cardiovascular system of an athlete. There are decrease heart rate, increase systolic volume, also by athletes with moderate prevalence of autonomous regulation circuit increase heart rate variability indicators: SDNN, CV, Mo, pNN50, RMSDD ( $p < 0.001$ ). Also, using this mixture during 20 min after the maximum load is faster recovery of the cardiovascular and respiratory systems of elite skiers. **DISCUSSION** The use of BAM containing 93% oxygen has a positive effect on the functional state of athletes and is also a specific factor that increases the reserve capacity of respiratory and non-specific stimulus, mobilizing the adaptation body's structures athletes. The use of oxygen support before maximum load capacity increases athletes aerobic capacity, anaerobic power and efficiency performance. **REFERENCES** Han, S-W., Kim, H-R., Lim, S-G. & Kim, C-S. (2011) J Exercise Nutrition and Biochemistry, 15(1), 20-27. Power, G.A., Handrigan, G.A. & Basset, F.A. (2012). E J Sport Sci, 12:6, 491-498.

## **EFFECT OF ACUTE MOUNTAIN SICKNESS ON POSTURAL FLEXIBILITY**

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**Introduction** Fast ascents to high altitude regions may provoke head ache, acute mountain sickness (AMS) or even high altitude cerebral or pulmonary edema (HACE, HAPE). Hypoxia is supposed to affect the basal ganglia and cerebellar pathways which are important for postural adjustments. Hiking on mountain trails often demands well controlled posture to avoid stumbling and slipping. Deterioration of postural control is linked to HACE, but no relationship between postural control and AMS has been observed (Bird et al., 2011). Short term learning effects to map postural flexibility have not yet been taken into account. **Methods** Seventy healthy subjects (mean age 26, SD 5 y) were exposed for 7h to normobaric hypoxia at a simulated altitude of 4500m (12.6% FIO<sub>2</sub>). The Lake Louise Score (LLS) was used to diagnose AMS after 0.5h and 6h followed by balance testing (S3-check, Raschner et al., 2008) which was also performed 10 min before entering the hypoxic chamber. Half of the subjects balanced on a platform with anterior-posterior tilt and medio-lateral tilt respectively. Three trials of 30 s each were registered and resulted in a stability score. 15 s of warming up were permitted before each trial. Subjects showing a LLS > 3 were rated as having AMS. ANOVA with repeated measures (3 trials, 3 time points: before, 50min and 6h:50min in hypoxia, 2 groups: AMS yes or no) was conducted for each balance task separately to reveal differences in short term learning effects according to AMS status. Significance level was fixed at  $p < 0.05$ . Results Twenty-four participants suffered from AMS. An overall learning effect was seen in the ante-posterior task without any interactions. In the medio-lateral task a significant main effect of trials (Greenhouse-Geisser corrected  $F(1.6,56) = 5.3$ ,  $p = 0.014$ ,  $\eta^2 = 0.16$ ) and an interaction of trials and time points ( $F(4,112) = 3.67$ ,  $p = 0.008$ ,  $\eta^2 = 0.12$ ) showed that hypoxia affects adaptation strategies within trials. Interestingly the AMS group tended to adapt differently

( $F(4,112)=1.96$ ,  $p=0.106$ ,  $\eta^2=0.07$ ) and showed significantly less improvement within trials in hypoxic conditions compared to the non-AMS group (contrasts:  $F(1,28)=4.39$ ,  $p=0.045$ ,  $\eta^2=0.14$ ). Discussion Whereas non-AMS participants showed a similar progression of trials at different time points, AMS patients seemed to deteriorate in the ability to select relevant information for improving performance in consecutive trials. The general effect of hypoxia on postural flexibility should be investigated with a control group design. Differences in adaptation of AMS patients could be sharpened by executing more test trials. References Bird B, Wright A, Wilson M. et al. (2011), *Wilderness Environ Med.*, 22,172-176. Raschner C, Lember S, Platzer H-P. et al. (2008), *Sportverletz Sportschaden*, 22, 100–105.

## GROWTH AND BODY COMPOSITION OF RHYTHMIC GYMNASTICS ATHLETES OF ON THE SOMATIC MATURATION

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**Introduction** The effect of sports training on normal growth and sexual maturation of rhythmic gymnastics athletes is still a matter of debate. Studies report that the intense training at an early age can adversely affect physical growth, maturation and body composition in young female athletes (Daly et al., 2005). Therefore, the aim of the study was to analyze the growth and body composition of athletes in rhythmic gymnastics in relation to somatic maturation. **Methods** A descriptive cross sectional study with a sample of 136 athletes from 23 Rhythmic Gymnastics teams in 10 states of Brazil. We evaluated anthropometric measurements of weight, sitting height. We calculated the lean and fat mass, fat percentage and peak height velocity (PHV). The weight and height were transformed into z scores compared with the average of the reference for age and sex (WHO, 2007). **Results** The z scores for weight and height were negative in all ages, and the average weight ranged from -0.3 to -0.8 and from -0.2 to height of -0.8. The maximum PHV appeared to  $12.1 \pm 0.8$  years and up to four years after it was observed a significant increase in weight, height, sitting height, body fat percentage, fat mass and lean. The average age of menarche was  $13.2 \pm 1.3$  years. **Discussion** The rhythmic gymnasts in this study had weight and height below the reference for age, peak growth rate and age at menarche within the normal and delayed recovery of weight and height during puberty. There was an increase in the percentage of fat and the fat and lean mass after 2 years of PHV and the occurrence of menarche, which can be explained by the fact that female puberty be modulated by estrogen which promotes fat accumulation (Georgopoulos et al., 2010). Thus, periodic controls of growth in children and adolescents during the sports training are needed. References Daly RM, Caine D, Bass S, Pieter W, Broekhoff J (2005). Growth of highly versus moderately trained competitive female artistic gymnasts. *Med Sci Sports Exerc* 37:1053-60. Georgopoulos N, Roupas ND, Theodoropoulou A, Tsekouras A, Vagenakis AG, Markou K (2010). The influence of intensive physical training on growth and pubertal development in athletes. *Ann N Y Acad Sci* 1205:39-44. WHO (2007). Disponível em [http://www.who.int/growthref/bmifa\\_girls\\_5\\_19years\\_z.pdf](http://www.who.int/growthref/bmifa_girls_5_19years_z.pdf) Do not insert authors here

## THE EFFECT OF "FUNCTIONAL SOCKS" FOR FOOT ARCH AND EMG OF THE LOWER LEG MUSCLES DURING TREADMILL WALKING AND RUNNING

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**Introduction** In recent years, socks for the purpose of the support of the foot arch named 'functional socks' are spread out. The functional socks is not the pressure to calf muscles, but it support a heel and foot arch by original knit, and an aim of the socks fatigue reduction. However, there is not the report that examined the effect of these socks. Therefore, the purpose of this study was elucidate the effect of "functional socks" during treadmill walking and running. **Methods** This study comprised 20 healthy college student volunteers. In all volunteer, EMG of the calf muscle using PowerLab (AD Instrument) and the foot pressure mapping using F-scan system (Nitta). %MVC (normalized by maximum voluntary contraction) during treadmill walking and running were calculated from surface EMG. The foot pressure evaluated the load ratio of the middle foot part for the whole foot part except the toe (Modified Arch Index : MAI). **Results** MAI of 'functional socks' group showed a high value from the normal socks group, but the significant difference was not seen. In 'functional socks' group, the %MVC of the flexor hallucis longus muscle showed lower value than normal socks group during walking and running. The %MVC of the soleus muscle and the medial gastrocnemius muscle also showed low value in 'functional socks' group. **Discussion** These results suggest that the 'functional socks' did not have significant effect to structural support for the foot arch. However the 'functional socks' may be able to reduce muscle fatigue.

## TEAM DOCTOR IN FORMULA ONE: EPIDEMIOLOGY

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**INTRODUCTION** The physician for a sports team is the physician who is in charge of coordinating the medical staff and medical services for the team. A Formula One (F1) team consists of 75 people of which only 2 or 3 are athletes, with the balance comprising of mechanics, engineers, technicians and managers. The FIA regulations do not require the presence of a doctor for each team. **METHODS** This paper refers to three F1 world championships (2009-2010-2012 seasons respectively of 17 Grand Prix (8 non-European), 19 (10) and 19 (10). Data has been collected on the types of medical intervention required, and has been classified by medical specialty, by the time of the week / day and by the patient who underwent the treatment. The average duration of a GP in Europe was  $6.5 \pm 1.1$  days, and  $13.7 \pm 1.2$  days for travel since many of the non-European GPs are back to back. **RESULTS** Only 1% of the recipients of the medical service were the drivers. Most of the work performed was on the team crew (76%). 13% was carried out on other teams, while the remaining 10% on other individuals (journalists, photographers, members of the catering crew, guests). The average of interventions was  $54.3 \pm 2.7$  per day in overseas GPs while  $41.7 \pm 1.9$  per day in Europe. With reference to the type of interventions, 27% were related to orthopaedic problems, 17% pulmonology and ENT, 15% gastrointestinal problems, 7% urogynaecological disorders, 13% surgical issues and the remaining to others (emergencies, insect bites, dehydration, dental, etc...). The most of the events occurred during overnight or during the hours of qualifications or GP. The events were concentrated in the first and last days of the event. **DISCUSSION** In conclusion, it is clear that the doctor meets more illnesses than injuries, many of which are seen in the family doctor medicine. The timing of events can be related to hazardous and strenuous activities when assembling and setting down the garage, sometimes associated with jet lag as well as the moments that require greater speed and accuracy as qualifying sessions and GP. According to the number and types of cases, the presence of a doctor within each team has to be strongly recommended. The F1 team doctor must be a good general practitioner and must have an excellent knowledge of anti-doping regulations and BLS procedures as dangerous and life-threatening injuries may always occur in Motorsports. **REFERENCES** -Hunter HC: Medical team coverage of motor sports events. *J Am Osteopath Assoc*. 1996;96(3):179-180 -

Watkins ES: The Physiology and Pathology of Formula One Gran Prix Motor Racing. *Clinical Neurosurgery* 2006;53:145-152 -Micheli, L et al: 'Team Physician Manual', FIMS

### **HAEMODYNAMIC RESPONSES DURING GRADED PLANTAR FLEXION EXERCISE IN MIDDLE-AGED MEN AND WOMEN WITH TYPE 2 DIABETES**

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In this study we tested the hypothesis that type 2 diabetes (T2D) impairs the haemodynamic responses to a maximal incremental plantar-flexion exercise but that these impairments are not sex-specific. Forty-four middle-aged individuals with T2D (30 male, 14 female), and 34 age- and BMI-matched healthy individuals (16 male, 18 female) were tested. After establishing each participant's maximal voluntary contractions (MVC), participants performed an intermittent incremental plantar-flexion exercise (6s duty cycle: 2 s contraction, 4 s relaxation) until failure in the supine posture. The test began with a force production of 100N for 2 min, and thereafter the required force was increased every two minutes by 200N (men) or 150N (women). Calf blood flow (BF) was measured contraction by contraction using venous occlusion plethysmography. Ethical approval was obtained from the Trinity College Dublin Faculty Research Ethics Committee. Peak force expressed as a percentage of the MVC (% MVC) was significantly reduced in men and women with T2D compared with their respective non-diabetic counterparts (men,  $60.4 \pm 11.1$  vs.  $68.0 \pm 10.8$ ; women,  $63.3 \pm 11.2$  vs.  $74 \pm 21.4$ ). Peak BF (ml/min) and hyperaemic (slope of BF vs the percentage of peak force; ml/min/%peak F) responses were also reduced in women with T2D compared with healthy women (Peak BF,  $460.6 \pm 126.8$  vs.  $628.3 \pm 347.7$ ; slope,  $3.78 \pm 1.74$  vs.  $5.85 \pm 3.14$ ) and in men with T2D compared with non-diabetic men (Peak BF,  $621.7 \pm 241.3$  vs.  $721.2 \pm 359.7$ ; slope,  $5.75 \pm 2.66$  vs.  $6.33 \pm 3.63$ ). The magnitude of these impairments was not different between males and females. The results suggest that the type 2 diabetes-induced impairments in calf incremental plantar-flexion exercise are related to reductions in blood flow but that they are not affected by sex in middle aged participants.

### **CHANGES IN STRENGTH OF KNEE EXTENSORS AND FLEXORS FOLLOWING REPEATED FOOTBALL MATCHES DURING A WEEKLY MICROCYCLE**

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High intensity, accumulated fatigue and muscular strain induced by a football match as well the dynamic match/training scheduling predisposes football players to injury during subsequent training or competition. Among football injuries, muscle strains of hamstring origin are considered to be the most prevalent. The aim of the present study was to determine the effects of consecutive football matches on knee extensor and flexor muscle strength and damage. Forty elite football players were randomly assigned to either an experimental group that participated in three football matches (EG, N=20) or a control group that participated only in training (C, N=20). Three days after an initial 8-day preparatory period consisting of daily practices, EG played three matches within a 7-day microcycle (Sunday-Wednesday-Sunday matches). Participants in both groups trained daily according to an in-season training model. Blood samples were collected, muscle damage was determined (DOMS, delayed onset of muscle soreness; KJRM, knee joint range of motion) and muscle strength (at 0 deg/sec as well as concentric and eccentric strength at 60 and 180 deg/sec on an isokinetic dynamometer) of knee flexors and extensors was measured before and after the preparatory period, before and after each match and daily in between matches (and for 3 days after the last one). Blood was analyzed for inflammatory markers (creatine kinase activity, c-reactive protein, leukocyte counts). Data analysis revealed that isometric, concentric, and eccentric strength of knee flexors and extensors was considerably reduced after each match. This reduction was more prolonged after the first two matches and it was accompanied by marked alterations of the flexor to extensor strength ratios (both concentric/concentric and eccentric/concentric). This reduction was correlated to CK elevation. Muscle damage and strength reduction was more evident and prolonged for knee flexors than extensors. These results suggest that consecutive football matches may result in a reduction of athlete's potential for knee stabilization.

### **INVESTIGATION OF THE FIRST AID KNOWLEDGE LEVELS OF UNIVERSITY STUDENTS WHO ACTIVELY DO SPORTS**

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Introduction Death rates caused by the accidents and natural disasters are high both in our country and in the world. Among the 21 objectives of the "Health for Everyone in 21st Century" issued by World Health Organization which aims to protect and improve human health in a life-long period, the ninth aim is "Reducing Accidental Injuries" The skill and knowledge levels of the society and individuals in the field of first aid is unknown. In this context, training and informing the society about first aid is gaining high importance. For this reason, this article can be considered as a descriptive study conducted on 1386 students which aims to evaluate the level of knowledge of university students who are actively involved in sports and who are not. Methods 1386 students, having an average age of 21.46, 660 of which are females and 726 of which are males, who are engaged in team or individual sports or none voluntarily participated the study. A survey form composed of 16 questions and demographic inquiry was used as the data collection instrument. Statistical analysis of the data was carried out using SPSS 16.0 program, the results were presented as "mean and  $\pm$  standard deviation" and t-test was performed in order to find out whether there is a statistically significant difference between the mean scores of the study groups. The results of the analyses were evaluated within 95% confidence interval ( $p < 0.05$ ). Results A statistically significant difference of  $0.039 \pm 0.14$  was detected between the first aid knowledge levels of male and female students ( $p < 0.05$ ). No statistically significant  $0.92 \pm 0.14$  difference was detected between the first aid knowledge levels of the students who actively do sports and who do not ( $p > 0.05$ ). It was discovered that, out of the 318 students who actively do sports, 37.1% encountered an incident which required first aid once, 27% twice, 21.4 three times, 8.8% four times, 5.1% five times and 0.6% six times. In the study, it was found out that a large number of students (18.6%) had not received first aid related training. There is a  $0.001 \pm 0.18$  statically significant difference between the participants who received first aid training and those who did not ( $p < 0.005$ ). It was also discovered that 15 of the participants had first aid certificates, 1373 of the participants did not have any such certificates and a statistically significant difference of  $0.002 \pm 0.16$  was detected between the participants who have first aid certificates and those who do not ( $p < 0.005$ ). Discussion According to the findings of this study which aims to determine the university students' level of knowledge regarding first aid, it was found out that the students did not possess sufficient knowledge about first aid,

and that, being aware of their lack of knowledge, they confessed their need for first aid education. References Health 21 for European Region, WHO

### **MEDICAL DISQUALIFICATIONS FROM COMPETITIVE SPORT: TRENDS DETECTED IN COURSE OF THE PRE-PARTICIPATION SCREENING AT THE SPORTS MEDICINE SERVICE OF BOLZANO/BOZEN FROM 1983 UNTIL 2010**

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**Introduction** In contrast to many other countries, the Italian sports medical pre-participation screening program is not limited to elite athletes, but everyone participating in organized training and competition is required by law to undergo a periodical preventive medical evaluation consisting in personal and family history, 12-lead electrocardiograms at rest and after exercise, spirometric test and physical examination. If irregularities are detected, further medical diagnostics are requested to evaluate the eligibility for competitive sports. **Methods** All cases of medical disqualification, from the implementation of the regional Sports Medicine service in 1983 until 2010, were reviewed, annual prevalence and sorts of cardiovascular causes were analyzed. Data of the period before and after 1997 were statistically compared. Results Overall, in the course of 28 years at the Sports Medicine service of Bolzano/Bozen 189,830 pre-participation screening tests were performed and 762 times the detection of a severe pathology motivated the medical disqualification (558 cases before and 204 cases since 1997). The annual prevalence was on average 0.44±0.30%, but was significantly higher during the first period (0.69±0.20% vs 0.19±0.07%). The annual percentages of cardiovascular motivated disqualifications increased in time (66.2±11.8% vs 77.9±9.6%). While the annual proportion of arrhythmias, conduction anomalies and cardiomyopathies within cardiovascular causes were not significantly different before and after 1997, valvulopathies (13.2±5.3% vs 19.6±6.5%) and congenital heart diseases (2.0±2.0% vs 7.8±5.3%) have become proportionally more frequent. Ischemic heart disease became more prevalent as cardiac reason for disqualification (9.1±5.6% vs 14.1±7.7%;  $p=0.058$ ). **Discussion** The benefit of the Italian pre-participation screening system is impressively demonstrated by the decline of sudden cardiac death among athletes since its implementation in 1982 in Veneto region (1). Our data document a decreasing annual prevalence of disqualifications as a result of the continuous progress in differential diagnostics and therapies. Cardiovascular pathologies are by far the most frequent motivation for medical disqualification from participation in sports and have proportionally further increased in the recent years. Concepts to further improve effectiveness and cost-value ratio of the medical pre-participation screening are discussed. References 1 Corrado D, Basso C, et al. (2006). JAMA, 296, 1593-1601.

### **THE EFFECT OF X-CUPWARE IN SOCCER TRAINING IN YOUTH.**

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Soccer players who become professional drag injuries due to bad training during youth. We watch 476 patients from different categories of soccer from youth teams and professional trying to figure out how to prevent those injuries, and prevent that some of the player who won't become professionals could continue practicing the sports without health issues. We developed special software (X-cupware) to upload the data we collected (anthropometrics, dynamics, imagenology, surgery reports). And we gave the trainers web access, to our artificial intelligence method, the software automatically makes a suggestion in where the player should be more effective. But our software not only give suggestion to the coach but also to medical boards of the teams in how to resolve in time the injuries so they could be back in the team in healthy conditions. There is a big underreporting about injuries in base soccer in Spain, the main cause is due to what we call sports momentum timing, a big factor it's also players don't know the basics about athletism and the coaches refer they don't have time to teach that. With our software and direct intervention we reduced indirect injuries over 40% and the rehabilitation period reduced by 60% on direct injuries. Also the software was used by parents and coaches to learn about the status and correct procedures during the injury. With our system what we are trying to do is to create a milestone in youth soccer teams in Spain, we all know this follow up system is well known by the big teams (Real Madrid-Barcelona), but most of the worst injuries happens in early steps. By using mibox software technology, combined with footplus IBP system, and adidas dynamic recording system, we bring up a tool wich is in used by CENETED soccer school professionals to prevent these injuries from happening at the palm of their hand using a x-cupware terminal phone at very low cost. Do not insert authors here

### **RELIABILITY OF GLUTEUS MAXIMUS MUSCLE THICKNESS MEASUREMENTS WITH ULTRASOUND**

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**Introduction** Gluteus maximus muscle (GM) is a large muscle that engages the movement of the hip joint. This muscle connects to trunk and lower limbs, and plays a big role in various movements. But it is difficult to evaluate the form of this muscle exactly by using ultrasound. Although MRI is utilized by medical professionals for its high accuracy, it is not readily available in many settings and considered inconvenient due to its expensive cost and lack of portability. On the other hand, ultrasound is more suitable for collect much data. In assessing GM by using ultrasound, it must be noted that gaining the reliability of the use of ultrasound as an imaging tool is crucial since its accuracy is influenced by the positioning of the ultrasound probe. Little study has been done to measure the thickness of GM using ultrasound in Japan. The aim of this study was to measure the thickness of GM by using ultrasound to examine its intra-rater reliability. **Methods** Japanese male rugby football players were recruited in this study (n=6). The thickness of GM was measured twice on different days using ultrasound. Landmarks were marked at proximal 1/4, middle, and distal 1/4 of the straight line from posterior superior iliac spine to greater trochanter. Interclass Correlation Coefficient (ICC) was used to examine the intra-rater reliability of two testing data taken on two different days. ICC=0.81~1.00 was considered high (Landis et al., 1977). Results The differences between the two testing data were the proximal 1/4; 0.24cm (ICC=0.97), the middle; 0.40cm (ICC=0.85), the distal 1/4; 0.32cm (ICC=0.88). The maximum difference between the two testing date was ICC>0.85 (0.77cm). The averages of the thickness (±SD) were proximal 1/4; 5.74cm (±1.20), middle; 5.98cm (±0.86), distal 1/4; 5.19cm (±0.73). **Discussion** All data showed high reliability (ICC >0.80) in this study. Our result showed that an ultrasound is suitable to measure the thickness of GM. The proximal 1/4 had the highest reliability (ICC=0.97). However it was the middle point that reported the largest thickness. Therefore, further study must be done to decide the best landmark of these three points when measuring GM. More study is needed to decide the best landmark to measure GM by comparing and considering the data taken by using MRI. Further study in this area using ultrasound will be useful to establish a portable and cost efficient method to evaluate the thickness of

GM that can be use in on-site sports settings. References Landis JR, Koch GG: The measurement of observer agreement for categorical data: *Biometrics*, 33: 159-174, 1997

### **INFLUENCE OF POST-EXERCISE LIMB BLOOD FLOW STIMULATION ON PERFORMANCE RECOVERY**

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Introduction Elite sport requires athletes to complete multiple bouts of high-intensity exercise with limited rest periods that are not sufficient for full recovery. To facilitate the performance recovery, recovery therapies like active,1 immersion2 or neuroelectromyostimulation3 (NEMS) have achieved very good results. It has been hypothesized that the increase of blood flow with these strategies could accelerate the supply of oxygen rich blood, increase the flush of waste products and help reduce H+ levels associated with lactic acid build-up. Consequently, the assumption of a strong relationship between blood flow and high intensity performance recovery is often cited although never tested. Therefore, the aim of this study was to test this hypothesis by stimulating the blood flow at three different levels during a 30-min recovery intervention period between two sessions of multiple sprint interval (three 30-s WanT) exercise. Methods Thirty-seven trained athletes participated in a randomized controlled trial. Each session consisted of performing 3 x 30 WanT (bouts 1-3) followed by a randomly assigned 30-min recovery intervention of either: high blood flow (Veinoplus Sport®)(HBF), low blood flow (Cefar-Compex Theta 500®)(LBF); sham NEMS device (SHAM; that does not stimulate the blood flow) and passive recovery (PAS). A 30-s WanT was then repeated (bouts 4) and compared to bout 1 for peak power and mean power. Measures of blood flow, blood lactate and heart rate were recorded every 3 min throughout the recovery intervention period to monitor physiological responses. Results Blood flow was significantly higher in HBF group compared to PAS, SHAM and LBF groups. Examination of heart rate and blood lactate revealed no recovery effect. The recovery of mean power was likely beneficial in the HBF group compared with the SHAM group and very likely beneficial compared with the PAS group and the LBF group. The recovery of peak power in the HBF group was likely beneficial and very likely beneficial compared with the LBF group and the PAS group, respectively. Conclusion Stimulate total blood flow at a high velocity is a mean of preserving performance when repeating acute exhausting exercise interspersed by short recovery period. However this positive effect is not accompanied by a greater lactate removal. References 1. Heyman E, et al. (2009) Effects of four recovery methods on repeated maximal rock climbing performance. *Med Sci Sports Exerc* 41: 1303-10. 2. Pournot H, et al. (2011) Short term effects of various water immersions on recovery from exhaustive intermittent exercise. *Eur J Appl Physiol* 111: 1287-95. 3. Bieuzen F, et al. (2012) Recovery after high-intensity intermittent exercise in elite soccer players using VEINOPLUS sport technology for blood-flow stimulation. *J Athl Train* 47: 498-506.

### **CELLULAR AND BIOCHEMICAL PARAMETERS OF EXERCISE-INDUCED OXIDATIVE STRESS: EFFECTS OF EXPLOSIVE-TYPE MODERATE INTENSITY TRAINING IN THE ELDERLY**

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BACKGROUND: Reactive oxygen species (ROS) production increases during aging. This could be due, almost in part, to a decrease of antioxidant capacity and other protective mechanisms such as heat shock proteins (HSPs), thus making elderly subjects susceptible to oxidative stress. Regular physical activity has been hypothesized to provide protection against oxidative damage at all ages. Several studies have incorporated, as an attractive exercise modality for older adults, a low frequency explosive-type moderate resistance training (EMRT). It is highly effective in eliciting a significant enhancement in muscular strength without stress-related negative effects. The purpose of this work was to investigate the effect of EMRT on both biochemical and cellular biomarkers of oxidative stress evaluated in trained elderly subjects in response to a maximal exercise stress test. METHODS: Sixteen elderly persons (aged 72.5 years), were randomly assigned to two different groups: a training group (explosive-type resistance training for 12 weeks) and a control group (that not participate to training protocol). Plasma redox homeostasis (total antioxidant status, (TAS) and glutathione (GSH)), oxidative damage (malondialdehyde (MDA) and protein carbonylation levels), and repair system (Hsp70 and Hsp27 expression in leukocytes) were evaluated before and after the maximal exercise stress test. RESULTS: No differences were found comparing biological and biochemical parameters between two groups before the training protocol. The maximal exercise stress test lead to an increase of all the parameters related to oxidative stress. However, after the EMRT, the training group showed a less pronounced increase in oxidative stress parameters following the maximal exercise stress test compared to control group. A 25% reduction ( $p < 0.05$ ) were found in GSSG levels and GSH/GSSG ratio was increased by 20% ( $p < 0.05$ ) compared to control group. MDA and protein carbonylation levels were 25 % reduced respect those found in control group. Hsp70 and Hsp27 expression showed a lower protein basal levels in the trained group, with a higher protective response after 24 hrs from the test ( $p < 0.05$ ). CONCLUSIONS: Our data show that, in trained elderly subjects, the EMRT protocol is able to induce a cellular adaptation, through influencing glutathione homeostasis and heat shock proteins levels after a maximal exercise stress test.

### **FACTORS INFLUENCING THE APPLICATION OF INFRARED THERMOGRAPHY IN ATHLETES: A CLASSIFICATION PROPOSAL**

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Introduction Infrared Thermography (IRT) is a technique with a rising number of new and interesting applications on physical activity and sport field, as for example the prevention and monitoring of injuries (Hildebrandt et al., 2010). However, working with IRT requires taking into account many factors, which could influence either the evaluation or the interpretation of the thermal images (Zaproudina et al., 2008). The primary objective of this work is to propose a classification of the factors that influence IRT applications in athletes. Methods We performed a systematic review using 9 search engines to identify studies that are related to IRT and its influencing factors. Search queries included IRT synonyms and keywords related with the influencing factors. The inclusion criteria were: (1) the literature was written in English, (2) the participants were humans, and (3) the skin temperature was assessed using non-contact IRT. Potentially relevant studies that may have been missed in the original search were also included by reviewing the bibliography of the identified articles. The original studies that were published in the previous 20 years were preferentially considered. Results: 378 articles were selected from database. Based on these articles, we propose a classification of factors into three primary groups: • Environmental factors: Related to

the place where the evaluation is made. • Individual factors: Those factors that are related to the subject being assessed and his/her personal characteristics, which could influence skin temperature (Tsk). These factors will be divided into intrinsic and extrinsic factors. • Technical factors: Factors that are linked to the equipment that is used during the IRT evaluation. Conclusion: IRT has suffered periods of lost of credibility due to a lack of standardization and under-estimation of its limits (Head et al., 2002). Nowadays, the increase of knowledge, the technological advances and the new human IRT applications draw an optimal scenario to start a new period based on a more standardised and reliable research field. This proposed classification is a first step in order to build a common framework for future research. Nonetheless, further investigation is needed to increase the knowledge about the degree of influence of the most factors listed in this work. References • Head, J. F., & Elliott, R. L. (2002). Engineering in Medicine and Biology Magazine, IEEE, 21(6), 80-85. • Hildebrandt, C., Raschner, C., & Ammer, K. (2010). Sensors, 10(5), 4700-4715. • Zaproudina, N., Varmavuo, V., Airaksinen, O., & Narhi, M. (2008). Physiol Meas, 29(4), 515-524.

## THE ROLE OF PHYSICAL ACTIVITY ON WOMEN ANTIOXIDANT CAPACITY

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**Introduction** Regular physical activity induces several health benefits reducing several risk factors action that enhance the development of hypokinetic diseases. The relevance of the relation between physical activity and health increases when the age related loss of functionality is considered. Particularly in women, the study of age related changes functionality are frequently confounded due to hormonal changes. Considering, oxidative stress importance in many pathophysiological conditions, and the hormonal and exercise influence in antioxidant capacity, the aim of this study was to analyze the association between daily physical activity in women over 40 years of age antioxidant capacity. **Methods** Thirty seven women over 40 years of age (from 41 to 82 yrs), not suffering from any motor incapacity, participated in this study. Daily physical activity was quantified by IPAQ, Antioxidant capacity (Catalase activity) was analyzed in plasma with the subjects in fasting conditions. Descriptive data analysis and Pearson correlation between variables was done in SPSS. Significant level was set at  $p < 0.05$ . **Results** Our results revealed that no association between age and daily physical activity exist with serum Catalase activity. **Discussion** Considering the multiple and complex reactive oxidant species (ROS) scavenges systems, our results suggest that other antioxidants systems should be more prone to changes induced by age and daily physical activity. It is possible that other antioxidants systems have changed or that ROS production has not increased significantly with age. Moreover, it is possible that an exercise program may produce different results due to the control of training workload. **References** Valletta EA, Berton G. Desensitization of macrophage oxygen-metabolism on immobilized ligands: different effect of immunoglobulin-G and complement. J Immunol. 1987;138(12):4366-4373. This study has been founded by FCT through PTDC/DES/121575/2010 project. 16806

## Training and Testing

### EFFECTS OF SHORT-TERM HIGH-INTENSITY INTERVAL TRAINING ON OXIDATIVE STRESS RESPONSES AND ANTIOXIDANT STATUS IN HEALTHY HUMANS

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**Introduction** High-intensity interval training (HIT) has been characterized as an effective method for improving both aerobic and anaerobic fitness and promoting health (Gibala et al., 2012). Although high-intensity exercise elevates oxidative stress markers, limited information exists regarding the effects of short-term HIT on the antioxidant mechanism. It was hypothesized that nine sessions of HIT would reduce oxidative stress and improve antioxidant status responses to high-intensity exercise. **Methods** Eight physically active males performed nine HIT sessions over 3 weeks. Each session included four to six 30-s bouts of high-intensity cycling separated by 4 minutes of rest. Blood samples, collected before and after (30 min, 24 h, 48 h) the first and last training session, were analyzed for creatine kinase (CK) activity, protein carbonyls (PC), thiobarbituric acid reactive substances (TBARS), total antioxidant capacity (TAC), glutathione peroxidase (GPX) and catalase activity (CAT). **Results** Before training, acute exercise elevated PC, TBARS, GPX, TAC and CK, which peaked 24 h post-exercise ( $252 \pm 30\%$ ,  $135 \pm 17\%$ ,  $10 \pm 2\%$ ,  $85 \pm 14\%$  and  $36 \pm 13\%$ , above baseline, respectively;  $p < 0.01$ ), while CAT peaked 30 min post-exercise ( $56 \pm 18\%$  above baseline;  $p < 0.01$ ). Training resulted in a reduction of oxidative stress markers (PC by  $13.3 \pm 3.7\%$ ; TBARS by  $7.2 \pm 2.7\%$ ,  $p < 0.01$ ) and CK activity, despite the fact that total work done was  $10.9 \pm 3.6\%$  greater in the post- compared with the pre-training exercise test. Training also induced a marked elevation of antioxidant status indices (TAC by  $38.4 \pm 7.2\%$ ; CAT by  $26.2 \pm 10.1\%$ ; GPX by  $3.0 \pm 0.6\%$ ,  $p < 0.01$ ). **Discussion** Short-term HIT attenuated oxidative stress and up-regulated antioxidant activity after only nine training sessions totaling 22 min of high intensity exercise. Antioxidant enzyme up-regulation in muscle may be related to the increased maximal oxygen uptake after training (Jenkins et al., 1984, Burgomaster et al., 2005) since a relationship between antioxidant enzyme activity and succinate dehydrogenase activity as well as with fiber type composition in muscle has been reported (Laughlin et al., 1990). These results led further support to the effectiveness of HIT not only for physical conditioning but also for promoting health. **References** Burgomaster KA, Hughes SC, Heigenhauser GJ, Bradwell SN, Gibala MJ. (2005). J Appl Physiol, 98, 1985-1990. Gibala MJ, Little JP, Macdonald MJ, Hawley JA. (2012). J Physiol, 590, 1077-1084. Jenkins RR, Friedland R, Howald H. (1984). Int J Sports Med, 5, 11-14. Laughlin MH, Simpson T, Sexton WL, Brown OR, Smith JK, Korthuis RJ. (1990). J Appl Physiol, 68, 2337-2343.

### THE INFLUENCE OF MOTOR ABILITY AND PHYSICAL CAPACITY ON TEAM SELECTION AND PHYSICAL MATCH PERFORMANCE IN YOUTH SOCCER PLAYERS

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**Introduction** When identifying talent for team selection, many confounding factors may influence a coach's perception. The dynamic nature of sport talent therefore requires a multidimensional approach so that potentially gifted players are not overlooked (Vaeyens et al. 2008). The aims of this study were to examine 1) how a multitude of physical- and coordination-related characteristics related to team selection and 2) the effect of these characteristics on the match physical activity profile of different playing levels in youth soccer players. **Methods** 170 adolescent soccer players (aged 10-16 y), ranging from sub-elite to recreational, participated in the study. Players had previ-

ously been graded by soccer coaches into the A, B or C team for each of the five age-groups. Maturity was estimated using anthropometrical measures of stature, body mass and leg length. Physical characteristics of endurance, leg power, flexibility, strength, speed, repeat-sprint ability and agility were assessed. Motor coordination (KTK) and soccer-specific coordination (UGent Dribble) were also measured. Physical activity profile data was collected during soccer matches using 15Hz GPS devices. Results Regression analysis revealed that 42% of the adjusted variance in distance/min during matches could be explained by measures of endurance, motor coordination and dribbling ability ( $Y = 83.515 - 0.18 \text{ moving sideways} + 0.235 \text{ jumping sideways} - 0.2 \text{ soccer dribble} + 0.473 \text{ YoYo IR1 distance}$ ). Physical fitness, motor coordination, dribbling ability and physical match performance significantly influenced team selection ( $p \leq 0.001$ ). Multivariate analysis showed "A" players to cover more total distance/min, low-intensity running/min, high-intensity running/min and very high-intensity activity than their counterparts during matches (all  $p \leq 0.05$ ). No difference in chronological age or maturity was observed between playing levels. Discussion The present results highlight the multitude of physical- and coordination-related factors that influence team selection in youth soccer. In agreement with previous research (Vaeyens et al. 2006), these results show that selected youth soccer players possess superior physical quality and skilled performance. Physical match performance was also shown to influence playing level, with "A" team players producing superior total distance/min and distance/min in all intensity categories. These findings show physical capacity and motor coordination to be associated with physical match performance, and the important implications this may have for talent selection in youth soccer. References Vaeyens, R. et al. (2008). *Sports Med*, 38(9), 703-14. Vaeyens, R. et al. (2006). *Br J Sports Med*, 40(11), 928-34.

## **EFFECTS OF PARKOUR TRAINING ON STRENGTH AND BODY COMPOSITION IN ADOLESCENTS**

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Introduction The aim of the study was to describe effects of Parkour training on strength characteristics and body composition in adolescents. Materials and Methods Six participants (age =  $16 \pm 2$  years) took part in a controlled indoor Parkour intervention - ten week training with the frequency one hour per unit two times a week. Training units were prepared in accordance with the Parkour Generations teaching materials (Parkour Generations, 2013). Standing broad jump was used to measure explosive strength, hand grip test to evaluate the grip strength, sixty second sit-up test and bent-arm hang test were used to measure muscle endurance. BIA 2000 M (Data Input, Germany) was used to quantify the changes in fat, fat free mass (FFM), and the ratio of extracellular and body cell mass (ECM/BCM). Paired t-test ( $p = 0.05$ ) and omega squared were calculated to assess the differences between pretest and posttest. Results We found a significant increase in standing broad jump ( $p = 0.01$ ),  $\uparrow 17$  cm; sit-up test ( $p = 0.05$ ),  $\uparrow 4$ . (Tab. 1) There were no significant differences in hand grip ( $p = 0.48$ ),  $\downarrow 1$  kg; bent-arm hang ( $p = 0.13$ ),  $\uparrow 0.9$  s; fat ( $p = 0.12$ ),  $\downarrow 1.4\%$ ; FFM ( $p = 0.16$ ),  $\uparrow 1$  kg; ECM/BCM ( $p = 0.52$ ),  $\downarrow 0.01$ . (Tab. 1; Tab. 2) Discussion We agree with Leite et al. (2011) who stated that Parkour training has positive effect on explosive strength of lower extremities. We stated higher explosive strength and abdominal muscle endurance after the Parkour training. We have not found a significant effect on the muscle endurance of upper-body, the grip strength and the body composition. The main limitation of the study is the small sample size and the absence of control group. Conclusion In conclusion, the Parkour training increased explosive strength of lower extremities and abdominal muscle endurance. There were no changes in upper-body endurance, grip strength and body composition. References 1. PARKOUR GENERATIONS. (2013). [www.parkourgenerations.com](http://www.parkourgenerations.com) 2. LEITE, N. et al. (2011). *Rev Bras Med Esporte*, 17(3), p. 198-201.

## **EFFECT OF RECOVERY ON PACING STRATEGY IN THE HEAT**

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Introduction Recovery from exercise is an integral component of training and performance. Although recovery modalities are gaining wide acceptance among elite athletes, little information is available with regard to the effects of recovery interventions on performance and pacing strategy during a subsequent exercise trial the same day in the heat ( $30^{\circ}\text{C}$ ). The purpose of the present study was to determine the effect of active recovery (AR), passive rest (PR) and cold water immersion (CWI) after 90min intensive cycling on pacing strategy and performance on a subsequent short time-trial (TT2;  $\pm 12$ min). Methods Nine trained male subjects (age:  $22 \pm 3$  years;  $\text{O}_2\text{max}$ :  $62.1 \pm 5.3 \text{ ml} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$ ) completed a maximal cycle test, familiarization trial and 3 experimental trials. All experimental trials were performed in  $30^{\circ}\text{C}$  (RH 50%) and included a one hour constant load trial at 55% of the maximal power output ( $\text{W}_{\text{max}}$ ), followed by a TT in which subjects had to complete a predetermined amount of work as fast as possible (calculated duration: 30min @75%  $\text{W}_{\text{max}}$ , subjects were free to change the resistance), a 15min recovery intervention, a 45min rest period and TT2 (calculated duration: 12min @85%  $\text{W}_{\text{max}}$ ). During CWI subjects were seated in  $15^{\circ}\text{C}$  water until sternum level. AR consisted of cycling at 80W. Friedman tests ( $p < 0.05$ ) were performed. Post-hoc analysis with Wilcoxon Signed-rank tests was conducted with a Bonferroni correction applied. A one sample t-test (within each condition) was used to reveal changes in pacing strategy. Results A significantly different pacing strategy emerged during TT2 after CWI compared to AR and PR. CWI resulted in an even pacing strategy, while AR and PR resulted in a gradual decline of power output after the onset of TT2 ( $p \leq 0.046$ ). This consequently led to 4.2% and 4.7% slower TT2 finishing times in PR and AR compared to CWI. However, these differences were not statistically significant. Discussion A 4% faster TT performance is consistent with the findings of Vaile (2011), who found an ergogenic effect of CWI on a subsequent 30-35min performance, and Peiffer (2010), who showed CWI between two cycle bouts improved the second performance in the heat (no rest between recovery and second bout). Furthermore, the pacing strategy during TT2 differed. CWI resulted in an even pacing strategy, whereas after AR and PR subjects immediately decreased the power output. The difference in pacing strategies between the recovery conditions is likely due to decreased thermal strain after CWI. References Vaile J et al. *Br J Sport Med* 2011;45(10):825-9; Peiffer J et al. *Br J Sport Med* 2010;44:461-465

## **HEAVY STRENGTH TRAINING IMPROVES BOTH SPRINT AND TIME TRIAL PERFORMANCE IN HIGH-LEVEL CYCLISTS**

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INTRODUCTION During the last decade, there has been an increased research focus on the effect of strength training on cycling performance (1,3,4). Most of the studies indicating a performance enhancing effect of strength training have been performed on cyclists with maximal oxygen uptake ( $\text{VO}_2\text{max}$ )  $< 65 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ , and there is still lack of knowledge of the effects of heavy strength training in very skilled cyclists. The aim of the present study was therefore to test the hypothesis that heavy strength training improves classical indicators

of endurance cycling performance in high-level cyclists. METHODS Twenty cyclists, which were close to the criteria suggested by Jeukendrup et al. (2) that describes elite cyclists, were assigned to either usual endurance training combined with heavy strength training [E+S; n=12 (♂=10, ♀=2), mean age (year±SD)=19±2 years, body mass=67±8 kg, height=178±9 cm, VO<sub>2</sub>max=77±7 ml·kg<sup>-1</sup>·min<sup>-1</sup>] or to usual endurance training only [E; n=8 (♂=6, ♀=2), age=20±2 years, body mass=72±9 kg, VO<sub>2</sub>max=72±6 ml·kg<sup>-1</sup>·min<sup>-1</sup>]. The strength training was performed twice a week and consisted of four lower body exercises (3x4-10RM) for 10 weeks. Pre-tests were performed 12-15 days after the end of the competition season and consisted of maximal voluntary contraction force (MVC) in isometric half squat, peak- and mean power output during 30 s Wingate test, power output at 4 mmol blood lactate concentration during an incremental cycling test, VO<sub>2</sub>max, mean power output during 40-min all out cycling, and lower body lean body mass (LBMLB). RESULTS At the pre-test, there were no differences between the groups in any of the measurements. After the intervention period, E+S increased LBMLB (2.3±1.8%), MVC (21±13%), peak- and mean power output in the 30 s Wingate test (6±5% and 3±3%, respectively), mean power output during 40-min all out cycling (5±6%), and had a tendency of 3±5% improvement in power output at 4 mmol blood lactate concentration (p=0.06). These variables were not changed in E. There was a significant difference between groups in relative improvement in MVC half squat, mean power output during Wingate test, mean power output during 40-min all out cycling. CONCLUSION Adding heavy strength training to usual endurance cycling training results in favourable adaptations in classical performance indicators without compromising the development of VO<sub>2</sub>max in high-level cyclists. This finding is in agreement with previous observation in less trained cyclists (e.g. 2,4). REFERENCES 1. Bastiaans et. al., EJAP, 2001;86:79-84 2. Jeukendrup et al. JSMS, 2000;3:414-33 3. Koninckx et al. EJAP, 2010;109:699-8 4. Sunde et al. JSCR, 2010; 24:2157-65

### EFFECT OF BALLISTIC ISOMETRIC CONTRACTION PROTOCOL IN THE STABILIZATION OF NEUROMUSCULAR VARIABLE IN ELDERLY

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Introduction: To accurately determine of results in a strength evaluation is indicated the perform of familiarization process to achieve the stabilization of measure (WALLERSTEIN et al., 2010). About this process, Bazzuchi et al. (2004) suggest that the measure variation should be lesser than 5% among tests, indicating that only one familiarization session would not be sufficient to achieve the stabilization of measure. Aim: To verify the stabilization of Peak of Torque (PT) in a ballistic isometric test in elderly. Methods: Participated of this study 10 individuals (67 + 8.52 years, 68.49 + 6.60 kg and 1.64 + 0.07 m). The participants performed a maximum ballistic isometric contraction (MBIC) protocol on isokinetic dynamometer (Biodex System 4, Biodex Medical Systems, USA) composed by ten 2-s submaximal isometric contraction separated by 20-seg intervals as warm-up and four 2-s MBIC separated by a 3-min interval. Were measured the knee extensor muscle Peak of Torque (PT) that was provided in real time on the dynamometer screen during the trials. To comparison among the trials was used ANOVA for repeated measures. Results: No difference in PT (Nm) among the trials of individuals was found (set 1 = 134.3 + 39.13, set 2 = 139.8 + 41.23, set 3 = 139.6 + 42.88, set 4 = 146.1 + 42.76), where the percentage of variation was in mean of 3%. Discussion: Ordway et al. (2006) related a variation of almost 8% in values of PT in second session of isometric tests. In the same way, Wallerstein et al. (2010) reported that the elderly needed of three familiarization sessions to stabilize PT values during MBIC, while the present study found the stabilization of PT in only one session. Conclusion: Using a specific protocol of MBIC, we found the stabilization of PT in first familiarization session. References: Bazzuchi, I. Felici, F. Differences between young and older women in maximal force, force fluctuations, and surface EMG during isometric knee extension and elbow flexion. *Muscle Nerve*, 30: 626-635, 2004. Ordway, R. N., Hand, A. et al. Reliability of knee and ankle strength measures in an older adult population. *Journal of Strength and Conditioning Research*, 20 (1), 82-87, 2006. Wallerstein, L.F., Barroso, R., Tricoli, V., Mello, M.T., Ugrinowitsch, C. The influence of familiarization sessions on the stability of ramp and ballistic isometric torque in older adults. *J Aging Phys Act*, 18: 390-400, 2010.

### OXIDATIVE STRESS MARKERS IN DIFFERENT ALTITUDE TRAINING STRATEGIES IN ELITE ATHLETES

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Introduction Hypoxia is known to induce oxidative stress in animal models and humans due to increased oxygen uptake and electron drain at the mitochondrial respiratory chain, resulting in increased biological tissue oxidation (Guzy & Schumacker 2006). During altitude training exposure two independent stimuli (intense exercise and hypoxia) may have a cumulative effect on oxidative stress (Pialoux et al., 2006). We aimed to analyse the prooxidant-antioxidant balance during different strategies of moderate altitude training in elite athletes. Methods 57 elite swimmers took part in four training camps at moderate altitude (CAR Sierra Nevada, 2320 m), living and training at "high" (H) or "low" (L) level, using different strategies during a period of four (LL-TL, LH-TH, LH-TL) or three weeks (LH-TH3). Prooxidant-antioxidant balance was evaluated before (W0) and once a week during the camp (W1 to W3 or W4) in peripheral blood samples by measuring plasma free radical NO (nitrites), lipid (LPO) and protein (carbonyls) oxidation, and the erythrocyte antioxidants glutathione (GSH), glutathione disulphide (GSSG), glutathione peroxidase (GPx) and glutathione reductase (GRd), with different commercially available kits. Two-way RM ANOVA was used for group comparisons. P<0.05 was considered significant. Results Compared to baseline values (W0), nitrites increased in W2 in the LH-TH group, reaching greater levels than LH-TL and LH-TH3 groups, but returned to baseline at W4. LPO increased more than two-fold in LH-TH and LH-TL at W4. Carbonyls increased in all groups from W3 onwards (from W2 in LH-TL). The erythrocyte activity of GPx did not change in any of the groups. GRd activity was higher in LH-TH at W3 and W4 as compared to LH-TL only. GSH did not change in any of the groups, while GSSG increased in LL-TL but decreased in LH-TL at W4. The GSSG/GSH ratio did not change in any of the groups. Discussion Four weeks of AT resulted in an increase of oxidative damage markers in moderate altitude compared to training at sea level. The free radical NO increased in LH-TH as compared to LH-TL, indicating a higher risk of health disturbances when living and training at altitude for more than three weeks. However, a seemingly adequate antioxidative defence was maintained, since intracellular GSH, the ratio GSSG/GSH, and the activity of GPx and GRd remained stable. References Guzy RD, Schumacker PT (2006). *Exp Physiol*. 2006;91(5):807-19 Pialoux V, Mounier R, Ponsot E, et al. (2006). *Eur J Clin Nutr*, 60, 1345-1354.

## EFFECTS OF A SIX-WEEK PLYOMETRIC AND BALLISTIC RESISTANCE TRAINING ON VERTICAL JUMPING PERFORMANCE

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**Introduction** Muscle power is a prerequisite for success in many sports and thus several studies have aimed to determine the most effective training programs that maximize adaptations. Previous studies have shown that a combination of power training (i.e. vertical jumps without an external load) and high load strength training (i.e. 90% of maximal strength) for 12 weeks, improves jump height and power across a wide range of external loads (Cormie et al., 2007). The purpose of the present study was to examine the effect of a combination method of training with eccentric and ballistic exercises for six weeks, in vertical jump height and power. **Methods** Eight physically active male students (age:  $21.2 \pm 1.8$  years, body mass:  $78.6 \pm 7.7$  kg, height:  $1.78 \pm 0.05$  m) were trained for six weeks (3 sessions per week). During session 1 and 3 of each week, participants performed six sets of two eccentric squat movements with a load of 65% of maximum half squat strength (1 repetition maximum-1RM), separated by a four-minute recovery. In the second training session of each week, participants performed six sets of four maximal-effort jump squats with a load of 30% of 1RM separated by a four-minute recovery. In the first, second and third minute of recovery after each set in all training sessions, participants performed a maximal-effort counter-movement jump. Loaded (15%, 30%, 45% and 65% of 1RM) and unloaded vertical jump performance was measured before and after training. A two-way ANOVA followed by Tukey post-hoc test was used to examine the influence of training on vertical jump performance. **Results** After 6 weeks of training, half squat strength was increased from ( $146 \pm 25$  kg to  $166 \pm 7$  kg,  $p < 0.01$ ). Jump height was increased for loaded and unloaded trials (0% =  $35.9 \pm 5.4$  vs.  $42.3 \pm 6.8$  cm; 15% =  $24.2 \pm 3.4$  vs.  $30.6 \pm 3.7$  cm; 30% =  $18.3 \pm 2.8$  vs.  $23.1 \pm 3.1$  cm; 45% =  $12.7 \pm 2.7$  vs.  $17 \pm 3.2$  cm; 65% =  $6.05 \pm 1.6$  vs.  $10.3 \pm 3.4$  cm; before vs. after training,  $p < 0.01$ ). Relative peak power (W/kg body mass) was also increased across all loads (0% =  $47.1 \pm 4.2$  vs.  $51.8 \pm 5.2$  W/kg; 15% =  $38.0 \pm 2.4$  vs.  $42.9 \pm 2.8$  W/kg; 30% =  $33.3 \pm 2.2$  vs.  $37.0 \pm 1.9$  W/kg; 45% =  $29.0 \pm 1.7$  vs.  $32.2 \pm 2.1$  W/kg; 65% =  $23.7 \pm 2.3$  vs.  $26.9 \pm 2.0$  W/kg; before vs. after training,  $p < 0.01$ ). **Discussion** The combined training program with eccentric and ballistic exercises resulted in a relatively large improvement of jump height (16.8% in the unloaded jump) and peak power (about 11.7% across all loads), in only 6 weeks. The results of this study may have practical applications in training for sports that require high leg muscle power. **References** Cormie P, McCaulley GO, McBride JM. (2007). *Med Sci Sports Exerc*, 39 (6), 996-1003.

## COMPARISON OF TWO INCREMENTAL FIELD TESTS TO DETERMINE MAXIMAL AEROBIC VELOCITY IN ASIAN PROFESSIONAL FOOTBALL PLAYERS

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**Introduction** The aim of this study was to determine whether the maximal aerobic running velocity (MAV) determined from an incremental intermittent (45-s run/15-s rest) field test (45-15FIT) and the peak velocity (VYo-Yo) achieved during the Yo-Yo Intermittent Recovery Test level 2 (YYIR2) could be used interchangeably. **Methods** Thirty-three international football players (age:  $23.2 \pm 2.8$  years), members of two Asian Football Confederation national teams, randomly performed two intermittent field-tests: the 45-15FIT (Assadi and Lepers 2012) and YYIR2 (Krustrup et al. 2006). The velocity reached during the last stage of the 45-15FIT was considered as the MAV, while the VYo-Yo achieved during the YYIR2 was calculated according to Kuipers et al. (Kuipers et al. 1985). During both tests, heart rate was continuously recorded at 5-s intervals and peak values (HRmax) were determined. **Results** The MAV achieved during the 45-15FIT was higher ( $18.8 \pm 0.9$  vs.  $18.3 \pm 0.4$  km.h<sup>-1</sup>;  $p < 0.01$ ) than VYo-Yo measured during the YYIR2 (distance covered =  $913 \pm 209$  m). Similarly, HRmax values were higher ( $195 \pm 5$  vs.  $188 \pm 6$  bpm;  $p < 0.05$ ) at the end of the 45-15FIT compared to the YYIR2. Those HRmax values were significantly correlated ( $r = 0.60$ ,  $p < 0.001$ ). Moreover, MAV was correlated with both VYo-Yo ( $r = 0.56$ ,  $p < 0.001$ ) and the distance reached during the YYIR2 ( $r = 0.52$ ,  $p < 0.01$ ). However, the error of the estimate ( $0.77$  km.h<sup>-1</sup>) was not constant: above  $18.1$  km.h<sup>-1</sup>, (i.e. the velocity where MAV and VYo-Yo are equal) MAV values tended to be higher than the VYo-Yo, whereas MAV values tended to be lower than VYo-Yo below  $18.1$  km.h<sup>-1</sup>. **Discussion** Despite a significant relationship between MAV and VYo-Yo, it is probably not appropriate to estimate MAV from the VYo-Yo, due to the exaggerated standard errors observed here. Moreover, higher HRmax values reached during the 45-15FIT when compared to the YYIR2 may indicate that peak velocities reached during those field tests should not be used interchangeably to individualise high-intensity intermittent training intensities in football players. **References** Assadi H, Lepers R (2012) Comparison of the 45-second/15-second intermittent running field test and the continuous treadmill test. *Int J Sports Physiol Perform* 7: 277-284 Krustrup P, Mohr M, Nybo L, Jensen JM, Nielsen JJ, Bangsbo J (2006) The Yo-Yo IR2 test: physiological response, reliability, and application to elite soccer. *Med Sci Sports Exerc* 38: 1666-1673 Kuipers H, Verstappen FT, Keizer HA, Geurtens P, van Kranenburg G (1985) Variability of aerobic performance in the laboratory and its physiologic correlates. *Int J Sports Med* 6: 197-201

## THE IMPORTANCE OF SCALING VO2MAX TO PREDICT CROSS-COUNTRY SKIING PERFORMANCE

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**Introduction** A high maximal oxygen uptake (VO2max) is of importance for success in elite male competitive distance cross-country skiing (Carlsson et al. 2012). However, it is still debatable how VO2max should be expressed to best indicate skiing performance. Therefore, the purpose of this study was to establish the optimal body mass exponent for VO2max to indicate performance in elite-standard male cross-country skiers. **Methods** Twenty-four elite-standard male cross-country skiers completed an incremental treadmill roller skiing test in diagonal stride technique determining VO2max. Performance data was compiled from a 15-km classic technique race. To predict performance a log-transformation of power-function model:  $\text{Race speed} = \beta_0 \cdot \text{VO2max}^{\beta_1} \cdot m^{\beta_2}$  was used, where  $\beta_0$  to  $\beta_2$  are constants, and  $m$  is body mass. Statistical analyses used R version 2.13.2 (R Development Core Team, New Zealand) and alpha was 0.05. **Results** Participants' VO2max was  $5.39 \pm 0.57$  l/min (mean  $\pm$  s) and  $m$  was  $75.5 \pm 6.3$  kg. Mean race speed was  $5.83 \pm 0.41$  m/s. The model that best predicted performance was:  $\text{Race speed} = 8.829 \cdot \text{VO2max}^{0.663} \cdot m^{-0.355} = 8.829 \cdot (\text{VO2max} \cdot m^{-0.535})^{0.663}$ , that explains 69.2% of the variance in race speed for the 15-km classic technique race ( $P < 0.001$ ). For the VO2max-to-mass ratio within the model, the 95% confidence interval (CI) for the body-mass exponent ranged from -0.947 to -0.122. **Discussion** The optimal body mass exponent for VO2max to indicate performance in elite-standard male cross-country skiers was -0.535. Moreover, the CI for the body-mass exponent does not support the use of simple ratio-standard scaling and absolute expression of VO2max as indicators of 15

km classic ski racing performance in elite-standard men skiers. References Carlsson M, Carlsson T, Hammarström D, Tiivel T, Malm C, Tonkonogi M. (2012). *J Strength Cond Res.* 26(6), 1496-504.

### HEREDITY: A STUDY OF FLEXIBILITY IN PAIRS OF MONOZYGOTIC AND DIZYGOTIC TWINS

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Introduction: The understanding of the influence of hereditary and environmental can build an important criterion to guide the practice of physical activity appropriate to the characteristics of individual and collective. The aim of the study was analyzing the heredity of flexibility using dizygotic (DZ) and monozygotic (MZ) twin pairs, in Brazilian northeast. Methods: Was analyzed 36 twin pairs of 08-36 years old in Natal/Brazil, 20 MZ and 16 DZ individuals respectively. For determining zygosity, besides family information, was applied questionnaire (PEETERS et al., 1998) and anamnesis. Flexibility was evaluated with the subjects in supine position, they perform three times the movement of hip flexion, with one minute interval between each movement. The angular positions were recorded by an electronic goniometer (Miotec Ltda, Brazil), the highest value being adopted as reference. The statistical analyses were made of the variance in pairs of twins and sequence determination of the medians of these variances. Intervening variables such as gender, age, and sexual maturation were controlled. It was calculated the index of heritability for the variable of the study demonstrating how much has genotypic and phenotypic character. Was used the Clark (1956) equation: Heritability ( $h^2$ ) =  $(S^2_{DZ} - S^2_{MZ}) / S^2_{DZ}$ . Results: The median of in pairs variances were of 15.53 to MZ and 44.66 to DZ. It was observed that the heritability for flexibility presented moderate (59%). Discussion: Findings of this study agree with literature (BOUCHARD, 1997; BOUCHARD et al., 1989), where the estimate of heritability of hip flexibility of 70% was also classified as moderate heritability, while the age used was limited to 10 to 17 years old, we understand that even increasing age, as the case in this study, there was no change in percentile ranking. Suggesting that the level of flexibility tends to decrease individually and over time due to various factors as demonstrated in the literature. It was concluded, therefore, that the environment influences in part in trainability this motor capacity, which is an indicator of physical fitness. References BOUCHARD, C. Genetics of human obesity: recent results from linkage studies. *The Journal of nutrition*, v. 127, n. 9, p. 1887S-1890S, 1997. ISSN 0022-3166. BOUCHARD, C. et al. Genetic effect in resting and exercise metabolic rates. *Metabolism: Clinical and Experimental*, v. 38, n. 4, p. 364-370, 1989. ISSN 0026-0495. CLARK, P. J. The heritability of certain anthropometric characters as ascertained from measurements of twins. *American Journal of Human Genetics*, v. 8, n. 1, p. 49, 1956. PEETERS, H. et al. Validation of a telephone zygosity questionnaire in twins of known zygosity. *Behavior Genetics*, v. 28, n. 3, p. 159-163, 1998. ISSN 0001-8244.

### ASSESSMENT WITH TENSIOMYOGRAPHY OF FATIGUE-INDUCED CHANGES IN THIGH MUSCLES DURING 1-DAY BASKETBALL TOURNAMENT

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Background: Several studies have used tensiomyography (TMG) to detect mainly acute fatigue-induced changes in muscle contraction properties; these changes are exercise-type specific. Aim: We aimed to investigate acute and delayed fatigue-induced changes in the tensiomyographic twitch response in the biceps femoris (BF) and vastus lateralis (VL) in amateur basketball players, during a 1-day basketball tournament. Materials and methods: Six healthy, amateur basketball players (mean age  $35 \pm 3$ , BMI  $26 \pm 3$ ) participated in the study. TMG was used on the dominant BF and VL, to measure muscle contraction time (Tc), reaction time (Td), relaxation time (Tr), maximum radial displacement (Dm) and sustain time (Ts). Contraction velocity (Vc) and ratios of parameters between VL and BF were calculated. Subjects played in the same team and tournament rules ensured each player played approximately the same amount of time. TMG measurements were conducted before and after the first and second games, with a 4-hour rest period between games. Paired t-test was used to evaluate statistical significance between results. Results: VL Tc was significantly lower prior to the first game than before ( $p=0.020$ ) and after the second game ( $p=0.042$ ). VL Td before the first game was significantly lower than before ( $p=0.046$ ) and after ( $p=0.025$ ) the second game. VL Dm, Vc, Tr and Ts did not differ significantly throughout the measurements. BF Dm and Vc were significantly higher (respectively  $p=0.009$  and  $p=0.003$ ) before the first game compared to after the second game. There were no other significant changes in muscle contraction properties for the BF. The ratios of Tc and Dm between VL and BF were significantly lower prior to the first game than at the end of the second game. No other significant differences in ratios between VL and BF were found. Discussion: Contraction time is a parameter that readily distinguishes slow and fast motor units; studies have shown that Tc is a good predictor of %MHC in the estimation of fiber type muscle composition. The increase in VL Tc after the second game may indicate the muscle's inability to recruit type II fibers due to fatigue. The increased VL Td, indicating an increased electromechanical delay, further supports our findings. In the BF these increases were not apparent suggesting that the BF was not as fatigued as the VL. Furthermore, increases in BF Dm and Vc suggest the muscle was potentiated. A 4-hour rest period did not affect the muscle contraction properties between games. TMG presents a sensitive method to study fatigue-induced changes in muscle contraction properties in individual muscles in order to assess individual athlete and whole team preparedness. Similar study designs in larger study samples should provide more consistent results.

### RELATIVE AGE EFFECTS IN AUSTRALIAN FOOTBALL LEAGUE DRAFTEES

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Introduction: It is well known that the relative age effect (i.e. having a birth date earlier within an age grouping) provides a selection advantage in competitive sport. This advantage persists into adulthood and has been demonstrated through bias in seasonal patterns in the dates of birth in many professional sports. The relative age effect is underpinned by a number of physical, social and psychological advantages provided to relatively older players within an age group, but these advantages may not persist into adulthood. In Australian Football (AF), both adolescent (i.e.  $<20$  y) and mature-age (i.e.  $>20$  y) athletes are recruited to the professional league via a player draft, but the relative age effects in this group have not been examined. Therefore, this study examined the birth distribution for adolescent and mature age players selected in the Australian Football League (AFL) National Draft between 2001 and 2011. Methods: Birth-date information was accessed for all first time draftees selected in the AFL National Draft between 2001 and 2011 ( $N=737$ ). Players were classified as either adolescent (i.e.  $<20$  y the draft year,  $N=694$ ) or mature (i.e.  $>20$  y in the draft year,  $N=43$ ) draftees. Results: Chi squared analysis showed clear bias in the birth distribution of adolescent draftees towards players born in the first part of the classification period for both quartile ( $p<0.001$ ) and half-year ( $p<0.001$ ) compared to the Australian national population. There was a reverse relative age effect for

mature age draftees, with a significant bias towards players born in the latter part of the selection period for both quartile ( $p=0.034$ ) and half-year ( $p=0.003$ ) compared to the Australian national population. Discussion: The selection bias towards relatively older adolescents in adolescent AFL draftees may be related to advanced physical and psychological maturity, and exposure to higher level coaching compared to their younger counterparts. The new finding of a reverse RAE in mature age draftees supports the need for strategies to encourage continued participation pathways for talented AF players born later in the selection year.

### CHANGES IN HIGH-INTENSITY RUNNING CHARACTERISTICS OF ELITE YOUTH RUGBY LEAGUE PLAYERS DURING MATCHES

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**Introduction** Elite senior rugby league players show a reduction in high intensity running activity towards the end of a match (Sykes et al., 2011). These players are also susceptible to temporary reductions in high intensity running capacity after intense periods of activity during a game (Waldron et al., 2012). Changes in high intensity running towards the end of a match and after the most intense periods of play have yet to be elucidated in elite youth rugby league players. Therefore, the purpose of this study was to describe the changes in high intensity running of elite youth rugby league players during competitive matches. **Method** Twenty-six elite youth rugby league players ( $18.9 \pm 1.2$  y,  $1.83 \pm 0.05$  m,  $95.9 \pm 9.7$  kg) were classified into positional groups of outside backs ( $n = 10$ ), pivots ( $n = 4$ ), props ( $n = 7$ ) and back row ( $n = 5$ ). Data were collected from five different games (81 performances;  $3 \pm 1$  matches per player) during the 2011 competitive season. Using 5 Hz GPS the overall locomotive rate (m/min) and high intensity locomotive rate ( $>14.4$  km/h) were recorded. The high intensity locomotive rate for each 5 min period of the match was also calculated, with the highest value being taken as the peak 5 min period. **Results** Overall relative distance covered during a match was  $92.7 \pm 6.2$ ,  $98.4 \pm 6.0$ ,  $95.3 \pm 6.7$  and  $95.0 \pm 5.8$  m/min for outside backs, pivots, props and back row, respectively ( $P > 0.05$ ). In all positions, high intensity locomotive rate was lower in the first half ( $13.6 \pm 5.2$  m/min) compared to the second half ( $15.6 \pm 4.8$  m/min;  $P < 0.05$ ). The peak high intensity locomotive rate was only different between outside backs ( $29.2 \pm 7.1$  m/min) and props ( $22.4 \pm 2.9$  m/min;  $P < 0.05$ ), as values for pivots ( $26.2 \pm 6.1$  m/min) and back row players ( $24.9 \pm 3.7$  m/min) were not different ( $P > 0.05$ ). High intensity locomotive rates in the 5 min after the peak period were lower for all positional groups, with values of  $13.2 \pm 7.9$ ,  $13.8 \pm 6.5$ ,  $9.3 \pm 3.3$  and  $13.1 \pm 5.0$  m/min (all  $P < 0.05$ ) for outside backs, pivots, props and back row players, respectively. However, the reduction in high intensity locomotive rate in the subsequent 5 min period was only lower than the overall mean high intensity rate for props ( $P < 0.05$ ). **Discussion** Increases in high intensity running from the first to the second half suggest that elite youth rugby league players do not fatigue towards the end of a match. However, reductions in high intensity locomotive rates after the most intense period of exercise indicate that temporary fatigue does occur during a match. As well as enlightening conditioning practices, these data are useful for informing the coach's tactical decisions and interchange strategies. **References** Sykes D, Twist C, Nicholas C, Lamb K. (2011). *J Sports Sci* 18, 1263-1271. Waldron M, Highton, J, Daniels, M, Twist C. (2012) *Int J Sports Physiol Perf*, In Press.

### EFFECT OF INTERVAL TRAINING AND SMALL-SIDED GAMES ON SPECIFIC RESISTANCE ON AMATEUR SOCCER PLAYERS

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Seven university soccer players (age= $20.0 \pm 1.6$  years; height= $175.6 \pm 7.6$  cm; weight= $73.3 \pm 8.5$  kg; experience= $2.1 \pm 1.5$  years) participated in this study to determine the effect of two training protocols in soccer specific resistance. They executed YYIRT1 before a 4 weeks period of the interval running training (IRT) (4x3 minutes running at 90-95% HRmax with 3 minutes of active recovery at 60% HRmax). They executed the YYIRT1 again and started a new period of 4 weeks with resort to small-sided games (SSG) with the same load of IRT (4x4, area of 20x20 meters, limit of 2 consecutive touches for player). Repeated the YYIRT1. We used Friedman test and in the cases with significant statistical differences we have used the non parametric multiple comparison test. No statistically significant differences in VO2peak (50.30, 51.65 and 52.90 ml.kg<sup>-1</sup>.min<sup>-1</sup>). In the distance covered in YYIRT1 we observed significant statistical differences ( $P < 0.05$ ), between the first and third (1062m and 1320m) evaluation and between the second and the third (1191m and 1320m). In future studies will be important no determine VO2max in laboratory, use 2 different groups and to submit the training methods for 8-12 weeks, at least 2 times a week.

### NORMALIZED HEART RATE: A NEW CONCEPT TO BETTER SUMMARIZE EXERCISE INTENSITY AFTER TRAINING SESSIONS

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**NORMALIZED HEART RATE: A NEW CONCEPT TO BETTER SUMMARIZE EXERCISE INTENSITY AFTER TRAINING SESSIONS** Zabala, M.1,2 Morente-Sánchez, J.1& Mateo-March, M.2,3 1 Faculty of Sport Sciences, University of Granada (Spain) 2 Spanish Cycling Federation, Madrid (Spain) 3 University Miguel Hernández, Elche (Spain) **Introduction** Heart Rate is a one of the most common used variables to describe exercise intensity, while some other variables have been used as e.g. time/distance, watts, etc. Some years ago a new concept was developed to better describe what happened after a cycling workout: the so-called Normalized Power [1], which pretends to better describe the variation in wattage during a workout to get a more representative value of the session rather than the average value that can not reflect any variation itself. So, e.g. the same value of 150 ppm does not mean the same objective or work developed, because it could be reached after continuous constant intensity (low variation), or after interval-series training (high variation). So, the aim of the study was to propose the use of normalized Heart Rate (HRn) instead of the average HR (HRavg) to better describe exercise intensity as a summary of a training session. **Methods** Twelve under-23 elite road cyclists (mean age:  $19.67 \pm 1.12$  years) participated in the study. Training was monitored during  $20 \pm 2$  training sessions measuring HR (Polar RS800). Then HRn was calculated following 4 steps: 1) to get an average mobile value of 30 seconds from the original HR data in a new column, 2) to raise to the power of four of the previous column in a new one, 3) to get the average value of the previous column, and 4) to get the fourth root of the previous value. Descriptive and correlation statistics was carried out. **Results** Values of HRavg and HRn were calculated for each session that were divided into a) Continuous, and b) interval-series sessions. The respective values for HRavg and HRn were  $138.4 \pm 10.8$  vs.  $143 \pm 10.2$  ppm for a), and  $139.5 \pm 33.3$  vs.  $150 \pm 11.3$  ppm for b). The correlations between HRavg and HRn were  $r=0.89$  in a), and  $r=0.50$  for b), but there was no correlation when relating HRavg and HRn of all the sessions -a) and b)-. **Discussion** HRavg does not discriminate how we have reached this value after a training session, so if we cannot see all the HR data we cannot know accurately which kind of exercise intensity has been developed. The

same value of HRavg can be reached by means of completely different training stimulus. On the other hand, HRn shows another aspect that represents much better the type of exercise developed. This is why in a) the differences between HRavg and HRn are small and there is a significant correlation, while in b) the difference between HRavg and HRn is important and the correlation is low. So, we suggest the use of HRn as a better summary of training intensity and, more important, to use this value instead of HRavg to get the training load using TRIMP. References 1. Allen H & Coggan A. 2006 Velopress.

### **INFLUENCE OF THE PLAYING SURFACE ON PHYSIOLOGICAL, PHYSICAL AND PERCEPTUAL RESPONSES DURING A SMALL-SIDED-GAME ON HIGH-LEVEL FEMALE SOCCER PLAYERS**

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**Introduction** It is well known that playing surfaces in soccer influenced physical performances, physiological responses and recovery from fatigue induced by the game in male soccer players (Andersson et al 2008). However, little is known in female soccer players. Consequently, the aim of this study was to analyze the influence of three playing surfaces (wet turf (WT), dry turf (DT) and artificial turf (AT)) on women physical, physiological and perceptual responses during a small-sided game (SSG). **Methods** Eight soccer women players (national level) ( $21.25 \pm 1.5$  yr.) participated in three games, separated by at least 48h: (3 x 4 min, 4 vs. 4 players on a pitch of 20 x 30 m, with 2 minutes of passive recovery between each 4 min). Three surfaces were tested on randomized order: WT, DT and AT. Different variables were measured: physical performances using GPS, heart rate during exercise (HR<sub>ex</sub>), blood lactate (La) and rate of perceived exertion (RPE). Each player performed a Counter Movement Jump (CMJ) before and after each game in order to analyze the strength and power recovery of lower limbs. **Results** The results show that HR<sub>ex</sub> was significantly higher ( $p < 0.05$ ) during WT ( $171.0 \pm 6.8$  bpm) than during AT ( $163.8 \pm 8.6$  bpm) and DT ( $162.3 \pm 2.2$  bpm). Hence, blood La was significantly higher ( $p < 0.05$ ) during WT ( $3.0 \pm 0.4$  mmol.L<sup>-1</sup>) than during AT ( $2.2 \pm 0.5$  mmol.L<sup>-1</sup>) and DT ( $p < 0.001$ ) ( $1.7 \pm 0.6$  mmol.L<sup>-1</sup>). In addition, significant decrease of CMJ performances was observed after WT comparing to AT and DT ( $p < 0.05$ ). However, no significant differences were noted concerning the RPE between the three surfaces ( $10.7 \pm 0.7$ ;  $10.5 \pm 0.9$  and  $9.8 \pm 0.6$  respectively for WT, AT and DT). **Conclusion** In conclusion, our results suggest that playing surface has an influence on physical and physiological responses during small-sided games in high level women soccer players. However, players perceived no differences between the three surfaces concerning the hardship of playing surface. References Andersson H, Ekblom B, Krstrup P. (2008) J Sports Sci. 26 : 113-122.

### **EFFECT OF HEAVY STRENGTH TRAINING ON PERFORMANCE DETERMINANTS AND PERFORMANCE IN TRAINED FEMALE CYCLISTS**

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**Introduction** Equivocal findings exist on the effect of adding heavy strength training (HST) to the normal endurance training on cycling performance in trained cyclists (1,3,4,5). Most previous research in this area is performed with male subjects. The only study focusing on female cyclists did not find any effect of adding HST to the normal endurance training on cycling performance (2). However, the strength training volume in that study was low including only one strength exercise (squat). Therefore, the purpose of this study was to investigate the effects of HST on determinants of cycling performance and cycling performance in trained female cyclists. **Methods** Nineteen trained female cyclist ( $33 \pm 8$  years,  $64 \pm 7$  kg,  $VO_{2max}$ :  $54 \pm 3$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) were randomly assigned to either usual endurance training combined with HST (E+S, n=11) or to usual endurance training only (E, n=8). The strength training consisted of four lower body exercises (3 x 4-10 repetition maximum (RM)), which were performed twice a week for 12 weeks. 1 RM in one-legged leg press,  $VO_{2max}$ , power output at 3.5 mmol.L<sup>-1</sup> blood lactate concentration ([La-]), oxygen consumption at 150 W and mean power output during a 40 min all-out time trial were measured before and after the intervention. **Results** There were no differences between the groups in any of the measurements at the pre-test. E+S increased 1RM in one-legged leg press more than E (39% vs. 6%,  $p < 0.05$ ). Body mass was slightly reduced in E (1.4%,  $p < 0.05$ ), while there were no change in E+S. E+S improved body weight adjusted (BWA) power output at 3.5 mmol.L<sup>-1</sup> blood [La-] and mean BWA power output in the 40 min all-out trial with 8% and 6% respectively ( $p < 0.05$ ). None of these changes occurred in the E group. BWA oxygen consumption at 150 W was reduced by 4% in the S+E group ( $p < 0.05$ ) with no change in the E group and the changes were different between the groups. BWA  $VO_{2max}$  did not change in any group. **Discussion** The main finding of this study was that adding HST to usual endurance training in female cyclists increased mean power output during a 40 min all-out time trial and power output at 3.5 mmol.L<sup>-1</sup> blood [La-]. This seems in part to be caused by a better cycling economy because there was no increase in  $VO_{2max}$ . These improvements could not be seen in a group only performing their usual endurance training. These findings are in agreement with recent findings in male competitive senior and junior cyclist (1,3,4), but contradicts a study on female cyclist (2). References 1. Aagaard et al., SJMSS, 2011; 21:298-307 2. Bishop et al., MSSE, 1999; 31:886-891 3. Levin et al., JSCR, 2009; 28:2280-2286 4. Rønnestad et al., EJAP, 2010; 108:965-975 5. Sunde et al., JSCR, 2010; 24:2157-2165

### **THE RELATIONSHIP BETWEEN PHYSICAL ABILITIES AND BOTH BALL-CARRYING AND TACKLING AMONG UNDER-15 TO -17 ELITE, YOUTH RUGBY LEAGUE PLAYERS**

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**Introduction:** In rugby league, physical collisions, such as tackling and ball-carries, are some of the most demanding aspects of match performance. Video analysis techniques can reliably identify tackles, carries and their outcomes during rugby league competition. Among adolescent players, there has been no investigation of such skills during match play or an attempt to identify the physical qualities that contribute to their successful execution. Accordingly, it was the aim of this study to investigate the relationships between the physical abilities of adolescent rugby league players and their tackling and ball-carrying skills performed during competitive matches. **Methods:** Ethical approval was given to undertake a three-season (under-15, -16 & -17) study with a total of 28 elite youth rugby league players. Participants were annually assessed for predicted aerobic power (multi-stage fitness test), vertical jump height, sprinting performance (10-30 m) (velocity, acceleration & force) and anthropometric variables. Players' average frequency of successful and unsuccessful tackling and ball-carrying skills during match time were also assessed across the season. **Results:** Relationships (R) were found between successful ball-carrying and 10 m sprinting force among under-15 ( $R = 0.702$ ,  $P < 0.001$ ), -16 ( $R = 0.607$ ,  $P < 0.001$ ) and -17 players ( $R = 0.671$ ,  $P < 0.006$ ). There were no relationships ( $P > 0.05$ ) found between tackling during matches and any measured physical ability.

Discussion: Consistent with the general match demands of rugby league, the results show the importance of force generation (mass x acceleration) in performing successful ball-carries at all adolescent age groups. Such findings further support the previous assertion that horizontal motion can facilitate success in contact situations during rugby league match play (Baker & Newton, 2008). That none of the measured physical abilities explained tackling performance perhaps highlights the greater importance of technique (which was not assessed) in executing tackles during matches. Rugby league practitioners should prioritize the development of 10 m acceleration, alongside gains in 'propulsive' body mass, in order to optimize ball-carrying, but not tackling, performance during competition. Baker DG., Newton, RU. (2008). *J Strength Cond Res*, 22(1), 153–158.

### SYNCHRONIZED SWIMMING SHUTTLE TEST: A PHYSICAL FITNESS TEST FOR SYNCHRONIZED SWIMMERS

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This study developed a physical fitness test for synchronized swimmers: The Synchronized Swimming Shuttle Test (SSST). Phase one of the study tested the reliability of the test. Forty eight female volunteer athletes were tested twice with an interval of 48 hs. Results showed a good reliability (correlation coefficient of 0.80 ( $p \leq 0.01$ )). Phase two of the study tested the sensitivity of the SSST. Eight athletes from the Brazilian national team were tested twice with 3 month interval in between tests. Results showed an improvement of 26.3% (Wilcoxon,  $p=0.011$ ,  $p < 0.05$ ). The proposed test is sensitive to differences in levels of categories. So the average results of the test and retest for the SSST senior categories (test = 112.5 m; retest = 125m), junior (test = 87.5 m; retest = 112.5 m) and juvenile (test = 87.5 m; retest = 93.8 m) showed that the performance SSST increases with age. The SSST results were correlated against the existing national team selection physical fitness tests (TAFT) and the results of a routine. Results showed no correlation (Spearman,  $r = -0.006$ ,  $p = 0.99$ ). between the TAFT and the SSST and there was no strong correlation between the SSST and the routine (Spearman,  $r = -0.006$ ;  $p = 0.99$ ). The results of the present study suggests the test can be applied to measure progress from one phase to the other of training but is not ideal to predict routine results in team trials. Future research should focus on the correlation between the SSST and physiological golden standards such as oxygen consumption and lactate to determine if the test is a good indicator of the level of fitness of synchronized swimmers. Do not insert authors here

### POSITIONAL DIFFERENCES IN MATCH RUNNING PERFORMANCE IN MEN RUGBY SEVENS

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Introduction Recent investigations have shown that rugby sevens is characterized by relatively high running demands and short recovery periods between running bouts (Higham, Pyne, Anson, & Eddy, 2012; Suarez-Arrones, Nunez, Portillo, & Mendez-Villanueva, 2012). These running demands appear to be higher than those encountered in both rugby union and rugby league, but the impact of playing position associated with rugby sevens match play are presently unknown. The aim of this study was, therefore, to describe the running match demands relative to positional groups in male rugby sevens. Methods Time-motion analysis of running activity was collected in 10 highly-trained men rugby sevens players during 23 matches. GPS technology was used to assess match running demands. Results The average total distance ( $\pm$ SD) covered by the players throughout the match was  $102.3 \pm 9.8$  m $\cdot$ min $^{-1}$  with a range of 85.9 to 127.4 m $\cdot$ min $^{-1}$ . As a percentage of total distance, 35.8% ( $36.6 \pm 5.9$  m $\cdot$ min $^{-1}$ ) was covered walking, 26.0% ( $26.6 \pm 5.5$  m $\cdot$ min $^{-1}$ ) jogging, 10.0% ( $10.2 \pm 2.4$  m $\cdot$ min $^{-1}$ ) running at low intensity, 14.2% ( $14.5 \pm 4.0$  m $\cdot$ min $^{-1}$ ) at medium intensity, 4.6% ( $4.7 \pm 1.6$  m $\cdot$ min $^{-1}$ ) at high intensity, and 9.5% ( $9.7 \pm 3.7$  m $\cdot$ min $^{-1}$ ) sprinting. Over the whole match, backs covered substantially more total distance ( $+10.0 \pm 0.96\%$ ; moderate ES), distance at speeds  $>14.0$  km $\cdot$ h $^{-1}$  ( $+26.4 \pm 6.2\%$ ; moderate ES) and  $>20.0$  km $\cdot$ h $^{-1}$  ( $+35.0 \pm 10.8\%$ ; moderate ES) than forwards. Discussion For the first time, we report positional differences in match running demands in rugby sevens. Overall, backs presented augmented running demands in comparison with the forwards. As expected, both playing positions, backs (107 m $\cdot$ min $^{-1}$ ) and forwards (98 m $\cdot$ min $^{-1}$ ) covered greater distance per minute than the same positions in other rugby codes. References Higham, D. G., Pyne, D. B., Anson, J. M., & Eddy, A. (2012). Movement patterns in rugby sevens: effects of tournament level, fatigue and substitute players. *J Sci Med Sport*, 15(3), 277-282. Suarez-Arrones, L. J., Nunez, F. J., Portillo, J., & Mendez-Villanueva, A. (2012). Running demands and heart rate responses in men rugby sevens. *J Strength Cond Res*, 26(11), 3155-3159.

### ENERGY CONTRIBUTIONS OF 200M SPRINT-CANOEING ON WATER

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Introduction 200m sprint-canoeing had its debut in 2012 London Olympic Games. There is a lack of investigation on energy contributions of this sport event, especially when paddlers performing on water. The aim of this study was to investigate the energy contributions of 200m sprint-canoeing on water. Methods Eight male national successful sprint-canoeists ( $21 \pm 3$  yrs,  $180 \pm 2$  cm,  $79 \pm 4$  kg) participated in a 40s all-out paddling on water to simulate the 200m race. Oxygen uptake and blood lactate were measured with MetaMax 3B (MetaMax 3B, Cortex Biophysic GmbH, Leipzig, Germany) and Biosen S-line (BIOSEN S line, EKF Diagnostic, Barleben, Germany) during the tests. The calculation of energy contributions was based on fast component of oxygen debt (anaerobic alactic, AnAl), maximum net blood lactate after 40s (anaerobic lactic, AnLa), and accumulated oxygen uptake above resting level during 40s (aerobic, Aer) (Beneke et al. 2004). Results The energy contributions during the 40s all-out sprint-canoeing from AnAl, AnLa, and Aer were  $46.8 \pm 22.6$  kJ,  $33.3 \pm 6.4$  kJ, and  $34.5 \pm 4.5$  kJ, with relative contributions of  $38.4 \pm 12.6\%$ ,  $30.3 \pm 8.8\%$ , as well as  $31.3 \pm 5.4\%$  from AnAl, AnLa, and Aer, respectively. Discussion The relative aerobic contribution in this study was similar to that in sprint-kayaking on ergometer with Japanese university males (29.4%; Nakagaki et al. 2008), but much lower than those in sprint-kayaking and canoeing on ergometer with US national team members (35-40%; Byrnes and Kearney 1997), which might result from possible different factors (e.g. method in calculating energy, testing protocol, level of exhaustion, individual physiological character, etc.). As the first approach to analyze the energy contributions in 200m sprint-canoeing on water with the measurement of oxygen uptake and blood lactate, this study displayed an energetic profile for this sport event, which should be considered when establishing the training philosophy of this discipline. References Beneke R, Beyer T, Jachner C, Erasmus J, Hutler M (2004). *Eur J Appl Physiol*, 92, 518-523. Byrnes WC, Kearney JT. (1997). *Med Sci Sports Exerc*, 29, 220. Nakagaki K, Yoshioka T, Nabekura Y. (2008). *Jpn J Phys Fitness Sports Med*, 57, 261-270.

## CHRONIC EFFECTS OF A COMPLEX TRAINING PROGRAM ON SPRINT AND MUSCLE ARCHITECTURE OF PROFESSIONAL SOCCER PLAYERS

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Do not insert authors here! Introduction In a recent meta-analysis (Gouvea et al., 2012), complex training has been shown to acutely improve performance in sport activities that require muscle power. Only two studies have looked at the chronic effects, particularly in sprint activities (Alves et al., 2010; Kotzamanidis et al., 2005), but none have looked at the possible mechanisms that would explain performance improvement. The study aimed to observe the effects of four weeks of a conditioning activity (AC) on the 30 meter sprint run (T30) and see whether these changes were accompanied by modifications in the vastus lateralis (VL) muscle architecture – fascicle pennation angle, fascicle length and muscle thickness. AC is defined as a heavy strength stimulus prior to a main activity, such as sprint. Methods: Eighteen players (age:  $21 \pm 1.5$  years; mass:  $69.7 \pm 7.24$ kg), randomly separated in two groups, were submitted to three sets of a 30 m sprint with one min rest between runs (CON= control) or one set of three repetition maximum on a smith machine, nine min prior to the same runs (EXP= experimental), for four weeks, twice a week. All runs were monitored by an electronic system (Proteksen 1.0, Proteksen, RJ, Brasil). All subjects went through an extended field of view ultrasonography scan of the muscle vastus lateralis using dedicated software (GE Logic E & LogicView, GE Healthcare, EUA) with the images assessed by a public domain software (ImageJ, NIH, EUA, Ver.1.45s). All procedures were repeated at the end of the training period. Results Repeated measures Anova (group x time) showed significant main (group) effect ( $P < .001$ ). The EXP showed significant decreases ( $P < .001$ ) in time at the end of the study, while no differences were observed for the CON. A 2x2 anova showed significant increases in fascicle length, ( $P < .001$ ) but no changes in pennation angle or muscle thickness in the EXP as a result of training. No changes were observed in CON group. Discussion The present study not only confirmed that sprint time can be improved (Kotzamanidis et al. (2005) with complex training, but also that this can be accomplished with shorter periods of time (4 weeks). Muscle architecture changes were only observed for fascicle length, possibly explained by the addition of sarcomeres in series in the muscle that could hypothetically increase muscle-shortening velocity. References Gouvea A, Fernandes IA, César EP, Silva WAB & Gomes PSC. (2012). *J Sport Sci. Nov.9* [Epub ahead of print] Alves JMVM, Rebelo AN, Abrantes C, Sampaio J (2010). *J Strength Cond Res, 24:936-994*. Kotzamanidis C, Chatzopoulos D, Michailidis C, Papaiaikovou G, Patikas D (2005). *J Strength Cond Res, 19:369-375*. Study supported by a research grants from FAPERJ and CNPq, Brasil. P.S.C. Gomes is a CNPq supported researcher.

## CONTINUITY OF YOUNG SOCCER PLAYERS IN A PROFESSIONAL CLUB

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Acknowledgements This study was partially supported by a grant from the Basque Government (UE09+/07) IBL is supported by a predoctoral fellowship from the Basque Government (BFI2010-35) Introduction In elite soccer, clubs have the interest to identify the most talented players. Therefore, the aim of this study was to analyze the differences between players who were successful or unsuccessful in progressing to the next category in a professional club. Methods 37 soccer players of the Athletic Club of Bilbao participated in this study (mean age  $12.83 \pm 0.62$ ). The following measurements were taken during season 2010-2011: -Anthropometry: height, sitting height, weight, six skinfolds, diameters and perimeters. Body composition was calculated. -Performance tests: velocity (15m), agility (Barrow's test), Yo-yo IT level 1, CMJ and hand dynamometry. The results of each test were transformed into z-scores and summed up to make a total score of performance (SCORE). -Age at peak height velocity (APHV) was calculated to divide players into 3 maturity groups: early (EM), average (AM) and late (LM) (Sherar et al., 2005). Mean  $\pm$  standard deviations were calculated and to show differences among groups Student t-test or U-Mann-Whitney test and Cohen's d were used. Results In season 2011-2012, 20 players (51.3%) continued in the club (C) whereas 17 players (43.6%) dropped-out (D). Players who continued were taller and heavier ( $p > 0.05$ , but  $d = 0.417$  and  $0.519$ , respectively). There were significant differences ( $p < 0.05$ ) in: sum of skinfolds (mm) [47.23(C) - 52.04 (D)], Yo-yo IT level 1 (m) [1378(C) - 1131.76(D)] and SCORE [0.97(C) - -1.14(D)]. APHV was 13.3 to 15.4 years. 15AM and 5LM players continued while 16AM and 1LM players dropout. There were not EM players. There was a trend for AM players having larger body-size and more fat ( $d = 0.567$  to  $0.954$ ). We found significant differences ( $p < 0.05$  to  $0.01$ ) between maturity groups in: velocity (m/s) [6.27(AM) - 6.54(LM)], agility (s) [11.24(AM) - 10.76(LM)], CMJ (cm) [34.32(AM) - 37.77(LM)], Yo-yo IT level 1 (m) [1190.96(AM) - 1646.66(LM)] and SCORE [-0.69(AM) - 3.59(LM)]. Discussion Players that continued were larger in body-size, had less fat and performed better in performance tests. The two groups did not differ significantly in maturity status. However, most LM players continued in the club: they had less body-size, less fat and significant better results in performance than their older peers. This is in agreement with Deprez et al. (2012) that suggest that LM players remain in their sport by outperforming their more mature counterparts. References Sherar LB et al. (2005) *J Pediatr* 147, 508-14 Deprez D et al. (2012) *Int J Sports Med* 33, 987-93

## RELIABILITY OF RPE DURING FUNCTIONAL FITNESS TESTS IN FEMALE FIBROMYALGIA PATIENTS

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Introduction: The functional capacity fitness tests are commonly used for monitoring health status in fibromyalgia patients. Frequently, the rating of perceived exertion (RPE) is used to assess perceived effort during and after testing. Several psychological factors are often altered in fibromyalgia patients. Therefore, it is unknown how accurate RPE is on this specific population. Consequently, it is of interest to analyze the reliability of the RPE while performing the tests in this population. The aim of the present study was to assess the reliability of the RPE for estimating perceived effort after performing each of the functional capacity tests in female fibromyalgia patients. Methods: Sixty eight female fibromyalgia patients (age: 51.5y; SD: 8.8y) performed the following functional capacity fitness tests in two different occasions separated by 7 days: chair sit and reach, back scratch, hand grip strength, chair stand, 8 feet up & go, and 6-minute walk. Patients were asked to perform the tests at their maximum level. The RPE was assessed after completing each test. The test-retest differences in the functional capacity tests and RPE were analyzed by paired samples Student's t-test for normally distributed variables and Wilcoxon for non-normally distributed variables. The test-retest reliability of the RPE was analyzed by means of the intraclass correlation coefficient (ICC) and standard error of the measurement (SEM). Results: Significant test-retest differences were found in chair stand and arm curl test scores (both,  $P < 0.001$ ). No test-retest differences were observed in RPE ( $P > 0.05$  for all tests). The ICC (95% confidence inter-

val) and SEM observed for the RPE were: 0.72 (0.54-0.83) and 1.8 points for chair sit and reach; 0.72 (0.55-0.83) and 1.8 points for back scratch; 0.71 (0.54-0.82) and 1.7 points for hand grip strength; 0.75 (0.60-0.85) and 1.6 points for chair stand; 0.76 (0.61-0.85) and 1.7 points for 8 feet up & go; 0.69 (0.50-0.81) and 1.6 for arm curl test; 0.65 (0.39-0.80) and 1.9 points for 6-minute walk. Discussion: The ICC showed values ranging from moderate to good, indicating a fair reliability of the RPE for assessing perceived effort after the functional capacity tests in female fibromyalgia patients. These results were also supported by the SEM. Therefore, the results of the present study suggest that the RPE might be used for monitoring perceived effort in female fibromyalgia patients.

### **EFFECTS OF DIFFERENT PACESETTERS ON THE ENERGY EXPENDITURE DURING ARM CRANK ERGOMETER EXERCISE**

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**Introduction** Although training synchronized with music has been recognized to have a positive effect on physical activity (1), there is a lack of knowledge concerning the use of others pacesetters on performance. Therefore, the aim of this study was to verify the effects of visual and acoustic pacesetters on oxygen consumption (VO<sub>2</sub>) and heart rate (HR) during exercise performed on an arm crank ergometer. **Methods** Six physically active male subjects (age: 27.0±5.5 yrs; height: 177.5±2.5 cm; weight: 75.5±6.8 kg) participated in this pilot study. Participants were underwent to a 20 minutes exercise at an individualized load corresponding to the 80% of the ventilatory threshold, performed on arm cranking ergometer (Monark 881E, Stockholm, Sweden). Three randomized experimental sessions were performed by each subject: training with music (TM), training with a video representing an exercise performed by another subject with no audio (VS) and training with a video including a series of rhythmic images with no audio (VRI). HR and VO<sub>2</sub> were continuously (K4 b2, Cosmed, Rome, Italy) measured during the three sessions. Level of significance was set at p<0.05. **Results** VO<sub>2</sub> (1.8±0.4 l.min<sup>-1</sup>) and HR (135.1±9.5 b.min<sup>-1</sup>) were lower (p<0.05) in the VRI with respect to TM (VO<sub>2</sub>: 2.4±0.1 l.min<sup>-1</sup>; HR: 163.6±19.5 b.min<sup>-1</sup>), while no differences emerged with respect to VS (VO<sub>2</sub>: 2.03±0.23 l.min<sup>-1</sup>; HR: 142.6±11.7 b.min<sup>-1</sup>). **Discussion** Findings from this preliminary study showed lower energy expenditure when exercising watching an image sequence than observing an athlete performing the same technical movements. The lower metabolic and cardiac response observed could be explained by the theory of mirror neurons (2). In fact, watching another person performing a motor task could activate neurons coding the same specific motor task while reducing the neuronal activity linked to intermediate cognitive mediation. Comparing the two visual sessions, differences in VO<sub>2</sub> and HR could be due to the fact that in the VRI the rhythm is better time locked while in the VS the recurring motion of athlete's gesture makes the rhythm less obvious. Moreover, a tempting hypothesis could be that visual pacesetters may increase the arousal state and reduce noises (i.e. other than the motor task). **Results** from this investigation could be used for the development of new training strategies, in which images projected at various frequencies can be showed to the athletes to indicate the correct rhythm of the technical movement. **References** 1. Karageorghis et al. *Res Q Exerc Sport* 2006 2. Rizzolatti et al. *Nat Clin Pract Neurol* 2009

### **TIME-MOTION ANALYSIS IN KICKBOXING COMPETITIONS**

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**Introduction** Kickboxing is as a combination of martial arts including Karate, Muay Thai and Western boxing. It is a high-intensity sport activity, based on kicking and punching techniques (Arseneau et al. 2011). Although successful performance is determined by a combination of both complex technical and tactical skills within an unpredictable situation (El Ashker 2012; Buse et al. 2008), scant information is available regarding time-motion aspects of actual competition. Thus, the aim of this study was to analyze the time-motion structure of Kickboxing competitions. **Methods** A time-motion analysis was performed (Dartfish TeamPro, Lausanne, Switzerland) from 6 video recordings of 12 elite Italian Kickboxing athletes (weight categories: -57kg; -67kg; -71kg; -75kg; +91kg) during the 2012 National Tournament organized as a selection for the upcoming European Championship. Duration (s) of fighting and nonfighting phases was recorded during full-contact (athletes can throw punches and kicks with full power at legal targets above the waist) matches (three 2-minute rounds, with 1-minute rest in between). Differences (p<0.05) in relation to rounds (round1 vs round2 vs round3) were analyzed. **Results** No differences emerged for combat phases duration (fighting: 2.3±2.3s; nonfighting: 2.1±1.9s). Fighting showed a difference (p<0.05) between rounds with longer actions during round2 (2.4±2.7s) and round3 (2.4±2.1s) with respect to round1 (1.8±1.8s). On the other hand, nonfighting phases did not show any difference with respect to rounds (round1: 1.9±1.9s; round2: 2.4±2.2s; round3: 2.0±1.8s). **Discussion** Findings indicate that no differences emerge in fighting and nonfighting duration during elite kickboxing competitions and that fighting actions are shorter during round1 with respect to the last ones. This was probably due to the presence of a greater number of explosive actions (shorter in duration) during round1 with respect to the last part of the match, probably due to fatigue and/or to a tactical strategy. Since it is often difficult to plan an appropriate training program that reflects the real match conditions, this study could provide useful indications to coaches and staff. In particular, our findings underline the importance of high-intensity activities in kickboxing, suggesting an intermittent training regimen with an effort to rest ratio of 1:1 (2s effort: 2s rest). **References** Arsenau et al. VO<sub>2</sub> requirements of boxing exercises. *J Strength Cond Res* 2011 Buse & Santana. Conditioning strategies for competitive Kickboxing. *Strength Cond J* 2008 El Ashker. Technical performance effectiveness subsequent to complex motor skills training in young boxers. *Eur J Sport Sci* 2012

### **TIME COURSE OF STRENGTH GAIN IN ELBOW FLEXOR MUSCLE INDUCED BY DYNAMIC RESISTANCE TRAINING**

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**Introduction** It becomes possible to predict the effects of varied regimens of resistance training on muscular strength gain by analyzing the results of a number of previously reported studies with different regimens (Wernbom et al., 2007). However, comparing the results of studies with different training period is difficult, and the use of simple "gain rate", i.e., dividing total strength gain by training period, would be insufficient. This problem arises from the non-linear characteristics of the time course of strength change induced by strength training. To solve this problem, this study investigated the time course of strength gain in elbow flexor muscle induced by unilateral arm curl training, and tried to fit the results to several functions. **Methods** Fourteen untrained male subjects (age, 22-26 yr) performed three sets of dynamic elbow flexion exercise three days per week for fifteen weeks. Intensity was 80%1RM (1RM, one-repetition maximum), and subjects performed repetitions until failure. Elbow flexion strengths (isometric torque and 1RM) were measured prior to every training session, and the exercise load was adjusted to 80%1RM. Before the experiment, the subjects were asked about their experiences of training or regular sport activities. The muscle thickness of Biceps brachii was measured with B-mode ultrasound imaging before and after the

period of training. Results Muscle thickness, isometric torque and 1RM showed significant increases after the period of training ( $P < 0.05$ ). The changes in 1RM strength during the period of training showed two different characteristics depending on the subjects: exponential with time for major group ( $n=9$ ) and quasi-linear with time for minor group ( $n=5$ ). All of the subjects in major group had some previous experiences of sport activities, whereas four out of five subjects in minor group had not the exponential time course was not described with single rate constant, and could be divided into an initial rapid phase and a late slow phase around 3 wk after the beginning of training. Discussion The present results suggest that, in most cases, an exponential function with two rate constants or a combination of exponential and linear functions can adequately predict the strength gain during the period of training. The initial rapid increase would be mainly caused by neural adaptation, whereas the later slow phase would be limited by the increase in muscle mass. References Wernbom M, Augustsson J, Thomee R. (2007). *Sports Med* 37(3): 225-264 DeFreitas J, Beck T, Stock M, Dillon M, Kasishke P. (2011) *Eur J Appl Physiol* 111: 2785-2790

### CAFFEINE-CONTAINING ENERGY DRINK IMPROVES PHYSICAL PERFORMANCE OF FEMALE FOOTBALL PLAYERS DURING A SIMULATED MATCH

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Introduction The effects of caffeine ingestion on male team-sports players have been recently established (Del Coso et al, 2012). However, there is little information about the effects of caffeine intake on female team-sports (Astorino et al, 2012). Since the ability to perform repeated sprints with minimal recovery is one of the most important capacities on team sport, the aim of this study was to investigate the effects of a caffeine-containing energy drink on the capacity of female football players to repeat sprints. Methods A double-blind placebo controlled and randomized experimental design was used in this study. On two different days separated by a week sixteen semiprofessional female football players ( $161.2 \pm 5.9$  cm and  $57.8 \pm 7.69$  kg) ingested 3 mg of caffeine per kg of body mass in the form of an energy drink (Fure@ProEnergetics) or the same drink without caffeine (placebo). After sixty minutes for caffeine absorption they performed a counter-movement jump (CMJ) and a 7x30m sprint test. Later, a simulated football match was played (2x40min, with 15min half time). Distance and speed were measured using global positioning satellite devices (GPS, 5Hz) and heart rate was recorded during the game. Results In comparison to the placebo drink the ingestion of the caffeinated energy drink increased the mean CMJ height ( $27.3 \pm 3.8$  vs  $26.2 \pm 3.8$  cm;  $P < 0.05$ ), the average ( $24.2 \pm 1.6$  vs  $24.5 \pm 1.7$  km/h;  $P < 0.05$ ) and the maximal running speed during the sprint test ( $25.0 \pm 1.4$  vs  $25.6 \pm 1.4$  km/h;  $P < 0.05$ ). During the simulated match, the energy drink increased the total running distance ( $6631 \pm 1618$  vs  $7087 \pm 1501$  m;  $P < 0.05$ ), the number of sprints bouts ( $16.3 \pm 9.2$  v  $21.4 \pm 13.3$ ;  $P < 0.05$ ) and the running distance covered at  $> 18$  km/h ( $161 \pm 99$  vs  $216 \pm 103$  m;  $P < 0.05$ ). No significant differences were found for the heart rate ( $P > 0.05$ ). Discussion An energy drink with a dose equivalent to 3 mg of caffeine/kg increased the ability to repeatedly sprint and the jump height during football specific tests. In addition, increased the total running distance covered during a simulated game, the number of sprints bouts and the running distance covered at high-intensity. These results suggest that energy drinks might be an effective ergogenic aid to improve physical performance of female football players. References Del Coso J, Muñoz-Fernández VE, Muñoz G, Fernández-Elias VE, Ortega JF, Hamouti N, Barbero JC, Muñoz-Guerra J. (2012) Effects of a caffeine-containing energy drink on simulated soccer performance. *PLoS One* 7:e31380. Astorino, TA, Matera, AJ, Basinger, J, Evans, M, Schuman, T, Marquez, R. (2012). Effects of red bull energy drink on repeated sprint performance in women athletes. *Amino Acids* 42(5):1803-8.

### EFFECTS OF FATIGUE ON POWER AND COORDINATIVE PERFORMANCES

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Introduction Fatigue during exercise is a complex phenomenon with a number of contributing factors (3). Literature suggests an exercise-related arousing effect after team sport competitions addressing the central nervous system ability to cope with the control of complex tasks in trained subjects (1,2). Because no study investigated the effect of local fatigue on fine neuromuscular activation patterns, the purpose of this study was to establish the acute effects of a fatigue protocol (FP) on jump and inter-limb coordinative performances in field settings. Methods Sixteen (Male=11, Female=5) young adults (age range: 20-24 yrs) answered the International Physical Activity Questionnaire (IPAQ) to ascertain quantity and quality of their weekly physical activity (PA). The load imposed by FP (squatting activity at a frequency of 60bpm to exhaustion) was ascertained by ratings of perceived exertion (RPE) and muscle pain (RMP). Before and after FP, countermovement jump (CMJ), in-phase (IP) and anti-phase (AP) inter-limb coordination (synchronized hand and foot flexions and extensions at 80, 120, 180bpm) were recorded. ANOVA for repeated measures was used to verify difference ( $p < 0.05$ ) between pre and post data. Results No gender differences emerged for the analyzed variables. IPAQ showed that subjects engaged in  $4 \pm 2$  sessions/weekly of vigorous and moderate PA. During FP, subjects performed  $233 \pm 116$  squats. Subjective ratings at the end of FP were significantly ( $p < 0.001$ ) higher (RPE:  $7.2 \pm 1.2$ pt; RMP:  $6.1 \pm 2.1$ pt) with respect to basal values (RPE:  $1.5 \pm 2.3$ pt; RMP:  $0.6 \pm 1.4$ pt). Post-fatigue CMJ ( $41.7 \pm 6.7$ cm), IP (80bpm:  $55.1 \pm 13.4$ s; 120bpm:  $45.8 \pm 17.5$ s; 180bpm:  $23.0 \pm 17.2$ s), and AP (80bpm:  $40.3 \pm 19.4$ s; 120bpm:  $15.1 \pm 15.3$ s; 180bpm:  $6.9 \pm 5.3$ s) performances did not show any difference with respect to pre-fatigue (CMJ:  $42.5 \pm 8.0$ cm; IP: 80bpm= $57.0 \pm 10.3$ s; 120bpm= $47.7 \pm 17.4$ s; 180bpm= $22.8 \pm 16.4$ s; AP: 80bpm= $34.9 \pm 24.4$ s; 120bpm= $10.4 \pm 14.3$ s; 180bpm= $4.1 \pm 4.7$ s) values. Discussion The proposed FP posed a high load on subjects, who rated the exercise as "very hard". Although an arousing effect counteracting fatigue effects and facilitating performance of complex motor behaviors has been reported after high intensity activities (1,2), CMJ, IP and AP performances did not show any change at the end of FP. It could be speculated that the high PA level of participants might have helped them preserving their power and coordinative performances at the end of FP. However, the total duration (8-min) of FP might not represent an acute exercise bout of appropriate intensity and duration to find beneficial effects on performances. References 1. Cortis et al *JSCR* 2011 2. Cortis et al *JSCR* 2013 3. Enoka & Duchateau *JP* 2008

### INCREASED TRAINING ADAPTATIONS WHEN TESTING ON OWN BIKE VS. LABORATORY ERGOMETER

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Regular laboratory testing of lactate profile and maximal oxygen uptake ( $VO_{2max}$ ) on cycle ergometers is important to monitor training adaptations in competitive cyclists (1). Laboratory ergometers might be suitable for tracking small, but important changes in the competi-

five cyclists' performance (2). However, previous research indicates that peak power output achieved in the laboratory may be different compared to outdoor cycling (3). Cyclists spend a lot of time optimizing their seating position and the waste majority of training is done on their own bike (OB). We are not aware of any studies comparing training adaptations tested on a laboratory ergometer with adaptations tested on the cyclists OB. We hypothesized that after a training period there would be a larger improvement in power output at a blood lactate concentration ( $[La]$ ) of 1.5 mmol·l<sup>-1</sup> on the cyclists OB compared to laboratory ergometer. Thirteen trained cyclists (body mass 76±7 kg, height 181±5, VO<sub>2</sub>max 63±6 ml·kg<sup>-1</sup>·min<sup>-1</sup>) was assigned to performed a 12 week training program of 9.5 ± 3.8 h·week<sup>-1</sup>. Power output at  $[La]$  of 1.5mmol·l<sup>-1</sup> was determined during an incremental cycle test. Pre- and post-tests were performed both on Lode Excalibur Sport ergometer and on their OB in the laboratory, stationed on Tacx Flow with PowertapSL+ mounted on the rear wheel. The test order was randomized and cadence, length of the crank arm, time of day and preparation to the two tests were the same at pre and post-tests. Following the training period the power output at  $[La]$  of 1.5mmol·l<sup>-1</sup> increased significantly from 197±11 W to 227±11 W ( $p>0.05$ ) on OB, while there was a non-significant increase on the Lode ergometer from 196±10 W to 216±11 W. At a power output of 225 W a reduction in heart rate was observed on OB (from 149±4 beats·min<sup>-1</sup> to 142±5 beats·min<sup>-1</sup>;  $p<0.05$ ), while the reduction on the Lode ergometer was non-significant (from 147±5 beats·min<sup>-1</sup> to 144±5 beats·min<sup>-1</sup>). There was no significant change in VO<sub>2</sub> at 225W with either OB or the Lode ergometer. The overall finding was that using a cyclists' own bike to test power output at  $[La]$  of 1.5 mmol·l<sup>-1</sup> seems to be more sensitive towards adaptations that actually takes place during a training period. Although the Lode ergometer can be adapted to the individual cyclist in numerous ways, it appears that using a cyclists' OB to test power output at  $[La]$  of 1.5 mmol·l<sup>-1</sup> is more sensitive than the ergometer to measure training adaptations following a training period. Therefore, statistical significant improvements were detected when cyclists were tested on their own bike, while no statistical significant changes was detected by using the Lode ergometer. References 1. Paton et al. Sports Med 2001 31:489-96 2. Paton et al. Sports Med 2006 27:444-7 3. Bertucci et al. Sports Med 2005 26:868-73

### A CAUSAL-MORPHOLOGICAL EVALUATION OF SPRINT MOTIONS FOR ELEMENTARY SCHOOL CHILDREN

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**Introduction** The purpose of this study was to establish a preliminary causal-morphological model of the sprint skill in order to develop some effective methods for teaching the overhand throw in the physical education class of elementary school. **Methods** The causal-morphological model of the sprint skill was drawn on the cycle-causal model, which was applying cause and effect diagram or fishbone diagram, one of the quality control tools. The model covered the descriptive checkpoints of previous studies. It was composed 3 major motions; ground catching, driving, and swing action, which included 25 morphological observation points. Every morphological observation was categorized into 2-3 levels respectively. Intermediate sprint forms of 30 elementary school children; 18 boys and 12 girls, 8-10 years old, were shot by digital video cameras. Their forms were played in slow motion or frame-by-frame, and an investigator evaluated the checkpoints. Qualitative factor analysis was applied in order to identify uni dimensionality of sprint skill. Correlation coefficient was calculated between object scores and running time of 10-meter intermediate sprint. **Results and Discussions** Two factors were extracted from 21 variables; the eigenvalues were 5.969(28.4%) for first factor and 2.652(12.6%) for second factor, the Cronbach alphas were 0.874 and 0.654. Four variables were omitted because of low communality. In the first factor, "arm swing down motion" (factor loading was 0.770) and "elbow longitudinal direction motion"(0.703) showed the highest factor loading. Twelve of 21 variables showed the factor loadings of 0.6 or more, and every factor loadings were positive, though "foot over push"(0.209) showed lowest factor loadings in the first factor. In the second factor, although "highest knee position" (-0.657) showed highest factor loading, the value was negative. Only four variables showed factor loadings above 0.5, and the factor loadings of 11 variables were negative in the second factor. The correlation coefficient between the first factor and sprint time was -0.374( $p<0.05$ ), that of second factor and running was 0.067(Ins). Therefore it is suggested that the first factor reflect the sprint skill. However, the correlation coefficient is not so high, because viewpoints of the pitch and stride were not fully included in the evaluation criteria. In addition, we observed some children who waving their arms in the lateral direction in order to induce a twist action. Such aspects were not included in this study. **Conclusions** Sprint motion was able to evaluate with one-dimensional scale from 21 viewpoints. It explained sprint time significantly. We need to improve further aspect because the viewpoints did not reflect some of the observed motions. This work was supported by Grant-in-Aid for Scientific Research(C), (24500697) Japan.

### ESTIMATION OF LOAD MAXIMIZING MECHANICAL POWER OUTPUT USING THE BALLISTIC BENCH PRESS AND BENCH THROW TEST

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**Introduction:** Training at the load that maximizes peak mechanical power (P<sub>max</sub>) is considered superior for the development of power (Nibali et al., 2013). Ballistic bench press (BP) and bench throw (BT) are often used for the determination of P<sub>max</sub> load in the upper body. Because of the braking phase in BP that occurs when using a light or medium load (Sanchez-Medina et al., 2010), the load-power spectrum in BP is different from that found in BT. The result is that the P<sub>max</sub> load for BP is different from that of BT. The purpose of this study was to determine the relationship between BP and BT, with respect to P<sub>max</sub> and P<sub>max</sub> load. **Methods:** Thirteen male collegiate footballers participated in the study. Testing session one involved the determination of each subject's one-repetition maximum (1RM) bench press strength using a Smith machine. Testing session two involved the performance of ballistic BPs and BTs using the Smith machine set at several different loads ranging from 30.0 kg to 90% of 1RM. Barbell positions were measured using a linear position transducer, and barbell velocity, force and power output during ballistic BP and BT were calculated using a dynamic equation. P<sub>max</sub> and P<sub>max</sub> load were determined by fitting second-order polynomials to the data. **Results:** P<sub>max</sub> in BP was significantly smaller than in BT ( $P<0.05$ ). However, P<sub>max</sub> load in BP was significantly greater than in BT. P<sub>max</sub> in BT was significantly correlated with P<sub>max</sub> in BP ( $P<0.05$ ). P<sub>max</sub> load in BT was not significantly correlated with P<sub>max</sub> load in BP. **Discussion:** The results suggest that P<sub>max</sub> load is higher when using the BP test compared with BT and that it is difficult to predict P<sub>max</sub> load for BT using the P<sub>max</sub> load for BP. **References:** Nibali ML, Chapman DW, Robergs RA, Drinkwater EJ. (2013). J Strength Cond Res, 27, 388-97. Sanchez-Medina L, Perez CE, Gonzalez-Badillo JJ. (2010). Int J Sports Med. 31, 123-9.

### MAXIMAL SWIMMING DISTANCE AT ANAEROBIC CRITICAL VELOCITY

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**Introduction:** Recent studies showed strong relationships between anaerobic critical velocity (AnCV) and distances with high anaerobic demands (Fernandes et al., 2008; Neiva et al., 2011). As an inexpensive and non-invasive method it seems relevant to conduct further studies to verify the use of this recent functional parameter. Therefore, the aim of this study was to assess AnCV in swimming, its relationships with short distance performance and determine the maximal distance that can be performed at this assessed velocity. **Methods:** Nine male swimmers performed 15, 25 and 50 m maximal front-crawl swimming to calculate ACV. Each swimmer also performed 100 m front-crawl at maximal velocity. Additionally, it was aimed to assess the maximal distance that could be performed at the previously assessed individual AnCV (up to 150 m). Capillary blood lactate concentrations and biomechanical variables were assessed on both swimming tests. **Results:** Results show that AnCV and maximal 100 m front-crawl were highly correlated ( $r=0.88$ ,  $P<0.01$ ) and no differences ( $P>0.05$ ) were noted between them ( $1.61 \pm 0.07$  m.s<sup>-1</sup> and  $1.60 \pm 0.08$  m.s<sup>-1</sup>, respectively;  $P=0.34$ ). The swimmers were able to perform  $97.22 \pm 20.51$  m at AnCV. However, no relationship was found between the total distance achieved and AnCV ( $r=0.27$ ,  $P=0.49$ ) and 100m performance ( $r=0.49$ ,  $P=0.19$ ). Blood lactate concentration values were also different in the 3rd and 5th minutes of recovery between the two tests ( $P<0.05$ ). Likewise, variations of the biomechanical variables were noted between the tests. **Discussion:** Linear relationships and no differences were found between AnCV and 100m swimming velocity, corroborating data found in the literature. This result suggests that AnCV is an important indicator of performance in short events. However, swimmers were not capable to maintain the velocity correspondent to AnCV for more than  $97.22 \pm 20.51$  m as possible changes in technique due to fatigue could lead to an increase in body drag. Moreover, no consistent relationships were found between the total distance achieved at AnCV and AnCV, which highlights that higher assessed velocities are not necessarily correspondent to more swimming distances. More research is needed to understand the effects of training on anaerobic power and on anaerobic capacity and the relationship between these two components of swimmer's anaerobic fitness level. **References:** Fernandes, R., Aleixo, I., Soares, S., Vilas-Boas, J. (2008). Anaerobic Critical Velocity: A new tool for young swimmers training advice (chapter 10). In: W. Beaulieu (Ed.), Physical Activity and Children. New research, 211-223, New Science Publishers, Inc. New York. Neiva, H., Fernandes, R., Vilas-Boas, J. (2011). Anaerobic Critical Velocity in Four Swimming Techniques. International Journal of Sports Medicine, 32, 195-198.

### RELATIONSHIP ON PARA-CYCLISTS CATEGORIES IN MAXIMAL AEROBIC POWER OUTPUT AND TIME TO EXHAUSTION DURING BICYCLE ERGOMETER EXERCISE

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**Introduction** The Para-Cycling Classification separates the blind and visually impaired (B on tandem with a valid pilot; P), impairments of leg muscle (divided into 5 classes; C1-5) and those with impaired coordination and balance (using tricycle; T1-2) [UCI Cycling Regulations]. The average speed of the winners of time-trial men event, measured during the last Olympic and Paralympic Games, shows a linear decrease in speeds in different classes of disability ( $y=-2.61x+53.73$ ;  $R^2=0.95$ ) and reflects the degree of muscle strength deficit in the production of mechanical power and pedalling efficiency. The aim of this study was to examine the relationship between the 9 classes of para-cyclists in the maximal power associated at VO<sub>2</sub>peak (pVO<sub>2</sub>peak) and the time to exhaustion at pVO<sub>2</sub>peak (tlim). **Methods** 23 men of the French team of Para-cycling (3P, 3B, 5C5, 2C4, 3C3, 3C2, 1C1, 2T2, 1T1) participated in a training session. With their bikes, they took a continuous incremental test based on their disability category (15, 20 or 25 Watt.min<sup>-1</sup>) with a Cyclus2 ergometer to determine VO<sub>2</sub>peak and pVO<sub>2</sub>peak. 48 hours later, following a standardized warm-up (30 min), they performed exhaustive (tlim) exercise at their MAPO. Cardiorespiratory parameters (VO<sub>2</sub>peak, VEpeak, HRpeak) were measured breath-by-breath with the Cosmed K4b2. In investigating the relationships between respective items of measurement, a Pearson's correlation coefficient was calculated. The level of significance was set at  $P<0.05$ . **Results** Means pVO<sub>2</sub>peak, VO<sub>2</sub>peak, VEpeak, HRpeak and tlim were respectively ( $313 \pm 74$ W;  $64.9 \pm 6.1$  mL.min.kg<sup>-1</sup>;  $158 \pm 17$  L.min<sup>-1</sup>;  $187 \pm 11$  b.min<sup>-1</sup>;  $242 \pm 57$ s). The degree of disability was linearly correlated with the inter-class changes in pVO<sub>2</sub>peak ( $R^2=0.92$ ) but not in VO<sub>2</sub>peak, VEpeak and HRpeak. No significant relationship was found between VO<sub>2</sub>peak and tlim ( $r=0.61$ ,  $p=NS$ ). tlim was inversely correlated with pVO<sub>2</sub>peak ( $r=-0.75$ ,  $P<0.05$ ). **Discussion** pVO<sub>2</sub>peak pilots are the highest and are similar to those recorded by Billat et al., 1996 and unlike the pVO<sub>2</sub>peak, B's tlim are superior. This result is different from that of Caputo et al. (2003) who showed that endurance training seems to influence tlim differently. We found a relationship between pVO<sub>2</sub>peak and tlim similar to what Renoux found in swimmers (2001). Billat et al., 1996 observed the tlim at vVO<sub>2</sub>peak higher among kayakers compared to runners and cyclists. Limitation caused by muscle disease requires improved endurance during an exhaustive exercise at pVO<sub>2</sub>peak. This result has an application in training. **References** UCI Cycling Regulations (2012), F0712, part 16. Billat A et al. (1996) Ergonomics, 39:2, 267-277. Renoux JC. (2001) Arch Physiol Biochem. 109 (5): 424-9. Caputo F, Mello MT, Denadai BS. (2003) Arch Physiol Biochem. 111(5): 461-6.

### THE INFLUENCE OF AUDITORY DISTURBANCE ON BALANCE ABILITY IN YOUNG PEOPLE: A PILOT STUDY

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**Introduction** Balance plays an important role in sports related performance. Visual, vestibular, and proprioceptive feedbacks are key factors to maintain balance. Auditory stimulation or noise was considered as a proprioceptive disturbance in balance test. In previous studies, music has been shown to have a beneficial effect in sports related performance by increasing muscular coordination and oxygen saturation. However, no study demonstrates how auditory disturbances affect balance parameters, such as steadiness, symmetry, and dynamic balance. Therefore, the purpose of this study is to explore the influence of auditory disturbance on balance in young people. **Methods** Nineteen health young people (aged 19 to 25) without hearing deficit were included in this study. Each participant was tested in 4 different conditions randomly: quiet with eye open, white noise with eyes open, quiet with eyes close, and white noise with eyes close. The white noise that produced by Adobe Audition 2.0 was exported through earphone and the volume was set in 85 dB. Sway area, sway path length, forward/backward and lateral deviation of each participant's COG were measured by Zebris FDM platform during one leg standing balance test to quantify static standing balance. **Results** No statistically significant difference was found in eyes close conditions. However, in eyes open situation, there was a significant difference in the sway path length between quiet and white noise condition ( $p=0.019$ ). Regardless in white noise or quiet condition, better balance performances were noted in one leg standing

balance test. Conclusion The study indicated that 85dB white noise may disturb one leg static standing balance in eyes open condition in healthy young population. In other words, noise may have an adverse effect on balance related performance. But the influence of other of auditory characteristics in balance, such as frequency, volume and rhythm, are still unknown and will be discussed in further study. References Rhea CK, Sliver TA, Hong SL, Ryu JH, Studenka BE, et al. (2011). PLoS ONE 6(3): e17696 Park et al. (2011). Journal of NeuroEngineering and Rehabilitation 8: 67. Tamura H, Ohgami N, Yajima I, Iida M, Ohgami K, et al. (2012). PLoS ONE 7(6): e39807. Liang M, Zhao F, French D, Zheng Y. (2012). J acoust Soc Am. 131(6):4526-34.

## COMPARISONS OF MECHANICAL OUTPUTS, ELECTROMYOGRAMS, MUSCLE DAMAGES, AND PHYSIOLOGICAL RESPONSES BETWEEN MANUAL AND WEIGHT RESISTANCE TRAININGS

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Introduction Manual resistance training (MRT) has many advantages over traditional weight resistance training (WRT), such as minimal requirements for equipment and potential for maintaining maximum muscular tension throughout the movement, including in the eccentric phase. Although MRT has been widely adopted in practice, there have been no studies examining the biomechanical and physiological characteristics of MRT. The purpose of the present study was to investigate the force generation, muscle activity, and physiological responses of MRT and to compare these data with those of WRT. Methods Unilateral elbow flexion was performed 10 repetitions by 8 healthy male adolescents. Flexion was performed with a repetition maximum (RM) of 10 using manual resistance for one arm and weight resistance for the other in randomized order. In both conditions, the joint moment, joint work, and muscle activity observed by electromyography (EMG) were evaluated. The muscular force in MRT was measured using a custom-made instrument. Muscle fatigue and damage were measured before, immediately after, 15 and 30 min after the exercises for fatigue markers, and 2 and 4 days after the exercises for damage markers. Results As compared with WRT, MRT showed significantly greater joint moments (35 Nm vs. 28 Nm within the concentric phase; 50 Nm vs. 28 Nm within the eccentric phase) as well as more negative joint work in the eccentric phase (-73 J vs. -45 J). Additionally, the markers of muscle damage were significantly greater in MRT than in WRT. There was no significant difference in the EMG and muscle fatigue markers. Discussion Results of the present study suggested that MRT can provide muscles with higher-intensity mechanical stimulation than traditional high-load WRT, while maintaining similar degrees of muscle activity and fatigue. Thus far, several studies have investigated the effects of MRT on physical fitness through practical approaches (Dorgo et al., 2009). The present study revealed the biomechanical and physiological basis for the effects of MRT. Theoretically, the greater overload achieved by MRT should result in more pronounced strength development (Andamovich et al., 1987). Note, however, that during the implementation of MRT, trainees are prone to submaximal performance because quantification of the resistance by a spotter is unavailable. Therefore, to take advantage of the greater mechanical loading in MRT, it is important to take into account both the trainee's effort and the spotter's instruction. References Andamovich DR, Seidman SR. (1987). Natl Strength Cond Assoc J, 9, 57-59. Dorgo S, King GA, Rice CA. (2009). J Strength Cond Res, 23(1), 293-303.

## ACUTE EFFECTS OF TWO DIFFERENT WARM-UP PROTOCOLS ON FLEXIBILITY AND LOWER LIMB EXPLOSIVE PERFORMANCE IN ELITE FEMALE ARTISTIC AND RHYTHMIC GYMNASTS

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Introduction Little evidence exists on the effects of the combination of static stretching and sport specific exercises that induce post-activation potentiation (PAP) on subsequent muscle performance (Tsolakis, & Bogdanis, 2012). The aim of this study was to examine the combined effect of static stretching and tuck jumps on leg muscle power and flexibility of elite female gymnasts. Methods Twenty-four elite female gymnasts (14 artistic and 10 rhythmic), participated in this study. A repeated measures, within subject randomized design was used to compare the effects of the two different warm-up protocols on hip joint flexion range of motion (ROM) and counter-movement jump (CMJ) height. One warm-up included short (15 sec) static stretching followed by 5 tuck jumps (S-WU), while the other included longer static stretching (30 sec) followed by 3x5 tuck jumps (L-WU). ROM was measured before and after warm-up, after the stretching interventions and after the tuck jumps. CMJ was measured after warm-up, after stretching, immediately after and at 4, 8 and 12 min of recovery following interventions in order to examine possible interaction between fatigue and PAP. Results The 3-way ANOVA revealed significant main effects for sport, warm-up protocols and time for ROM ( $p < 0.01$ ). As expected, rhythmic gymnasts had greater ROM than artistic gymnasts. A warm-up protocol x time interaction was also found for ROM ( $p < 0.01$ ). L-WU increased ROM more than S-WU by 8.3% for both artistic and rhythmic gymnasts. This increase peaked immediately after stretching and remained unchanged after the tuck jumps. The 3-way ANOVA for CMJ performance showed only a sport and time main effect ( $p < 0.01$ ), with no main effect for condition. Artistic gymnasts had greater CMJ than rhythmic gymnasts. CMJ remained unchanged compared to the baseline value in the S-WU condition, but increased by 4.6%, 4 min into recovery in the L-WU condition. Discussion The L-WU protocol, that included a combination of 30 s static stretching and 3 sets of tuck jumps, resulted in a significant increase in flexibility and leg muscle power in both artistic and rhythmic gymnasts. Although ROM was higher in rhythmic gymnasts and CMJ was higher in artistic gymnasts, the effects of the two warm-up protocols were similar in the two groups of athletes, with L-WU giving better results for both ROM and CMJ. References 1. Tsolakis, C, & Bogdanis, G.C. (2012). Acute effects of two different warm-up protocols on flexibility and lower limb performance in male and female athletes. J Sports Sci Med, 11, 669-675.

## EFFECTS OF MUSCLE CONTRACTION TYPE ON POSTACTIVATION POTENTIATION

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Introduction Previous studies examined PAP and noted that the type of muscle contraction might have different effects on PAP (Rixon et al. 2007). In those studies the volumes of preload have not been equalized. The primary purpose of this study was to examine the effect of isometric, concentric and eccentric muscle contraction as a preload on vertical jumping performance with equated volumes. The secondary purpose was to determine the individual timing potentiation. Fourteen athletes that involved with athletic jumps participated in a control condition and three experimental conditions. Methods Fourteen track and field athletes (height:  $1.77 \pm 0.05$  m; body mass:  $79.0 \pm 7.1$  kg; body fat:  $9.1 \pm 6.8\%$ , maximal half squat strength, one repetition maximum-RM:  $173 \pm 29$  kg) took part in this study. Following familiarization and preliminary testing, participants visited the laboratory on four randomly assigned occasions, one week apart. On each occa-

sion, participants performed the conditioning exercise (isometric, eccentric, concentric and control) followed by performance testing (countermovement jump-CMJ), at 15 seconds, 2, 4, 6, 8, 10, 12, 15, 18 and 21 minutes. The load on all conditions was equated by measuring the impulse of the force on a force plate. Data were analyzed using a 2-way ANOVA with repeated measures on both factors (condition x time). Significance was accepted at  $p < 0.05$ . Results The 2-way ANOVA showed a condition x time interaction ( $p < 0.01$ ) as well as a time main effect ( $p < 0.01$ ). In all experimental conditions, CMJ performance was decreased immediately after the end of the conditioning muscle contractions and then recovered over time. When data were examined on an individual level, CMJ performance was increased ( $p < 0.01$ ) by  $0.6 \pm 1.0\%$ ,  $1.5 \pm 1.2\%$  and  $3.0 \pm 1.2\%$ , respectively, in the concentric, eccentric and isometric conditions. In the control condition, CMJ performance was progressively decreased over time reaching a low of  $-7.3 \pm 0.5\%$  after 21 min. Discussion Isometric conditioning exercise was found to give the greatest potentiation on subsequent explosive muscle performance. These results are in accordance with those reported by Rixon et al. (2007), who also found that an isometric protocol similar to that used in the present study resulted in a 2.9% increase in CMJ compared to a dynamic protocol (3 RM). These results have practical value for coaches and suggest that brief isometric contractions can be used to attain a postactivation potentiation effect on leg muscle power.

## EXECUTIVE FUNCTION IS IMPROVED FOLLOWING A MULTICOMPONENT MOTOR-CONTROL TRAINING IN OLDER PEOPLE

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**INTRODUCTION.** Although some studies have pointed to promising effects of physical training on cognition in older adults, a recent review has not found sufficient evidence and further trials are claimed (1). Therefore, our purpose was to evaluate whether a multicomponent motor-cognitive training was able to enhance executive control among older people. **METHODS.** 15 participants (13 women, 2 men;  $71.3 \pm 3.9$  yrs) were involved in this pilot study. They exercised for 1 hour, twice-weekly for 7 months. Training program consisted of mainly gait and strength exercises in which coordinative, cognitive and balance challenges were progressively added using a dual-task methodology. The Stroop Colour Word Test was employed to assess cognitive functioning. Performance was quantified by the time (in seconds) participants took to read the 100 items of each part. Following Colcombe et al. review (2), part A (SCWTA) and B (SCWTB) were considered controlled processes tasks and part C the executive task (SCWTC). Interference score (SCWTINT) served as the measure of executive function. Participants were tested one week before and after the intervention. Non-parametric Wilcoxon test was conducted to assess the effect of the exercise upon cognitive functioning (SCWTA, SCWTB and SCWTINT) and Cohen's *d* was used to evaluate the magnitude of the effect. **RESULTS.** A significant improvement following the training was observed both in a controlled process task and executive function. Time in SCWTA and SCWTINT score decrease 12% ( $d=0.63$ ;  $p < 0.05$ ) and 16% ( $d=0.46$ ;  $p < 0.05$ ) respectively. Improvement in SCWTA was also nearly significant ( $d=0.28$ ;  $p=0.064$ ). **CONCLUSIONS.** The outcomes of this pilot study, although preliminary, suggest that multicomponent approaches based on dual-task methodology and a progressive increase in coordinative, balance and cognitive demands hold a great potential for enhancing executive function in older adults. This is line with other recent studies (3, 4). However, our improvement in both controlled process task (i.e., SCWTA) and executive function differs from the selective improvement hypothesis proposed by Colcombe et al. (2), according to which only executive function tasks were enhanced following physical training. **REFERENCES.** 1. Snowden M, Steinman L, Mochan K, Grodstein F, Prohaska TR, Thurman DJ, et al. Effect of exercise on cognitive performance in community-dwelling older adults: review of intervention trials and recommendations for public health practice and research. *J Am Geriatr Soc* 2011 Apr;59(4):704-16. 2. Colcombe S, Kramer AF. Fitness effects on the cognitive function of older adults: a meta-analytic study. *Psychol Sci* 2003 Mar;14(2):125-30. 3. Forte R, Boreham CA, Leite JC, De Vito G, Brennan L, Gibney ER, et al. Enhancing cognitive functioning in the elderly: multicomponent vs resistance training. *Clin Interv Aging* 2013;8:19-27. 4. Voelcker-Rehage C, Godde B, Staudinger UM. Cardiovascular and coordination training differentially improve cognitive performance and neural processing in older adults. *Front Hum Neurosci* 2011;5:26.

## ARE GAINS IN PHYSICAL AND COGNITIVE EXECUTIVE PERFORMANCE FOLLOWING A FUNCTIONAL TRAINING IN OLDER ADULTS RELATED?

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**INTRODUCTION.** It has been found no associations between gains in VO<sub>2</sub>max and cognitive performance following physical training in older adults (1). Similarly, Karavirta et al. (2) reported no significant correlations between training responses in cardiovascular endurance (VO<sub>2</sub>max) and strength (maximal leg extension force) following a endurance-strength concurrent training. Hence, our target was to evaluate whether executive function (EF) and functional fitness (FF) responses following a multicomponent motor-cognitive training in older people were related to each other or not. **METHODS.** 15 participants (13 women, 2 men;  $71.3 \pm 3.9$  yrs) were involved in this pilot study. They exercised for 1 hour, twice-weekly for 7 months. Training program consisted of gait and strength exercises aimed at improving participants' functionality through progressively increasing coordinative, cognitive and balance demands. Stroop Colour Word Test interference score (SCWTINT) was used to evaluate EF. FF was assessed by means of chair-stand test (CST), 6-min walk test (6MWT) and timed Up&Go test (TUGT). Participants were tested one week before and after the intervention. Spearman rank-order correlation coefficient was used to study possible relationships between changes in studied variables from pre to post-test condition. **RESULTS.** No significant relationships were found among variables. However, a tendency towards significance was found between CST and TUGT ( $r=0.488$ ;  $p=0.065$ ). **CONCLUSIONS.** The nearly significant association between CST and TUGT is probably due to shared neuromuscular mechanisms involved in both tasks (3), whilst gains in 6MWT seem to be mediated by different pathways. Meanwhile, the absence of relationship between gains in physical and cognitive performance displayed in our pilot study coincides with previous investigations (1). Notwithstanding, further studies with larger samples but similar promising training approaches (4, 5) are needed to deepen into the mediators of cognitive enhancement following physical exercise. **REFERENCES.** 1. Etnier JL, Nowell PM, Landers DM, Sibley BA. A meta-regression to examine the relationship between aerobic fitness and cognitive performance. *Brain Res Rev* 2006 Aug 30;52(1):119-30. 2. Karavirta L, Hakkinen K, Kauhanen A, Arijia-Blazquez A, Sillanpaa E, Rinkinen N, et al. Individual responses to combined endurance and strength training in older adults. *Med Sci Sports Exerc* 2011 Mar;43(3):484-90. 3. Granacher U, Muehlbauer T, Zahner L, Gollhofer A, Kressig RW. Comparison of traditional and recent approaches in the promotion of balance and strength in older adults. *Sports Med* 2011 May 1;41(5):377-400. 4. Forte R, Boreham CA, Leite JC, De Vito G, Brennan L, Gibney ER, et al. Enhancing cognitive functioning in the elderly: multicomponent vs resistance training. *Clin Interv Aging* 2013;8:19-27. 5. Voelcker-Rehage C, Godde B, Staudinger UM. Cardiovascular

and coordination training differentially improve cognitive performance and neural processing in older adults. *Front Hum Neurosci* 2011;5:26.

### **THE IMPACT OF TRAINING SURFACE IN VO2MAX OF PREPUBESCENT VOLLEYBALL PLAYERS.**

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**INTRODUCTION** Volleyball and beach volleyball are characterized by rapid accelerations, decelerations and sudden changes of direction (Young et al., 2001, Bishop, 2003). Performance recovery and repeated maximal efforts ability are influenced by aerobic metabolism (Lidor and Ziv, 2010). The purpose of the present study was to examine the impact of training surface in VO2max of prepubescent volleyball players. **METHODS** Thirty female prepubescent volleyball players (age:  $11.2 \pm 0.6$  yrs) took part in this study and were randomly allocated in two groups. Group A (N=15) participated in a 10 week training programme on sand surface, while group B (N=15) participated in a same programme on land surface. 20m shuttle run tests were conducted on hard surface before (pre) and after (post) the training period. The equation of Leger et al. (1988) was used for the prediction of VO2max. Differences in VO2max pre - post training and between the groups were analysed using T-test. Results are presented as mean  $\pm$  SE. **RESULTS** VO2max did not differ between groups in the pre condition (Group A:  $44.4 \pm 0.1$  ml/kg/min vs. Group B:  $44.4 \pm 0.1$  ml/kg/min,  $p=0.09$ ) while it was significantly improved ( $p<0.001$ ) in both groups in the post condition (Group A:  $48.8 \pm 0.3$  ml/kg/min vs. Group B:  $45.9 \pm 0.2$  ml/kg/min). In the post condition VO2max differed significantly between groups Group A:  $48.8 \pm 0.3$  ml/kg/min vs. Group B:  $45.9 \pm 0.2$  ml/kg/min,  $p<0.001$ . **DISCUSSION** Despite the fact that VO2max was improved in both groups after the 10-week training program, the much greater improvement achieved in group A suggests that the training surface may play an important role. **REFERENCES** 1. Young, W.B, McDowell, M.H., Scariett, B.J. (2001). *J. Strength Cond. Res.*, 15(3): 315-319. 2. Bishop, D. (2003) *J. Sport Med. & Phys. Fitness.*, 43: 418-23,2003. 3. Lidor R., Ziv G. (2010). *J. Strength Cond. Res.*, 24(7): 1963-1973. 4. Leger L., Mercier D., Gaboury C., Lambert J. (1988). *J Sports Sci* 6(2): 93-101.

### **INFLUENCE OF A SOCCER-SPECIFIC TRAINING PROGRAM IN PHYSIOLOGICAL CHARACTERISTICS OF PRE-PUBERTAL BOYS**

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**Introduction** Participation in structured training programs seems to promote growth and maturation in children (Cunha et al., 2011, Moore et al., 2010). The purpose of the present study was to investigate the influence of a soccer-specific training program on physiological characteristics of prepubescent boys. **Methods** 24 prepubescent boys (age:  $10.6 \pm 0.4$  yrs) took part in this study and were randomly allocated in 2 groups. Exercise group (EG, n=12) participated in a soccer-specific training program (3 days/week) for three months, while control group (CG, n=12) did not participate in any structured training program. Body mass, body height, percent body fat, counter-movement jump (CMJ) and Illinois agility test were measured in both groups before (pre) and after (post) the completion of the 3-months training program. Differences between groups were analyzed using T-test and the results are presented as mean  $\pm$  SE. **Results** Body mass and body height did not differ between groups neither in the pre nor in the post condition (Pre:  $p=0.12$ , Post:  $p=0.19$ ), but were significantly increased in both groups after the 3-months period ( $p<0.01$ ). Changes in percent body fat did not differ between groups in the pre condition (EG:  $13.3 \pm 0.5\%$  vs. CG:  $13.6 \pm 0.4\%$ ,  $p=0.62$ ), while in the post condition percent body fat increased significantly only in the control group (CG:  $13.6 \pm 0.4\%$  vs.  $13.9 \pm 0.3\%$ ,  $p<0.01$ ). CMJ and Illinois agility test did not differ between groups in the pre condition. Performance in CMJ was significantly improved in both groups after the 3-months period, but the EG performed significantly better than the CG (EGpost:  $27.3 \pm 0.7$ cm vs. CGpost:  $23.5 \pm 1.4$ cm,  $p<0.05$ ). In the post condition Illinois agility test was significantly improved only in the EG and differed significantly from the CG (EGpost:  $19.4 \pm 0.3$ sec vs. CGpost:  $20.5 \pm 0.3$ sec,  $p<0.01$ ). **Discussion** The results of the present study suggest that a 3-months soccer-specific training program induces significant decreases in body fat and significant performance improvements in CMJ and Illinois agility test. **References** Cunha G., Lorenzi T., Sapata K., Lopes A.L., Gaya A.C., Oliveira A. (2011) *J Sports Sci* 29(10): 1029-1039. Moore S.A., Moore M., Klentrou P., Sullivan P., Falk B. (2010). *J Sports Med Phys Fitness* 50(4):486-493.

### **STRENGTH AND PSYCHO-BIOLOGICAL DECLINING IN ULTRA-CYCLIST: A DESCRIPTIVE CASE-STUDY**

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**Introduction** The long duration sport events affect to endurance performance, physical and mental, conditioning the performance. However, the decrease in these physical-biological aspects in a long-distance cycling test (1000km non-stop) could be interesting to reach the highest level for the ultra-athletes. **Methods** A well-trained ultra-endurance sport man completed 1000km non-stop of cycling in a circuit (4.7km) with a maximum of 40 hours. During the entire test (before, during -6 occasions- and immediately at the end) we evaluated the decreasing of power output and the psycho-biological markers through strength levels (counter-movement jump, CMJ and squat jump, SJ), and psychobiological markers (rate of perceived exertion -RPE scale- and moods -POMS scale). All data were compared longitudinally. **Results** Strength or peak power output levels, expressed by SJ and CMJ, were diminished during the test, appearing in a progressive declining until the end (SJ= -14.9%; CMJ= -9.4%). These losses were accompanied of similar variations in POMS and RPE scales. Thus, the value of Fatigue was positively correlated with RPE scale and the Tension was inversely correlated with the RPE scores in the measures. **Discussion** To consider a psycho-biological approach between realized and perceived effort with the mood state is an interesting tool to assess the relation in power capacity and perceived exertion in these ultra-endurance events. **References** • Del Coso J, González-Millán C, Salinero JJ, Abián-Vicén J, Soriano L, Garde S, Pérez-González B. (2012). *Plos One.* 7(8):e43280. • Nicol C, Avela J, Komi PV. (2006). *Sports Med* 36:977-999. • Smilios I. (1998). *J Strength Cond Res.* 12(3):204-208.

## SESSION-RPE IN SOCCER: RESPONSE SHIFT AND RECALL BIAS

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Introduction Session-RPE is frequently used to monitor the training process as a valid measure of internal training load in soccer [1]. Nevertheless some methodological aspects that may influence the session-RPE have been not studied yet. Is it possible to collect RPE after 48 hours particularly when players are not too collaborative as could happened after a match? To answer this question, it is needed to investigate two attributes: response shift and recall bias. Response shift concerns a change in perception due to reconceptualization, reprioritization, scale recalibration after a period of time [2]. Recall bias concern the ability to remember the RPE given and could have influenced the retrospective assessment of RPE. The aims of this study were to investigate response shift (RS) and recall bias (RB) in session-RPE. Methods Fifty-eight soccer players (age  $21.6 \pm 5.0$  yrs, height  $178 \pm 6.5$  cm, weight  $72.4 \pm 6.4$  kg) reported RPE (BorgCR100®) after a training/match and after 48 hours (RPE48). RS has been investigated with a retrospective assessment using the widespread used "Then-test" (during the first part of the season). In a second part of the season RB was investigated asking players whether they remembered exactly the RPE given. If RPE was not remembered, a new rating was requested and considered an addition evaluation of RS. RS and RB were assessed in training sessions (RST and RBT) and matches (RSM and RSM). Bland-Altman method was used to study the agreement between RPE and RPE48. Results Data are presented mean ( $\pm$ SD). The number of players analysed were 58, 22, 34, 51 for RSM, RST, RBM and RBT. The mean RPE and RPE48 in RSM was  $59.2 \pm 13.2$  and  $58.6 \pm 12.8$  au respectively with mean difference RPE48-RPE of  $-0.5$  au (95%LOA  $-6.0$  to  $5.06$  au). The mean RPE and RPE48 in RST was  $46.8 \pm 9.8$  and  $48.9 \pm 9.5$  au, respectively with mean difference RPE48-RPE of  $2.2$  au (95%LOA  $-11.7$  to  $16.1$ ). The mean RPE and RPE48 in RBM was  $55.7 \pm 17.7$  and  $57.1 \pm 18.5$  au, respectively with mean difference RPE48-RPE of  $1.4$  au (95%LOA  $-6.9$  to  $9.7$ ). The mean RPE and RPE48 in RBT was  $46 \pm 11.6$  and  $47.1 \pm 12.8$ , respectively with mean difference RPE48-RPE of  $1.1$  (95%LOA  $-4.4$  to  $6.6$ ). Discussion Response shift was not found after matches suggesting that the perception of the construct of interest (effort) was not changed after 48 hours. Despite the "then test" is frequently used to investigate RS in clinical assessment, we are not able to exclude players focused on the previous rating. The RST assessment showed that session-RPE can be collected even after two days without, influencing the rating and therefore the TL calculation. However, for both RSM and RST we cannot exclude an effect on RPE48 due to the rating already given (effect of recall); therefore these findings should be confirmed with other experimental approach other than the "then test" for investigating RS in RPE. 1. Impellizzeri. *Med Sci Sports Exerc*, 2004. 36(6): p. 1042-7. 2. Schwartz. *Quality of Life Research*, 2010. 19(4): p. 455-464.

## AGE-RELATED DIFFERENCE AND THE EFFECT OF BALL CARRYING TECHNIQUE ON ACCELERATION AND MAXIMUM RUNNING SPEED IN RUGBY PLAYERS

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Introduction In rugby, there are different ways to carry the ball while players are running. The most common ways are to carry the ball in both hands and to carry it under one arm (1). The aim of this study was compare the effect of ball carrying technique on acceleration and maximum running speed in rugby players and the age-related difference. Methods Sixteen high-level senior rugby players, thirteen U20 rugby players and twenty-two U16 rugby players participated in this study. The sprint performance of players was determined using a 40-m sprint effort with electronic timing gates with split time at 10-m. Some players also were asked to wear a GPS unit. Players performed 3 sprints: without ball, with the ball under one arm and with the ball in both arms. Results Senior rugby players were significantly faster than U16 in 10-m distance, although there were no differences between senior rugby players and U20 or between U20 rugby players and U16. Senior and U20 rugby players were significantly faster than U16 in 40-m, with no differences between two of them. The average sprint time showed that in 10-m there were no significant differences when players carried the ball with one or two hands or without ball. In 40-m, senior and U20 rugby players had the fastest sprint without ball and we only had significant differences when they carried the ball with both hands. U16 rugby players decreased significantly their speed when they carried the ball with one or two hands compared to running without the ball. The sprint distance to reach the peak of speed (GPS) was significantly higher in senior and U20 than in U16. Discussion According to prior studies (Walsh et al. 2007), our results showed that different ways to carry the ball have not a significant effect on sprint time in 10-m. Similar to Grant et al. 2003 (2), in 40-m sprint distance players reflected higher sprint times running with the ball in two hands than running with the ball in one arm or running without the ball. These differences increased in younger players who also worsened sprint time with the ball in one arm. References 1. Walsh, M, Young, B, Hill, B, Kittredge, K, and Horn, T. The effect of ball-carrying technique and experience on sprinting in rugby union. *J Sports Sci* 25: 185-192, 2007. 2. Grant, S. J., Oommen, G., McColl, G., Taylor, J., Watkins, L., Friel, N. et al. The effects of ball carrying method on sprint speed in rugby union football players. *J Sports Sci* 21, 1009 – 1015, 2003.

## ISOKINETIC MUSCLE STRENGTH PROFILE OF ELITE MALE HANDBALL PLAYERS

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Introduction Handball is a complex highly demanding intermittent sport where powerful high-speed actions of the upper- and lower-extremity muscles are repeatedly performed throughout the game (Póvoas et al., 2012). This may contribute to the high incidence of the knee and shoulder joint injuries (Langevoort, Myklebust, Dvorak, & Junge, 2007). Thus, we aimed to analyse shoulder internal/external rotators and knee extensor/flexor isokinetic muscle strength profile of elite male team handball players according to playing position. Methods Sixty-three elite players (18 wings, 26 backcourt players, 9 pivots and 10 goalkeepers) from six teams of the Portuguese Handball Professional Male League performed concentric strength tests of both dominant (D) and non-dominant (ND) upper and lower limbs at  $90^\circ$  s $\rightarrow$  1 (1.57 rad.s $\rightarrow$  1) on an isokinetic dynamometer (Biodex-System 2, New York, USA). Shoulder internal and external rotators and knee flexor and extensor muscles peak torque and bilateral muscle strength deficits and antagonist/agonist ratio were determined. Results Shoulder internal rotation and knee flexor/extensor strength of the D limb was higher than the ND limb. No significant differences were observed between D and ND shoulder in the external rotation muscle strength. Shoulder and knee bilateral deficit values were equal or less than 7%. Shoulder and knee antagonist/agonist balance ratio was 55 and 52% for the D side and 56% and 54% for the ND. No significant differences were observed between the two sides or playing positions. Discussion Lower limb bilateral deficit and antagonist/agonist balance ratio are within recommended values for low velocities (<10–15% and between 50 a 60%, respectively) (Aagaard,

Simonsen, Magnusson, Larsson, & Dyhre-Poulsen, 1998; Brown, 2000). The upper-limb values are lower than those suggested in the literature for asymmetric sports, although no handball players were included in the sample. These values appear to be specific to handball players. Playing position demands seem to have no effect on shoulder and knee isokinetic strength profile or to induce an "unbalance" (out of the recommended) pattern between agonist and antagonist or D and ND muscle strength. References Aagaard, P. et al. (1998). *Am J Sports Med*, 26(2), 231-237. Brown, L. (2000). *Human Kinetics*. Langevoort, G., et al. (2007). *Scand J Med Sci Sports*, 17(4), 400-407. Póvoas, S. et al. (2012). *J Strength Cond Res*, 26(12), 3365-75.

## COMPARISON HIGH AND LOW FREQUENCIES WHITE NOISE IN BALANCE FUNCTION

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**Introduction** The study aimed to discover if balance function would be affected by the low and high frequencies white noise stimuli. Noise and music composition can contain a variety of frequency. There are many kinds of noises existed in our environment in daily living. Most people like to listen music by wearing earphone when they are having exercises or outdoor activities. The acoustic signals were transferred into vibration form to inner ear. The characteristics of acoustic signal may affect the balance system. One of acoustic signal characteristics is frequency. **Methods** Nineteen participants were recruited in this study and had been tested their hearing with normal range. The one leg standing tests were performed and four parameters, sway area, sway path length, vertical and horizontal distances, were recorded. The white noise generated and divided into high and low frequency by Adobe Audition 2.0. The earphone had been calibrated the intensity of presented sound by artificial ear. The stimuli were separated into low and high frequencies white noise respectively at 85 dB. All participants were asked to wear on earphones during the test with eye opened condition. **Results** The results of low frequencies white noise indicated higher values of sway area, sway path length, vertical and horizontal distances in average when compared with the results of high frequencies. There were two significant differences in sway area and vertical distance when compare with high and low frequency noises ( $p < 0.05$ ). **Discussion** The inner ear consists of cochlear and vestibular. The membrane labyrinth connects these two parts. The low frequencies elements travel along from the basal to the apical of cochlear. The pattern of traveling wave is the high to low frequency. The results may suggest that low frequency white noise would cause more interference to the balance function. **References** Bassi Luciani L, Genovese V, Monaco V, Odetti L, Cattin E, Micera S., (2012). Design and evaluation of a new mechatronic platform for assessment and prevention of fall risks. *J Neuroeng Rehabil.*, 28;9:51. Tamura H, Ohgami N, Yajima I, Iida M, Ohgami K, Fujii N, Itabe H, Kusudo T, Yamashita H, Kato M., (2012). Chronic exposure to low frequency noise at moderate levels causes impaired balance in mice. *PLoS One*, 7(6):e39807. doi: 10.1371/journal.pone.0039807.

## ROBUSTNESS OF THE LINEAR CRITICAL VELOCITY MODEL FOR SPRINT PERFORMANCES

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**Introduction** In the linear models of Critical Power and Critical Velocity (CV), intensities or distances are chosen that lead to exhaustion within 2 to 15 min (1). Whipp et al. (2) state that intensities which result in less than 2 min exhaustion times are to be avoided. Regardless of intensity or duration, the two parameter model presupposes that a fixed percentage of  $VO_{2max}$  is instantly available, that it can be sustained throughout the test, and that the anaerobic work capacity is fully explored. According to Hill and Kennedy (3) these requirements do not fit test durations of less than 1 min. This study investigated if durations of less than 2 min fit the two parameter linear distance-time CV model. **Method** 16 active subjects (mean  $\pm$  SD: age  $22 \pm 3$  yr, body mass  $73 \pm 10$  kg,  $VO_{2max}$   $47.34 \pm 5.17$  ml $\cdot$ kg $\cdot$ min $^{-1}$ ) performed a test to exhaustion on a treadmill for  $VO_{2max}$  determination. Subjects run 3200m, 1600m and 800m and sprint distances over 400m, 200m and 100m in randomised order separated by 24 h. The linear distance-time model was used for CV and anaerobic running distance (ARD) estimations using the long distances (CVL) and the long and sprint distances (CVLS). CVL was used to examine the fit between the sprint performances over 400m, 200m & 100m and the distance-time model. A paired t-test was used to identify statistical differences. **Results** A significant difference between mean CVL and mean CVLS values ( $3.54$  m.sec $^{-1} \pm 0.35$  and  $3.79$  m.sec $^{-1} \pm 0.86$  respectively,  $t(15) = -17.72$ ,  $p \leq 0.01$ ,  $r = 0.99$ ) and between mean ARDL and ARDLS values ( $277$  m  $\pm 50.8$  and  $132$  m  $\pm 16.8$  respectively,  $t(15) = 16.42$ ,  $p \leq 0.01$ ,  $r = 0.94$ ) was observed. **Discussion** Even though fitting the regression line, there was a significant difference between measured variables. Whilst the measured values for CVL consistently underestimated values for CVLS, the opposite applied to ARD values. This is supported by data reported by Hill and Kennedy (3), who state that a certain portion of  $VO_{2max}$  in nature is not instantly available, and that the anaerobic work capacity is not fully expended in performances of less than 1 minute durations. Interestingly, when comparing CVL with CV values derived from the 3200m, 1600m, 800m and 400m performance times, a significant difference was not evident, whilst remaining for ARD values. It is not the mechanical constraints that appear to limit the linear critical velocity model as proposed by Whipp (2), but fundamental physiological processes as outlined by Hill and Kennedy (3). **References** 1. Poole DC, Ward SA, Gardner GW, Whipp BJ. Metabolic and respiratory profile of the upper limit for prolonged exercise in man. *Ergonomics*. 1988; 31: 1265-1279. 2. Whipp BJ, Huntsman DJ, Stoner N, Lamarra N, Wasserman K. A constant which determines the duration of tolerance to high intensity-work. *Fed Proc*. 1982, 41:1591. 3. Hill D, Kennedy AM. Modelling the relationship between velocity and time to fatigue in rowing. *Med Sci Sports Exerc*. 2003, 35: 2098-2105

## MEASUREMENT SYSTEMS OF WELLNESS AND SPORTS TECHNOLOGY

Hakkarainen, A.1, Heikkinen, T.1, Kaikkonen, V.2, Mäki, M.2, Ollikkala, A.2, Rätty, J.2, Hemming, B.3, Laurila, T.3, Ohtonen, O.1, Piirainen, J.1, Korhonen, T.4, Linnamo, V.1

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**INTRODUCTION** The purpose of the Measurement Systems of Wellness and Sports Technology project is to develop measurement systems which can be utilized in individual sports and wellness applications as well as demanding industrial measurement technologies. Project is a part of Centre for Measurement and Information Systems (CEMIS) and it aims to develop research methods for elite cross-country skiing research, coaching and ski service as well as for snow properties. Demands for non-invasive and wireless measurements are present both in elite sport research and coaching and in individual wellness and healthcare applications. **METHODS** Project has been divided in five different method sections. I: Measuring optical properties of snow using holographic and diffuse reflectance imaging, II: Measuring of a ski profile with an optical non-contact chromatic confocal microscopy (2D and 3D), III: Non-invasive measurements for

sports and wellbeing applications - development of an immunosensor for the determination of salivary cortisol, IV: Versatile measurement system with wireless data transmission for skiing and V: Development of a dynamic balance measurement and training system. RESULTS I: Imaging method can be used to calculate the size of a snowflake or ice crystal, and applied to measure any similar size objects in free fall. II: Method was applied to analyze grinding profiles of 100 pairs of skis in co-operation with the Finnish Olympic Committee and University of Helsinki. III: Cortisol immunosensor based on the direct competitive enzyme linked immunosorbent assay (ELISA) method was used for determining cortisol concentrations in a buffer at physiological levels. IV: A prototype of a versatile skiing measurement system was developed. V: System was used in a research project in which the effects of proprioceptive and plyometric training on dynamic balance control in young and elderly women were studied. DISCUSSION This co-operation project has proven to be very fruitful and developed methods such as ski profile and dynamic balance system have already been utilized in data collection for scientific publications. Dynamic balance system appears to be useful also for training purposes. For some methods, however, the results are still preliminary and more research is needed to clarify the applicability of the method. Challenges exist e.g. in verifying the function of wireless measurements and synchronization of the data and on the matrix interferences caused by saliva enabling salivary cortisol measurements.

### **STUDY OF PHYSICAL, TECHNICAL AND ANTHROPOMETRIC FACTORS IN AN ELITE JUNIOR FOOTBALL TEAM ACCORDING TO THE AGE**

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Introduction: At junior football levels it is necessary to evaluate physical, technical and anthropometric parameters, in order to undertake correct planning and control of the training. In this field, research with adult football players cannot be applied to junior categories. The aim of this study was to assess the physical and technical parameters and anthropometry of young players aged 13 to 19 through specific and nonspecific tests (Gorostiaga et al. 2004). Methods: 130 young footballers belonging to the junior teams of a professional football team ( $15.5 \pm 1.9$ ), performed a countermovement jump on a force plate, a repeated sprints test (RSA) with time measured by using photoelectric cells, a specific running test with a ball under control, while anthropometric parameters were measured by bioimpedance. Results: The age of the players was significantly correlated with all the variables studied. There was a significant correlation between age and the best sprint ( $r = -.73$ ) and the average of all sprints ( $r = -.71$ ) in the RSA test. Correlation between age and CMJ was significant ( $r = .64$ ). The CMJ height improved up to the age of 18 years and then the improvement plateaued. The relation with age in the dribbling test was lower ( $r = -.314$ ). Controlling body size, all the correlations remained significant ( $P < 0.05$ ). Discussion: The higher rate of development in the running sprint capacity is between 13 and 15.6 years. Jump capacity and dribbling ability improved from 13 to 17.5 years. From these ages on, the rate of improvements significantly dropped. The use of specific tests is a worthwhile instrument for gauging the development and maturation in young football players. This may help coaches to design appropriate training sessions, focusing on the development of different physical abilities. References: Gorostiaga, E.; Izquierdo, M.; Ruesta, M.; Iribarren, J.; González-Badillo, J.J.; and Ibáñez, J. (2004) Strength training effects on physical performance and serum hormones in young soccer players. *European Journal of Applied Physiology* 91, (5-6), 698-707.

### **THE INFLUENCES OF A PROGRAM CONTENT ON THE FUNCTIONAL ABILITIES AND PERFORMANCE VELOCITY IN TECHNICAL MOVEMENTS USED IN KARATE SPORT**

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Introduction Researches of the influence of the program content on functional abilities and performance velocity are of particular importance, as the karate is a very complex sport, in which facts mentioned here are important for efficacy of the results achieved at the competition (Kapo, 1999). The aim of this work is to determine the influence of program content on the functional ability and velocity of execution of technical movements in karate sport. Method Research sample consisted of 15 male respondents, aged between 15 and 19 years, who attended the training process for three years at least. The program content activities have been conducted within a period of two months, in six microcycles. In order to assess the functional abilities, we have implemented the Konkoni test, and for evaluation of technical elements execution, we used the modified tests (Kuleš, 1998). To determine the relations between functional capabilities and specific variables, the Pearson's correlation coefficient has been used, as well as Kolmogorov-Smirnov's Z-value and multiple analysis of variance. Results and Discussion The values of Pearson's coefficients of correlation between various indices of movement velocity in situations before and after program activities, indicates that correlation, which is statistically important at the level less than 1%, visible between the variables Kiz - kizame tsuki and Bag before (0,94) and Kiz and Bag (0,97), Kiz and LM - left mawashi - (0,69), Kiz and RM - right mawashi (0,80), after program activities. The significance of Pearson's correlation coefficients does not have a level of 0.5% between indexes of muscle and fat mass, at one hand, and velocity of individual movements in karate at the other hand, before and after program activities indicates that the variable BFM significantly and negatively correlated with variables Bag and LM, that means that increasing of BFM values (fat mass) the values in Bag and LM are lower, and vice versa. Variable BFM significantly and negatively correlated only with variables LM and RM after the program activities. The analysis of variance with repeated measurements indicates that all F-ratios statistically significant at levels far lower than 1% and the possibility of their accidental occurrence is practically equal to 0. This mean that changes in average values of the dependent variables before and after program activities are significant. Conclusion Based on correlation coefficients of functional capabilities and situational-motor abilities it has been proved that program activities have an impact on the functional capacity and the velocity of execution of technical movements in karate sport, indicating their importance in the specification equation of karate sport, and are responsible for a quick recovery and high intensity during the combat. References Kuleš, B. (1998): The training of karate players, Zagreb: Grafokor Kapo, S. (1999): The influence basic-motor abilities on the efficiency of execution of competitive techniques and tactics in karate – Master Thesis, Sarajevo.

### **ANALYSIS OF FAST BREAK ACTIONS IN ELITE AND SUB-ELITE ITALIAN MALE BASKETBALL GAMES**

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Introduction In basketball, fast-break actions (FB) are the best way to create easy scoring opportunities, however in literature few studies investigated these actions. Therefore, this study aimed to investigate a potential difference of performance in FBs, during elite (E) and sub-

elite (SE) basketball games. Methods Hence a notational analysis was carried out during 5 E (1st division) and 5 SE (3rd division) Italian male games. The FB were classified as primary and secondary, while the executions were categorized in 3 successive phases: initiating, advance, completion (Refoyo et al., 2009). In turn, for each phase the different type of actions (phases: initiating (rebound, steal, interception and throw in), advance (dribbling and passing) and completion (scored and not scored)) and playing zones (phases: initiating (lane, baseline-free throw line, free throw line-half court line; frontcourt, out of bound), advance (center or sideline) and completion (lane; intermediate; outside 3pt line)) were analyzed. Furthermore, FB actions were divided in those performed with an equal (attacking vs defending team) and with an unequal (superiority for the attacking team) number of players. The duration of FB was also calculated. Descriptive statistics (frequency and percentage) and Chi-square were applied to investigate the FB performance parameters, and to estimate differences between E and SE games. Results A significant difference was found between E and SE games for primary and secondary FB actions ( $p < 0.05$ ), while the Chi-square analysis showed no differences between E and SE games for number and execution of FBs, so data were pooled for descriptive analysis. Thus, rebound ( $43.5 \pm 19.1\%$ ) and lane ( $59.7 \pm 15.7\%$ ) during initiating phase, dribbling ( $75.7 \pm 11.8\%$ ) and center ( $60.2 \pm 15.4\%$ ) during advance phase and scored ( $48.5 \pm 22\%$ ) and lane ( $70 \pm 13.5\%$ ) during completion phase were registered as frequency of occurrence for type of actions and playing zones, respectively. Moreover, regarding the number of players involved, most of FB actions were performed with superiority ( $52.3 \pm 14.2\%$ ), while the mean duration of FB actions was  $4.92 \pm 1.22s$  and  $5.10 \pm 1.24s$  for E and SE games, respectively. Discussion This study showed no differences in terms of number and execution of FB in E and SE games. Furthermore, these results could give information to coaches about the planning and the organization of FB training, suggesting to set up drills by means of teams with both the same number and superiority of opponents. Besides, the duration of FB actions should be up to 5 seconds. Reference Refoyo I, Uxia Romaris I, Sampedro J. (2009) *Revista de Psicología del Deporte*, 18, 439-444.

### DIFFERENCES IN THE PERFORMANCE TESTS OF THE FAST AND SLOW SSC AMONG PROFESSIONAL AND ELITE YOUTH SOCCER PLAYERS

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Introduction The requirement profile in team sports is very complex. In addition to technical and tactical requirements, there are conditional requirements. These conditional requirements are the basis for technical and tactical tasks (Verheijen 1998). Therefore, increasing the power performance of an athlete should facilitate entry into higher divisions, which should integrate elite junior players into the professional sport. The aim of this investigation was to evaluate a suspected difference in performance tests of the slow and fast SSC among professional, amateur and elite youth soccer players with and without strength training experience ( $n=86$ ). Methods A cross-sectional data were collected. The participants were divided into 3 groups. Group 1 consisted of professional players in the first and second division in Germany (PRO,  $n=26$ ). Group 2 contained youth elite soccer players in a U19 (under 19 years old) team at the youth training centre of a professional team (JUN,  $n=30$ ). Group 3 consisted of players in the U19 team that required a minimum of 2 years of strength training at the training centre of a professional team (KT,  $n=30$ ). All soccer players were tested in 10-, 20- and 30 meter sprint, change of direction sprint (COD), SJ, CMJ and DJ from four different heights. Results The results of the SJ showed a significant better performance ( $p < 0.01$ ) of the KT ( $41.1 \pm 4.9$  cm) compared to all groups. In the CMJ, the KT ( $42.4 \pm 5.0$  cm) was significant ( $p < 0.01$ ) better compared to JUN. There were found no significances between KT and PRO. In all DJ performances PRO was significantly ( $p < 0.01$ ) better compared to JUN. There were found no significances between KT and PRO. The JUN displayed a significant ( $p < 0.01$ ) poorer performance in straight sprint over 10-, 20- and 30m compared to PRO and KT. There were no significant differences between PRO and KT. In the COD, the KT displayed a significant ( $p < 0.01$ ) better performance compared to JUN and PRO. Discussion The data suggest that additional periodised strength training in youth soccer players has a positive effect on concentric force development and the fast and slow SSC (Rønnestad et al. 2008). In some cases, youth players who completed complementary strength training for at least two years attained better strength and power performance than the PRO players, and the youth players never performed worse than the PRO players. High performances in speed, changes of direction and high jumping ability determine the level of performance in soccer, and they can determine the success or failure of a player (Reilly 2007; Verheijen 1998). References Reilly, T. (2007). *Science of training – soccer*. London: Routledge. Rønnestad, B.R., Kvamme, N.H., Sunde, A. & Raastad, T. (2008). Short-term effects of strength and plyometric training on sprint and jump performance in professional soccer players. *J Strength Cond Res*, 22: 773-780. Verheijen, R. (1998). *Conditioning for soccer*. Spring City: Reedswain.

### EFFECTS OF LONG-TERM STRENGTH TRAINING ON SPRINT PERFORMANCE IN ELITE YOUTH SOCCER PLAYERS

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Introduction In soccer, strength and power are important because of the large number of power actions performed during the game. Therefore, the aim of this study was to examine the influence of periodised strength training for power performance over two years. Methods In this study, 134 elite youth soccer players were recruited from two youth training centres. The cohorts were arranged as follows: A (under 19 years), B (under 17 years), and C (under 15 years). The participants in each cohort were divided into two groups. One group (STG) was subjected to regular soccer training in addition to strength training (hypertrophy- and IK-blocks) twice a week for two years. The other group (CG) completed only the regular soccer training. For strength training, both the front squat and the back squat were performed once a week. The subjects were tested on the one-repetition maximum of the front and back squat and a linear sprint over 30 metres. Results There was significantly better performance from the STG on 1RM ( $p < 0.001$ ) of up to 300%. The CG also showed significantly better performance on 1RM of up to 65%. In the sprint, the STG displayed significantly better improvements ( $p < 0.05$  to  $p < 0.001$ ) of up to 6%. The CG showed significantly better performance of up to 3%. Discussion This investigation illustrates the positive influence of strength training on maximum strength and sprinting performances in adolescent soccer players. Other studies have not shown such large percentage changes in maximum strength after strength training (Blimkie 1992; Chelly et al. 2009; Hartmann et al. 2012). In Sprint performance, Comfort, Haigh & Matthews (2012) demonstrated similar changes of 5.9% to 7.6% (5 m, 10 m and 20 m) of elite rugby players after an 8-week strength training programme. This finding is justified by the coordinative difficulty of the sprint movement. During the sprint, in addition to the power level, technical elements influence performance. The effects of strength training are reflected in the sprint performance. Therefore, it seems beneficial for youth to perform strength training to exploit the reserve capacity in sprint performances. References Blimkie, J.R. (1992). Resistance training during preadolescence. *Sports Medicine*, 15 (6), 389-407. Chelly, M.S., Fathloun, M., Cherif, N., Amar, M.B., Tabka, Z. & VanPraagh, E. (2009). Effects of a back squat training program on leg power, jump, and sprint performances in junior soccer players. *Journal of Strength and Conditioning Research*, 23 (8), 2241-2249. Comfort, P., Haigh, A. & Matthews, M.J. (2012). Are changes in maximal squat strength during preseason training reflected in changes in sprint performance in

rugby league players. *Journal of Strength and Conditioning Research* 26, 772-776. Hartmann, H., Wirth, K., Klusemann, M., Dalic, J., Matuschek, C. & Schmidtleicher, D. (2012). Influence of squatting depth on jumping performance. *Journal of Strength and Conditioning Research*, 26 (12), 3243-3261.

### USE OF VIDEO ANALYSIS TO TRAIN SPIKE IN VOLLEYBALL

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**Introduction** The video analysis is an effective tool in the Match and Performance Analysis (Raiola 2011). As volley is a quick and return sport, it helps to identify in the delayed time the single movement and evaluate the attacks assigning score. However, there is no study concerning the use of this video analysis in teaching and education of technical skills. The aim of this study is to verify whether the use of video analysis tool in the methodology of training is useful to get the skills of the attack. Another purpose is to verify if the visual feedback has a weight in learning and performance improvement (Raiola 2012). **Methods** The work involves the use of video analysis software Kinovea during training. The athletes involved are female, under 16, divided into two groups: control and experimental. Both groups are filmed for 30 workouts. They all follow the same path as specific training for the attack. At each meeting, is proposed the video of the previous training attack to every athlete belonging to 'experimental' group. The coach doesn't comment the video and doesn't give information about errors. At the end of the training the coach assesses the performance with indicators and defined descriptors. The data concerning the first and last video are compared for each individual athlete and for each groups. The parameters analyzed in the video are: preparation of the body to the gesture and body angle with the floor, sequence of steps, angle of the arms, attack's phase, position of the body relative to the ball, fall to the ground with both feet. The evaluation of the ability of the attack is carried out by a coach with a table which lists the parameter markers and quantitative descriptors. **Results** All athletes improve attack skills. The experimental group has an higher average, median and mode than the control group. The multiple and linear regression showed a constant increase trend of skills during the training of individual athletes. In the experimental group the maximum habilitation levels of the control group are attained before. **Discussion** The results show the usefulness of video analysis in the training. In all athletes of the experimental group are found improvements compared to the athletes of control group. This highlights the absolute utility of the tool. The difference between the experimental group and the control group is related to the visual feedback. It would be useful to do research on the development of others volley skills with the use of video analysis to include this assessment tool in the theory of volley training. **References** Raiola G. (2011) Bodily Communication in Volleyball and New Data System, *Journal of Social Sciences* 7 (4): 671-675, Science Publications, USA Raiola G (2012) La complessità dello studio in ambito educativo sportivo, *Pensa, Lecce, Italy* Hughes, M. and Bartlett, R. (2002) Special edition on performance analysis. *Journal of Sports Sciences*, 20, 735-737. UK

### THE EFFECT OF DIFFERENT FORMS OF HIGH-INTENSITY INTERMITTENT RUNNING EXERCISES ON NEUROMUSCULAR FATIGUE

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**Introduction** Intermittent exercise has been found to cause a greater degree of neuromuscular fatigue than constant load exercise on a cycle ergometer. In this study we compare central and peripheral components of neuromuscular fatigue on knee extensor (KE) muscles following different forms of high-intensity intermittent running exercises. **Methods** 8 male subjects (24±5 yrs) completed four 16 min running trials. The mean running speed was the same across all trials (8.9 km/h). Subjects performed 1 trial at constant speed (CON) and 3 trials with three different forms of intermittent running; comprising of the same total and high-intensity distance (1173 m at >15 km/h) but different number of accelerations (LOW, 55; MID, 80; HIGH, 190). Blood lactate concentration and RPE were recorded at the end of each trial. To assess KE muscle contractile properties, passive mechanical responses to electrical stimulations, maximal voluntary isometric contraction, and maximal muscle activation levels were measured before and after completion of the running exercise. Peripheral KE neuromuscular properties were determined using 3 paired stimuli at 10Hz (low frequency) and 100Hz (high frequency). Maximal activation levels were established using twitch interpolation technique. EMG signal was also recorded during the test. Differences between the conditions were analyzed using ANOVA's. **Results** RPE was higher after all intermittent trials compared to CON (p<0.05). Blood Lactate was significantly higher after LOW compared to all the other conditions, whereas CON was significantly lower than all intermittent trials (CON, 2.4±1.0; LOW, 8.1±3.2; MID, 5.8±2.7; HIGH, 4.7±2.4 mmol/L). No evidence of the presence of central fatigue was found, while peripheral fatigue was evident in all conditions. However, KE peak torque values obtained using 10Hz electrical stimuli decreased significantly more after HIGH compared to all other conditions, with the reduction being significantly lower after CON (CON, -31%, LOW, -35%, MID, -36%, HIGH, -39%). **Discussion** All trials induced peripheral fatigue, temporarily altering KE muscle contractile properties. HIGH increased the quantity of low-frequency fatigue compared to all other conditions; this might be explained by the greater number of accelerations. Differences in blood lactate concentrations suggest a dissimilar contribution of anaerobic glycolysis. In conclusion, different forms of high-intensity intermittent running exercise can significantly impact upon energetic system activation and the quantity of peripheral fatigue induced.

### IMPACT OF FIELD WORK ON MORPHOLOGICAL CHARACTERISTICS AND MOTOR EFFICIENCY

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**Introduction** In our research we have decided to explain how field work influence on morphological characteristics and motor ability. Successful job performance of police officers and criminal investigators significantly depends on endurance, speed and strength. **Methods** The main aim of this research was to establish the correlations between field work and certain dimensions of the motor and morphological space between police officers and criminal investigators. With 12 morphological and 4 motor variables (run over 60 m, hang with elbows bent, long jump, run over 2400 m) we defined morphological status and motor efficiency. The significance of the difference between the arithmetic means has been evaluated by the t-test. The connection and dependence of individual subspaces of psychosomatic status has been determined by regression analysis. **Results** The results pointed out that police officers in their professional daily work are forced to greater use of different motor activities than criminal investigators. The basic statistic parameters showed that criminal investigators are on average four years older than police officers and they also have 17% more fat tissue. The larger quantity in fat tissue

could be explained by the theory on the increase accumulation of subcutaneous fat tissue on the upper body associated with age (McArdle et al., 1996) and the other reason for increased fat tissue could be motoric of the work performed. The results also showed a large influence of morphological characteristics (subcutaneous fat) on motor abilities. Police officer's work requires a well developed energy component of movement which reflects in the motor abilities associated with speed and strength endurance. Professional work of police officers require mastering complex motor programs (coercive means, overcoming the hurdles, etc.) which are characterized by variability and involvement of several different factors, are much greater in comparison with criminal investigators. Discussion By the research it has been established that field work is in a large extent an important factor for morphological and motoric status of police force. Test subjects significantly differ in the thickness of the subcutaneous fat (morphological status) and in repetitive, aerobic ability and explosive power (motor status). We are convinced their training program and psychosomatic tests in relation to the motor space should be monitored more regularly. References McArdle, W., Katch, F., Katch, V. (1996). Exercise Physiology: Energy, Nutrition and Human Performance. 4th Edition. Donna B. (ed.) Maryland, Baltimore, USA, Williams & Wilkins publishing company

### **PHYSIOLOGICAL CHARACTERISTICS OF FEMALE GYMNASTS; A FOLLOW UP STUDY.**

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Introduction Maturation and growth influence physiological characteristics, especially flexibility and strength (Baxter et al. 2002). The purpose of the present study was to investigate differences in physiological characteristics of female gymnasts after a three-year training period. Methods Nine female recreational gymnasts participated in this study. Measurements of flexibility (sit and reach) and arm strength (handgrip) for both hands were conducted at first when children were  $10.8 \pm 1.1$  yrs (body weight:  $33.7 \pm 8.6$  kg, body height:  $138.1 \pm 11.1$  cm) and were repeated again when they were  $13.8 \pm 1.1$  yrs (body weight:  $42.4 \pm 10.3$  kg, body height:  $147.2 \pm 12.7$  cm). Differences between measurements were analyzed using T-test. Results are presented as mean  $\pm$  SD. Results BMI differed significantly between measurements ( $19.2 \pm 2.1$  vs.  $17.4 \pm 2.7$  kg/m<sup>2</sup>,  $p > 0.01$ ) since both body height and body weight were also significantly increased ( $p < 0.001$ ). Flexibility was significantly reduced ( $31.0 \pm 5.9$  vs.  $29.7 \pm 5.1$  cm respectively for the two measurements,  $p > 0.01$ ) while on the other hand arm strength was significantly increased in both hands ( $p < 0.001$ ). Percent improvement of arm strength was  $25.5 \pm 12.1\%$  and  $29.9 \pm 13.9\%$  for the right and left arm respectively and did not differ between arms ( $p = 0.49$ ). Discussion Results of the present study indicate that gymnastics training promotes flexibility, since it was not decreased despite the fact that body height was significantly increased. It also seems to promote symmetrical development of arm strength, since there are no differences between hands. References Baxter-Jones AD, Maffulli N. (2002). Br J Sports Med, 36(1): 13-15.

### **ASSESSMENT OF A COMPLEX DIVING TASK OF YOUTH SOCCER GOALKEEPERS – REPRODUCIBILITY OF TWO NEW TESTS**

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Introduction: The present study examined the test proprieties of two goalkeeper-specific performance protocols developed to assess a complex diving task (with catch of the ball) in young soccer goalkeepers. Methods: Twenty-six volunteers ( $14.5 \pm 2.5$  years) carried out the Sprint & Dive (SpD) and Shuffle & Dive (ShD) tests in two main sessions, each separated by one week. The SpD requires goalkeepers to accelerate during 3-m and dive and catch a stationary ball after performing a change of direction in a total distance of 10-m. The ShD test involves a lateral shuffle in a total distance of 12.55-m. Participants performance was measured as total time for right (R) and left (L) sides. The paired samples t-test was used to compare the means of trial 1 and 2. Reproducibility was assessed using the technical error of measurement (TEM) and relative TEM. Reliability coefficient was also calculated (Mueller & Martorell, 1988). The Bland-Altman (1986) procedures were conducted to determine limits of agreement (LOA) between trial 1 and trial 2. Results: For both tests, performance significantly differed between trials 1 and 2 (SpD-R:  $t = 2.801$ ,  $p = 0.010$ ; ShD-R:  $t = 4.059$ ,  $p = 0.000$ ), except when performed to the left side (SpD-L:  $t = -1.152$ ,  $p = 0.260$ ; ShD-L:  $t = 1.313$ ,  $p = 0.201$ ). Test-retest analyses are quite similar for the protocols and side variation: SpD-R (TEM=0.09;  $r = 0.90$ ; LOA=-0.16 to 0.28), SpD-L (TEM=0.09;  $r = 0.89$ ; LOA=-0.29 to 0.23), ShD-R (TEM=0.19;  $r = 0.90$ ; LOA=-0.24 to 0.58) and ShD-L (TEM=0.20;  $r = 0.88$ ; LOA=-0.47 to 0.61). Data also indicated a within-subject variance of 4.18%, 4.37%, 3.97% and 4.16%, respectively for test protocol and side. Discussion: The present data demonstrate that the SpD and ShD are reproducible. However, future research is needed to examine the validity of the test to discriminate goalkeepers by competitive level. Project supported by Fundação para a Ciência e Tecnologia (SFRH/BD/72111/2010). References Bland, JM, & Altman, DG (1986). Statistical methods for assessing agreement between two methods of clinical measurement. Lancet, 1, 307-310. Mueller, W. & Martorell, R. (1988). Reliability and Accuracy of Measurement. In T. Lohman, A. Roche, & R. Martorell (Eds.). Anthropometric Standardisation Reference Manual. Champaign, Illinois: Human Kinetics.

### **THE INFLUENCE OF GAME ACTIONS ON THE RECOVERY KINETICS OF PHYSICAL PERFORMANCE AND SUBJECTIVE RATINGS IN SOCCER**

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Introduction Measures of overall distance covered and high-intensity running activity are commonly used to monitor players' physical exertion during a soccer match (Carling et al., 2008). However, game actions such as jumps, contacts and changes in direction can induce muscle damage affecting the magnitude of fatigue and time to recover fully after competition (Nédélec et al., 2012). This study aimed to examine the relationship between the frequency of such actions performed during a match and the recovery kinetics of physical performance and subjective ratings. Methods Time motion analyses were performed from video recordings on 10 outfield professional soccer players (age:  $21.8 \pm 3.2$ yr; height:  $178.1 \pm 5.4$ cm; body mass:  $76.5 \pm 7.6$ kg) over 4 competitive matches (14 observations in total). The frequency of 8 playing actions completed by players during the match was recorded by the same experienced observer: sprint <5m; sprint >5m; high-intensity running; change in direction; contact with opponent; jump to head ball; shot/long pass; tackle. Subjective ratings (sleep, fatigue, muscle soreness, stress) and physical tests were performed before and 24, 48 and 72h after the match. Physical tests included countermovement jump (CMJ) on a force platform (Kistler AG), 3-s isometric maximum voluntary contraction of the hamstrings (Schache et al., 2011) and a 6-s sprint on a non-motorised treadmill (Woodway Force 3.0). Results Significant correlations were found between muscle soreness and number of sprints <5m performed at 48h (Pearson  $r = 0.74$ , 95%CI: 0.35 to 0.91,  $p < 0.01$ ) and 72h

post-match (Pearson  $r=0.57$ , 95%CI:0.05 to 0.84,  $p<0.05$ ). A significant relationship (Pearson  $r=-0.55$ , 95%CI:-0.84 to -0.03,  $p<0.05$ ) was also established between CMJ performance decrement at 24h and the number of changes in direction performed during the game. Discussion Our results suggest that a higher frequency of short sprints and changes in direction performed during soccer match negatively impacts the recovery kinetics of CMJ performance and muscle soreness. These playing actions are associated with rapid accelerations/decelerations which are particularly damaging to muscles (Howatson and Milak, 2009; Magalhães et al., 2010) and should be taken into account when evaluating soccer match-induced fatigue. References Carling C, Bloomfield J, Nelsen L, Reilly T (2008). *Sports Med*, 38, 839-862. Howatson G, Milak A (2009). *J Strength Cond Res*, 23, 2419-2424. Magalhães J, Rebelo A, Oliveira E, Silva JR, Marques F, Ascensão A (2010). *Eur J Appl Physiol*, 108, 39-48. Nédélec M, McCall A, Carling C, Legall F, Berthoin S, Dupont G (2012). *Sports Med*, 42, 997-1015. Schache AG, Crossley KM, Macindoe IG, Fahrner BB, Pandy MG (2011). *Knee Surg Sports Traumatol Arthrosc*, 19, 38-41.

## DEEP AND SUPERFICIAL ABDOMINAL MUSCLE ACTIVATION DURING TRUNK EXERCISE WITH BREATHING CONTROL

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Introduction Intra-abdominal pressure (IAP) development is closely related to breathing behavior (Kawabata et al. 2010). The transversus abdominis (TrA) has been ascribed a specific role in spine stabilization, which has motivated core stability exercises (Bjerkedals et al. 2010). However, it is not well known that deep and superficial abdominal muscle activation during trunk exercise with breathing control. The purpose was to evaluate the levels of activation of the TrA and the superficial external oblique (EO) muscles during prone bridge exercise with and without breathing control. Methods Maximal IAP during the Valsalva maneuver (maxIAP) and maximal electromyographic activity (EMG) of TrA and EO during isometric trunk strength were measured in 8 trained men. They performed a prone bridge exercise with abdominal breathing, pilates breathing (thoracic breathing with pulling the lower part of the abdomen towards the spine), and long exhale breathing. Inspiratory and expiratory volumes were calculated from air-flow data. The data of IAP and EMG during prone bridge exercise were measured, and normalized by maxIAP and maximum EMG, respectively. Results In a prone bridge exercise, the IAP and TrA during inhale and exhale were greatest with pilates breathing. There are higher %maxIAP in abdominal, pilates, and long exhale breathings than normal breathing. TrA activity with abdominal, pilates, and long exhale breathings was greater than with normal breathing. However, EO was not different from each breathing control. Discussion Our finding of an increase in TrA activation independent of EO indicates that their deep abdominal muscle activate with breathing control. However, superficial abdominal muscle is not affected by breathing control. This increased TrA activation with breathing control is more variable during exhale breathing than inhale breathing. These results suggest that breathing control during core stabilization training affect their deep abdominal muscle activity. References Kawabata M, Shima N, Hamada H, Nakamura I, Nishizono H(2010). *Eur J Appl Physiol*. 109(2), 279–286. Bjerkedals A, Ekblom MM, Josefsson K, Thorstensson A (2010). *Man Ther*. 15(5), 502-507.

## THE ANTHROPOMETRIC CHARACTERISTICS OF YOUNG PADDLERS AND ITS RELATIONSHIP WITH PERFORMANCE

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Introduction The aim of this study was to describe the anthropometric characteristics of athletes competing in the level of 15 and 16 years old and its relationship with performance. Methods The sample included a total of 23 paddlers ( $15.39 \pm 0.46$  years) who participated in the national control, competing at 1000 meters and organized by the Portuguese Canoe Federation. The physical fitness of the athletes was assessed by performing a test of sit-ups, push-ups, pull-ups (Fitnessgram, 1999) and handgrip strength (Eurofit, 1988). Anthropometric assessment included body mass, stature, sitting height, lengths (arm span, arm, forearm and hand), circumferences (brachial, brachial in maximum contraction and chest) and biacromial diameter. Body composition (Slaughter et al., 1988) and upper limb volume in the dominant limb (Rogowski et al., 2008) were also assessed. Biological maturation was assessed by maturity offset (Mirwald et al., 2002) and percentage of predicted mature stature (Khamis & Roche, 1994-1995). Results An association was found between participants who performed better at 1000m and body mass ( $\rho \leq 0.05$ ), brachial circumference ( $\rho \leq 0.01$ ), brachial circumference in maximum contraction ( $\rho \leq 0.01$ ), chest circumference ( $\rho \leq 0.01$ ), upper limb volume ( $\rho \leq 0.05$ ), arm volume ( $\rho \leq 0.01$ ) and pull-ups ( $\rho \leq 0.01$ ). Maturity offset correlated with stature ( $\rho \leq 0.01$ ), sitting height ( $\rho \leq 0.01$ ), body mass ( $\rho \leq 0.01$ ), arm length ( $\rho \leq 0.05$ ), hand length ( $\rho \leq 0.05$ ), brachial circumference in maximum contraction ( $\rho \leq 0.05$ ), chest circumference ( $\rho \leq 0.01$ ) and the upper limb volume ( $\rho \leq 0.01$ ). Discussion This study offers the anthropometric profile of the young male paddler, and reveals that the athletes with slightly larger upper body dimensions and with better results in the pull-up test have better performance at 1000 meters, which may allow the use of this information as a guide in the process of talent identification in flatwater racing by the sports agents (federations, clubs and coaches). References Council of Europe (1988). Eurofit: Handbook for the Eurofit tests of Physical Fitness. Rome: Council of Europe. Khamis HJ, Roche AF (1994, 1995 - erratum). Predicting adult stature without using skeletal age. *Pediatrics*, 94 (4): 504-507. Mirwald RL, Baxter-Jones ADG, Bailey DA & Beunen GP (2002). An assessment of maturity from anthropometric measurements. *Medicine & Science in Sports & Exercise*, 34(4): 689–94. Rogowski I, Ducher G, Brosseau O & Hautier C (2008). Asymmetry in volume between dominant and nondominant upper limbs in young tennis players. *Pediatric Exercise Science*, 20 (3): 263–72. Slaughter MH, et al (1988). Skinfold equations for estimation of body fatness in children and youth. *Hum Biol* 60: 709-723. The Cooper Institute for Aerobics Research. (1999). Fitnessgram : test administration manual. (M. D. Meredith & G. J. Welk, Eds.). (2nd Edition.). Human Kinetics.

## THE EFFECT OF STATIC STRETCHING DURATION ON SPEED AND AGILITY PERFORMANCE

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Introduction Stretching constitutes an integral part of the warm-up process for many sports (McHugh & Cosgrave, 2010). Although static stretching (SS) has been used from coaches for many years, recent studies indicate that SS may have a negative or no effect on athlete's anaerobic performance (McHugh & Cosgrave, 2010; Van Gelder & Bartz, 2011). However there is limited information regarding the optimal duration of SS in respect to speed and agility performance. Therefore, the aim of this study was to investigate seven SS durations on 10, 20 m. and T-test performance of various sports athletes. Methods Following a familiarization period, twenty healthy young athletes (age  $20.1 \pm 1.9$  yrs, height  $1.82 \pm 6.8$  m, weight  $76.3 \pm 4.4$  kg, % Body fat  $7.2 \pm 2.9$ ) participated in our stretching protocols and performance assessment in a counterbalanced fashion. SS (10, 15, 20, 30, 40, 60 seconds) and control (C, no stretch), were performed for gluteus,

quadriceps, hamstrings, adductors and calves, following eight minutes of aerobic exercise in a self-defined intensity. Two trials of 20 m. with a 10 m. split and two trials of T-test (New test, photocells system, Finland) separated by 3 minutes rest periods, were performed 3 minutes following the C or SS protocols. Differences were examined through an ANOVA repeated measures. Results SS protocols of 15 and 20 seconds induced a 1.6–2 % improvement on 10 and 20 m. speed ( $p < .05$ ). Performance on T-test remained unaffected by all SS protocols. Discussion These results indicate that SS of short duration may improve speed (10 m., 20 m.). Longer durations had no effect on speed. SS appears to leave agility unaffected. These results indicate that SS does not produce adverse effects on speed and agility performance. References Van Gelder LH and Bartz SD. (2011). *J Strength Cond Res*, 25(11), 3014–3021. McHugh MP, Cosgrave C H. (2010). *Scand J Med Sci Sports*, 20, 169–181.

### PHYSIOLOGICAL, BIOCHEMICAL AND AUTONOMIC RESPONSES TO THREE DIFFERENT TRAINING SESSIONS PERFORMED IN TETHERED SWIMMING

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Introduction It is not well established if acute tethered swimming training sessions with same load, but with variations in volume and intensity will lead to similar responses of physiological, biochemical and autonomic parameters. Thus, we investigated the biochemical, physiological and autonomic responses after different training sessions in tethered swimming. Methods Trained swimmers ( $n=6$ ) performed an incremental tethered swimming test to determine the anaerobic threshold (AT) (Papoti et al., 2009) and performed training at Z1=below 75% of AT during 40min; Z2=100% of AT during 30min; Z3=above 150% of AT during 20min. Before and after these sessions, blood lactate concentrations ([Lac]), rating of perceived exertion (RPE) and heart rate variability (HRV) parameters (i.e. standard deviation of all beat to beat intervals – SDNN, square root of the mean square of the differences between interval consecutive heart beats – RMSSD, and low-frequency - LF) were determined. In addition, biochemical measurements (testosterone - T, cortisol - C, and creatine kinase - CK) were measured before, after and 24h after the training sessions. Loads were measured by training pulse (TRIMP), which was assumed as the final product of the intensity (%AT) by effort time. The all TRIMPs corresponded to 3000 u.a. Results [Lac] (mM) after Z3 was significantly higher ( $6.74\pm 3.38$ ) compared to Z2 ( $2.63\pm 2.24$ ) and Z1 ( $0.93\pm 0.19$ ). [Lac] after Z2 was significantly higher than Z1. RPE after Z3 ( $88.2\pm 17.2$ ) was significantly higher than Z2 ( $12.07\pm 2.27$ ) and Z1 ( $8.25\pm 0.88$ ). CK (U/L) after Z3 ( $45.8\pm 9.2$ ) was significantly different from Z2 ( $45.8\pm 9.2$ ) and Z3 ( $43.8\pm 10.6$ ) U/L, and C (mcg/dL) after Z3 ( $12.5\pm 6.5$ ) was significantly different than Z1 ( $6.4\pm 1.8$ ). The HRV (SDNN) after Z1 ( $108.48\pm 10.23$  ms) was different from Z2 ( $70.38\pm 16.39$  ms) and Z3 ( $48.78\pm 22.51$  ms). The RMSSD (ms) after Z1 ( $89.44\pm 24$ ) was different from Z2 ( $47.12\pm 19.48$ ) and Z3 ( $38.34\pm 27.52$ ) while, LF (ms<sup>2</sup>) after Z1 ( $4637.40\pm 2928.65$ ) was different from Z3 ( $774.00\pm 769.63$ ). Discussion The results about [Lac] and PSE corroborate with previous studies that showed that these markers are more sensitive to intensity than volume. The behavior of C and T was more influenced by intensity while, CK was more influenced by volume. The autonomic system was more stressed by intensity than volume. We can conclude that intensity seems to be the pivotal factor for the significant alterations of the physiological, biochemical (except CK) and autonomic parameters. References Papoti et al. (2009). *Int J Exerc Sci*, 2(4):269–79.

### A COMPARISON OF DEVELOPMENT IN STRENGTH, POWER, AND ENDURANCE IN FEMALE NATIONAL TEAM JUDOKAS, WRESTLERS, AND BOXERS OVER A 6-YEAR PERIOD

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Introduction: Female wrestling, boxing and judo are relatively new sports in the summer Olympic Games, and physiological profiles in these athletes are limited. The purpose of this study was to describe and compare the development of strength, power, strength endurance and endurance in female national team wrestlers, judokas, and boxers from 2006–2011. Methods: Between the years 2006–2011, national team female judokas, wrestlers, and boxers were assessed twice/year. Upper and lower body maximal strength was analyzed using a 1-repetition maximum (1-RM) bench press and parallel back squat while strength endurance was assessed using maximum repetition chin ups, dips, and the “brutal bench”. Relative strength in bench press and back squat was calculated as weight lifted divided by body weight. Power was analyzed using a hop mat and timing gates performing a squat jump (SQJ), a countermovement jump (CMJ), a countermovement with arms (CMJa), and a 10m sprint run (Maulder & Cronin, 2005). Endurance was measured manually with a 3000 meter Cooper run test. Repeated measures ANOVA was used to detect any significant differences in the aforementioned physical qualities from 2006–2011 within the sport while an independent T-test was used to detect differences in physical qualities between sports. Results: Boxers were significantly weaker both maximally and relatively than judokas and wrestlers (both  $P<0.05$ ). As for strength endurance, boxers performed less repetitions in all three exercises ( $P<0.05$ ). Moreover, wrestlers jumped significantly higher in the SQJ than judokas and boxers. In the CMJ, both boxers and judokas jumped higher than boxers while in the CMJa only wrestlers’ jumped higher than boxers ( $P<0.05$ ). Wrestlers ran faster over 10 m than both judokas and boxers ( $P<0.05$ ). Judokas ran significantly slower than wrestler and boxers in the 3000 meter Cooper test ( $P<0.05$ ). No significant changes in strength, strength endurance, power, and endurance occurred from 2006–2011 in respective sports ( $P>0.05$ ). Conclusion The sport of judo and wrestling produce a stronger and more powerful female athlete than boxing. This would be expected as both these sports require more strength and power to perform point-scoring techniques. However, no significant development in strength, strength endurance, power and endurance has occurred over a 6-year period in female judokas, wrestlers and boxers. References Maulder, P. & Cronin, J. (2005) “Horizontal and vertical jump assessment: reliability, symmetry, discriminative and predictive ability” *Physical Therapy in Sports*, 6: 74–82

### VALIDITY OF COD5X5M TEST IN SOCCER PLAYERS

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Introduction Soccer is a team sport which is characterized by an intermittent activity profile that implies a sudden variation of movement (Stolen et al., 2005). Change of direction (COD) performance is considered as a fundamental prerequisite to achieve sport success in soccer players (Mujika et al., 2009). Nevertheless, to assess COD in soccer, COD test are based on observational studies and have only logical validity. Therefore, the aim of the present study was to assess COD5x5m reliability and to examine the ability of COD5x5m to differ between soccer players of different ages and competitive level. Methods The present study has consisted in 2 studies that implied a total of 81 soccer male players during 2009–2010 competitive season. In the first study, 14 semiprofessional soccer players belonging at the

same team were asked to perform the COD5x5m on two identical test sessions (separated by 5-7 days) to examine test-retest reliability. In the second investigation, 81 professional and semiprofessional soccer players were tested at three different times during competitive season. COD5x5m test consisted in performing 5 x 5-m sprints with 4 45° COD as fast as possible. The best value of each player was selected to posterior analysis. Players were classified in 5 groups depending of their level: professionals (Adelante League), semiprofessionals (3rd Division), amateurs (4th Division), U17 (national level) and U18 (regional level). Results Relative and absolute reliability to TEM was 0.11 s (CL90% 0.08 to -0.17 s) and 1.5% (CL90% 1.1 to 2.3%), respectively. No significant differences existed between trial 1 and 2 to COD5x5m (6.62 ± 0.3 s vs 6.65 ± 0.4 s, respectively; TE: 0.09 (trivial)). Mean change between trials has been 0.03 s (CL90% -0.05 to 0.11 s) and ICC was 0.91 (CL90% 0.74 to 0.97). Professional players showed an almost certainly better performance than semiprofessional, amateurs and young players. Almost certainly differences were found between semiprofessional and amateur players in comparison to U17 and U18. Furthermore, a substantial difference (likely) was provided between U17 and U18 players. Discussion COD5x5m is a reliable test to assess COD in soccer players. Furthermore, COD5x5m test is able to discriminate between players of different ages and competitive level. Therefore, this ability supports its validity and use in a wide variety of soccer players. References Stolen T, Chamari K, Castagna C, Wisloff U. (2005). *Sports Med*, 35 (6), 501-536. Mujika I, Santisteban, Impellizzeri FM, Castagna C (2009). *J Sports Sci*, 27 (2), 107-114.

### EFFECT OF COMBINED REPEATED SPRINT AND STRENGTH TRAINING ON REPEATED SPRINT ABILITY IN RUGBY PLAYERS

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**Introduction** In addition to specific improvements in repeated sprint performance, repeated sprint training might also promote adaptations leading to performance increases in single sprint performance and cardiorespiratory fitness in team sport players (Bishop, Girard, & Mendez-Villanueva, 2011). On the other hand, strength training may lead to some gains in repeated sprint performance (Bishop, et al., 2011; Buchheit, Mendez-Villanueva, Delhomel, Brughelli, & Ahmaidi, 2010). Therefore, the purpose of this study was to examine the effect of repeated sprint training and combined repeated sprint and strength training in trained rugby players. **Methods** Sixteen semi-professional, well-trained rugby players (27.0 ± 5.2 years old, 91.3 ± 15.5 kg, and 179.6 ± 7.0 cm) voluntarily accepted to participate in this study. During 6 weeks, one group performed repeated sprint training (RST, n = 8) two days a week. The other group performed repeated sprint training one day a week and on the second day performed squat resistance training (RST+SRT, n = 8) on a vibration platform. **Results** Substantial improvements in RSAbest, RSAmean, fatigue index (FI) and squat maximal power output (absolute and relative to body mass) were observed in both groups compared to the pre-test. However, the magnitude of improvements in RSAbest, RSAmean and squat maximal power output were substantially greater in the RST+SRT in comparison with the RST (ES: 0.48, 0.46 and 0.81, respectively). There were no differences between groups in FI. **Discussion** In semi-professional rugby players, 6 weeks of combined repeated sprint and strength training resulted greater improvements in both repeated-sprint ability and lower body strength than repeated sprint training alone. **References** Bishop, D., Girard, O., & Mendez-Villanueva, A. (2011). Repeated-sprint ability - part II: recommendations for training. *Sports Med*, 41(9), 741-756. Buchheit, M., Mendez-Villanueva, A., Delhomel, G., Brughelli, M., & Ahmaidi, S. (2010). Improving repeated sprint ability in young elite soccer players: repeated shuttle sprints vs. explosive strength training. *J Strength Cond Res*, 24(10), 2715-2722.

### COMPARISON OF A RAMP-INCREMENTED VO2MAX TEST PROTOCOL WITH A STEP-INCREMENTED PROTOCOL CLAMPED BY RATINGS OF PERCEIVED EXERTION

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**Introduction** Historically, there has been an interest in identifying new VO2max test protocols that improve the reliability, validity, and the utility of the test. A recent study reported that a novel 10-minute step-incremented test protocol, where the exercise intensity at each step was clamped by ratings of perceived exertion (RPE), elicited a significantly higher VO2max than a traditional step-incremented protocol (Mauger and Sculthorpe, 2012). A more recent study, however, found no significant difference (Chidnok et al., 2013). Given these contrasting findings, the main purpose of the present study was to further investigate whether an RPE-clamped protocol would elicit higher VO2max values than a ramp-incremented protocol. **Methods** Sixteen trained cyclists (12 male; age: 34.4 yr ± 7.4; BMI: 24.1 ± 2.2) performed a traditional ramp-incremented VO2max test and an RPE-clamped protocol performed one week apart in a randomized, completely counterbalanced, cross-over design. The RPE-clamped protocol replicated that of Mauger and Sculthorpe and consisted of five, 2-minute stages clamped at RPE values of 11, 13, 15, 17 and 20. In the RPE-clamped protocol, subjects were allowed to self-select the power output to maintain the RPE at a given step. After completion of both test protocols, subjects were asked which one they preferred. **Results** The mean test time was not significantly different between the two test protocols (p = 0.09). There was no difference in VO2max (3.86 ± 0.18 L·min<sup>-1</sup>; p = 0.9) between the two protocols. Test preference did not appear to have an effect on test outcome for VO2max (p = 0.81) or peak power output (p = 0.24). There was no significant mean differences for peak power output (Ramp: 330 ± 71 W, Clamp: 317 ± 97 W; p = 0.21), maximal minute ventilation (p = 0.97), maximal respiratory exchange ratio (p = 0.09), maximal heart rate (Ramp: 171 ± 12 bpm; Clamp: 172 ± 10 bpm; p = 0.51), or post-test blood lactate concentration (p = 0.58), however, RPE at peak effort was significantly higher during the RPE-clamped protocol compared to the ramp protocol (p < 0.01). **Discussion** Unlike Mauger and Sculthorpe's untrained subjects, our trained cyclists did not elicit a higher VO2max in the RPE-clamped protocol. In fact, the two tests were similar in length and elicited almost identical physiological and performance responses, despite achieving a significantly higher perceived exertion in the RPE-clamped protocol, suggesting that an RPE-clamped protocol may be of value in the exercise science field as a regular maximal testing protocol. **References** Chidnok, W, et al. (2013). *Eur J Appl Physiol*, 113, 529-539. Mauger, AR, Sculthorpe, N. (2012). *Br J Sports Med*, 46, 59-63.

### THE EFFECT OF HIGH INTENSITY INTERMITTENT TRAINING BY THE RUNNING ON ENDURANCE PERFORMANCE IN BALL GAMES

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**Introduction** When we provide some physical training program of ball games, it is easier to provide running program than it is actually to provide bicycle program for athletes during sports practice at the field. Previous study (Tabata et al.) reported that short-term bicycle ergometer training increased endurance performance. We need to have training program for easy in the field. Thus, we have developed from bicycle training program to running training program. The aim of this study was to estimate the effect of this program. **Methods**

Twenty five male soccer players were divided into three groups (A: bicycle ergometer training, B: running training, C: Control). A and B group performed maximum effort training 3 day/week for 2 weeks and technological practice of soccer. Training of A consisted of seven sets of 20-s exercise at an intensity of a load of 7.5% of body weight with a 10-s rest between each bouts. Training of B consisted of seven sets of 100m running with a 10-s rest between each bouts. C was only technological practice. Oxygen uptake, onset of blood lactate accumulation (OBLA), wingate anaerobic test (WAnT), Yo-Yo intermittent recovery test (YYIR2) were measured at pre and post training. Results There were no interactions. On the other hand, OBLA, WAnT, and YYIR2 increased in post training. These were no significantly higher than those in pre training. Discussion Gibala et al. and Hazell et al. reported that 2 weeks of intermittent training increased oxygen uptake. In this study, there were no effects of training program on endurance performance. The reason may be related effects of technological practice of soccer. There were no differences due to training programs in the results. However, only six training have the potential of effective for improvements in OBLA, WAnT, and YYIR2. Reference Tabata et al. *Med Sci Sports Exerc.* 1996 Oct;28(10):1327-30. Gibala et al. *J Physiol.* 2006 Sep 15;575(Pt 3):901-11. Hazell et al. *Eur J Appl Physiol.* 2010 Sep;110(1):153-60.

### THE EFFECTS OF AN ECCENTRIC HAMSTRING STRENGTHENING PROGRAM ON H/Q RATIO IN 10-11-YEAR OLD FEMALE HANDBALL PLAYERS

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**Introduction** During drop jumps with increasing drop heights, the activation level of the quadriceps (Q) increases, but the hamstrings' (H) does not, so the strain on the anterior cruciate ligament (ACL) increases (Ford 2011). The torque of the H does not increase after the age of 11 significantly in women athletes (Barber-Westin 2006). We aimed to apply specific strength training for H muscles to increase the H/Q ratio. **Methods** We measured the eccentric (EC) peak torque of the H at 60 °/s, and the concentric (CC) H and Q peak torque at 60 and 180 °/s constant angular velocities by 22, 10-11 year-old women handball players in Multicont-II dynamometer. We calculated the functional H/Q ratio in 60 °/s, and the conventional H/Q ratio in 60 and 180 °/s for both legs. We measured the jumping height using a contact mat during counter-movement jumps (CMJ) without arm swing. The players were randomly assigned to either a training (EC, n=13, 11,28±0,52 years) group, who carried out progressive body-weight eccentric H strength training twice a week (Nordic hamstrings, 2\*5-3\*15 repetitions) or a control group (KO, n=9, 10,89±0,50 years) who took part only in the handball training. After 10 weeks data of the same variables were collected. **Results:** The EC H peak torque using 60 °/s increased significantly in both groups, as well as the CC Q peak torque in 60 and 180 °/s and the CC H peak torque in 180 °/s in the EC group (p≤0,05). The functional H/Q ratio on 60 °/s increased significantly in the control group in the right leg (p≤0,05). We did not find any other differences in the groups. The jumping height increased significantly in the EC group (18,25±2,29 cm-22,48±2,64 cm, p<=0,001). **Conclusion:** The first half of the study was during the preparation phase of the year, maybe this was the reason of the increase of the torques in the control group. The CMJ jump height increased significantly only in the training group. It seems that the recovery time for the experimental group was too short after training intervention and therefore the H/Q ratio did not increased significantly. Also, it can be imagined that ten weeks were not enough to result in significant alteration in muscle strength of H which is in agreement with the findings of Kramer and Fleck (2005). It is unknown why the control group increased the H/Q ratio without specific H training. To solve this problem further studies are needed. **References** Ford KR, Myer GD, Schmitt LC, Uhl TL, Hewett TE. (2011) *J Appl Biomech.* 27(3):215-22. Barber-Westin SD, Noyes FR, Galloway M. (2006): *Am J Sports Med* 34(3):375-84. Kraemer W., Fleck S.J (2005): Strength training for young athletes. *Human Kinetics*

### EFFECT OF TWO DIFFERENT STRENGTH TRAINING METHODS ON CYCLING PERFORMANCE IN HIGHLY TRAINED VETERAN CYCLISTS

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**Introduction** Cycling has been a fast growing veteran sport. In efforts to improve cycling performance many veteran cyclists perform strength training. This study aimed to investigate effects of two different strength training methods on cycling performance. **Methods** 23 highly trained male cyclists (age: 47±7 yr; VO2max: 57±6 ml·kg<sup>-1</sup>·min<sup>-1</sup>; body fat: 11±4%) participated in a 9 week pre-to post-test training intervention. The participants were randomised to one of three groups: strength training with 4 repetition maximum (RM) in 4 series (4RMG, n=9), 20 RM in 4 series (20RMG, n=7) and a control group (CG, n=7). The training intervention consisted of leg press with two sessions per week in addition to normal endurance training. Pre- and post-tests: VO2max, lactate threshold (LT<sub>watt</sub>), 20 minutes time-trial test (TT<sub>watt</sub>), maximal leg strength with left and right foot separately (1RM<sub>LPL</sub>, 1RM<sub>LPR</sub>) and submaximal leg press with a load at 80% of 1RM in pre-test (LPL80, LPR80). VO2max, LT<sub>watt</sub> and TT<sub>watt</sub> were performed on a Velotron bike (DynaFit Pro). Heart rate was measured using a Polar RS 800 CX. VO2 was measured using a Jaeger Oxycon Pro. Lactate was measured using a Lactate Scout device. Strength tests were performed in apparatus from Cybex International, and body composition with InBody 720. **Results** No significant effect from pre- to post test was found for VO2max, body mass and percent body fat (p=0.07). TT<sub>watt</sub> and LT<sub>watt</sub> increased from pre- to post- test by 14.9±13.6 W and 24.7±19.9 W, respectively, for all subjects pooled (both p<0.001) with no differences between groups. Maximal leg strength increased from pre- to post test (1RM LPR: +5.0±5.6 kg; 1RM LPL: 4.1±6.2 kg; both p<0.001). Interactions were found for the group factor, showing that the 20RMG was superior to the CG in 1RM LPR (diff.: +9.1±2.8 kg, p=0.02) and to the 4RMG (diff.: +6.4±2.4 kg, p=0.048) and CG (diff.: +11.3±2.6 kg, p=0.001) in the 1RM LPL. In the submaximal strength tests, there was a pre- to post test increase both for the LPR80 (+6.0±7.7 reps, p<0.001) and the LPL80 (+4.7±7.9 reps, p=0.003). Significant interactions for the group factor showed that the 20RMG increased LPR80 compared to both the 4RMG (diff.: +10.5±3.2 reps, p=0.01) and the CG (diff.: +13.8±3.5 reps, p=0.003), and LPL80 compared to the 4RMG (diff.: +10.1±3.6 reps, p=0.04). **Discussion** Strength training over 9 weeks in addition to regular cycling exercise does not have any effect on cycling performance in highly trained veteran cyclist compared with cycling alone. Strength training with 20 RM produced greater effect on muscular endurance than both 4RMG and CG and was superior to the CG in enhancing 1RM.

### DETERMINANTS OF ACCELERATION IN TEAM HANDBALL YOUNG PLAYERS: DOES A 45° ANGLE MATTER?

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**Introduction** Acceleration is an important parameter in team handball (TH) and it occurs during the game, not only in straight line, but also with changes of direction. The aim of this study was to examine the anthropometric and physiological factors that influence the acceleration performance either in straight line or with an angle of 45° on the right or on the left in young TH players. **Methods** Twenty-one TH

players (age  $15.6 \pm 0.8$  years, weight  $69.5 \pm 9.9$  kg and height  $1.75 \pm 0.06$  m) were tested for body fat (BF), sit-and-reach test, squat (SJ) and countermovement jump, Bosco test, Force-velocity test, Wingate anaerobic test and three conditions of 10-m sprint: in-line (A), with an angle of  $45^\circ$  in the middle of the sprint distance on the right (B) and on the left (C). A repeated measure ANOVA compared performance among the three conditions. A stepwise regression analysis was performed to investigate variables that predict performance in the three conditions of acceleration. Results A repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean acceleration performance differed statistically significantly between A, B and C condition ( $p < 0.001$ ,  $\eta^2 = 0.64$ ). Post-hoc tests using the Bonferroni correction revealed that A condition elicited faster acceleration than B ( $-0.13$  s ( $-0.17$ ;  $-0.08$ ), mean difference (95% CI)) and C ( $-0.13$  s ( $-0.18$ ;  $-0.08$ )). SJ was the best predictor of A acceleration, and BF the second predictor, together explaining 70% of the variance of performance in this condition. In conditions B and C, we found different predictors (maximal velocity assessed by the Force-velocity test and mean power in Bosco test, respectively) and smaller multiple correlation coefficients in the models that predict acceleration (44% and 52%, respectively). Conclusions These findings indicate different performance between acceleration in straight line and acceleration with angle of  $45^\circ$ , but not between right and left angles. The regression analysis revealed that there are different predictors of acceleration performance among the conditions we used, and, therefore, TH coaches and trainers should focus on the training of the physiological predictors of acceleration depending on which mode of acceleration they target.

### AGE-RELATED DIFFERENCES IN SPRINT STEP CHARACTERISTICS IN HIGHLY TRAINED YOUNG SOCCER PLAYERS

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**INTRODUCTION** Acceleration and maximum running speed are considered to be determined by a combination of specific physiological, metabolic, biomechanical, and morphological factors. However, our current knowledge on how acceleration and maximum sprinting speed develops in children and adolescents is still limited. Therefore, the aims of this study were to describe the step characteristics 1) between two different age and maturity groups (i.e., pre- and post-peak height velocity) and 2) fastest and slowest within each age group of young elite soccer players. **METHODS** Sprint performance and step characteristics of fifty-five highly-trained young male soccer players (Under 14 (U14),  $n=33$ ; Under 18 (U18),  $n=22$ ) were measured via the Optojump system (Microgate, Bolzano, Italy). Contact time (CT), stride rate (SR), step length (SL) and flight time (FT), were extracted during the acceleration (Acc; first 6 steps) and the peak velocity (PV; fastest 10 m split time) phases of the 40 m sprint. **RESULTS** During the Acc phase, U18 players have substantially shorter CT ( $0.15 \pm 0.01$  vs.  $0.18 \pm 0.01$  s, effect size (ES)=1.26, 90% confident limits (CL) [0.73;1.79]), higher SR ( $4.47 \pm 0.18$  vs.  $4.19 \pm 0.23$  Hz, ES=1.17, 90% CL [0.66;1.69]), and higher SL ( $1.37 \pm 0.10$  vs.  $1.30 \pm 0.14$  m, ES=0.94, 90% CL [0.42;1.45]) to the U14 players. Similarly, during the PV phase, U18 players have substantially shorter CT ( $0.12 \pm 0.01$  vs.  $0.14 \pm 0.01$  s, ES=1.42, 90% CL [0.89;1.95]), higher SR ( $4.51 \pm 0.21$  vs.  $4.19 \pm 0.21$  Hz, ES=1.51, 90% CL [0.99;2.04]), and higher SL ( $1.94 \pm 0.13$  vs.  $1.80 \pm 0.14$  m, ES=1.36, 90% CL [0.83;1.90]) to the U14 players. The U18 faster players have substantially shorter CT ( $0.11 \pm 0.01$  vs.  $0.12 \pm 0.01$  s, ES=1.86, 90% CL [0.78;2.95]), higher SR ( $4.63 \pm 0.28$  vs.  $4.43 \pm 0.123$  Hz, ES=0.79, 90% CL [-0.31;1.88]), higher SL ( $2.04 \pm 0.16$  vs.  $1.84 \pm 0.08$  m, ES=1.40, 90% CL [0.30;2.50]) and higher FT ( $0.11 \pm 0.01$  vs.  $0.10 \pm 0.01$  s, ES=0.75, 90% CL [-0.34;1.84]) during PV. While during the Acc phase SL was substantially higher ( $1.50 \pm 0.13$  vs.  $1.31 \pm 0.10$  m, ES=1.28, 90% CL [0.18;2.38]). These players were lighter ( $59.2 \pm 7.2$  vs.  $64.5 \pm 7.4$  kg, ES=0.66, 90% CL [-0.42;1.75]) and had similar height ( $1.71 \pm 7.7$  vs.  $1.70 \pm 5.4$  m, ES=0.08, 90% CL [-0.99;1.15]) than the slower U18 players. Whereas, the faster U14 players were heavier ( $54.2 \pm 9.7$  vs.  $38.3 \pm 4.4$  kg, ES=1.86, 90% CL [0.87;2.86]) and taller ( $1.64 \pm 9.5$  vs.  $1.50 \pm 6.9$  m, ES=1.81, 90% CL [0.84;2.78]) than the slower U14 players. **DISCUSSION** Between-group differences in all step characteristics were observed in both Acc and PV phases, suggesting similar stride factors underline age-related differences in sprint performance. When comparing slowest to fastest in U18 players, differences in Acc performance was mainly mediated by differences in SL. Differences in sprinting ability (both Acc and PV) between the fastest and slowest U14 soccer players were largely mediated by differences in SL. However, the larger height and body mass observed in the fastest U14 players suggests that anthropometrical factors might be behind these differences.

### QUANTIFYING THE INFLUENCE OF A HYPER-THERMIC ENVIRONMENT ON SOCCER SPECIFIC PHYSIOLOGICAL AND PERFORMANCE CAPACITY UTILISING A VALIDATED SOCCER NON-MOTORISED TREADMILL PROTOCOL

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**1**University of Bedfordshire, Bedford, UK, **2**Newman University, Birmingham, UK **Introduction** Playing soccer in the heat can result in high body temperatures, accelerating the development of fatigue, thus decreasing performance compared to similar activity in a temperate environment. Utilising an individualised and validated non-motorised treadmill soccer simulation (intermittent soccer performance test (iSPT) – Aldous et al, 2012 – in review) facilitates quantification of maximal performance capacity in temperate and hot environments. This study aims to assess the maximal physiological performance of soccer players in a hot (30°C, 30% RH; HOT) and temperate control environment (18°C, 50% RH; CON). **Methods** 8 male soccer players reported to the laboratory on 5 occasions. Visit 1-3: 3 familiarisation sessions. 4-5: iSPT (90 min duration 45 min - 1st half, 15 min - half time, 45 min - 2nd half). Participants completed iSPT on two occasions in CON and HOT. Relevant physiological (Heart Rate (HR), skin (Tsk) and rectal (Tre) temperature), perceptual (Ratings of Perceived Exertion (RPE) and thermal sensation (TS)) measures were recorded continuously and at 5 min intervals respectively. Body mass and hydration status were assessed pre and post iSPT. Changes in blood lactate and plasma levels were measured every 15 min. Results were analysed using a two way repeated measures ANOVA. Results Tmu (CON:  $38.4 \pm 0.07$  °C, HOT:  $39.2 \pm 0.02$  °C,  $P=0.03$ ) and Tre (CON:  $39.27 \pm 0.05$  °C, HOT:  $39.55 \pm 0.03$  °C,  $P=0.03$ ) were significantly greater in HOT compared to CON. Total distance (TD) covered (CON:  $9172.67 \pm 253.91$  m, HOT:  $8876.2 \pm 328.95$  m,  $P=0.004$ ), and sprint distance (SD) (CON:  $1063 \pm 19.94$  m, HOT:  $1047.52 \pm 6.28$  m,  $P=0.04$ ), were significantly greater in CON compared with HOT. Fatigue index (FI) between halves for TD covered (CON:  $64.39 \pm 55.33$  m,  $P < 0.001$ ; HOT:  $83.32 \pm 35.12$  m,  $P=0.04$ ) was greater in HOT compared to CON, but no change was observed for SD (CON:  $17.42 \pm 21.33$  m,  $P < 0.001$ ; HOT:  $25.63 \pm 13.01$  m,  $P=0.06$ ). **Discussion** A significant reduction in overall TD covered and SD was reported in HOT compared to CON. FI for TD covered between halves was greater in HOT compared to CON, however, this was not apparent for SD. Heat stress has shown to lower the work rate of players in HOT reducing oxygen delivery and aerobic energy turnover within the exercising muscles, provoking fatigue (Grantham et al, 2010). An individual's true maximal performance in CON is decreased in HOT. The data presented is the first utilising a validated and reliable soccer simulation (iSPT), quantifying decrements in performance between CON and HOT. Reference Aldous et al, (2012) – In review Mohr et al, (2012) Plos one, 7(6) 1-10 Grantham et al, (2010) Scand J Med Sci Sport

## INTERPRETATION OF PEAK POWER ASSESSMENTS IN YOUNG SOCCER PLAYERS

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Background: Although episodes of anaerobic effort occur on a smaller scale during the game, they play a decisive role in performance. By inference, anaerobic fitness seems to be an important parameter for success in elite soccer. This study examined the relationship between peak power outputs and body size descriptors before and after adopting an allometric modelling approach. Methods: The sample was composed by 42 male soccer players (13.9±0.6 yrs, 164.4±9.3 cm, 53.9±10.3 kg). Fat free mass was measured by air displacement plethysmography and thigh volume estimated using the anthropometric equation proposed by Jones and Pearson (1969). Peak output was determined using the Wingate test (WAnT). Correlation of Pearson determined the association between peak output and several size descriptors (body mass, fat free mass, and thigh volume). Power function ratios were obtained using ANCOVA. Results: WAnT peak output was 671.9±178.2 Watt. Absolute values of WAnT-peak were correlated with body mass (+0.90, p<0.01), fat free mass (+0.90, p<0.01) and thigh volume (+0.85, p<0.01). Exponents were b=1.21 (95% CI, 1.02-1.40) for body mass; b=1.17 (95% CI, 1.00-1.34) for fat free mass, and b=0.91 (95% CI, 0.71-1.11) for thigh volume. After allometric modelling the correlations were near zero (-0.20 to 0.00, p>0.05), which mean that it was possible to obtain size free model of WAnT peak output. Conclusions: WAnT seemed to be substantially correlated with total and regional size descriptors and the interpretation of maximal short-term fitness derived from the above mentioned cycling protocols performed in a seated position claim for appropriate models as an alternative to traditional approaches that express WAnT output in watt per unit of body mass. Jones & Pearson (1969). *J Physiology*. 204: 63-66 Supported by Fundação para a Ciência e Tecnologia – PhD Grant SFRH/BD/69447/2010

## PROFILING YOUNG SOCCER PLAYERS BY PLAYING POSITION: BODY SIZE, BODY COMPOSITION, MATURATION AND SHORT-TERM MAXIMAL EFFORT

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Background: Specialization by playing position is a relevant topic in the discussion of long-term athletic development. Physical and functional characteristics of young soccer players by playing position are less extensive in literature compared to available information in adult soccer. The current study profiles adolescent soccer players as defenders, midfielders and attackers on body size, composition and short-term maximal effort. Methods: The sample is composed of 74 male soccer players (14.9±1.2 yrs, 169.4±0.1 cm, 60.0±11.4 kg). Body composition was assessed by air displacement plethysmography. Biological maturation was given by current stature expressed as % of predicted mature stature (PMS). Short-term maximal performance (peak and mean outputs) was derived from the Wingate Test (WAnT). ANCOVA (decimal age as covariate) compared participants by playing position. Significance was set at p<0.05. Results: Mean values for defenders, midfielders and forwards were, respectively: 172.4 cm, 168.0 cm, 165.7 cm (p<0.01) for stature; 63.6 kg, 59.2 kg, 56.1 kg (p<0.01) for body mass; 57.0 kg, 52.9 kg, 50.5 kg, p<0.01) for fat-free mass; 95.4%, 95.1%, 94.8% (p=0.586) for %PMS; 804, 752 watt, 700 watt, (p<0.05) for WAnT-peak; 562 watt, 528 watt, 495 Watt (p<0.05) for WAnT-mean. Conclusions: Defenders tended to be larger in body size, including fat free mass, and obtain better performance in the WAnT. The current results correspond to the baseline of a longitudinal study that will inform about the developmental changes of WAnT outputs during adolescent years for the total sample and by playing position. Supported by Fundação para a Ciência e Tecnologia – PhD Grant SFRH/BD/69447/2010

## CARDIORESPIRATORY RESPONSES OF TRAINED CEREBRAL PALSY CYCLIST DURING EXHAUSTIVE SEVERE EVENT: A CASE STUDY

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Introduction de Groot et al. (2012) reported a lower strength but similar maximal oxygen uptake (VO<sub>2</sub>) and the associated power (pVO<sub>2</sub>peak) in untrained adults with cerebral palsy (CP) compared to healthy counterparts. Ludberg (1978) also attributed the poor mechanical performance in CP to the extra O<sub>2</sub> cost required for muscle changes during cycling exercise and fatigue to reduced VO<sub>2</sub> (Bar-Or 1986). Muscle strength and O<sub>2</sub> delivery may be limiting factors in CP for exercise. The aim of this study was to determine the ability of trained subject with CP to attain and maintain a high VO<sub>2</sub> value during exhaustive constant cycling event. Method On separated days, a French para-cycling team member with CP performed on cyclus2 ergometer (RBM, Germany): 1) an incremental test (GCT) to determine maximal values of VO<sub>2</sub>, cardiac output (CO), heart rate (HR) and pVO<sub>2</sub>peak; 2) a time to exhaustion at pVO<sub>2</sub>peak (tlim) after 30-min warm-up. Respiratory and cardiac parameters were continuously measured by gas exchange analyzer (K4b2, Cosmed, Italia) and impedance (Physioflow, Manatec, France). Modeling data (f1) and oxygen deficit (DO<sub>2</sub>) were calculated according to Demarle et al. (2001). Result Maximal values of VO<sub>2</sub>, CO and HR measured during tlim (6min05) corresponded to 59.1% (35.6 vs. 60.2mL.O<sub>2</sub>.min<sup>-1</sup>.kg<sup>-1</sup>), 93.3% (21.9 vs. 23.5L.min<sup>-1</sup>) and 100% (210 vs. 209bpm) of the peak GCT values. The low VO<sub>2</sub> response was explained rather than a weak value of tidal volume (tlim: 0.92 vs. GCT: 1.68L), which rose continuously during tlim, rather than breath frequency (tlim: 81.6 vs. GCT: 72.2breath.min<sup>-1</sup>), which after abrupt increase dropped until exhaustion. Other cardio-respiratory responses to tlim were fitted to a mono-exponential model. t1HR was shorter than t1VO<sub>2</sub>, which was greater than t1CO. DO<sub>2</sub> was equal to 4.77LO<sub>2</sub> Discussion In trained CP, tlim was similar to data previously reported in trained healthy subjects (Billat et al. 1996) what contrasted to premature fatigue in untrained CP attributed in the weakness of endurance muscle strength (de Groot et al. 2012) or a high O<sub>2</sub> cost of locomotion (Ludberg 1978). Ventilation rather than CO also explained the low value of VO<sub>2</sub> during sustained severe exercise with regard to GCT. Respiratory muscle fatigue induced by warm-up and competitive limb muscle recruitment at the onset of strenuous exercise could explain VO<sub>2</sub> responses. Reference Bar-Or O. (1986), *Med Sci Sports Exerc*, 18, 276-82. Billat VL, Hill DW, Pinoteau J, Petit B, Koralsztein JP. (1996), *Arch Physiol Biochem*, 104, 313-21. de Groot S, Dallmeijer AJ, Bessems PJ, Lamberts ML, van der Woude LH, Janssen TW. (2012), *J Rehabil Med*, 44, 932-8. Demarle AP, Slawinski JJ, Laffite LP, Bocquet VG, Koralsztein JP, Billat VL. *J Appl Physiol*, 2001, 90, 947-53. Lundberg A. (1978), *Dev Med Child Neurol*, 20, 205-10.

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**Traumatology**

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**PREVALENCE OF INJURIES AMONG HANDBALL PLAYERS**

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**Introduction** The handball is characterized as a contact sport with a high potential of injury (Akgun et al., 2008), and to identify and describe the injury problem is an important first step to prevent them (Olsen et al., 2006). The main purpose of this study was to identify the prevalence of injuries in male and female team handball players, as well their diagnosis. **Methods** Handball players, 63 male ( $21.2 \pm 5.3$  years) and 59 female ( $19.9 \pm 5.3$  years), from three different teams (São Paulo/Brazil) participated in this retrospective study. They were interviewed by the researchers, and a specific questionnaire was used (DE ROSE, TADIELLO, DE ROSE JR, 2006). The injuries related were also classified in acute or chronic according Yang et al. (2012). The results are presented as absolute and relative values. **Results** The number of injuries related was 218, and the most common injury type was sprains ( $n = 38$ ). The body region more affected by injuries was the lower limb (62%), with the knee and ankle showing similar number ( $n = 58$ ). It was verified a greater number of acute injuries ( $n=110$ ) in relation to chronic ( $n=52$ ). **Discussion** The main findings of this study were that the acute injury is higher in handball players, and that injuries occurred mainly in the knee and ankle joints (Olsen et al., 2006). In the future, more studies would aid in establishing a prevention program. **References** Akgun, U. et al. (2008). *Knee Surg Sports Traumatol Arthrosc*, 16(5), 522–530. De Rose, G. et al. (2006). *EFDportes Revista Digital*, Buenos Aires, 94 (10). Olsen, O.E. et al. (2006). *Scand J Med Sci Sports*, 16(6), 426-432. Yang, J. et al. (2012). *Journal of Athletic Training*, 47(2), 198-204.

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