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MARCELLO FAINA AND ARSENIO VEIC-STEINAS OPENING LECTURE

Thinking and action: a cognitive perspective on self-regulation during endurance performance

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Whole-body endurance events present unique and sometimes unexpected challenges to athletes. Endurance activity is often associated with exercise-induced pain and discomfort, for example, during the pursuit of personally held goals. To optimise performance, endurance athletes are required to manage this discomfort and to regulate their work rate by making goal-directed decisions regarding when and how they invest their energy. As such, endurance performance can be considered an example of a self-regulated behaviour, or the ability to successfully monitor and control one's thoughts, feelings, and actions in accordance with the demands of a task. Self-regulation involves change to bring one's thinking and behaviour in line with often consciously desired standards and goals. In essence, this requires both 'thinking' (e.g. engaging cognitive strategies, such as motivational self-talk or relaxing) and 'thinking about thinking' (i.e. meta-cognition) to plan, monitor, and adapt situationally-appropriate cognitive strategies during endurance performance. In this keynote address, Dr Noel Brick will provide a cognitive perspective on the processes required to optimise endurance performance. He will consider the roles of attentional focus and cognitive strategies in the self-regulation of endurance performance. He will also present evidence to suggest that what an athlete thinks about has an important influence on effort perceptions, physiological outcomes, and, consequently, endurance performance. This address will also provide an account of how an athlete might control their cognitions and focus attention during an endurance event. As such, it will propose that effective cognitive control during performance requires both proactive, goal-driven processes and reactive, stimulus-driven processes. Finally, the role of metacognition during endurance activity will also be considered. Metacognition is an essential component of self-regulation and its primary functions are to monitor and control the thoughts and

actions required for task completion. The implications for endurance performance, and longer-term endurance activity behaviour will be discussed.

INVITED LECTURE

Reflections on the attempt to run a < 2 hour marathon

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On 6th May, 2017, exactly 63 years after Sir Roger Bannister ran the first sub-4 min mile, three elite distance runners attempted the (almost) unthinkable: to run a 26.2 mile marathon in less than 2 hours. This event, performed at the Formula 1 race track in Monza, Italy, was the culmination of more than 2 years of scientific development work by Nike and its associates (including the presenter). The existing marathon world record for men stood at 2 hours, 2 minutes and 57 seconds and there had been much speculation amongst sports scientists and the athletic community over whether a sub-2 hour marathon may be humanly possible (and, if so, when and how it might occur). In the 'Breaking 2' event, Eliud Kipchoge of Kenya ran 2:00:25, just one second per mile shy of a sub-2 hour performance. In this presentation, I shall describe the physiological limitations to human endurance exercise performance and outline the strategy employed by the Nike team with regard to athlete selection and creation of the optimal conditions to make the sub-2 attempt viable. This will include information on the battery of laboratory and field-based physiological tests used to identify the athletes most likely to achieve the feat and insight into consideration given to the environmental, training, course, pacing, drafting, biomechanical and nutritional factors that can impact marathon performance.

FRIDAY ORAL SESSION

OP1 SPORTS AND EXERCISE PHYSIOLOGY

OP1-1 KEYNOTE

Arterial blood gas analysis in breath-hold divers at the breaking-point

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Purpose: This project aimed to investigate human blood gases at BHD breaking point after a dive at 40 m.

Methods: Six well trained, healthy breath-hold divers regularly completed this study (41.67 ± 8.78 years, 72.83 ± 7.88 kg and 1.79 ± 0.08 m). Prior to submersion, an arterial cannula was inserted in the radial artery of the non-dominant limb. In the post conditions, blood samples were drawn before the breaking point, with face still submerged. Blood samples were drawn in four different time-points: Blood sampling out of water before diving (PRE). Moreover, blood sampling after breath-holding at surface (POST SUR), at depth (POST DP) and at depth with muscular exercise (POST DP-EXE). Withdrawals took place measuring PH, pCO₂ (mmHg) pO₂ (mmHg) HCO₃ (mmol/L), so₂ (%), tco₂ (mmol/L) and lactate.

Results: Levels of paO₂ progressively and significantly decrease between the PRE and POST DP-EXE condition. In particular, the PRE value (96.17 ± 7.03) is significantly higher with respect to POST SUR (64.50 ± 4.72 , $p < 0.001$), POST DP (39.83 ± 8.66 , $p < 0.001$) and POST DP-EXE (31.6 ± 16.95 , $p < 0.001$) values. Furthermore, values registered in the POST SUR condition are significantly higher compared with those observed in POST DP ($p < 0.01$) and POST DP-EXE, ($p < 0.001$). Values of paCO₂ did not show a regular behavior with a significance registered. In particular, paCO₂ was significantly higher in the POST SUR (42.75 ± 6.03) condition with respect to POST DP (31.38 ± 3.70 , $p < 0.01$) condition. There were variable changes in arterial lactate after the descent, with a growing tendency between the four progressive conditions. In detail, the POST DP-EXE value (2.09 ± 0.35) is significantly higher with respect to POST SUR (0.79 ± 0.17 , $p < 0.001$), POST DP (1.18 ± 0.17 , $p < 0.001$), and PRE (0.64 ± 0.38 , $p < 0.001$).

Conclusions: We have demonstrated that hypoxia and lactate at surface are increased by exercise, hypercapnia exists to a lesser degree than would be expected from calculation of alveolar paCO₂, presumably due to pulmonary gas exchange abnormalities caused by lung compression and because of carbon dioxide uptake and storage in the blood and tissues.

Reference

1. Bosco G et al. (2018) Arterial Blood Gas Analysis in Breath-Hold Divers at Depth. *Frontiers in Physiology*. 9: 1558

OP1-2

Acute muscle stretching does not alter balance control ability: the compensative role of neuromuscular activation

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Purpose: Balance control (BC) is the resultant of an integrative network involving sight, hearing, vestibular function, and proprioceptive feedback¹. Perturbations of one of these contributors could turn into a worsening of BC regulation². Passive stretching (PS) has been reported to affect proprioceptive feedback³, thus possibly decreasing BC ability. This study evaluated the acute effects of PS and active stretching (AS) of the lower limbs on static and dynamic BC parameters.

Methods: Thirty-eight participants (age: 26 ± 3 yrs; stature: 1.72 ± 0.10 m; body mass: 69 ± 17 kg, mean \pm SD) underwent PS, AS and control sessions randomly on different days. Stretching routines had similar durations and involved bilaterally the muscles acting around the knee and ankle. Before and after the intervention, hip, knee and ankle range of motion (ROM), maximum voluntary isometric contraction (MVC), and maximum muscle activation [surface electromyography, sEMG, root mean square (RMS) from the investigated muscles] were measured. Static and dynamic BC parameters were determined by stabilometry in bipedal and monopodal conditions (with both open and close eyes). sEMG was recorded during the balance test and normalized to MVC.

Results: After the intervention, ROM increased in all the joints ($p < 0.001$) and MVC decreased (PS: $p < 0.001$; AS $p = 0.03$) together with sEMG RMS (PS: $p = 0.01$; AS $p = 0.02$) in all the investigated muscles. BC was unaffected. However, an overall significant increment in sEMG RMS was found in all the tested muscles during balance tests (p from 0.02 to < 0.001).

Conclusions: These findings suggest that muscles directly involved in BC were more activated to maintain a similar performance, likely as a possible compensation in response to altered proprioceptive feedback from the stretched muscles.

References

1. Lima BN et al. (2014) The acute effects of unilateral ankle plantar flexors static-stretching on postural sway and gastrocnemius muscle activity during single-leg balance tasks. *Journal of Sports Science and Medicine* 13: 564–570
2. Chatzopoulos D et al. (2015) Acute effects of different stretching methods on balance, agility, reaction time and movement time. *Journal of Sports Science and Medicine* 13: 403–409
3. Trajano GS et al. (2017) Neurophysiological Mechanisms Underpinning Stretch-Induced Force Loss. *Sports Medicine* 47: 1531–1541

OP1-3**Respiratory frequency is associated with exhaustion during a maximal incremental cycling test**A. Nicolò¹, G. Toffoli^{1,2}, M. Girardi¹, M. Sacchetti¹¹Department of Movement, Human and Health Sciences, University of Rome “Foro Italico”, Italy;²Université de Bordeaux, Faculté des STAPS, Pessac, France

Purpose: Respiratory frequency (f_R) is emerging as a valid marker of physical effort during cycling exercise^{1,2}. Accordingly, it is conceivable that f_R is associated with exhaustion during incremental exercise. We tested the hypothesis that f_R is more sensitive to the occurrence of exhaustion compared to traditionally measured physiological variables.

Methods: 27 well-trained male cyclists performed a ramp incremental test to exhaustion with an increase in work rate of 30 W·min⁻¹. Ventilatory and cardiorespiratory variables were measured throughout the test. The time course of the physiological variables was assessed, with a particular interest for the last minute of the test, which was subdivided into three parts of 20 s. A Cox proportional hazard model was used to verify if exhaustion can be predicted by the time course of the selected physiological variables.

Results: Within the last minute of the incremental test, f_R increased more ($10 \pm 12\%$; $P < 0.001$) compared to other physiological variables such as heart rate ($1.3 \pm 0.9\%$; $P < 0.001$) and respiratory exchange ratio ($2.2 \pm 2.8\%$; $P < 0.001$). Conversely, $\dot{V}O_2$, tidal volume and total respiratory cycle duration (Ttot, the inverse of f_R) showed a significant ($P < 0.001$) decrease. A Cox model showed that the slope of the linear regression of Ttot predicts exhaustion with good accuracy, along with the slope of heart rate and respiratory exchange ratio.

Conclusions: Our findings show that f_R is more sensitive than other physiological variables to the occurrence of exhaustion and that the time course of its inverse (Ttot) predicts exhaustion with good accuracy. These findings have important implications for exercise testing and performance prediction.

References

1. Nicolò A et al. (2017) Differential control of respiratory frequency and tidal volume during high-intensity interval training. *Experimental Physiology* 102: 934-949
2. Nicolò A et al. (2017) Respiratory frequency during exercise: the neglected physiological measure. *Frontiers in Physiology* 8: 922

OP1-4**Electrical stimulation-induced fatigue in the contralateral leg impairs endurance exercise performance**F.G. Laginestra¹, M. Amann², E. Kirmizi^{1,3}, G. Giuriato¹, F. Ruzzante¹, C. Tarperi¹, M. Venturelli¹¹Department of Neurosciences, Biomedicine, and Movement, University of Verona, Italy;²Department of Anaesthesiology, University of Utah, Salt Lake City, Utah, United States;³Department of Physiology, Faculty of Medicine, Uludag University, Eskisehir, Turkey

Purpose: During fatiguing exercise, the development of peripheral fatigue and the associated increased firing of group III/IV afferent

fibers, promote central fatigue. The aim of this study was to assess whether peripheral fatigue in one leg (i.e. contralateral), induced by direct electrical quadriceps stimulation to bypass central command, would impair endurance performance of the subsequently exercising other leg.

Methods: Eight young healthy males were recruited for this study. After completing an incremental test to exhaustion on the single-leg knee extensor ergometer, the subjects performed two tests on separate days. On the first day, they performed a time-to-exhaustion test at 85% of their maximal power output (NF trial). Exercise-induced quadriceps muscle fatigue was assessed by evaluating changes in supramaximal electrical femoral nerve stimulation ($Q_{tw,pot}$), maximal voluntary contraction (MVC) and voluntary activation (VA) from pre to post exercise. On the second day, the same exercise bout was preceded by the induction of fatigue in the contralateral quadriceps through electrical stimulation (F trial). The pre-fatiguing protocol was terminated once the subjects reached the maximum tolerance score on a 1-10 visual analogue scale (duration: 6.6 ± 0.9 min).

Results: Time to exhaustion in the F trial was reduced by 41% (9.1 ± 1.5 to 5.4 ± 1.2 min, $p < 0.05$). The reduction in MVC (-36 ± 8 vs $-23 \pm 10\%$, $p < 0.05$) and $Q_{tw,pot}$ (-53 ± 3 to $-39 \pm 9\%$, $p < 0.05$) was more accentuated in the NF trial compared to F. Conversely, VA was more affected in F than in NF (-21 ± 7 vs $-15 \pm 5\%$, $p < 0.05$).

Conclusions: Pre-induced muscle fatigue in the contralateral limb impairs endurance performance of the exercising limb. This crossover effect is likely mediated by the inhibitory influence associated with group III/IV muscle afferent feedback and not related to central changes associated with central command.

Reference

1. Amann M et al. (2013) Peripheral fatigue limits endurance exercise via a sensory-mediated reduction in spinal motoneuronal output. *Journal of Applied Physiology* 115: 355-364

OP1-5**Effects of fatigue after sustained maximal isometric contractions on peak relaxation rate during the TMS-induced silent period in upper versus lower limbs**G. Vernillo^{1,4}, J. Temesi^{2,4}, A. Khashtarash⁴, G.Y. Millet^{3,4}¹Department of Biomedical Sciences for Health, Università degli Studi di Milano, Milan, Italy;²Faculty of Health & Life Sciences, Northumbria University, Newcastle upon Tyne, United Kingdom;³Université de Lyon, UJM-Saint-Etienne, Inter-university Laboratory of Human Movement Biology, EA 7424, F-42023, Saint-Etienne, France;⁴Human Performance Laboratory, Faculty of Kinesiology, University of Calgary, Calgary, Canada

Purpose: Data are scarce on the effect of sustained maximal isometric voluntary contractions (MVCs) on the rate of muscle relaxation (mRR) in upper- (UL) vs lower- (LL) limb muscles. Assessment with transcranial magnetic stimulation (TMS) removes the descending drive and yields information that cannot be obtained via the classical approach of measuring the force response to peripheral nerve stimulation in relaxed muscle because no information about the properties of the muscle in its most functionally relevant state (during voluntary contraction) is provided. By using a 2-min MVC model¹, we aimed to investigate whether fatigue affects mRR during the TMS-induced silent period similarly in UL and LL.

Methods: Twelve men performed a 2-min MVC of the elbow flexors (EF) and knee extensors (KE) on separate days. Peak muscle relaxation rate (pRR) was assessed with TMS during brief MVCs before (PRE), at the end of the 2-min MVC (POST), and 5 more times within 8 min of recovery. pRR was determined from the decrease in EF and KE force during the TMS-induced silent period and calculated as the negative slope over a 10-ms interval (5 ms either side of the steepest instantaneous slope) and normalized to the total force (voluntary plus evoked) prior to the silent period. This measure reflects pRR of all EF or KE muscle fibers active in the ongoing contraction (or activated during the TMS-induced motor-evoked potential).

Results: EF presented faster pRR than KE at PRE (-11.2 ± 2.9 vs -6.6 ± 2.9 s⁻¹, $p < 0.001$) but not POST ($p = 0.31$). pRR was slower than PRE for EF only at POST (-73% , -6.1 ± 2.5 s⁻¹, $p < 0.001$; all other time points $p \geq 0.32$ vs PRE). For KE, pRR was not different from PRE either at POST (-23% , -5.4 ± 2.4 s⁻¹, $p = 0.24$) or during recovery ($p \geq 0.99$).

Conclusions: pRR is faster in EF than KE at baseline and slowed with fatigue in EF but not KE, meaning that higher rates of motoneurone discharge would be required to generate maximal force. These data are important to understand the effect of fatiguing exercise on in vivo muscle contractile properties and may have real world implications since EF and KE are functionally different¹ and mRR is prolonged in a number of neuromuscular diseases².

References

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- Kleine BU, Stegeman DF (2007) Stimulating motor wisdom. *Journal of Applied Physiology* 102: 1737-1738

SATURDAY ORAL SESSION 1

OP2 PHYSICAL EXERCISE AS PREVENTION AND THERAPY

OP2-1 KEYNOTE

Effects of acute whole-body vibration practice on maximal fat oxidation in adult obese male

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Purpose: Whole-body vibration (WBV) training has been established to be a useful method to improve physical fitness in obese individuals. However, the effects of WBV exercise on maximal fat oxidation (MFO) have not been examined in obese subjects yet.

Methods: MFO was evaluated during a cardiopulmonary exercise test (CPET) on a treadmill in 12 adult obese males (BMI = 34.9 ± 3.3 kg/m²) after three different warm-up conditions: static half squat plus

WBV (HSV), static half squat without WBV (HSWV) and rest (REST). Cortisol levels were evaluated before (PRE) and after (POST) the warm-up, and 1 min (T1), 10 min (T10) and 30 min (T30) of recovery phase.

Results: MFO was significantly higher in HSV ($p = 0.013$; 569.4 ± 117.9 mg/min) and HSWV ($p = 0.033$; 563.8 ± 142.9 mg/min) than REST (445.5 ± 117.9 mg/min). Cortisol concentrations at T1 were significantly higher in HSV ($p = 0.023$) and HSWV ($p = 0.015$) than REST. Moreover, cortisol concentrations were significantly lower at T30 than T1 in HSWV ($p = 0.04$). No differences were found between T30 and T1 in HSV.

Conclusions: Active warm-up increases MFO, however, vibration stimulus during half squatting does not increase MFO during a cardiopulmonary exercise test, in obese subjects. The lack of significant differences of cortisol concentrations in HSV during recovery phase might suggest a long-term effect of whole-body vibration on endocrine system.

Reference

- Giunta M et al. (2012) Growth hormone-releasing effects of whole body vibration alone or combined with squatting plus external load in severely obese female subjects. *Obesity Facts* 5: 567-574

OP2-2

Monitoring physical activity through digital technologies boosts the adherence to a multidisciplinary weight loss program

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Purpose: Technological innovations provide significant opportunities for physical activity promoters to reach populations, leading a larger amount of individuals to maintain a positive lifestyle change¹. Our aim is to evaluate the effectiveness of a 6 months smartphone-based physical activity program (IG), compared to unsupervised home-based (CG) intervention, to improve 3 and 6 months appointments' attendance and overall outcomes in patients with severe obesity, who completed a 3-week inpatient exercise and nutritional intervention.

Methods: 338 patients (CG: 62%F, 53 ± 13 yrs, 41.8 ± 8.1 kg/m²), who completed the 3-week inpatient program before July 2017, received general indications about physical activity without any monitoring after discharge. Since then, we developed and proposed to 37 patients (IG: 48%F, 53 ± 10 yrs, 42.8 ± 7.9 kg/m²) a smartphone application (CERISM + Salute), through which they recorded their daily steps and exercise sessions and received motivational support. After 3 and 6 months from discharge, attendance rate to follow-up (%) and changes in anthropometric parameters (weight, BMI, Waist and neck circumference), functional performance (6 Minutes Walking Test, 30'' Chair Stand and 30'' Arm Curl) and the amount of physical activity (IPAQ questionnaire) of both groups were evaluated.

Results: Both IG and CG improved anthropometric and performance parameters over time ($p < .001$), and increased the amount of PA without any significant difference between groups ($p > .05$).

Furthermore, the rate of attendance to follow-up increased significantly ($p < .001$) in IG compared to CG: the adherence was 86% and 72% in IG and 57% and 33% in CG after 3 and 6 months, respectively.

Conclusions: Both groups showed a significant improvement in anthropometric and physical performance parameters, which is related to reduced cardio-metabolic risk. In addition, *CERISM + Salute*, by providing tailored practical and motivational support, increased the compliance of patients in terms of physical activity participation, sustained weight loss, and overall adherence to the treatment protocol after the inpatient phase. This is essential, because low attendance to follow-up appointments after a weight loss program may limit data analysis and interpretation².

References

1. Bort-Roig J et al. (2014) Measuring and influencing physical activity with smartphone technology: a systematic review. *Sports Medicine* 44: 671–686
2. Miller BM, Brennan L (2015) Measuring and reporting attrition from obesity treatment programs: a call to action! *Obesity Research and Clinical Practice* 9: 187–202

OP2-3

Effects of supervised sport-practice and unsupervised walking activity on physiological and body composition variables in obese adults

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Purpose: The literature has shown that physical activity (PA) can be an effective prescription to improve health and fitness in obese people. However, guidelines for PA interventions are still controversial. This study aims to investigate the effects of sport-practice and unsupervised PA on obese adults' aerobic capacity and body composition.

Methods: The sport-practice group (SpG), 13 obese adults (men = 7, women n = 6; age = 32.7yrs; body mass index (BMI) > 30 kg/m²) attended four months twice a week 80 minutes of supervised volleyball sessions combined with track and field exercises. The unsupervised PA group (UnsG), 14 obese adults (men = 4, women = 10; age = 35.5 yrs; BMI > 30 kg/m²) took part in a four-month unsupervised walking activity (30 minutes, three times a week) at the intensity corresponding to the individual aerobic threshold. Participants' weight, body composition (BMI, fat mass, fat free mass), maximal oxygen uptake (VO_{2max}) and metabolic equivalent (MET) were evaluated before and after the intervention.

Results: All variables were analysed using a 2 (group) x 2 (time) repeated measures ANOVA followed by appropriate post-hoc. Significant differences in VO_{2max} ($p < 0.01$) and MET ($p < 0.01$) in the interaction between group and time were observed. SpG significantly improved VO_{2max} and MET while the UnsG did not show any significant changes. No significant differences were found on body composition.

Conclusions: Our results suggest that sport environment and the presence of physical education teacher are highly important factors in successful PA interventions. Moreover, PA without an individualized diet program might not be enough to obtain positive effects on body composition.

References

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2. Emerenziani G, et al. (2013) Physical exercise intensity prescription to improve health and fitness in overweight and obese subjects: A review of the literature. *Health* 5: 113–121

OP2-4

Preliminary validation of the Italian version of the volition exercise questionnaire

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Purpose: The World Health Organization (WHO) estimates in 2016 that 39% of women and 39% of men aged 18 and over were overweight. Recent studies confirm that motivation represent an important factor in exercise adherence. Studies of adherence to physical activity protocols in obese show that 43% of subjects dropped out after two months and percentage increased until 60% after four months. Therefore, it is important to investigate not only motivation but also volition. To this purpose the aim of the current study is to validate the Volition Exercise Questionnaire (VEQ) in Italian.

Methods: Volition Exercise Questionnaire (VEQ), Exercise Motivations Inventory (EMI-2) and Psychobiosocial States in Physical Education (PBS-SPE) were administered to 250 university students (age 21.0 ± 2.3 yrs; 71 females and 179 males). Principal component analyses (PCA), using the method of extraction of the main axes and Varimax oblique rotation was carried out. Reliability analysis with Cronbach's alpha values was calculated. Finally, a Pearson's correlation among VEQ, EMI-2 and PBS-SPE was performed.

Results: The results of the PCA supported the original structure of the six factors of the VEQ. The reliability of the scales was estimated by Cronbach alpha whose values were: 0.78 for Volitional Inhibition (VI) Reasons, 0.82 for VI Post-training, 0.85 for VI Unrelated Thoughts, 0.84 for Volitional Facilitation (VF) Self-confidence, 0.72 for VI Approval and 0.79 for VF Coping with failure. No gender differences were found. Significant positive correlation with some EMI-2 factors (Appearance, Competition, Social-Recognition, Strength & Endurance) between 0.121 and 0.171, while with PBS-SPE eight-factors have correlated between 0.130 and 0.216.

Conclusions: The results of the study highlight satisfactory psychometric properties of the VEQ Italian version. The questionnaire can therefore be administered to Italian subjects to investigate volition in special population such as Obese and osteoporotic.

References

1. Elsborg P et al. (2016) Development and Initial Validation of the Volition in Exercise Questionnaire. *Measurement in Physical Education and Exercise Science* 21: 57–68
2. Emerenziani GP et al. (2018) Effects of an individualized home-based unsupervised aerobic training on body composition and physiological parameters in obese adults are independent of gender. *Journal of Endocrinological Investigation* 41:465–473

OP2-5

Effects of an individualized home-based unsupervised aerobic training on oxygen pulse in obese women

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Purpose: Oxygen pulse (O₂P) has emerged as a strong prognosticator for cardiovascular diseases (CVD). The aim of the study was to investigate the effects of an individualized home-based unsupervised aerobic training on O₂P in obese adult women.

Methods: Forty-five obese adult women (age: 47.5 ± 11.5 years, BMI = 35.9 ± 5.9 kg/m²) were involved in this study. According to their compliance to exercise, subjects were divided into three groups: high compliance (HC, PA 3–5 d/wk) low compliance (LC, PA < 3 d/wk) and control group (CG, no PA). After body composition assessment, subjects performed a sub-maximal incremental graded exercise test on a treadmill to evaluate individual ventilatory threshold (IVT), O₂P, relative O₂P and oxygen uptake at peak (VO_{2peak}) at baseline and after 4-month of Physical Activity (PA). PA consisted in at least 30 minutes per day of unsupervised walking at IVT intensity.

Results: Significant time and time*group effects on body weight, BMI, percent of fat mass (%FM), fat free mass (FFM), relative O₂P (RO₂P) and VO_{2peak} (RVO_{2peak}) were observed. PA intervention induced significant improvements of body composition and weight only in HC and LC groups. RO₂P and RVO_{2peak} significantly increased in HC (+7%, +8%: RO₂P = 14.4 ± 1.9 *pre* vs 15.4 ± 2.2 ml/kg/beat *post*; RVO_{2peak} = 20.9 ± 3.3 *pre* vs 22.6 ± 3.5 ml/kg/min *post*) and LC (+12%, +8%: RO₂P = 13.8 ± 1.8 *pre* vs 15.4 ± 2.4 ml/kg/beat *post*; RVO_{2peak} = 19.9 ± 3.2 *pre* vs 21.5 ± 3.5 ml/kg/min *post*) whereas in CG (RO₂P = 15.1 ± 2.6 *pre* vs 14.9 ± 2.6 ml/kg/beat *post*; RVO_{2peak} = 21.7 ± 4.3 *pre* vs 21.2 ± 4.0 ml/kg/min *post*) they did not change.

Conclusions: Four-month of individualized home-based unsupervised aerobic training was effective for increasing the relative O₂P and VO_{2peak}, reflecting a reduced risk for CVD and an improved cardiorespiratory fitness, respectively, in obese adult women. Moreover, the exercise intervention was highly effective at improving body composition.

OP3 POSTURE AND FUNCTIONAL RECOVERY

OP3-1 KEYNOTE

Changes of proprioception after total knee arthroplasty

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Purpose: Total knee arthroplasty (TKA) is the gold standard procedure to treatment of severe arthrosis which aims to alleviate the pain

and restore the locomotor functions. TKA procedure can affect the proprioception which is a significant factor in balance, joint stability and coordination.

The aim is to evaluate proprioception and postural control in subject with TKA, before and after the surgery, using Delos Postural Proprioceptive System (DPPS; Delos, Turin, Italy).

Methods: This study included 12 subjects (6 women and 6 men; age 67.1 ± 4.9 years) scheduled for TKA. DPPS was used before and after the surgery. The two tests considered to evaluate postural and proprioceptive control were stabilometric test and static Riva test. Parameters considered were the Stability Index (SI; percentage score based on autonomy and postural instability), Autonomy (AU; percentage score based on hands support) and Postural Instability (PI; score in degree based on movement of trunk).

Results: The SI measured during the single stance test improved from 58.3% ± 22.0 to 71.6% ± 17.4 with open eyes and decreased from 36.8% ± 10.5 to 33.2% ± 10.2 with closed eyes in the operated limb. PI measured during the double stance test increased of 0.10° with open eyes and decreased of 0.10° with closed eyes. AU improved with open eyes and slightly decreased with closed eyes.

Conclusions: The reduction of pain and the restoration of limb alignment are probably the main reasons for the several improvements of SI and AU during open eyes tasks, whereas the lack or ineffectiveness of the proprioceptive system, could be the cause of failure improvement of closed eyes tasks. In TKA, mechanoreceptors of the knee are sacrificed, this should result in a drop of the proprioceptive information, and consequently a decreased of balance and increased of risk of falls.

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OP3-2

Low back pain prevalence in young alpine skiers

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Purpose: Despite several biomechanical studies analyzed the spinal loading patterns in alpine skiing, only a few focused on the prevalence of low back pain (LBP) in this sport^{1,2}. The aim of this cross-sectional study was to investigate the prevalence of LBP among young alpine skiers in the Veneto region, Italy.

Methods: 188 alpine ski racers (58.5% male) aged between 15 and 18 years volunteered. They filled-in the Nordic Musculoskeletal Questionnaire (NMQ) and the Graded Chronic Pain Scale (GCPS), and responded to a series of specific questions regarding skiing practice and athletic preparation (e.g. years of practice, number of competitions in the last season, number of training sessions/week, adoption of warm up before skiing).

Results: According to the NMQ, the prevalence of LBP during the previous twelve months was 80.9% and 79.5% in male and female, respectively. In contrast, the last seven days pain prevalence was 42.7% (male) and 60.3% (female). According to the GCPS, 57.4% of the subjects exhibited low intensity pain with low disability and 21.8% high intensity pain with low disability. No statistically

significant correlation was found between LBP intensity and training/competition parameters.

Conclusions: This study provides a new set of data regarding the prevalence of LBP in a significant sample of young alpine skiers. Irrespectively of the fact that the large majority suffered only low intensity LBP, a high LBP prevalence was present. Therefore, specific prevention actions should be implemented in this particular population.

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OP3-3

Electromyographic analysis of hip extension movement using unstable surfaces

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Purpose: Hip extension is an essential movement of lower body. Since there is a deep relation between hip region and the lumbo-pelvic complex, the neuromuscular pattern involved in this movement should be trained for injuries prevention, sport conditioning and rehabilitation. Even if previous studies suggested how to train those muscle in different conditions, the role of unstable surfaces is still debated. The aim of this study is to investigate the activation of hamstring, glutes and lumbar muscles during static prone hip extension movements executed with specific tools and joint positions.

Methods: Ten healthy and trained subjects volunteered for the study (8 males and 2 females, mean age 26.5 years). They performed unilateral hip extension movements in prone position using Mat, Bosu and Fitball. Each movement was executed in both sides of the body (Right: R, Left: L) by holding static muscle contraction at 0° and 20° hip extension. Participants were lying prone on Mat and above unstable surfaces with knee in both extended (EXT) and 90° flexed (FLEX) positions. Muscle activity was recorded using electromyography (EMG) for biceps femoris (BF), gluteus maximus (GL) and lumbar erector spinae (LUM) in right and left side. Data were analyzed in order to compare unstable surfaces (Bosu and Fitball) with Mat (reference condition) and to quantify the role of the stabilizing side of the body.

Results: Muscle activity increased with progression of range of motion (from 0° to 20°) and level of instability (growing order: Mat, Bosu, Fitball) for BF, GL and LUM ($p < 0.05$) in relation to muscle's functional role. In particular, GL and BF showed higher values on Bosu and Fitball compared to Mat in both EXT and FLEX conditions at 20° for R and L movement sides, while contralateral side evidence increasing in EMG activity, especially during R EXT and R FLEX using Fitball ($p < 0.05$). LM EMG values were similar for R and L side in R EXT, L EXT, R FLEX and L FLEX ($p > 0.05$), while Mat evidenced increased muscle activity compared to Bosu and Fitball in stabilizing side for R EXT (0° and 20°, $p < 0.01$) and L EXT (20°, $p < 0.05$).

Conclusions: In comparison to Mat, BF and GL increase their activity using unstable surfaces with higher values at 20° in both FLEX and EXT conditions, while at 0° they show similar EMG (compared to Mat at 20°) with lower LUM recruitment. Moreover, GL and LUM evidence an important stabilizing function for lumbo-pelvic region on the opposite side of movement. Consequently, isometric prone hip extension movement using Bosu and Fitball can be an effective exercise for posterior muscle chain conditioning.

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OP3-4

Postural balance, muscle strength, and history of falls in end-stage renal disease patients living with a kidney transplant: a cross-sectional study

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Purpose: End-stage renal disease patients living with a kidney transplant (KT) often present with frailty, functional disability, and mobility impairments that may result in a high risk of falls. Postural balance and muscle strength are implicated in the etiology of falls in the geriatric population, and both may be impaired in KT patients. Therefore, we explored the association between postural balance, muscle strength and falls in this patient population.

Methods: Fifty-nine prevalent KT patients (age = 53.2 ± 11 years) were classified as fallers/non-fallers and underwent a comprehensive, objectively-measured, assessment of postural balance and muscle strength.

Results: Thirty-four percent of the study participants reported at least one fall in the previous 12 months. In logistic regression analysis, postural balance (OR: 1.27, 95% CI: 1.08-1.48, $p = .003$), and ankle dorsiflexion strength (OR: 0.87, 95% CI: 0.75-0.99, $p = .044$) were independently associated with increased odds of falling.

Conclusions: This cross-sectional study indicates that patients living with a KT are at higher risk of falls compared to the non-uremic, age-matched population. Postural balance and strength are exercise-modifiable risk factors that should be incorporated in multifactorial interventions aimed to reduce falls. The minimal detectable changes at the 95% confidence interval of the postural balance variables are also provided within this paper.

OP3-5

The warm-up effect on postural stability in dominant and nondominant one-legged stance

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Purpose: Dominant (D-leg) and nondominant (ND-leg) legs exhibited differences in terms of postural control. Warm-up increased temperature elevation improves the output of sensory, integration, and motor functions. The aim of the present study was to evaluate the postural control between D-leg and ND-leg over time after a warm-up.

Methods: Twelve well trained students (8 m, 4 f) participated. The experiment consisted in a basal balance assessment (pre) followed by a warm-up (10 min of cycle ergometer at an intensity of 20 on the CR-100 Borg's scale) then, balance assessments after 2 (post), 5 (p5), 10 (p10), 15 (p15) and 20 (p20) minutes. The balance was assessed standing one-legged barefoot and as motionless as possible during 25.6 sec on a force platform. Were measured displacements center of foot pressure ($COP_{tot\ sway}$) in antero-posterior ($COP_{AP\ sway}$), medio-lateral ($COP_{ML\ sway}$) directions and calculated the ellipse ($COP_{ellipse}$).

Results: The Wilcoxon sign rank test showed a positive warm-up effect on D-leg after 20 min in all the parameters considered: $COP_{tot\ sway}$ ($p = 0.0009$), $COP_{AP\ sway}$ ($p = 0.002$), $COP_{ML\ sway}$ ($p = 0.009$) and $COP_{ellipse}$ ($p = 0.002$). Friedman's ANOVA showed a warm-up effect on the D-leg for the variables: $COP_{tot\ sway}$ ($p = 0.005$), $COP_{AP\ sway}$ ($p = 0.008$) and $COP_{ML\ sway}$ ($p = 0.02$) no significance differences were observed for ND-leg. The multiple comparison obtained by the Nemenyi post hoc test shows significant decrease in $COP_{tot\ sway}$ in D-leg between pre and p20 ($p = 0.005$), $COP_{AP\ sway}$ D-leg between pre and p20 ($p = 0.02$) and $COP_{ML\ sway}$ D-leg between pre and p20 ($p = 0.008$).

Conclusions: the results suggested that Warm-up induced an improvement of postural control 20 min after the end of the exercise but not in the same way between D-leg and ND-leg. This might be due to a different physiological response to the warm-up between the two legs.

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OP4 SPORTS AND EXERCISE PHYSIOLOGY

OP4-1 KEYNOTE

Cardiorespiratory responses to cycle exercise during a low-intensity sinusoidal work rate

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Purpose: Sinusoidal varying protocols have been recently re-proposed in assessing the cardiorespiratory response (CRR) to exercise to reflect the variability in long-lasting physical activities. Contrary to square-wave tests, the cyclic nature of sinusoidal work rate allows to

explore the CRR kinetics several times. Previous studies used to overlap CRR of successive periods; however, so far no study assessed whether CRRs are constant along different cycles. Therefore, this study aimed at investigating the CRR during an exhausting low-intensity sinusoidal work rate.

Methods: Seven subjects (age: 27 ± 7 yr, body mass: 72.5 ± 6.7 kg; stature: 1.8 ± 0.1 m) participated to the study. After determining on different days the maximum oxygen uptake ($\dot{V}O_{2max}$) by ramp cycle ergometric test and critical power (CP) via different submaximal exercises, they underwent a sinusoidal work rate until exhaustion. The exercise varied according to a sinewave function with a midpoint (MP) equal to 50 W below CP (CP-50), an amplitude (A) of 50 W and a period of 4 min. Expiratory ventilation ($\dot{V}E$), carbon dioxide output ($\dot{V}CO_2$), oxygen uptake ($\dot{V}O_2$) and heart rate (HR) were obtained breath-by-breath and fitted off-line by the sinewave functions that minimized the residuals. Thereafter, A, MP and the time-delay (tD, the latency between mechanical and CRR signals) were obtained for each cycle. A one-way ANOVA for repeated measures was applied to test the effect of fatigue.

Results: MP of $\dot{V}E$, $\dot{V}O_2$ and HR significantly increased as well as A of $\dot{V}E$ and $\dot{V}CO_2$ ($p < 0.05$ for all parameters). On the contrary, A of HR decreased during the test ($p < 0.05$). No changes were detected on tD in all CRRs parameters.

Conclusions: This study demonstrates that despite the low intensity level of the sinusoidal protocol, the dynamics of CRRs are not constant. Therefore, averaging the CRRs of different cycles might introduce a bias in the outcomes concealing a marked change in CRRs.

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OP4-2

Effects of a half-marathon run on mitochondrial respiration in women platelets

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Purpose: This study was designed to test the hypothesis that metabolic perturbations induced by a single prolonged running session (half-marathon) result in changes of activity of mitochondria. Due to the invasive nature of muscle biopsies, minimally-invasive alternatives are gaining interest. It is known that acute strenuous exercise is linked to perturbations of inflammatory cells¹. However, the effects of a single physical strain on mitochondrial metabolism in human blood cells have been investigated only in one study².

Methods: Nine female recreational athletes (average age: 39 ± 12 years; BMI 21.5 ± 2.3 kg/m²) participating to the 2019 edition of R4S (21 Km) joined our study. Measurements were performed in the days before the competition (PRE) and immediately after finishing the race (POST) by taking whole blood (15 ml). Mitochondrial respiration in freshly purified human platelets was performed using O2 K Oxygraph with an optimized protocol. Data for the ROUTINE (R), LEAK (L), and maximal electron transfer

system (ET) respiratory states were collected. Hematological and hemochemical analyses were performed PRE and POST race.

Results: The number of circulating platelets increased significantly during the run (1.24 folds; $p = 0.002$) without any significant change in MPV. Mitochondrial oxygen consumption was significantly increased in the “basal” unstimulated ROUTINE state (Flux 2.3 fold; $p = 0.005$; FCR +2.2 fold; $p = <0.0001$). The capacity to express the maximal oxygen consumption was reduced by 25% after the run (POST vs. PRE). The dissipative oxygen consumption in the LEAK state was increased (1.43 fold; $p = 0.02$), and consistently the ETS coupling efficiency was reduced (-5.5%, $p = 0.004$). Interestingly the ROUTINE-linked oxygen consumption is associated to plasmatic levels of the CK plasmatic marker for muscle damage both before and after the race (PRE $p = 0.04$ $r = 0.633$; POST $p = 0.04$ $r = 0.695$).

Conclusions: The increased mitochondrial activity in the ROUTINE indicates a higher metabolic for the cells rate after the run, while the decreased coupling efficiency and reduced ETS capacity suggest that oxidative stress has been accumulated during the race. Platelets could be a suitable source to investigate systemic mitochondrial function in response to strenuous exercise. The approach is relatively easy and non-invasive, and allows repeated measures. Such studies could be extended to a larger number of subjects and variety of activities to obtain information on mitochondrial fitness.

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OP4-3

A simple method to quantify the metabolic intensity of cycling in obese patients

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Moderate-intensity physical activity (i.e. 3-5.9 METs) on most days of the week for a minimum of 150/250 min per week prevents weight gain/facilitates weight loss and prevents weight regain in obese individuals¹. Accurate quantification and monitoring of exercise intensity, as described by METs, allows individualised prescription. Heart rate index (HR_{index}) was proposed as a simple alternative to costly gold-standard methods to estimate the metabolic intensity of exercise in healthy and clinical populations².

Purpose: We tested the performance of HR_{index} in estimating METs in obese individuals during cycling.

Methods: In 39 individuals with class III obesity (25♀, 14♂, 51 ± 11 years, BMI 41 ± 6, 21 ± 5 mLmin⁻¹) we measured oxygen consumption (VO₂) and HR during step-incremental cycling. We determined HR_{index} (= current HR/resting HR, equal to 68 b·min⁻¹, as *per* standard HR_{index} method²) and measured METs (mMETs = current VO₂ (mL·min⁻¹)/resting metabolic rate, as derived from population-specific, age-corrected equations³). Then, we estimated metabolic intensity as: eMETs = (HR_{index} *6)-5². Overall correspondence between mMETs and eMETs was evaluated by paired t-test, correlation and Bland-Altman analysis.

Results: Overall mMETs (5.4 ± 2.1 METs) was not significantly different from (5.5 ± 2.2 METs, $p = 0.68$) and significantly correlated with ($r = 0.76$ $p < 0.001$) eMETs. Bland-Altman analysis revealed a small, non-significant difference between mMETs and eMETs (bias = -0.03 METs, $z = 0.41$), however with a relatively large imprecision (SD of the difference = 1.45 METs).

Conclusions: Our data support the validity of HR_{index} to estimate the metabolic intensity of cycling exercise in obese patients. By offering a simple and valid alternative to the direct gold-standard determination of the metabolic intensity HR_{index} favours the generalised applicability of measures of exercise dose. The use of measured individual resting HR and resting metabolic rate may improve the method's precision.

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OP4-4

Is the 1:1 relationship between HRR and VO₂R preserved during steady-state aerobic exercise?

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Purpose: Guidelines on aerobic exercise intensity prescription recommend to use the percentages of oxygen uptake reserve (%VO₂R) or heart rate reserve (%HRR) interchangeably¹. However, their 1:1 relationship derives from incremental exercise, thus may not be preserved during steady-state exercise (SSE)². This study aimed to assess if the %HRR and %VO₂R parameters (PAR) show a 1:1 relationship during SSE and if their relationship is affected by exercise intensity (INT) and duration (DUR).

Methods: Eight physically active males (age 22.6 ± 1.2 yrs) were recruited. Pre-exercise HR (Polar V800) and VO₂ (Cosmed K5) were measured with participant standing, while maximal values were assessed using a graded exercise test (GXT) to exhaustion. On different days, four SSEs were performed (by running) at the randomly assigned DURs of 15 or 45 min, and INTs of 60 or 80% of the HRR calculated with pre-exercise and maximal values. Immediately after each SSE, HR and VO₂ maximal values were assessed using the GXT.

The HR and VO₂ averages of the last 5 min of each SSE were converted in percentages of the reserve (%RES) using pre-exercise values and post-SSE maximal values, and used in a 3-way RM-ANOVA to assess if they are affected by PAR, INT, and DUR ($\alpha = 0.05$).

Results: The %RES values were neither affected by PAR ($p = 0.056$) nor by the interactions of PAR with INT ($p = 0.319$) or PAR with

DUR and INT ($p = 0.117$). The %HRRs and %VO₂R were not different during the 15-min SSEs (mean difference = 0.6 percentage points, $p = 0.717$), whereas %HRR was higher than %VO₂R during the 45-min SSEs (mean difference = 6.7 percentage points, $p = 0.009$).

Conclusions: The 1:1 relationship between %HRR and %VO₂R seems to be preserved only during relatively short SSEs, whereas during longer SSEs the actual association between %HRR and %VO₂R needs to be further investigated.

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OP4-5 Repeated time to exhaustion running tests reliability is influenced by improvements in endurance capacity

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Purpose: Among the tests adopted in a laboratory setting, time to exhaustion (TTE) is one of the most commonly used and sometimes applied in repeated multiple sessions. However, the large variability in TTE could mask the training effect due to the intervention. Different fitness levels may also influence consistency in measures. The aim of this study was to investigate the effects of repeated TTE on endurance capacities in participants with different fitness levels, which may affect the reliability of TTE.

Methods: Twenty-five healthy males (28 ± 6 yr, 75 ± 10 kg, 175 ± 5 cm,) ran on a motorized treadmill six TTE at a speed associated to the 105% of the second ventilatory threshold, assessed during a ramp CPET incremental test, interspersed with 7 days of recovery between sessions. Intraclass correlation coefficient (ICC), coefficient of variation (CV), standard error of measurement (SEM), duration (s), heart rate (HR) and oxygen consumption ($\dot{V}O_2$) were assessed at the first (TTE1) and the last (TTE6) session. Subsequently, participants were divided into three sub-groups accordingly to the $\dot{V}O_{2max}$ to perform a stratified analysis (G1: $n = 8$, < 45 ml.kg.min⁻¹; G2: $n = 6$; G3: $n = 11$, > 55 ml.kg.min⁻¹).

Results: Comparing TTE1 to TTE6, ICC was 0.63, CV was $15.9\% \pm 9\%$, SEM was 222 s. For all groups, no differences were found at exhaustion for duration, while peak HR decreased at TTE6 (178 ± 10.1 vs 174 ± 9.5 bpm, $p = .001$). Peak $\dot{V}O_2$ increased significantly from TTE1 to TTE6 only for G1 (42.5 ± 2.1 vs 46.6 ± 3.1 ml.kg.min⁻¹; $p = .03$).

Conclusions: Repeated TTE produced physiological adaptations resulting in enhanced endurance capacity, especially in participants with lower fitness level (< 45 ml.kg.min⁻¹). This could represent a source of bias in different experimental conditions.

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OP5 SPORTS TRAINING AND TESTING

OP5-1 KEYNOTE

Off-training physical behaviors in athletes: preliminary results from the 3ST Project

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Purpose: Physical activity (PA) and sedentary behavior (SB) have been extensively studied in general and pathological populations, while in athletes the attention has been focused almost only on sleep. The 3ST Project aims to investigate off-training Spontaneous PA, SB, Sleep, in relation to Training, in competitive athletes.

Methods: Athletes from different sports (Rugby, Serie A; Soccer, youth regional league; Volleyball, Female Serie B), wore a triaxial accelerometer (Actigraph® GT9X Link +, Pensacola, FL, USA) at wrist for 5 to 10 days, during off-training time. Furthermore, they completed diaries regarding PA, SB, and sleep time.

Results: Rugby players were on average moderately active (1.5 METs), with high amount of time spent in moderate-intensity PA (107.8 ± 33.6 min/day). On the other hand, they spent about half of the waking off-training time in light-intensity PA ($51.5 \pm 5.9\%$) and one third in SB (34.0 ± 8.7). The players were less active during the postprandial hours and on Thursday than the other days of the week. During the day following the match (Sunday) the athletes were even more active with respect to the day of the match and the other days of the week. Youth soccer players spent a large amount of time using electronic devices (3 – 12 hour/day), while female volleyball players during pre-season used to sleep more hours during the morning (8:00 – 12:00) and less during the night (00:00 – 7:00) than in-season.

Conclusions: Off-training physical behaviors are related to the recovery of the energy that athletes spend in training and competition. Monitoring athletes should involve daily PA and SB assessment in addition to sleep evaluation.

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OP5-2**Rating of perceived exertion in active young people: effect of chronotype**

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Purpose: The differences existing between individuals are determined by different expression of the circadian rhythmicity. In this way, individuals display preferences to be active at certain time of the day and based on these differences, they can be classified in three different chronotypes: M-, N- and E-types. Although several authors have investigated the relationship between circadian rhythms and sport-related variables, few studies have specifically evaluated the relationship between chronotype and sports performance. The study aimed to evaluate the effect of chronotype on aerobic performance, heart rate (HR) and Rating of Perceived Exertion (RPE).

Methods: 101 students attending the Motor Sciences School, University of Milan, participated to the study. The Morningness-Eveningness Questionnaire (MEQ) was administered to determine their chronotype. To investigate the effect of chronotype on aerobic performance, HR and RPE, 22 participants (11 M-types, 11 E-types) performed the Cooper test at 9 a.m. and at 5 p.m. Before and after the Cooper test, the RPE was detected using the Borg Scale CR0-10.

Results: M-types perceived less effort in the morning compared to the afternoon session ($p < .05$), both before (CR-10: 1.1 ± 0.8 vs 2.5 ± 1.3) and after exercise (CR-10: 7.4 ± 1 vs 8.6 ± 1). E-types felt more fatigued in the morning than in the afternoon session ($p < .05$), both before (CR-10: 2.4 ± 1.4 vs 1.1 ± 1.1) and after exercise (CR-10: 8.4 ± 0.6 vs 7.5 ± 0.7). Moreover, in the morning session, E-types had a greater perception of the effort (CR-10: 2.4 ± 1.4 vs 8.4 ± 0.6) than M-types (CR-10: 1.1 ± 0.8 vs 7.4 ± 1). By contrast, in the afternoon session, M-types showed higher RPE values (CR-10: 2.5 ± 1.3 vs 8.6 ± 1) than E-types (CR-10: 1.1 ± 1.1 vs 7.5 ± 0.7). No differences were found for Cooper Test and HR.

Conclusions: M-types perceived higher effort in the afternoon session, by contrast, E-types showed an opposite trend and were more fatigued in the morning session. Then, the possibility to schedule the experimental sessions based on subject's chronotype to obtain the best performances may be useful to the coach to plane tailored training programs.

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OP5-3**Sleep architecture of elite athletes in relation to a night competition**

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Purpose: The context and timing of physical activity play a key role for athletes' sleep: high-intensity exercise, especially when performed late close to bedtime, could negatively affect sleep¹. Polysomnography is the gold standard method to objectively study sleep stages but it is not commonly used with top-level athletes because it is expensive and not easily portable². The aim of this study was to evaluate the effect of a night competition on the sleep architecture in professional team sport players using a valid, portable, self-applied and multi-channel recorder.

Methods: Professional male volleyball (N = 7) and roller hockey players (N = 7) wore the Sleep Profiler (Advanced Brain Monitoring, Inc., Carlsbad, CA, USA) for three consecutive nights, one before (PRE) and two following (POST1 and POST 2) a night competition (08:00 p.m.) for the assessment of the following sleep parameters: Sleep Efficiency, Sleep Time, Sleep Latency, Wake After Sleep Onset, Stage N1, Stage N2, Stage N3, and Stage R.

Results: One-way RM-ANOVA followed by the Tukey-Kramer post hoc test was applied for each parameters. ST varied among the three nights ($p < 0.05$): athletes significantly reduced their sleep time from PRE (6.5 ± 1.8 hours) to POST1 (5.8 ± 1.3) ($p < 0.05$). On the contrary, none of the other sleep parameters showed significant differences in PRE, POST1 and POST2.

Conclusions: This study could help coaches understand how sleep changes during 3 nights near to a night competition and, consequently, help them implement appropriate post-competition sleep hygiene techniques to ensure athletes' complete recovery.

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OP5-4**A multidimensional approach to monitoring fatigue in indoor cycling**

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Purpose: Indoor cycling (IC) is a highly demanding activity, that if performed too frequently could contribute to develop overreaching (OR). A psychophysiological monitoring may help to assess if an athlete is well adapting to a training program. The aim of this study was to monitor 9 weeks of IC training using a multidimensional approach.

Methods: 13 healthy active subjects (8 males, 5 females; 20.7 ± 0.8 years) performed a 9 week step-incremental training program. Before and after training program, VO_{2max} testing was performed. POMS questionnaire and RPE scores were collected before and after each training session, respectively; heart rate was recorded during the sessions. Global Mood Score (GMS), TRIMPs, Monotony, sRPE:TRIMP and RPE:HR ratios have been calculated. Test MANOVA for repeated measures was conducted ($\alpha = 0.05$).

Results: Participants completed 36 training sessions (61 ± 7 min). Training intensity distribution: $56 \pm 20\% < LT_1$, $LT_1 < 23 \pm 14\% < LT_2$, and $21 \pm 14\% > LT_2$. VO_{2max} and power output improved after training ($p < 0.05$). A linear reduction in both HR mean and max has been observed throughout the weeks ($p < 0.001$). Training monotony, sRPE, RPE:HR and sRPE:TRIMP ratios linearly increased during the training period ($p < 0.01$); an increasing trend has been found for GMS ($p = 0.015$).

Conclusions: A decrease in mean and max HR and increases in RPE:HR and sRPE:TRIMP ratios are consistent with what found in professional cyclists after a Grand Tour, and both high monotony values and increased GMS have been reported in overreached athletes. Nevertheless, after a 4 days recovery period, an improvement in performance was found in post-training VO_{2max} test, despite a reduction in HR_{max} . If IC is performed too frequently, it could lead to OR. A multidisciplinary monitoring approach may help to prevent OR negative outcomes.

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OP5-5

Immunoglobulins serum and cortisol levels response to antioxidant CoQ10 supplementation in repeated futsal matches

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Purpose: Insufficient dietary antioxidant intake could affect the immune system enhancing the risk of infections. Coenzyme Q10 (CoQ10) could decrease the risk of infection after intense physical activity. The study aim was to determine the effects of short-term antioxidant CoQ10 supplementation on immunoglobulins (Ig) and cortisol serum levels after subsequent exhaustive tasks in futsal.

Methods: Twenty-four male futsal players (age 24 ± 1 yrs; stature 1.74 ± 0.05 m; body mass 71.3 ± 3.5 kg; mean \pm standard deviation) were randomly assigned to four groups: i) Q10, ingesting

CoQ10; ii) M + Q10, ingesting CoQ10 and playing three futsal matches; iii) PBO, ingesting placebo, and iv) M + PBO, playing the three matches and ingesting placebo. Participants played three futsal matches on three consecutive days at about the same time of the day. Players took CoQ10 (100 mg) or placebo three times per day in the days of the matches. Blood samples were collected from the ante-cubital vein for assessment of Ig and cortisol levels at baseline, immediately and 24 h after the last match.

Results: Effects of supplementary CoQ10 on both Ig and cortisol serum levels emerged in M + Q10, in which immunoglobulin A (IgA) and immunoglobulin G (IgG) levels did not drop as in M + PBO immediately after the three matches and 24 hours after the match ($p = 0.001$). Lastly, cortisol levels in M + Q10 did not increase after the three matches as in M + PBO ($P = 0.003$).

Conclusions: given that Ig are good hallmarks of the immune system status, athletes and futsal players may benefit by CoQ10 supplementation, especially during exhausting tasks, to reinforce the immune system.

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SATURDAY ORAL SESSION 2

OP6 SPORTS TRAINING AND TESTING

OP6-1 KEYNOTE

Classic and specific bioimpedance vector analysis (BIVA) in the evaluation of body composition in male elite youth soccer players

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Purpose: This study aimed to compare the two different bioimpedance vector analysis (BIVA) approaches (classic and specific) in the evaluation of body composition in male elite youth soccer players.

Methods: A sample of 178 players (age 12.19 ± 1.64 years), registered in a professional Italian soccer team (Bologna FC 1909) was assessed according to their maturity status. Bioelectrical resistance (R) and reactance (Xc) were obtained with a phase-sensitive 50 kHz bioelectrical impedance analysis device. The classic and specific BIVA procedures, which respectively correct bioelectrical values for body height (R/H and Xc/H, ohm/m) and body geometry (Rsp and Xcsp, ohm cm), were applied. The length of the bioelectrical vector was calculated as the hypotenuses of individual impedance normalized values. Anthropometric measurements included body height,

body weight and sitting height to estimate age at peak height velocity (APHV). Percentage of fat mass (%F) was estimated from triceps and subscapular skinfolds, whereas total body water (TBW) from bioelectrical values.

Results: Players were divided into 3 groups by maturity status: age specific z-scores of the predicted APHV identified players as earlier ($n = 29$), on time ($n = 126$) or later maturing ($n = 23$). TBW was higher ($p < 0.001$) in adolescents classified by maturity status as “Early” compared to the other two groups and classic BIVA confirmed these results. On the contrary, no statistically significant differences were found in %F and in specific BIVA among the groups. In addition, in comparison with the other two groups, the mean vector of the earlier maturing players showed a position closer than that occupied by adult elite soccer players.

Conclusions: Our results confirm that classic BIVA turns to be more accurate for the body fluids assessment, while specific BIVA for the analysis of fat mass. Furthermore, given that muscle mass and function, as indicated by bioelectrical vector length and phase angle, increase with the achievement of a more advanced maturity status, biological maturity should be taken into consideration to adequately assess the players’ characteristics in talent identification.

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OP6-2

Pattern of fat mass distribution and body asymmetry in athletes with physical impairments

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Purpose: In physically impaired athletes (PIA), body composition anthropometric predictive equations are of limited use because of low accuracy. A satisfactory explanation for such a low accuracy is not available. One factor could be a peculiar distribution of fat mass (FM) in the PIA body and/or the presence of body asymmetry. To test this hypothesis, we assessed regional %FM in 48 PIA (wheelchair-bound [PIA_WB; $n = 22$] and walkers [PIA_Walk; $n = 26$]) in comparison each with an age- and %FM-matched group of able-bodied athletes (ABA).

Methods: Regional (upper limbs, lower limbs and trunk) %FM was assessed in all participants by means of Dual-Energy X-ray Absorptiometry. The independent t-test was used to assess differences in regional %FM between each group of PIA and their respective ABA control group. A mixed-design 4×2 Analysis of Variance (ANOVA) with group (PIA_WB, PIA_Walk and their respective ABA) and body side (right and left) as the factors was performed to assess group by side interaction for %FM. If a significant interaction was detected, post-hoc pairwise comparisons with Bonferroni correction were carried out. In the case of impairment predominantly affecting one lower limb, the non-affected lower limb was considered as “right” while the affected lower limb was considered as “left”.

Results: the PIA_WB group had significantly lower (-4.6% ; $P = 0.018$) %FM in the upper limbs along with significantly greater ($+7.0\%$; $P = 0.003$) %FM in the lower limbs vs. the corresponding

ABA control group. The PIA_Walk group had similar %FM in the upper limbs along with significantly higher ($+5.3\%$; $P = 0.002$) %FM in the lower limbs vs. the corresponding ABA group. ANOVA revealed a significant main effect of group \times side interaction for %FM in the lower limbs ($F = 8.39$ and $P < 0.001$). Post hoc analysis showed that %FM was significantly lower (-7.3% , $P < 0.001$) in the right versus the left side in the PIA_Walk group only. No significant side difference was found in the other groups.

Conclusions: The results of the present study revealed that the %FM is not distributed in a similar manner in PIA, especially in PIA_WB. Moreover, the PIA_Walk have substantial body asymmetry in the lower limbs. Taken together these results may offer substantial explanation for the low accuracy of anthropometric predictive equations validated in ABA when used for predicting %FM in PIA and prompt for the development of population-specific equations.

OP6-3

Validity of the Mirwald equation as an estimate of stature in elite Italian rugby players

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Purpose: This study aimed to investigate the validity of the Mirwald formula (MF) as an estimate of stature in a cohort of rugby players.

Methods: This was a prospective study with agreement analysis of stature assessments conducted in 39 male youth rugby players (mean age 15.1 ± 0.9 years). The athletes were selected during the season 2007/2008 by rugby coaches using subjective decisions based on current performance and future potential. Adult players height was collected looking on the websites of the players’ teams in June 2018. Stature was estimated using the MF, which uses anthropometric measures including height, sitting height, body weight and leg length. Method agreement was assessed by intraclass correlation coefficient (ICC), regression, and plotted by Bland and Altman analysis.

Results: Twenty athletes played in the Italian National team and 19 in the First Italian Division. The athletes time since age of peak height velocity was, on average, 2.4 years. The means for adult and predicted height were 189.1 ± 5.1 and 187.4 ± 4.3 , respectively. The predicted height from MF was strongly comparable to actual height. ICC was $r = 0.923$ (95% CI = 0.70 to 0.97), showing an at least fair agreement (lower bound of the 95% CI > 0.600).

Conclusions: The MF may reliably predict the adult height in youth male rugby players. Notably, the MF does not require any additional equipment and uses anthropometric measures including height, sitting height, body weight and leg length. Thus, the MF could provide simple and inexpensive means to estimate adult height in youth rugby players.

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OP6-4**Indicators of body image dissatisfaction and perception inconsistency in young rhythmic gymnasts**

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Purpose: Athletes engaged in aesthetic sports, especially at competitive level, are at greater risk of developing body image disturbance and, as a consequence, eating disorders. The aim of this study was to analyze body image dissatisfaction and preferences on a sample of pre-adolescent rhythmic gymnasts, evaluating the influence of sports practice and body size on body image ideals.

Methods: 64 preadolescents practicing rhythmic gymnasts at competitive and non-competitive level (mean age: 10.1 ± 1.8) and 71 schoolgirls (mean age: 11.4 ± 0.3) were included in the study. Using the body image silhouettes developed by Collins (1991), all the 135 girls were asked to indicate their actual body image, their desired body image and the body image that they considered ideal for a rhythmic gymnast. Body image dissatisfaction and distortion were then evaluated through three body image indices, FID, FAI, and FID^{SPORT}. Moreover, we directly collected several anthropometric measures (height, weight, skinfolds, and circumferences), that allowed us to calculate weight status (BMI) and body composition parameters (FM, FFM, and F%) for each subject.

Results: Anthropometric traits, especially adiposity indicators, were significantly different among subgroups. As regard body image parameters, rhythmic gymnasts, especially competitive ones, preferred a thinner body but reported low body dissatisfaction and a general consistent perception of their body. Moreover, a higher dissatisfaction between their perceived body and the body image considered ideal for their sport was observed within competitive subgroups. Finally, multiple linear regression model revealed that the practice of rhythmic gymnastics and BMI are negative predictors of ideal body image.

Conclusions: Our study reported a general desire to be thinner among preadolescent girls, especially among those who practiced rhythmic gymnastics at a competitive level. The desired body is even skinnier if the ideal body for a rhythmic gymnast is considered, as a result of the body satisfaction transiency. This underlines the importance of the use of the new proposed index to evaluate body dissatisfaction in aesthetic sports.

Reference

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OP6-5**Age-related effect and physical performance in pre-pubertal football players: an exploratory study**

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Purpose: In youth football, as in many other team sports, players are usually grouped based on their chronological age. Generally, more mature children present greater anthropometric parameters and could exhibit differences in biological maturity¹. Thus, this study aims to investigate the effects of age on aerobic capacity (VO₂max) and the technical abilities of leading the ball in U10 and U12 male players.

Methods: Nineteen U10 and fifteen U12 boys were recruited from a local soccer school. Aerobic capacity (VO₂max) was estimated by performing a Yo-Yo Test adapted for children². Technical abilities were assessed with the shuttle dribble test³.

Results: Participants' anthropometric characteristics were as follows. Under 10 group: age, 9 ± 1 years; height, 133.0 ± 7.0 cm; weight, 34.5 ± 7 kg; BMI, 18.17 ± 2.3 kg/m². Under 12 group: age, 11 ± 1 years; height, 146.4 ± 8.3 cm; weight, 40.2 ± 9.2 kg; BMI, 18.64 ± 3.4 kg/m². The U12 group showed significant differences in both technical abilities ($p < 0.0001$, -15% of time required) and aerobic capacity ($p = 0.0016$, +9%). No significant differences were detected on BMI between groups ($p = 0.9423$). A moderate negative correlation was observed between technical abilities and aerobic capacity ($r = -0.61$, $p < 0.0001$)

Conclusions: U12 show better technical abilities and greater aerobic capacity (VO₂max). On the other hand, BMI was not different between the groups. In addition, we have observed a link between technical abilities and aerobic capacity. Thus, the findings of this study suggest paying great attention to physical conditioning in pre-pubertal age, because a good fitness can positively affect the technical expression of leading the ball.

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OP6-6**Youth performances are not related to success at senior level: the career pathways of world class sprinters**G. Boccia¹, M. Cardinale², A. Rainoldi¹, P.R. Brustio¹¹NeuroMuscularFunction | Research Group, University of Turin, Italy;²Aspire Academy, Qatar

Purpose: The study of the career pathways of elite athletes can provide information on how talent develops. In track and field, recent studies^{1,2} have identified career progressions from youth to senior in various countries and various athletics events. Whereas such studies have been performed on athletes in individual countries, limited information exists on the career trajectories of elite subjects at World level. Therefore, the aims of this study were to examine the career trajectories of world class athletes to have a better understanding of performance development in sprinting event.

Methods: A total of 6000 male and female athletes competing in the 100 m, 200 m, and 400 m races, and ranked in the top 100 IAAF lists in any of the seasons between the 2000 and 2018 were included in the study. Individual performance trends were generated by fitting a quadratic curve separately to each athlete's performance and age data using a linear modeling procedure. Athletes were then grouped in those unable to succeed, vs athletes capable of succeeding at junior level only, junior and senior, and at senior level only. The age of entering competition, the personal best performance, the age of reaching personal best, and junior performance development were identified.

Results: The results showed that the athletes able to succeed only at senior level consistently produced yearly improvements larger than athletes succeeding at an earlier stage in their career. Furthermore, the athletes that succeed only at senior started their career (17 y.o.) and reached their personal best (26 y.o.) later than those who succeeded only at junior level (starting age: 15 y.o.; age of personal best: 23 y.o.). In general, most of the top-class athletes were not top level when they were under 18.

Conclusions: This study confirms that early success is not a predictor of success at senior level. The performance improvements and its tracking provide the most suitable approach to identify athletes more likely to succeed and on the path to elite performances. We hope that the results of this study can provide useful comparative data for talent identification and development programs.

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OP7 SPORTS AND EXERCISE PSYCHOLOGY**OP7-1 KEYNOTE****Psychobiological interventions to facilitate exercise in physically inactive adults**S. Marcora^{1,2}¹School of Sport and Exercise Sciences, University of Kent;²Department of Biomedical and Neuromotor Sciences, University of Bologna, Italy

Purpose: To present a psychobiological model of physical activity behaviour and how this model could be used to develop interventions to facilitate exercise in physically inactive adults¹.

Methods: After a theoretical overview of the psychobiological model and related interventions, we will present a placebo-controlled, randomized, cross-over trial testing the effects of pre-exercise caffeine ingestion (3 mg/kg body mass) in 10 physically inactive adults undergoing high-intensity interval training (HIIT). HIIT consisted of four 4-min bouts of incline walking at > 85% max heart rate (HR) interposed by 3 min active recovery periods. The main dependent variables were heart rate, ratings of perceived exertion (RPE), exercise enjoyment and choice between different training sessions.

Results: During the HIIT sessions with caffeine, RPE was lower ($p < 0.05$) and exercise enjoyment was higher ($p < 0.05$) compared to the HIIT sessions with placebo despite similar HR profiles. Participants chose the caffeine HIIT sessions 80% of the time ($p < 0.05$).

Conclusions: These preliminary results suggest that pharmacological and non-pharmacological interventions based on the psychobiological model of physical activity behaviour have the potential to facilitate exercise in physically inactive adults.

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OP7-2**Effects of physical activity and acute exercise on free-recall memory**S. Piazza¹, A. Avancini², M. Lanza³¹Master in Preventive and Adapted Physical Activity, University of Verona;²Biomedical, Clinical and Experimental Sciences, Department of Medicine, University of Verona;³Department of Neurosciences, Biomedicine and Movement Science, University of Verona

Purpose: A growing amount of research points to the positive relationship between different types of physical activity (PA) and cognition. The aim of the study is to evaluate the relationships among PA, different types of exercise and the short and long-term words memorization.

Methods: Seventy-four students (17-19y; 45% females) performed a test based on the free recall of terms from a list of 20 words. Students participated in four test sessions under different conditions: a) a session was held at the arrival of the students at school (Basic); b) a second session was held after an hour of theoretical lesson (Th); the

third session followed a lesson in Physical Education (PE) characterized by circuit training (CT); d) the fourth one followed a PE lesson dedicated to the invasion game (IG). For each session, the number of elements recalled by the entire list of words (Tot), by its initial part (Pry) and by the final portion (Rec) have been recorded twice, in conditions of immediate (IR) and delayed recall (DR), obtaining six measurements (IR-Tot, IR-Pry, IR-Rec, DR-Tot, DR-Pry, DR-Rec). The students also completed a questionnaire to quantify PA (IPAQ) and they answered a question that asked if they had done at least 10 minutes of moderate or vigorous physical activity to arrive at school (walking or cycling).

Results: No correlation was observed between PA and Basic both analysed overall and separately by gender. In Basic, no difference was found among subjects who had practised PA or not, to get to school. In all memory measurements, with the exception of IR-Rec, better results were obtained in the tests performed after PA ($p < 0.01 \div 0.001$). In particular, in IR-Pry the measurements after CT and IG show that the words stored are $13.7 \div 15.0\%$ more than in Basic and Th ($p < 0.05$). In DR-Pry the words stored after IG are $11.3 \div 13.9\%$ more than in Basic and Th. In IR-Tot the words stored after CT are 4.7% greater than in Th ($p < 0.05$). In DR-Tot the words stored after CT are 7.1% greater than in Basic ($p < 0.05$).

Conclusions: The results tend to confirm the beneficial effects of exercise on memory performance while chronic PA does not show correlations with Basic measurement. In subsequent investigations, it seems necessary to adopt objective measures of PA, to ascertain that the poor correlation with the memorization data is not attributable to the possible inaccuracy of the questionnaires. The slight differences in the effects of the two types of exercises suggest a deepening of the specificities of each of them on words memorization.

OP7-3

Stroke velocity, perceived control, hedonic tone, and performance in tennis: a case study

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Purpose: To examine the relationship between stroke velocity, perceived control, hedonic tone, and performance outcome of a tennis player in the framework of the multi-action plan (MAP) model^{1,2}.

Methods: The participant was a female elite-level player (age = 24 yrs), who ranked in the top 200 international athletes. She was asked to identify the core components (e.g., hit point overhead) of serve, forehand, backhand tennis fundamentals and execute 60 serves, 60 forehands, and 60 backhands to hit target areas placed in the tennis field. Performance scores ranged from 0 (target missed) to 8 (most difficult target area). Stroke velocity was recorded using a wearable tennis swing analyzer. Hedonic tone perception was assessed on a modified 11-point Borg before each stroke, while perceived control of the core component of action was rated on the same scale after each stroke.

Results: Logistical ordinal regression analysis was conducted to examine the relation of performance level to stroke velocity, perceived control, and hedonic tone. Results showed large within

individual differences and fluctuations of stroke velocity, perceived control, and hedonic tone scores across the three tennis fundamentals.

Conclusions: Study findings are in line with the MAP model tenets and suggest the use of both action- and emotion-centered strategies in combination to help the athletes attain optimal performance states.

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OP7-4

The effect of mental fatigue on endurance performance: an EEG study

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Purpose: Cognitive control is the ability to consciously regulate feelings, thoughts and behavior¹. The negative impact of prolonged periods of effortful cognitive control on physical endurance has been established² but the underlying mechanisms remain to be elucidated. We aim to investigate such mechanisms using electroencephalography (EEG) to measure three relevant signatures of cortical activity: Theta (4-7 Hz), Alpha (8-12 Hz) and Beta (13-30 Hz)³.

Methods: We started with a pilot study, proving that variability in the endurance performance between the three sessions exists, both in the TTE results ($p < 0.05$), in Alpha ($p < 0.001$) and Beta activity ($p < 0.001$) with no other possible physiological explanations. Subsequently we conducted a randomized crossover study with a mental fatigue manipulation in 8 athletes. They cycled to exhaustion at 70% of the peak power output achieved during a preliminary incremental exercise test after 45 min of a demanding cognitive task (mental fatigue) or 45 min of reading magazines (control).

Results: The ratings of effort and fatigue significantly increased over time (effort: $p = .002$ - fatigue: $p = .03$) and the average HR was significantly higher during the mental fatigue manipulation. However, no significant impairment was observed in the following TTE test compared to the control condition. However, there was an effect of condition on the EEG signatures we analysed (Theta: $p < .001$; Beta: $p < .001$; Alpha: $p < .001$.)

Conclusions: Coherently with the expectations, EEG amplitudes are higher in the mental fatigue condition, meaning that the mental effort requested is higher but, probably, this effect was not strong enough for interfere with the subsequent endurance performance. Increasing sample size and the duration of the mental fatigue manipulation could be a solution for future studies.

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OP7-5

Get in endurance zone! EEG neurofeedback and physical performance

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Purpose: Electroencephalographic (EEG)-neurofeedback training is a non-invasive technique for modifying brain activity. This intervention was used to enhance motor control tasks, e.g. golf. However, its effect on whole-body physical exercise has not been examined yet. Frontal asymmetric activation has been interpreted as the lateralization of motivational direction across the right and left frontal cortex. Previous studies effectively manipulated frontal EEG asymmetry with neurofeedback; yet no behavioural outcome was studied. Because of the possible relevance of frontal asymmetry in the regulation of goal-directed behaviours, in this study we assessed the effect of neurofeedback for frontal EEG asymmetry on a whole-body physical task.

Methods: 40 individuals were recruited for a randomised, single-blind, parallel design and allocated to 3 groups (increase left cortical activity, NFL, $N = 13$, increase right, NFR, $N = 13$ and control, CON, $N = 14$). They performed a depleting cognitive task followed by either EEG-neurofeedback (NFL and NFR), consisting of 6×2 min sessions, or time matched-videos of the neurofeedback display (CON). Next, they performed a cycling time to exhaustion test (TTE).

Results: EEG-neurofeedback intervention modified brain activity in the expected way. The NFL group performed for over 30% longer than the other groups in the TTE (mean \pm S.E. NFL = 1382 ± 25 , NFR = 878 ± 17 , CON = 963 ± 12 sec, contrast tests $p = 0.05$). There were no group-differences in mood state nor in the rate of perceived exertion measured during the TTE, suggesting that the mechanism underlying neurofeedback benefits was a neurophysiological shift towards approach motivation.

Conclusions: Our results show that EEG-neurofeedback can be used to modulate frontal hemispheric asymmetry, and greater relative left frontal activity may enhance endurance performance.

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OP7-6

Role of lactic acid on cognitive functions

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Purpose: The term bodybuilding literally means, ‘building the body,’ and it identifies a discipline consisting of progressive overload training. The aim of this research was description of changes in cognitive performance obtained during slow performance of a regimen of exercise sessions. The performance was assessed using the 15.5 Workout exercises, which were published in the official website CrossFit®. The workout involves two exercises: rowing on a rower and barbell thrusters, to be carried out in four repetitions in order of decreasing repetitions 27-21-15-9.

Methods: 15 male CrossFit® professionals participated in the study; CrossFit® professionals performed the Workout 15.5. The workout begins seated on the rower with the monitor set to zero calories. At the call of ‘3-2-1 ... go,’ the athlete grabs the handle and begins rowing until the display shows 27 calories, when he/she moves to the barbell for 27 thrusters, then back to the rower for the round of 21, and so forth. Each time the athlete returns to the rower he/she resets the monitor to zero before rowing. Rounding up is not allowed. The score will be the time it takes to complete all 144 repetitions. Blood lactate, blood glucose, reaction time (RT), divided attention of a dual cognitive task, number of errors, and number of omissions were measured at rest, at conclusion of the session, and after recovery for 15 min.

Results: The bodybuilders had slightly elevated basal lactate levels than in untrained individuals. The results show that the increase in the lactate values is associated to a deterioration in both the reaction times and the individual values of divided attention.

Conclusions: We conclude that bodybuilding fitness regimens lead to an increase in basal lactate levels to 3.16 mmol/L and that acute training sessions can improve attentional performance in relation to lactacidemia, suggesting pro-cognitive effects of a workout.

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OP8 BIOMOLECULAR ASPECTS OF EXERCISE AND SPORT

OP8-1

KEYNOTE Healthy longevity and lifelong football training: unraveling the molecular cross-talk

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Purpose: Football training is associated with higher VO₂max and improved cardio-respiratory fitness. Increasing evidence shows the beneficial effects of football training on cardiovascular, metabolic and musculoskeletal health variables¹. Recently we showed at transcriptomic level that lifelong football training positively influences exercise-induced autophagy processes and protein quality control in skeletal muscle, thus promoting healthy aging². Here we analyzed the protein/metabolite expression profiles in muscle biopsies from Veteran Soccer Players (VSP) compared to healthy age-matched untrained subjects (control group, CG).

Methods: Muscle biopsies of *V. lateralis* from 12 male volunteers (65–75 years), 6 belonging to VSP and 6 to CG, were analyzed by proteomic/metabolomic strategies. Bioinformatic tools allowed to classify the identified differentially expressed proteins according to gene ontology (GO) terms and to unravel relevant molecular networks.

Results: Proteomic data showed that CPT1B, ACADSB, and ACAA2 enzymes, involved in the fatty acid degradation process, were upregulated in muscle tissues from VSP compared to CG; moreover specific subunits of proteasome complex (PSMB1, PSMB4, PSMC4 and PSMC5) were downregulated in VPG muscles in respect with CG. Metabolomic data indicated that ornithine concentration was higher in VSP compared to CG ($p < 0.05$), whereas the opposite behavior was observed for citrulline concentration ($p < 0.05$).

Conclusions: The integration of transcriptomic², proteomic and metabolomic data allowed to draw a molecular model unraveling the cross-talk triggered by football training in muscles and promoting healthy longevity.

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OP8-2

Human skeletal muscle satellite cells adaptations to resistance training in healthy and diabetic older adults

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Background: Muscle regenerative capacity is compromised with aging and type 2 diabetes (T2DM), possibly due to impaired Satellite Cell (SC) function. The activation of inflammation after muscle damage promote macrophages accumulation, which have not only the important function of mediating the inflammatory process but also seems to support SC to promote myogenic repair and regeneration¹. Moreover, SC function may be regulated by circulating growth factors (IGF-1; IL-6) and their proximity to local microvascular flow may have some implication on muscle adaptation to exercise². However, the effect of aging and T2DM on SC adaptations to exercise has not been completely elucidated yet.

Methods: 19 healthy (71.1 ± 4.3 years; 27.6 ± 3.2 BMI) and 12 T2DM (69.8 ± 3.4 years; 32.3 ± 3.1 BMI) older adults participated to 12 weeks of progressive resistance training (RET). Muscle biopsy from vastus lateralis was collected pre and post RET. Immunohistochemical analysis was used to quantify macrophages (M1 and M2), SC content, capillaries and fiber cross-sectional area (CSA).

Results: T2DM presented with a lower SC content at baseline ($p < 0.05$). RET has a greater effect on Type II SCs in healthy subjects compare to T2DM. Change in M2 macrophages were positively correlated with fiber hypertrophy ($p < 0.05$) and satellite cells ($p < 0.05$) only in the healthy older adults.

Conclusions: Our data suggest that T2DM impaired SC function and macrophages contribution to the muscle response to RET.

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OP8-3**Effects of different training on glycolytic and oxidative metabolism in LHCN-M2 human myoblast cells**A. Mancini^{1,2}, G. Labruna², A. Terracciano^{1,2}, P. Buono^{1,2}¹Dipartimento di Scienze Motorie e del Benessere, Università “Parthenope” Naples, Italy;²CEINGE-Biotecnologie Avanzate, Naples, Italy**Purpose:** We investigated the effects of serum from long-term, different aerobic/anaerobic trained subjects on glycolytic and oxidative metabolism in the human LHCN-M2 myoblast cell line¹.**Methods:** Healthy young (19–28 y) males, long-term (at least 3y), differently trained (≥ 180 min/week): swimmers (SW, n.6), body-builders (BB, n.6), soccer (SO, n.6) and volleyball players (VB, n.6), were recruited. Human sera pool (HC, Randox Laboratories Ltd., Crumlin, UK) was used as untrained control. Blood samples were collected 8 h after the last training bout. LHCN-M2, human myoblast cells, were cultured in growth (GM, 15%FBS) or in differentiation medium, DM, supplemented with 0.5% serum from differently trained subjects or HC, respectively, for 4d (Myogenic differentiation was assessed by Fusion Index, Myogenin and MyHC- β mRNAs expression levels)². The extracellular acidification rate (ECAR) and the oxygen consumption rate (OCR), markers of glycolysis and mitochondrial respiration, respectively, were measured using Seahorse XFe96 analyzer (Seahorse Bioscience, North Billerica, MA). OxPhos: basal respiration, ATP-linked respiration, maximal respiration; Glycolysis: basal glycolysis and glycolytic capacity were measured; data comparison between groups was performed using the ANOVA test. Differences were considered statistically significant at $p < 0.05$ after Bonferroni correction.**Results:** As expected, ECAR and OCR resulted statistically higher in undifferentiated cells (GM) compared to cells growth in DM supplemented with different serum ($p < 0.001$). The ATP-linked respiration was higher in cells treated with “mixed” sports (VB + SO) compared to BB ($p < 0.05$) or HC sera ($p < 0.001$), respectively; further, ATP-linked respiration was higher in SW treated cells compared to HC ($p < 0.01$). Cells treated with sport trained sera showed a lower rate of basal glycolysis compared to HC-treated cells ($p < 0.05$); in particular, SW serum-treated cells showed a greater glycolytic capacity compared to BB serum-treated cells ($p < 0.05$).**Conclusions:** Our results suggest that mixed-sport activities induced the highest activation of mitochondrial respiration.**Acknowledgements:** This work was supported by University of Naples Parthenope, “Bando per la ricerca individuale, annualità 2017” “Bando di Ateneo per il sostegno alla partecipazione ai bandi di ricerca competitiva per l’anno 2016 (quota C)”.**References**

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OP8-4**The anti-inflammatory effects of whole-body cryotherapy in non-professional athletes**M. Nasi¹, D. Lo Tartaro², S. De Biasi³, E. Bianchini¹, R. D’alibera⁴, G. Savino⁴, T. Trenti⁵, L. Roli⁵, A.V. Mattioli¹, E. Guerra⁴, T. Polverari⁶, L. Gibellini¹, M. Pinti³, A. Cossarizza⁷¹Department of Surgery, Medicine, Dentistry and Morphological Sciences, University of Modena and Reggio Emilia, Modena, Italy;²Department of Biomedical, Metabolic and Neural Sciences; University of Modena and Reggio Emilia, Modena Italy;³Department of Life Sciences, University of Modena and Reggio Emilia, Modena, Italy;⁴Department of Public Healthcare, Sport Medicine Service Azienda USL of Modena Italy;⁵Department of Laboratory Medicine and Pathology Azienda USL of Modena Italy;⁶Poliambulatorio San Tommaso, Vignola (MO), Italy;⁷Department of Medical and Surgical Sciences for Children and Adults, University of Modena and Reggio Emilia, Modena, Italy**Purpose:** Cryotherapy has gained popularity among athletes across many sports, but is under strict investigation for possible doping-like effects. The main goal of whole-body cryotherapy (CRY) is to counteract inflammatory symptoms following athletic performance, in order to improve physical recovery. Nevertheless, very few data are available on the effects of CRY on immunological and bio-humoral parameters. The study aimed to examine the effect of CRY on several immune parameters, inflammatory markers, body metabolism and on the hormone levels in non-professional athletes.**Methods:** We enrolled 10 male non-professional bikers (mean \pm SD: 44 ± 5 years) during a training period. Athletes have undergone a once-a-day session of CRY (2 min in a cabin with an atmosphere ranging from -120°C to -170°C) for 3 consecutive days. Before the first and after the last session we collected venous blood. Hematologic parameters, serum chemistry, and plasma hormones were evaluated along with plasma levels of pro- and anti-inflammatory cytokines and chemokines (IL-1 β , IL-2, IL-6, IL-8, IL-10, IL-12p70, IL-18, TNF α , IL-1 α , VEGF, IL-1 α , CCL2, CXCL13 and CCL19, sFasL). Monocyte phenotype was analyzed by flow cytometry on the basis of the expression of the surface markers CD14, CD16, HLA-DR, CCR5, CCR2 and CXCR4. Lastly, we evaluated the effect of CRY on circulating mitochondrial (mt)DNA, which is released by damaged cell and acts as damage associated molecular pattern.**Results:** After CRY treatment, glucose, C protein and S protein decrease while HDL, urea, insulin-like growth factor (IGF)-1 and follicle-stimulating hormone increase. IL-18, IL-8, IL-1 α and CCL2 increased after treatment. The percentage of total, classical, non-classical and intermediate monocytes did not change after CRY, but CD14, CCR5, CCR2 and CXCR4 expression decreased in all monocytes. On intermediate monocytes, only CCR5 decreased. Conversely, CCR5 and CCR2 increased on non-classical monocytes. Finally, plasma levels of mtDNA increased after CRY treatment.**Conclusions:** CRY seems to have an anti-inflammatory and a pro-angiogenic effect on monocytes, since CD14 downregulation was observed in monocytes that favors vascular repair. CRY affects also the level of IGF-1, a potent mitogen involved in skeletal muscle growth and regeneration. These observations suggest that CRY could have beneficial effects in inflammatory diseases.

OP8-5**The molecular diagnostics in an asymptomatic amateur athlete found to be affected by hypertrophic cardiomyopathy**

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Purpose: The prevention of sudden cardiac death (SCD), in asymptomatic athletes, unknowingly suffering from cardiac disease, is an important objective that involves many areas of the medical profession and of the healthcare systems in general. In these years, the sports authorities have focused on pre-participation screening that may predict the risk of SCD and hence initiate preventive measures in at-risk athletes.

Case presentation: Here we report the case of an asymptomatic amateur cyclist, who, in the setting of pre-participation screening, to obtain clearance to take part in competitive sporting event, underwent cardiac clinical and instrumental examinations. Screening consisted of family and personal history, physical examination and 12-lead electrocardiography (ECG) as a first-line evaluation. He had no symptoms at medical examination. There was no personal history of shortness of breath during physical exertion or of dyspnea or syncope; however, he reported two episodes of lipothymia unrelated to physical exercise.

Results: ECG revealed mild repolarization abnormalities and echocardiography showed borderline septal wall thickness. Molecular analysis for mutations in eight sarcomeric genes, revealed double heterozygosity for mutations in the *TNNT2* (c.832C > T; p.Arg278-Cys) and *MYBPC3* (c.2689_2690insCCTGGCTGTGGCTACAGCA; p.Gly897Alafsx159) genes. The p.Arg278Cys is a previously described mutation, found in Hypertrophic Cardiomyopathy (HCM) patients with relatively mild and sometimes subclinical hypertrophy, but with a high incidence of sudden death. The p.Gly897Alafsx159 mutation, is not previously described, which produces a frame-shift reading error and the consequent generation of a premature termination codon.

Conclusions: This case report highlights that molecular analysis can reveal DNA alterations in asymptomatic athletes, which in many cases could cause SCD. This and previous cases show that Clinical Molecular Biology is now an essential addition to the clinical and instrumental approach of the pre-participation screening, to the evaluation of cardiac wellness, which could otherwise remain obscure.

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OP8-6**The role of exercise and “mechanokines” to prevent knee osteoarthritis**

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Purpose: The purpose of this study was to investigate the influence of moderate physical activity (MPA) on the expression of osteoarthritis (OA)-related (IL-1, IL-6, TNF- α , MMP-13) and anti-inflammatory and chondroprotective (IL-4, IL-10, lubricin) biomarkers in the synovium of an OA-induced rat model. The MPA-based approach may support joint tribology and synovial lubrication, leading to improved joint function and pain relief. In addition, in pathologic conditions, synoviocytes type A secrete cathepsins, MMPs, and pro-inflammatory cytokines/chemokines into the extracellular matrix, triggering tissue damage.

Methods: A total of 32 rats were divided into four groups: Control rats (Group 1); rats performing MPA (Group 2); anterior cruciate ligament transection (ACLT)-rats with OA (Group 3); and, ACLT-rats performing MPA (Group 4). Early OA was induced through the anterior cruciate ligament transection (ACLT) technique. Analyses were performed using Hematoxylin & Eosin staining, histomorphometry and immunohistochemistry.

Results: In Group 3, OA biomarkers were significantly increased, whereas, IL-4, IL-10, and lubricin were significantly lower than in the other groups. The results from MPA experimental group (Group 4) highlighted the decreased expression of OA-related biomarkers (IL-1, TNF- α , MMP-13) and the increased expression of chondroprotective ones (IL-4, IL-10, and lubricin).

Conclusions: We hypothesize that MPA might partake in rescuing type B synoviocyte dysfunction at the early stages of OA, delaying the progression of the disease and finally postponing the need for joint replacement.

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OP9 PHYSICAL EXERCISE AS PREVENTION AND THERAPY

OP9-1 KEYNOTE

Single passive leg movement in MELAS: how resistance training can improve vascular functions

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Purpose: Mitochondrial encephalopathy, lactic acidosis, and stroke-like episodes (MELAS) syndrome is a rare maternal inherited neurodegenerative disorder. MELAS is associated with nervous system and muscle dysfunction. Energy metabolism is mostly affected, with angiopathy-derived symptoms in smooth muscles and endothelium, leading to impaired blood perfusion and nitric oxide (NO) deficiency. Recent studies showed how resistance training (RT) may lower the mutation heteroplasmy, however its effect on vascular functions is unknown.

Methods: Femoral blood flow (BF) was recorded using a doppler ultrasound 30 sec prior to and 2 min after a single passive leg movement (sPLM) in one young patient with MELAS (age: 21 years) and in 7 healthy men (Control: 34 ± 12 years). The procedure was performed pre and post a 12 weeks resistance training intervention in the MELAS participant only. Femoral artery diameter, BF, Δ peak BF and area under the curve (AUC) were calculated.

Results: No changes in artery diameter were recorded. BF in MELAS post-intervention showed an improvement of 7% (Pre: 118 ml/min vs Post: 127 ml/min) during baseline and of 38% (Pre: 123 ml/min vs Post: 169 ml/min) after sPLM. The AUC after intervention increased by 1176% and the Δ Peak by 42% compared to pre-intervention.

Conclusions: Utilizing sPLM, a largely NO dependent method, this study suggests that RT can considerably improve vascular functions and NO bioavailability in patients with MELAS.

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OP9-2

Effects of a long term Adapted Physical Activity program on a subject with spina bifida: a case report study

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Purpose: In literature there are few data about the effects of adapted physical activity (APA) on people affected by spina bifida. The aim of this case report study was to evaluate the effects of a long-term APA program on a subject with spina bifida.

Methods: A 21-year-old woman with spina bifida, being in a wheelchair, followed an APA program from 2014 (T₀) to 2018 (T₁) aimed at improving strength, aerobic endurance, speed and consequently the ability to manoeuvre the wheelchair. The program was based on analytical and functional exercises. At the beginning and at the end of each year these evaluations were carried out: medicine ball throw, hand grip test, 20 second sprint test (30SST), Vanlandevijck's multistage field test (MFT). During workouts and tests, the level of perceived exertion was always monitored by using the Borg scale. A questionnaire was also administered at the beginning and at the end of each year to assess the satisfaction of the subject about different aspects of her life.

Results: The results of the strength test (handgrip T₀: 17 kg T₁: 21 kg; medicine ball throw T₀ 3.70 m T₁: 3.75 m), speed test (30SST T₀: 53 m T₁: 60.3 m), aerobic endurance test (MFT T₀: 120 m T₁: 300 m) have improved. Satisfaction about various aspects of life has also increased.

Conclusions: A long-term APA program was found to be effective in increasing physical abilities and satisfaction in the various fields of the subject's life. It would be interesting to evaluate the effects of the APA practice on a larger sample in order to perform large-scale APA interventions for people with spina bifida.

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OP9-3**Daily physical activity characteristics for psychophysical health of breast cancer survivors. Results from the “Allenarsi per la salute” research project**

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Purpose: both non-pharmacological and pharmacological treatments of breast cancer could have negative side effects in one or multiple domains, according to the interaction of treatment characteristics with lifestyle and both physio-pathological and psychological conditions of each woman. As both physical activity (PA) and exercise are domains of intervention, one aim of our study was to search for daily PA characteristics useful for psychophysical health of breast cancer survivors not practicing physical exercise.

Methods: three hundred and ten breast cancer survivors (BCSs) have been recruited and evaluated before to be randomly assigned to one of several intervention groups. Participants have been investigated for: body composition, endocrine (i.e. salivary cortisol and DHEA-s), metabolic, immune, cardiovascular, kinesiological, psychological (i.e. SF-36 and HAD-S questionnaires) and behavioral (i.e. objectively measured daily physical activity and self-reported dietary habits) characteristics. Of 310 BCSs, 92 BCSs, standardized for age and pharmacological treatments, have been used to verify the aim of this study.

Results: Pearson’s correlations, regression analyses and ROC curves have been used to individuate independent predictive variables, among those considered, of sleeping disturbance (i.e. the ratio between total nocturnal sleeping time and total nocturnal lying down), anxiety and morning salivary cortisol levels. Sleeping disturbance lower or equal than 10%, anxiety scoring lower than 9 and salivary cortisol lower than 80th percentile of distribution, at awakening, are associated to light and moderate intensity physical activities for almost 35% and 5%, respectively, of awake time.

Conclusions: daily physical activity, without physical exercise practice, could be a valid ally against a self-reinforcing negative loop, including sleeping disturbance, anxiety and morning salivary cortisol levels, leading to the onset and the worsening of the side effects of breast cancer treatments.

OP9-4**Prospective lifestyle (physical activity, nutrition and psychological aspect) assessment in early stage breast cancer**

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Purpose: Physical activity (PA) and weight management are important factors to prevent recurrence and decrease risk of mortality in breast cancer, during and after treatments¹. The purpose of this study was to examine change in PA, weight management and emotional functioning (EF) during and after adjuvant therapy for early-stage breast cancer.

Methods: A prospective longitudinal design was used to investigate lifestyle during and after therapies. The collected information included: anthropometric measures, the International Physical Activity Questionnaire (IPAQ) short version, EF assessed using EORTC QLQ C30 Quality of Life questionnaire. Clinical and demographic variables were obtained by Hospital registry. Descriptive analysis, Wilcoxon-Mann-Whitney and Spearman Rank Correlation were used.

Results: Overall 114 women (age ranging between 32 and 78) completed both baseline and follow-up assessment. At baseline, 51% of women were normal weight, 31% were overweight and 18% were obese and presented low score of EF (median 58.3). According to IPAQ scoring protocol, 71% of patients were in low PA category and the other 29% in moderate. The energy expenditure for PA at baseline was inversely correlated to body mass index (BMI) ($r_s = -0.40$; $p < 0.001$) and associated with a better EF ($r_s = 0.20$; $p = 0.05$). After the conclusion (median 10 months) of adjuvant treatment, 25% and 18% of patients were still overweight and obese, 57% resulted normal weight, while the EF level was increased (median 75). Regarding PA level, 43% and 41% of women remained in low and moderate category, while only 16% were in high. Comparison between baseline and follow-up showed a significant improvement in BMI ($p = 0.007$), in EF ($p = 0.009$) and in PA level ($p < 0.001$). At follow-up period, the energy expenditure for PA continued to be related to a better EF ($r_s = 0.25$; $p = 0.008$).

Conclusions: Most patients presented a low level of PA both during and after treatment. The percentage of patients overweight or obese was high, 49% during and 43% after therapies, while EF, especially during treatment was low. The validated importance of lifestyle in breast cancer and our preliminary results suggest that a comprehensive lifestyle intervention, delivered by a multidisciplinary team, is needed to increase PA levels and manage body weight control, allowing also an improvement in term of emotional functioning.

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OP9-5**The role of core in the movement. Preventive, rehabilitation and performance aspects. The effect of a six-weeks core training in individuals suffering from low back pain (LPB)**

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Purpose: The aim is to evaluate the effectiveness of a 6-week core training protocol aimed at individuals suffering from LPB.**Methods:** 11 individuals (5 women and 6 men) attending a fitness center and suffering from LBP were recruited. Short Form-36, Roland-Morris Disability Questionnaire (R&MDQ) and Numeric Scale (NRS) were used to assess quality of life, disability and pain. Seven resistance tests were administered to evaluate the core strength. The protocol included joint mobility training, breathing, isometric, isotonic and stretching exercises. The Student's T test and the proportions test have been used before and after the exercise period.**Results:** After the 6-week training program, participants showed significant improvements in each test ($p < 0.005$). Resistance to physical exercise has been doubled with 30% reduction in perceived pain.**Conclusions:** a multi-step core strengthening exercise program could be a treatment option to reduce disability and to improve the quality of life of people suffering from LBP.**References**

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OP9-6**Cardiac and peripheral adaptations following low- and moderate-frequency recreational football**R. Modena^{1,2}, F.M. Impellizzeri³, A. Fornasiero^{1,2}, S. Skafidas¹, F. Schena^{1,2}¹CeRiSM (Research Center Sport Mountain and Health), Rovereto, Italy;²Department of Neuroscience, Biomedicine and Movement, University of Verona, Verona, Italy;³School of Mathematical and Physical Sciences, University of Technology Sydney (UTS), Australia**Purpose:** This study aimed to evaluate cardiac structure and function as well as microvascular responsiveness adaptations to a 12-week recreational football exercise intervention (RF).**Methods:** 40 healthy and sedentary subjects (age 44.3 ± 5.9 years, body weight 81.9 ± 11.1 kg, height 177.4 ± 7.2 cm) were randomized in either a low-frequency group (LFG), performing RF once a week, or a moderate-frequency group (MFG) performing RF twice a week. Before and after the training intervention participants underwent echocardiographic (Echo) and microvascular responsiveness

(MR) assessment. MR was evaluated by near-infrared spectroscopy (NIRS), on the anterior tibialis' muscle belly. The changes in LFG and MFG were compared with changes observed after a 12-week control period (CON) performed by participants before the intervention.

Results: Regarding MR, we found higher values in area under the curve (AUC) in the LFG vs CON ($+ 366\% \cdot \text{sec}$ [CI 95% 12.6 – 719.5], $p = 0.04$) and in hyperaemic reserve (HR) in the MFG vs CON ($+ 1.6\%$ [-0.5 – 3.7], $p = 0.047$). No substantial differences were detected for the other parameters considered. Cardiac adaptations were recorded in both LFG and MFG. Left ventricular mass (LV mass) as well as LV mass normalized for the body weight (LV mass/BW) were higher in LFG ($+ 13.8$ [-0.4 – 28.1], $p = 0.04$ and $+ 7.5$ [0.1 – 15], $p = 0.02$) and MFG ($+ 17.5$ [4.8 – 30.3], $p = 0.001$ and $+ 10$ [3.3 – 16.7], $p < 0.001$) than CG. Increases in Left ventricular end diastolic diameter (LVEDd) ($+ 2.3$ [0.6 – 4], $p = 0.005$) and Right ventricular Outflow Track (RVOT) ($+ 1.47$ [0.4 – 2.5], $p = 0.003$) were recorded only in MFG vs CG. Cardiac function showed an increase in peak early diastolic velocity (E') in MFG ($+ 1.8$ [0.2 – 3.4], $p = 0.03$) whereas other diastolic indices considered were unchanged.**Conclusions:** 12 weeks of recreational football played once or twice a week induce ventricular remodelling, as attested by increased LV and RV diameters and LV mass. It seems that low-frequency recreational football is not enough to improve an already normal diastolic function in healthy middle-aged men. A small positive effect on microvascular responsiveness after 12 weeks of training may be present.**Reference**

1. Schmidt JF et al. (2014) Cardiovascular adaptations to 4 and 12 months of football or strength training in 65- to 75-year-old untrained men. *Scandinavian Journal of Medicine and Science in Sports* 24: 86-97

SATURDAY POSTER SESSION**PP1 SPORTS TRAINING AND TESTING****PP1-1****Comparison between high intensity interval training and small sided games training modalities on sleep quality and salivary cortisol concentration**M. Bonato^{1,2}, A. La Torre^{1,2}, M. Saresella³, I. Marvetano³, G. Merati^{1,3}, G. Banfi^{1,4}, J.A. Vitale¹¹Dipartimento di Scienze Biomediche per la Salute, Università degli Studi di Milano, Milano, Italy;²IRCCS Istituto Ortopedico Galeazzi, Milano, Italy;³IRCCS Fondazione Don Carlo Gnocchi, Milano, Italy;⁴Vita-Salute San Raffaele University, Milano, Italy**Purpose:** It has been suggested that there are no differences between High Intensity Interval Training (HIIT) and Small Sided Games (SSGs) as training modality for improving maximal aerobic power. However, no information is available about the acute effects of HIIT and SSGs with particular attention to sleep quality and salivary cortisol concentration. Therefore, the aim of this study was to compare the acute effects of HIIT and SSGs following an acute training session performed at the habitual training time in recreational soccer players.

Methods: This was a two-armed, parallel group, randomized controlled trial in which 32 players were recruited and allocated to either an HIIT group ($n = 17$) that performed 4 bouts of 4 minutes at 90–95% HR_{peak} with 3 min of recovery at 50–60% HR_{peak} , or an SSGs group ($n = 15$) that performed 4 vs 4 (36 x 24 m), with no goal keeper, lasted 4 minutes with 3 min of recovery. Sleep quality was monitored through actigraphy before (PRE) and two nights after (POST1, POST2) the SSG protocol. Moreover, salivary cortisol concentrations were evaluated before training (7.00 p.m.), after training (8.00 p.m.), and the morning after training (7.00 a.m.).

Results: Two-way analysis of variance with Bonferroni's multiple comparisons test showed significant inter-group differences in AST ($p < 0.0001$), SE ($p < 0.0001$), SL ($p = 0.047$), IT ($p < 0.0001$), MT ($p < 0.0001$) and FI ($p < 0.0001$) between PRE and POST 1 condition. Moreover, significant inter-group differences of SE ($p = 0.035$), IT ($p = 0.004$), MT ($p = 0.006$) and FI ($p = 0.048$) between PRE and POST 2 in HIIT group were also observed. Post-hoc intra-group differences in AST ($p = 0.014$), SE ($p = 0.048$), IT ($p < 0.0001$), MT ($p = 0.046$), between HIIT and SSG in POST 1 condition were noted. Significant interactions (group x time) for AST ($p = 0.004$), SE ($p = 0.006$), IT ($p = 0.005$), MT ($p = 0.004$), MT ($p = 0.004$), FI ($p = 0.004$) were found. Significant variations were observed for salivary cortisol concentrations over 7.00 p.m. (HIIT: 1.50 ± 0.43 ng/ml; SSG: 1.79 ± 0.48 ng/ml) with respect to post training samples both in the HIIT (8.00 p.m.: 5.63 ± 0.95 ng/ml, $p < 0.0001$; 7.00 a.m.: 5.35 ± 1.13 ng/ml, $p < 0.0001$) and in SSG (8.00 p.m.: 3.37 ± 1.42 ng/ml, $p = 0.0003$; 7.00 a.m.: 4.21 ± 0.6 ng/ml, $p < 0.0001$). Post-hoc intragroup comparisons showed that HIIT and SSG differed in salivary cortisol concentration in 8.00 p.m. condition (5.63 ± 0.95 ng/ml vs 3.37 ± 1.42 ng/ml). An interaction of $p < 0.0001$ was found.

Conclusions: Unless both protocols produce the same training stimulus the results of the present study showed a superiority of HIIT over SSGs on actigraphy-based sleep parameters and salivary cortisol following an acute evening training session in soccer players.

PP1-2

A systematic review of resistance training programs and muscle hypertrophy in adult women

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Purpose: The purpose of this review is to systematically analyze current scientific evidence to identify resistance training protocol, which has the highest magnitude in inducing muscle hypertrophy in women.

Methods: The PRISMA protocol has been adopted. PubMed and Web of Science were two databases searched for relevant studies examining resistance training interventions in healthy women aged 18–70. The primary outcome observed is hypertrophy i.e. skeletal muscle mass gained. Only original research studies published from 2000 until

2019 in peer-reviewed journals were included in the review. Pre and post intervention values of skeletal muscle mass were taken into account and discussed.

Results: 15 studies met eligibility criteria. Studies included were very heterogeneous with regards to study design (full body, upper body, lower body), duration of the intervention (7–24 weeks), training intensity (40–80% 1RM), measurement tools (DEXA, MRI, BIA, ultrasound imaging), and follow up period (0–52 weeks).

Conclusions: According to the current evidence, even though there is a significant sexual dimorphism between men and women, there are no clear, standardized guidelines on how women should train to induce muscle hypertrophy within the gym context.

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PP1-3

Use of oral contraceptives and changes on testosterone levels and physical performance among elite athletes: preliminary results

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Purpose: Hormonal variations that occur during menstrual cycle (MC) can influence the physical and mental performance. For this reason, oral contraceptives (OC) are commonly used by athletes. However, the real effect of the OC on the physical performance and testosterone level is unclear. Moreover, little is known about the difference in performance in those taking OC and not. The aim of this study was to explore the effects of OC on strength and maximal O_2 consumption (VO_{2max}) in elite athletes.

Methods: Athletes from Italian Federation (FIDAL) were assigned into two groups: who did not use oral contraceptives (MC) and who used it (OC). The MC group performed physical tests on three different days of menstrual cycle (menstrual, follicular and luteal phase). The OC group performed the tests during hormone-free interval (menstrual) and during OC (3rd week). Tests included: 1 repetition max (RM) at bench press, leg press and lat machine; maximal voluntary isometric contraction (MVIC) at chest press, leg extension and rowing machine and incremental test on treadmill. A saliva sample was collected before each test to determine testosterone level. To test similar conditions, we compared luteal versus taking OC phase and menstrual with suspension phase in OC. A non-parametrical test (Mann-Whitney) was used to determine significant difference ($p < .05$).

Results: Ten athletes (5 MC 24.37 ± 6 , 5 OC 22.6 ± 1.8 ; N^o, years, mean \pm SD) performed all tests. Concerning leg strength, 1RM for leg press and MVIC at leg extension were higher in MC (+2.5%;

+10.3%; $p = n.s.$). Moreover, OC group during hormone-free interval displayed significantly increased values of leg press (+18.6%; $p = 0.04$). To confirm these differences, the testosterone level was higher in athletes that did not use OC (+17.3%; luteal phase). Finally, 1RM lat machine, bench press and VO_{2max} were similar for both groups.

Conclusions: Despite we did not find relevant differences between groups, we reported a trend to achieve better performance for athletes that did not take OC. It could be that maximal leg strength is affected by the decrease of testosterone in OC group, an hypothesis consistent with previous findings¹. More data are needed to confirm our preliminary findings.

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PP1-4

Physical performance characteristics according to player position in professional soccer players

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Purpose: Global positioning system (GPS) based player movement tracking data are used by professional football clubs and academies to provide insight into activity demands during training and competitive matches. The purpose of this study was to provide a detailed analysis of the physical demands of Italian professional soccer players competing in the third division of Italian soccer (Serie C).

Methods: 38 match observations were undertaken on 17 players competing in competitive national matches during the 2017–2018 season, using GPS system.

Results: The most significant results are in the values of TD (Total Distance), CB is the role with the lowest value (9.6 ± 0.2 km), while CM and W have the highest data ($CM = 11.4 \pm 0.6$ km; $W = 11.5 \pm 0.1$ km). A similar trend can be observed in the DpM (Distance per minute), in fact the midfield roles have the highest values than the others. However, in HSRD (High Speed Running Distance) we can observe that FB role has a great data in this parameter ($FB = 1835.1 \pm 53.5$ m), but the best value is for W (2290.4 ± 256.5 m). In the VHSRD (Very High Speed Running Distance) central roles ($CB = 317.9 \pm 42.1$ m; $CM = 568.1 \pm 161.7$ m) has lower data than external roles ($FB = 706.7 \pm 130.9$ m; $W = 991.7 \pm 121.5$ m). The same trend is observed in SD (Sprint Distance). In the number of $Acc > 2$ m/s² and $Acc > 3$ m/s², the data show that the Wingers make the most of them ($Acc > 2$ m/s² = 282.1 ± 20.6 ; $Acc > 3$ m/s² = 102.0 ± 12.4) compared to the other roles. However, in $Dec > 2$ m/s² and $Dec > 3$ m/s², the role with the highest values is CM ($Dec > 2$ m/s² = 310.4 ± 28.3 ; $Dec > 3$ m/s² = 120.9 ± 14.4). In the parameter of PL (Player Load) the role with the lowest data is CB (474.0 ± 36.2), while Wingers and Strikers have the highest values ($W = 598.5 \pm 32.0$; $S = 581.6 \pm 38.3$). Regarding PS (Power Score), the midfield roles have also the highest score ($CM = 10.1 \pm 0.5$ W/kg; $W = 10.1 \pm 0.5$ W/kg). The same trend is showed in PP (Power Plays).

Conclusions: There are many differences in physical performance according to players' position. Probably, since that performance characteristics and differences depend on many factors, it is not

possible defining physical demands according to players' position, then each team needs to conduct its own analysis.

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PP1-5

Is the 3 min all out test a good performance predictor on the 5, 10 and 21 km race, in well-trained runners?

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Purpose: The 3 min all out test is a non-invasive field test, derived from cycling, used for the estimation of Critical Speed (CS), in running. The objective of this study is to verify the correlation between the CS value, obtained by the 3 min all out test, and running tests carried out on the 5, 10 and 21 km races.

Methods: Ten well-trained male runners took part in the study. Each of them was given the 3 min all out test on an athletics track. A wristwatch with GPS technology (Garmin Epix) and a shoe sensor (Garmin Foot Pod) were used to estimate the speed. The speed maintained by the athletes in the last 30 s of the test corresponds to the CS value. Furthermore, the times obtained in the 5, 10 and 21 km races, carried out at the end of the last racing season, or at the beginning of the new season were noted for each athlete. For each distance, 3 values were reported, with which an average was determined.

Results: The correlations made between the CS values, and the 5, 10 and 21 km speeds, are not statistically significant. In fact, between the CS data and the 5 km times, there is a correlation $r = 0.48$. Between CS and data on both the 10 and 21 km there is a correlation $r = 0.61$.

Conclusions: The 3 min all out test was born as a test for the estimation of CS. The study shows how the 3 min all out test overestimates the CS value. The data obtained in our work confirm earlier research. In light of these results we can hypothesize that the 3 min all out test, rather than estimating the CS, could be a test for the estimation of the Maximal Aerobic Speed (MAS). In support of this, we compared the values obtained in our study with works present in current literature, in which were reported the temporal differences, between the MAS data and the competition times on 5, 10 and 21 km. Further research will be needed to confirm this theory.

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PP1-6**Physical activity and asthma: a possible strategy**C. Schiraldi¹, F. Schiraldi²¹Federazione Medico Sportiva Italiana (FMSI), Policlinico Abano Terme, Padova, Italia;²Corso di Laurea in Scienze Motorie, Università di Padova, Italia

Purpose: Functional breathing disorders may complicate asthma¹. It has been observed that some asthmatic subjects began hyperventilating prior to exercise². The resulting respiratory alkalosis, not controlled by standard asthma medication, creates a state of sympathetic dominance. This includes heightened psychological and neuronal arousal, which leads to increased muscle tone, paresthesia and altered rate and depth of breathing³. This has consequences on performance⁴. We believe it is interesting to investigate the role of coordination training. Working on breath pattern quality and decreasing hyperventilation could be a strategy to improve health and performance.

Methods: Six asthmatic athletes underwent six fortnightly coordination training sessions. In addition they had to perform specific exercises on their own about 15 minutes a day for at least five days a week. During the sessions we worked on coordination breathing/movement and breathing/sport gesture. In particular, some specific exercises were designed for coordination of accessory respiratory muscles and pelvic floor and some exercises were performed during balance maintenance tasks. No respiratory muscle strengthening exercise was used. During this time the athletes continued their normal training.

Results: The results were detected through clinical investigations, ATC© and by monitoring sports performance. All subjects improved their health condition and reduced asthma symptoms and hyperventilation. In four cases, following an important decrease in the frequency and intensity of respiratory crises, it was possible to reduce the controller therapy. Two athletes reported that they no longer needed the reliever therapy for the next 6 months. All subjects improved their performance.

Conclusions: Treating breathing raises the question of considering a multitude of conditioning factors. We observed how strong are the implications deriving from individual emotional conditions. We have noticed, however, that in any case the approach with coordination training has an impact on respiratory modalities and also its consequences. If the improvement in performance is mainly due to the learning of more efficient technical gestures and less breathing expenditure, it is not yet clear why a change in bronchial responsiveness has occurred. It could support the thesis that bronchial response can be influenced by respiratory modalities. Although the data are insufficient to produce statistically and clinically significant results, there are some evidence to suggest that breathing coordination training is useful to improve health and performance in asthmatic athletes.

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PP1-7**Increase in stiffness patellar tendon after two different distance cycling races**

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Purpose: Stiffness is a parameter correlated with injury risk. Depending on its level, stiffness can enhance or decrease athletic performance, and excessive variations may increase the risk of injury. Cycling-related injuries frequently emerge from an overuse ground, and most of them affect knee joint (e.g. patellofemoral pathology and patellar tendinopathy). The aim of the present study was to evaluate variations in muscle and tendon viscoelastic property, namely stiffness, tone and elasticity, before and after two amateur cycling races of different distance.

Methods: 12 amateur road cyclists voluntarily participated in the study (38.4 ± 11.5 years; 175.0 ± 6.9 cm; 68.9 ± 8.1 kg; 22.5 ± 1.8 kg/m²); VO_{2max} was estimated by a validated questionnaire (47.3 ± 6.3 ml/kg/min). 6 cyclists performed a short race (83 km – D + 1200 m) and the other 6 a longer race (142 km – D + 2500 m). Race time of each participant was collected. MyotonPro was used to assess the viscoelastic characteristics of the dominant patellar and achilles tendons and vastus medialis pre- and post- race.

Results: All the participants completed the races, and all post-measures were collected within the 10 minutes from the end of the race. The data obtained from MyotonPro showed no significant difference in vastus medialis and achilles tendons. On the contrary, a significant increase of patellar tendon stiffness was detected (p < 0.05) in all cyclists in both races; a slight but significant race time/stiffness variation correlation (r = 0.56) was found only in the longer race.

Conclusions: Under the tested conditions, we observed an increase in stiffness of the patellar tendon in both races; in the longer one this increase seemed positively correlated to race time, i.e. the shorter the time, the lower the stiffness. These results might suggest the use of patellar tendon stiffness as a marker of ongoing overuse pathology. Future studies will be needed to verify this hypothesis.

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PP1-8**Natural load strength training in young track and field athletes**

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Purpose: If all authors agree by now in defining the pre- adolescent age as the excellent period of development of coordinative skills, still

the thought on the modalities of development of conditional skills is not unique.

Method: 24 subjects aged between 9 and 12 practicing track and field were divided into 2 groups, A and B. For 6 weeks each group assumed alternatively the role of experimental group and of control group (for a total of 13 weeks).

The experimental treatment involved two weekly 45' session with natural load strength exercises (3 lower limb exercises, 2 dynamic ones and 1 isometric; 1 upper limb exercise; 1 core exercise); the control group performed technical routine training exercises for that period.

Results: Following the experimental treatment in both groups, statistically significant improvements were not observed (FTest-TTest; $p < 0.05$) in the Standing Long Jump Tests (ST; A: 25.1 ± 4.0 cm to 28.6 ± 5.0 cm; B: 33.1 ± 6.3 cm to 35.4 ± 7.0 cm) and in the Sargent Test (JT; A: 140.0 ± 15.0 cm to 144.0 ± 14.0 cm; B: 154.1 ± 20.8 cm to 159.27 ± 23.0 cm). The protocol adopted with the control group proved to be sufficient for performance maintenance both for ST (A: 28.6 ± 5.0 cm to 29.4 ± 5.0 cm; B: 31.8 ± 6.7 cm to 33.1 ± 6.3 cm) than for JT (A: 144.0 ± 14.0 cm to 145.9 ± 14.0 cm; B: 155.3 ± 21.5 cm to 154.1 ± 20.8 cm).

The initial significant differences (FTest-TTest; $p < 0.05$) found between the two groups in ST (A: 25.1 ± 4.0 cm; B: 31.8 ± 6.7 cm) were offset by the end of the treatment period in group A (A: 28.6 ± 5.0 cm; B: 33.1 ± 6.3 cm), and then they turn out to be significant again by the end of the treatment period in group B (A: 28.6 ± 5.0 cm; B: 35.4 ± 7.0 cm).

Conclusions: For young athletes, the inclusion of specific natural strength exercises in the normal training routine can be a stimulating factor for the improvement of specific conditional skills. The protocol proposed, however, has not proved adequate to observe significant improvements. The normal training routine with a predominantly technical-training nature has proved to be sufficient for maintaining strength in the lower limbs, but not for its increase.

PP1-9

Acute effects of different strength training intensities on vertical jump height in young female volleyball athletes

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Purpose: It is widely recognized that improving athletic performance variables, such as vertical jump height (VJH), depends on the type of training program. Furthermore, each training program can have different results both in acute as well as in long-term. Thus, the purpose of the present study was to compare the acute effects of 3 different

working load percentage of an experimental strength training protocol (STP) on VJH in young female volleyball players.

Methods: Ten young female volleyball players (age: 14.0 ± 1.2 years, weight: 58.33 ± 10.25 kg, height: 1.65 ± 0.03 m, BMI: 21.52 ± 3.84 kg/m²) were enrolled for the study. All participants, in 3 separate sessions, performed 3 different training intensities of an experimental STP, based on athletes' body weight-related (BW) specific loads randomly distributed among the participants. The STP lasted about 90 minutes and included 10 minutes of warm-up; a central phase of 50 minutes of strength workout (i.e. no load; 10% of BW; 20% of BW for each training intensity respectively); 10 minutes of cool-down. Afterwards the maximum VJH was measured using an optoelectronic platform composed of 2 bars placed opposite to each other and connected directly to the PC via a serial port (Optojump, Microgate S.R.L., Italy) by: a) squat jump with hands on the hips (SJ); b) countermovement jump with hands on the hips (CMJ); c) countermovement jump with arm swing (CMJ-AS). Each participant performed 3 trials for each jump test before (pre-) and after (post-) each STP working load percentage with a rest time of 2 minutes between trials and the best trial was considered for the analyses. The effects of the different training intensities of the STP on the VJH were determined using a two-way repeated measures analysis of variance. Statistical significance was set at an alpha level of $p < 0.05$.

Results: Our results showed a decrease of VJH between pre- and post-training in all three conditions (i.e. no load; 10% of BW; 20% of BW) for each jump test (i.e. SJ; CMJ; CMJ-AS). However, the difference on VJH was statistically significant only for the 20% working load percentage of BW in all the jump tests ($p < 0.05$ in the SJ test; $p < 0.01$ in the CMJ test; $p < 0.01$ in the CMJ-AS respectively).

Conclusions: In summary, the findings of the present study revealed that in acute, as the working load increases, the vertical jump height decreases, and we suggest that these results could be related to the neuromuscular fatigue.

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PP1-10

Players are more able to monitor training in elite youth female basketball than coaches

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Purpose: The present study aimed at verifying if players' and coaches' (3 technical coaches, 1 physical trainer) session-RPE are able to effectively monitor elite youth female basketball training.

Methods: Fifteen elite youth female basketball players (age: 17 ± 1 y) were heart rate (HR) monitored during 19 team (268 individual)

training sessions (102 ± 15 minutes). Mixed-effects models were applied to evaluate if players' and coaches' session-RPE values were significantly related to Edwards' data, controlling for volume (total session duration) and maximal intensity (session duration at 90-100%HRmax) parameters, as well as for type of training (i.e., strength, conditioning, technique). In addition, an adding model has been applied to evaluate differences between players' and coaches' session-RPE in relation to the types of training.

Results: Significant relationships with respect to Edwards' method emerged only for players' session-RPE ($P = 0.019$). In addition, as expected, both players' ($P = 0.014$) and coaches' ($P = 0.002$) session-RPE scores were influenced by total session duration, but not by maximal intensity and type of training. Finally, players' and coaches' session-RPE resulted different ($P < 0.001$), due to the post-hoc differences emerged for conditioning ($P = 0.01$) and technique ($P < 0.001$) sessions.

Conclusions: Findings indicated that youth elite female basketball players are better able to quantify the ITL of their sessions than their coaches, especially during conditioning and technique sessions, strengthening the need of "individualized training" plans, where coaches should strongly consider the players' perceptions.

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PP1-11

Performance and anthropometrics of Italian powerlifters: which size matters?

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Since the first international competition in the early '70, Powerlifting is increasingly practiced, non-professionally, by athletes. To foster participation, the International Powerlifting Federation in 2012 introduced a variation of the discipline, called "Classic" in which athletes compete without supportive equipment. While the knowledge of the physiological and anthropometric characteristics of this type of athlete, in general, is scarce that of Italian classic powerlifters is totally absent.

Aim: to provide normative data on performance and selected anthropometric variables in adult elite and amateur powerlifters of both sexes.

Methods: During a single regional meeting we recruited 74 athletes (51 ♂, 23 ♀) recorded their age, years of experience (Exp) and performance in Squat, Bench and Deadlift; then we measured weight, stature and determined % body fat and lean body mass by plicometry. Athletes were divided in elite (E, > 350/335 Wilks points) and amateur (A, < 350/335 Wilks points) groups and compared by t-test between and within each sex category.

Results: All parameters significantly differed between sexes ($p < 0.05$ for all comparisons). In both sex groups, significant performance differences between A and E were not associated with differences in the other parameters, with the sole exception of a significantly longer Exp in E vs A males (Table).

	Males			Females		
	A (n 20)	E (n 31)	p	A (n 10)	E (n 13)	p
Age (yrs)	26 ± 5	26 ± 5	0.94	29 ± 7	29 ± 7	0.81
Exp (yrs)	2.6 ± 2.4	3.2 ± 2.9	0.01	1.1 ± 1.1	1.9 ± 1.7	0.21
Squat (kg)	161 ± 11	215 ± 33	0.00	106 ± 17	126 ± 29	0.11
Bench (kg)	106 ± 13	144 ± 24	0.00	59 ± 11	72 ± 14	0.04
Deadlift (kg)	189 ± 16	250 ± 32	0.00	120 ± 18	152 ± 28	0.01
Wilks score	307 ± 23	406 ± 42	0.00	303 ± 24	381 ± 37	0.00
Mass (kg)	82 ± 9	85 ± 13	0.36	64 ± 11	62 ± 11	0.80
Height (m)	176 ± 6	173 ± 7	0.10	164 ± 6	160 ± 7	0.14
%BF	18.5 ± 4.0	16.8 ± 4.7	0.19	22.7 ± 4.6	20.9 ± 6.1	0.45
LBM	66.4 ± 7.2	70.5 ± 8.7	0.10	49.0 ± 7.3	49.0 ± 7.5	1.00

Conclusions: Our study provides the first normative data on performance and anthropometric variables in Italian adult elite and amateur powerlifters of both sexes. While male and female athletes are clearly different, none of the measured characteristics differentiate between elite and amateur Powerlifters.

PP1-12

Relationships between muscle architecture and performance in elite Italian field hockey players

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Purpose: The purpose of the present study was to investigate the correlations between muscle architecture of vastus lateralis (VL) and maximal strength, power and agility performances in Italian 1st division Field Hockey (FH) players.

Methods: Twenty players (age = 25.4 ± 5.2 y; body mass = 78.5 ± 9.0 kg; body height = 179.6 ± 7.8 cm) were first assessed for anthropometrics and body composition. Then, Pro agility test (PRO) and 30-m sprint (SPRINT) were performed to assess agility and speed, respectively. Maximal isometric force was tested using parallel squat (ISQ), while low-body power was evaluated by a counter-movement jump (CMJ). In addition, pennation angle (PA), fascicle length (FL) and muscle thickness (MT) of VL were assessed via B-mode ultrasound. Pearson's correlation coefficients were used to assess the relationships between the examined variables.

Results: Large correlations were found between PRO and both PA and MT ($r = 0.62$; $p = 0.006$ and $r = 0.51$; $p = 0.032$, respectively). Furthermore, SPRINT showed a positive correlation with PA and negative correlation with FL ($r = 0.50$, $p = 0.046$; and $r = -0.50$; $p = 0.034$, respectively). A large negative correlation was also observed between SPRINT and ISQ ($r = -0.57$; $p = 0.013$). Large correlations were detected between body fat percentage and both PRO

and SPRINT ($r = 0.58$; $p = 0.012$ and $r = 0.61$; $p = 0.009$, respectively), indicating detrimental effects of body fat on agility and running speed performances.

Conclusions: The present findings show the existence of large relationships between muscle architecture of VL and physical characteristics related to elite performance in FH. Low PA and long FL of VL appear important parameters for agility and sprint performances. Assessments of lower body muscles architecture may be included in the process of talent identification when agility and sprint represent crucial factors for sport success.

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PP1-13

Mid-shin pull: a new evaluation for isometric force

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Purpose: The aim of the present study was to investigate the relationships between muscle architecture, lower body power and maximal isometric force produced at mid-thigh pull (MTP), and at mid-shin pull (MSP). To date only one study investigated the maximal force expressed from the initial position of deadlift and clean¹.

Methods: Twenty experienced resistance-trained men (age = 25.5 ± 3.2 yrs; body mass = 86.9 ± 12.4 kg; body height = 178.0 ± 5.3 cm) were tested for deadlift 1 repetition maximum (1RM), counter movement jump (CMJ), peak force (PF), and rate of force development (pRFD20) produced at isometric mid-thigh pull (MTP) and isometric mid-shin pull (MSP). Participants were also assessed for architecture of vastus lateralis (VL), physiological muscle thickness (PMT), and pennation angle (PA). Fascicle length (FL) were measured. Pearson's correlation coefficients were calculated to assess the relationships between variables.

Results: A higher correlation was observed between deadlift 1RM/MSP ($r = 0.78$; $p < 0.001$) compared to deadlift 1RM/MTP ($r = 0.55$; $p = 0.012$). A moderate correlation was observed between MSP PF and VLFL ($r = 0.55$; $p = 0.011$). MSP pRFD20 was the only parameter significantly correlated with CMJ ($r = 0.50$; $p = 0.048$). Significantly higher PF and pRFD20 were recorded in MTP compared to MSP ($p = 0.007$ and $p = 0.003$, respectively).

Discussion: The present results show that force produced from the floor position may be more important than force produced from a position that mimics the second pull of the clean for deadlift and vertical jump performances. Coaches and scientific investigators should consider using MSP to assess isometric peak force using a test correlated with both muscle architecture and dynamic performances.

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PP1 SPORTS AND EXERCISE PSYCHOLOGY

PP1-14

The influence of moral issues on youth athletes' aggressiveness: a review

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Purpose: The purpose of the current review is to identify the moral determinants of aggressiveness in youth athletes (children and adolescents). Aggressiveness is intended as the potential or actual behaviour that aims at harming intentionally someone. Moreover, the influence of other variables has been taken into consideration.

Methods: Through a literature search process, 11 original papers have been collected. A study was included if it employed a moral variable as predictor of aggressive tendency or antisocial behaviour and if it tested the hypothesis on youth (children and adolescents) sample. Therefore, about these 11 papers, the composition of the sample (age, numbers of males and females), the theoretical model, the instruments employed and the sport were noted. Moreover, other influencing features, as the motivational variables, have been considered for the discussion.

Results: From the examination of literature, it appears that this issue has been approached through different models and that detecting these relations is quite controversial. The young athletes' likelihood to aggress has been studied using structural developmental models and it seems to be predicted by the level of moral reasoning in children (6–12 years), while the influence of contextual variables, and in particular moral atmosphere, has been detected in a more socio-cognitive perspective and predicts the aggressive behaviour in adolescents (12–18 years). Specifically, children with less mature moral reasoning showed higher aggressive tendencies or antisocial behaviours, while moral atmosphere variables, as the perceived team pro-aggressive norms or the perceived team norms for cheating and aggression, were positively related to the likelihood to aggress. Furthermore, two main features of team norms have been studied in relation to moral atmosphere and aggression, that are masculinity and the role of the coach.

Conclusions: Moral issues are good predictors of aggressive behaviours in the sport domain, especially for adolescents. However, more efforts should be done for the identification of a common methodology able to detect them. Finally, while the research about moral atmosphere variables has grown, the study of moral development has stopped, thus future research should try to integrate this perspective with the new ones.

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PP1-15

The influence of 30 seconds Wingate test on young adults' executive functions: a pilot study

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Purpose: The association between executive functions and human movement has been extensively assessed. The results of a meta-analysis revealed that acute exercise (an activity of a single short term exercise between 10 and 40 min) and chronic exercise (consisting of an exercise program of multiple training sessions per week for a longer period of time, typically between 6 and 30 weeks) enhance executive functioning in children, adolescents and young adults. No studies were found about the effects of an acute bout on the executive functions. Thus the purpose of the current study is to assess the impact of 30 seconds Wingate test on young adults' executive functions.

Methods: The study employed 44 participants (22 males, 22 females) from 19 to 39 years (Mean age = 26.34, SD = 4.54). The executive functions were assessed through the Tower of London task, the Stroop test and the Corsi Block test using Inquisit 5 libraries. People were asked to complete the aforementioned tests, whose order was randomized per each respondent. Therefore, participants from the experimental group had to warm up by riding the cycle without any load for thirty seconds and to complete 30 seconds of Wingate test, with a load corresponding to the 7.5% of body weight, followed by three minutes of recovery (2 minutes of riding without load and one minute motionless). Control group was asked to stay motionless for five minutes. At the end, both experimental and control group completed again the three tests in the initial order.

Results: The t-test comparisons revealed no significant differences between the results of the two groups across the tests (Tower of London: $t = -0.30$, $df = 42$, $p = 0.77$; Stroop Test: $W = 222$, $p = 0.65$; Corsi Block Test: $W = 229$, $p = 0.77$) nor in people's reaction time (Tower of London RT: $W = 266$, $p = 0.58$; Stroop Test = 252, $p = 0.83$).

Conclusions: The present study found that an acute bout, as 30 seconds Wingate test, does not have an impact on people's executive functions either in their reaction time during the tasks. Since this was a pilot study, only 44 participants were tested, but future research

should employ a bigger sample, in order to increase the power of the study.

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PP1-16

The influence of emotions during the game: how to recognize and manage them in volleyball

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Purpose: Paul Ekman's interests have focused on nonverbal behaviour and communication, specifically on the expression and physiology of emotions. His studies demonstrated that we show, through facial expression, seven emotions in a universal way: fear, sadness, happiness, anger, contempt, disgust and surprise. The aim of this study was to explore if facial expression and related emotions are connected with positive or negative results during competition in team sport events.

Methods: In this preliminary study we video recorded and analysed (slow motion review using Kinovea 0.8.15 program) all winter matches of a professional female Volleyball Team, Igor Volley Novara, the Italian Serie A1 Championship winner in 2017. We chose two emblematic matches: the worst one in the season (lost 0-3) and the best one (won 3-0). All video frames were analysed with the FACS coder (*Facial Action Coding System*), a Paul Ekman's methodology used to codify all the possible human facial expressions.

Results: The results of this preliminary study show some interesting correlations between emotions and performance: the marker "Eye of the Tiger" (subtle expression of controlled anger/determination/focus on the match) is inversely related to victory, and this could also be applied to the facial expressions of disgust. Another interesting result concerns the happiness/relief facial expressions: happiness and exhilarating joy when the team scores a point during the playtime could be helpful for managing stress during all the game. In lost matches the scores were similar to those obtained when the match was won, but different behaviour and mindset (gloating gaze related to winning points) were more frequent in the won match compared to the lost match.

Conclusions: The impact of emotional skills in sports performance enables the athlete to better manage stress situations that may occur during training and sport competition. Learning to identify emotions in their early stages is likely to improve communication with athletes in several situations.

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PP1-17**Italian validation of motivation of marathoners scales**G. Russo¹, G. Ottoboni²¹Dipartimento di Scienze per la Qualità della Vita, Università di Bologna;²Dipartimento di Psicologia, Università di Bologna

Purpose: In sport activities, the link between the willingness and motivation is fundamental to reach the aim set. Several reasons push people to do physical activity, one of them is health, also defined by the term positive addiction. For these reasons, since the 70's a lot of people began to run and both social and sport psychologists developed an interest of that phenomenon. One of the most important was developed by Carmack and Martens¹. Finally, Master and colleagues³ performed an analysis of the research that investigated the motivation to run in order to develop the "Motivation of Marathoners Scales (MoMS)" questionnaire that examined the motivation of the marathon runners to run. Due to its excellent psychometric properties² we developed an Italian version of the MoMS (MoMS-it).

Methods: Before starting the administration and the data collection we translated the items following the translational procedure³. Anonymously, 604 marathon runners (117 females and 487 males; age 47.32 ± 9.79 yrs) filled the Italian version of the questionnaire. Cronbach' alpha was calculated to assess the internal consistency of MoMS-it. A series of confirmatory and exploratory factor analyses (CFA, ECA) were performed. Paired T-test was performed for each factor in order to verify the different expression of each motivation between the gender and or ages of participants using the median value of the sample.

Results: Cronbach's alpha coefficient for the entire questionnaire was .91, as well as they were the consistencies of each scale. The CFA showed results similar to what Master and colleagues reported³.

Conclusions: The data analysis showed that the translation of the items we performed produced a reliable Italian form of the MoMS and the results were similar to another recent work⁴.

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PP2 PHYSICAL EDUCATION AND SPORTS PEDAGOGY**PP2-1****Introducing short classroom active breaks in the school time: a feasibility study in the province of Naples**P. Pecoraro¹, F. Gallè², S. Sensi¹, C. Sorrentino¹, N. Postiglione², T. Mastantuono¹, G. Cerullo², M. Imoletti¹, R. Ricchiuti², S. Forte¹, P. Calella², G. Liguori², G. Valerio²¹UOS Igiene della Nutrizione, Dipartimento di Prevenzione – SIAN, ASL Napoli 3 Sud;²Dipartimento di Scienze Motorie e del Benessere, Università di Napoli Parthenope, Napoli

Purpose: Although school has been recognized as the main educational setting providing physical activity (PA) opportunities, classroom time has been identified as a contributing factor to sedentary behavior of children. The integration of classroom active breaks (CABs) during the school time seem to be promising to reduce children inactivity.

Methods: The exercise program "AulAttiva" was structured by the experts of the Department of Movement and Wellbeing Sciences of the University of Naples Parthenope and implemented by the Simple Operative Unit of Nutrition Hygiene of the Prevention Department at the Local Health Unit Napoli 3 Sud in some primary schools of the province of Naples in order to integrate CABs in the school time. The intervention includes preliminary training courses for teachers and informative sessions for parents. The exercise program is structured in two CABs of 5 minutes per day. The intervention was performed throughout two scholastic years with a total of 32 schools, 5,920 children, and 470 teachers involved. Questionnaires were used to assess satisfaction of children and teachers about the program.

Results: The satisfaction of children and teachers was high. The 85.2% of children considered pleasant the practice of exercises at school, and 70.2% of children reported the practice of the same exercises outside school. The majority of the teachers considered the intervention very interesting (89.2%), easy to perform (92%) and very appreciated by the children (97.3%).

Conclusions: CABs may be an effective and easy tool to reduce children inactivity during the school time. The program "AulAttiva" seems to be feasible in the local setting involved and widely accepted by children and teachers.

PP2-2**Dance improves motor skills among female scholars**

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Purpose: Recently, interest in improving fitness of dancers both for an optimization of performance and injury reduction has increased. Indeed, professional ballet dancers appear to have reduced fitness levels in regards to muscle strength and aerobic capacity when compared to athletes from other sports. This study examined the impact of 1 year of a typical ballet dance training program on anthropometric indices and muscle performance in young dancers.

Methods: A sample of 29 female scholar dancers (age = 9.6 + 1.66 years, height = 1.37 + 0.13 m, weight 40.27 + 10.51 kg, BMI = 21.15 + 3.67) participated. Subjects attended four weekly lessons (3 of ballet dance and 1 of modern dance with a average duration of 1 hour and half). Training was characterized by exercises like pliè, battements, relevè, jumps, tour, arabesque, stretching.

The assessments consisted of nine performance tests and joint flexibility and mobility tests validated by Comitato Olimpico Nazionale Italiano (CONI). Anthropometric data and life style habits were collected. T-test analysis was performed on collected data. *P* values were determined by Student's Unpaired t test (two-tailed); value < 0.05 was considered to indicate statistically significant results.

Results: After one year of training, with a mean frequency of 7.9 hours a week, on average of 3.4 years of the training before the beginning of the program, the dancers showed significant improvements in: 30-minutes running, push up, chin up; i.e. 3 of the 9 tests administered. No statistically significant difference was observed in anthropometric parameters if compared with the Italian standard curves even if the average of BMI and that of wrist circumference were improved.

Conclusions: The collected data suggest that dance has an important impact on motor skills like rapidity and endurance. Upper body strength, power and muscular endurance of the abdominals and hip-flexor muscles resulted significantly improved after one year of training.

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PP2-3**Illinois test vs. Crunning test in children living in southern Italy: an update of the ESA Program**

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Purpose: The purpose of the current study was to compare Illinois test and Crunning test performance among Italian children (referred as Quadrupe within ESA Program) in order to see if there is a possible link between the chosen tests in high and low performers.

Methods: A sample of one hundred and sixty-six (166) children were enrolled in this study, (93 boys and 73 girls), aged 7 to 12 years old from different schools. Weight (kg) of the sample varies from 20 kg up to 68 kg (mean 34.30, SD ± 9.79), while height (cm) varies from 119 cm to 170 cm (mean 135.11, SD ± 9.82). Both boys and girls were tested twice through a proper fitness test battery, including also the tests mentioned above.

Results: The data were normally distributed. The T-test showed gender differences in both performances, in Quadrupe Test (Girls 8.17 ± 2.59 sec vs. Boys 6.81 ± 2.15 sec) and Illinois test (Girls 24.63 ± 2.83 sec vs. Boys 23.49 ± 2.55 sec) respectively. Pearson's correlation showed a moderate link between the administered test (R = 0.45 – p < 0.0001) while looking at the overall sample and also in a case of gender stratification (Girls R = 0.43 – p < 0.0001; Boys R = 0.41 – p < 0.0001).

Conclusion: Our data show a moderate link between the Crunning (Quadrupe) and Illinois test. Both tests seemed to be accurate and reliable on assessing motor skills during the pediatric age, but the sample size was not big enough to draw conclusions or proper guidelines on this regards. In general, both tests, if administered together, provide an overall picture of the skills-related physical fitness levels in children and adolescents. Further investigation is needed in order to reaffirm our data.

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PP2-4**Analysis of posture in a sample of middle school students**

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Purpose: Although the level of students with postural imbalances has increased in recent decades, it is possible to achieve an improvement in this situation through the application of postural assessment exercise protocols. With this study we want to demonstrate how school can influence the growth of each person, not only from an educational, psychological and social point of view, but also from a motor and postural aspect.

Methods: A group of 137 children of middle school were examined (1st grade 37, 2nd grade 51, 3rd grade 49). Each student was given a specific test battery consisting of 5 assessment exercises following an order of cranio-caudal progression. The tests were carried out both in static and in dynamic with the passive participation of the operator. The evaluation sheet used was taken from the textbook of physical education “Lo Sprintario” which pays attention to the paramorphisms.

Results: The exercises in which it was preferred to postpone a medical check-up were the numbers 1, 4 and 5, respectively those concerning dorsal kyphosis, the attitude of the knee and the attitude of the plantar arch. The number of alterations found with respect to the total number of students analyzed was Dorsal kyphosis, 69/137 (1st grade 21/37, 2nd grade 21/51, 3rd grade 27/49); Knees, 61/137 (1st grade 21/37, 2nd grade 25/51, 3rd grade 15/49); Plantar arch: 62/137 (1st grade 14/37, 2nd grade 24/51, 3rd grade 24/49).

Conclusions: Thanks to the evaluation it was possible to find the presence of postural defects in the students. In particular, it can be seen that these attitudes mostly involve the lower limbs and the dorsal tract. The teacher of physical education in this way can give useful indications to the families and sensitize the students to pay attention to the postural aspects.

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PP2-5**Active breaks in primary school: a systematic review**D. Monacis^{1,2}, D. Colella¹¹*Department of Clinical and Experimental Medicine, University of Foggia, Foggia, Italy;*²*Department of Humanities, Cultural Heritage, Education Sciences, University of Foggia, Foggia, Italy*

Purpose: School is an ideal setting for proposing interventions aimed at increasing levels of physical activity, since it is the place where children spend most of their day during their childhood¹. The aim of the present study is to analyze for the effects of active breaks in

primary school, highlighting strengths and weaknesses regarding their rational proposal.

Methods: A systematic literature review was performed to underline the relationship between active breaks and physical, cognitive and psychological variables of primary school children. The literature search was performed using four databases (PubMed, SPORTDiscus, Scopus and Web of Science) from January 2009 to January 2019. Only studies based on the proposal of classroom-active breaks (excluding multicomponent studies) have been included.

Results: Fifteen works were selected and included in the review. The results show an increase in MVPA physical activity levels in 53% of the studies; only 13% did not show significance between LAF and active breaks. There are limited evidences about cardiorespiratory fitness improvement, and BMI management. Some studies show an improvement in cognitive and attention factors, perceived self-efficacy and behavior in the classroom; only one study did not report statistically significant data².

Conclusions: Active breaks represent an important opportunity to increase LAF. Results show a moderate positive impact on the improvement of motor skills, academic performance and psychological factors. Future researches on a rational application and proposal of active pauses are needed.

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PP2-6**Physical activity levels and physical self-efficacy of the children in relation BMI**C. d’Arando¹, D. Monacis^{1,2}, D. Colella¹¹*Department of Clinical and Experimental Medicine, University of Foggia, Foggia, Italy;*²*Department of Humanities, Cultural Heritage, Education Sciences, University of Foggia, Foggia, Italy*

Purpose: Physical activity offers various opportunities for entertaining motor experiences and promotes the development of perceived self-efficacy³. Appreciable levels of real and perceived motor competencies are essential to involve adolescents in physical education¹. Motor competence is positively associated with perceived competence and motor abilities. Objectives: a. group differences (Nw vs Ow/Ob) regarding motor performance, physical activity levels and perceived self-efficacy; b. the correlations between the physical activity levels and perceived self-efficacy in relation to BMI differences.

Methods: The sample consists of 755 middle school students divided into two groups according to gender and BMI differences (Nw vs Ow-Ob); Male, Overall n = 380; age 12.26 ± 0.88; BMI 21.14 ± 4.42; Female: Overall n = 375; age 12.34 ± 0.99; BMI 21.67 ± 4.04. In addition to the descriptive statistics (M ± SD) ANOVA 2 (group, Nw vs Ow / Ob) × 2 (gender) was performed, in relation to the variables considered. The significance index was set at p < .05. All the students performed 5 motor tests (Standing long jump; 2 kg medicine ball throw; shuttle run 10x5; 6 min WT; 1 mile run) and two self report: PACES - Physical Activity Enjoyment Scale; PAQ-C-Physical Activity Questionnaire for Older Children.

Results: Overweight and obese students show lower motor performance, perceived self-efficacy scores and levels of physical activity compared to the normal-weight group of students ($p < .05$). For Nw males, the study shows the following correlations between activity levels and self-efficacy: ($p = 0.000$; $r = 0.30$); for Ow-Ob males ($p = 0.000$; $r = 0.34$). Females show the following correlations: (Nw: $p = 0.000$; $r = 0.43$; Ow-Ob: $p = 0.000$; $r = 0.44$).

Conclusions: The BMI conditions physical activity levels and perceived self-efficacy. The convictions of effectiveness are decisive for the learning of motor skills and for acquiring active lifestyles. Levels of physical activity, fun and perceived self-efficacy are interdependent: opportunities for fun motor experiences promote motor activity in different contexts and at different ages².

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PP2-7

Effects of the practice of Pilates on a sample of high school students

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Purpose: Pilates represents a mind-body exercise program based on the key principles of concentration, control, fluidity, precision, breathing, center of gravity¹. Some studies show the effectiveness of the practice of Pilates in young students². The main purpose of this study is to evaluate the musculoskeletal adaptations created by the administration of 12 Pilates sessions on young students.

Methods: A total of 44 students aged 16 ± 0 (34 females and 9 males) was divided into two groups: group A and group B. Group A or experimental ($n = 22$, height 169 ± 5 cm, weight 54 ± 6 kg) performed a Pilates exercise protocol for 1 hour per week during physical education lessons, while group B or control group ($n = 22$, height 166 ± 7 cm, weight 61 ± 12 kg) performed the normal physical education lessons. The total number of students underwent 4 tests (sit and reach test, back saver sit and reach test, plank test e broad jump test) both before and after the 12-week period of Pilates.

Results: The analysis of the results shows that, although the sit and reach test values are improved, on average, in the experimental group, these improvements are not significant. The back saver sit and reach test, showed significant improvements ($p < 0.001$). Also in the plank test an improvement of the values was found in the boys of group A ($p < 0.01$). Finally, as regards the broad jump test, despite having obtained a slight improvement in the results there is no significant effect. In reverse, the results expressed in the tests performed by the control group are not significant for the study.

Conclusions: The study follows the evidence of scientific literature regarding the statistically significant increase in abdominal resistance and flexibility of hamstrings and posterior chain in young men and women, while no significant improvements were recorded as regards the explosive strength of the lower limbs.

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PP2-8

Motor and functional assessment in a middle school: Functional Movement Screen™ and Motorfit relationship

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Purpose: The specific purposes of our study were to examine the relationship between the Functional Movement Screen tests and the Motorfit and to investigate the relationship between the total scores of the FMS and the Motorfit. The Functional Movement Screen (FMS) consists of 7 basic movements¹. The Motorfit is a test battery to monitor the physical fitness of the students².

Methods: A total of 80 children took part in the study, including 45 boys (56.3%) and 35 girls (43.8%). The mean age of the sample was $12 \text{ years} \pm 1$ (height 156.3 ± 9.5 cm, weight 49.2 ± 12.6 kg, body mass index (BMI) 19.93 ± 3.72 kg/m²). The relationships between the FMS tests (i.e. Deep Squat, Hurdle Step, In-Line Lunge, Active Straight-Leg Raise, Trunk Stability, Push-up Shoulder Mobility and Rotary Stability) and Motorfit (i.e. Standing Long Jump Test, Sit and Reach, Sit-Ups in 30 seconds, Bent Arm Hang Test, 10 x 5 meter Shuttle Run and Cooper 12-minute Run Test) were analysed using Pearson's correlation.

Results: All Motorfit tests had a significant correlation with the total FMS score. The results indicate that the total FMS score has a significant correlation with all Motorfit tests: in particular, greater significance with moderate correlation for sit & reach ($r = 0.40$; $p < 0.001$), abdominals ($r = 0.44$; $p < 0.001$) and long jump ($r = 0.48$; $p < 0.001$).

Conclusions: The present research has determined a significant correlation between the Functional Movement Screen™ battery and the Motorfit ones. This shows that the functionality of a young person and the ability to express performance are closely connected and it is the task of the motor and sports teacher to pay great attention to the functional aspects in its design.

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PP2-9**Attentional performance, anthropometric parameters, physical activity level, aerobic fitness and school performance in adolescents**

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Purpose: To examine the relationship between adolescents' school performance and attentional performance, anthropometric parameters, physical activity level and aerobic fitness.

Methods: Fifteen tenth-grade adolescents (15-17 years of age) were tested in terms of their school performance (mathematics and Italian language skills), attentional performance (speed, concentration, accuracy, control), anthropometric parameters (weight, height, BMI), physical activity level and aerobic fitness.

Results: The multiple regression analysis indicated that the percentage of errors was significantly associated with mathematics skill ($p < 0.05$), although the percentage of variance it could explain was moderate (35%). Moreover, regression analysis indicated that 44% of the variability in Italian language skill was significantly accounted for by adolescents' physical activity level ($p = 0.01$).

Conclusions: The accuracy of attentional performance and the level of physical activity may have a beneficial influence on school performance in adolescents.

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PP2-10**Functional Movement Screen™: functional assessment system in a sample of students play different sports**

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Purpose: The FMS consists of 7 basic movements, 3 functional movements and 4 fundamental movements which collectively mimics total human movement. Functional Movement Screen (FMS) Testing and Practice of Different Disciplines interact with the test.

Methods: The sample taken into consideration consists of 289 students (males: $n = 168$; females: $n = 128$) from the middle school near Turin (Northern Italy). The mean age of the sample was 12 years \pm 0.5 (height 151.5 ± 9.5 cm, weight 45.8 ± 10.2 kg, body mass index (BMI) of 19.8 ± 3.3 . 241 subjects practice sport activities and

48 subjects do not practice any sport activity other than physical education practiced at school. Children who practice sports at least weekly have been classified as sportsmen. The sports practiced by students, take into account Soccer ($n = 47$), Dance Sport ($n = 42$), Swimming ($n = 29$), Volleyball ($n = 24$), Athletics ($n = 13$), Tennis ($n = 12$), Figure Skating ($n = 10$) Basketball ($n = 9$), Artistic Gymnastics ($n = 8$) Judo ($n = 7$) Baseball ($n = 4$) Parkour ($n = 4$)

Results: Students who practice sports have a score of 15.90 ± 2.37 , those non-practicing a score of 14.52 ± 2.03 , the difference is significant ($p < 0.001$). The scores of the students in relation to the different sports practiced are Soccer 14.83, Sport Dance 17.48, Swimming 14.69, Volleyball 17.15, Track and Fields 15.77, Tennis 15.25, Artistic Roller Skating 18.75, Basketball 15.78, Artistic Gymnastics 18.25, Judo 16.00, Baseball 18.25, Parkour 17.25. Furthermore, there is a significant correlation ($p < 0.001$) between the number of weekly sessions and the score in the test.

Conclusions: The analysis carried out seems to show that in the group of students examined the sport practice positively influences the score of the test. Furthermore the subjects who practice combining technical sport have higher scores than those who practice other disciplines and that the number of weekly sessions positively influences the score.

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PP2-11**Standing long jump test vs Crunning test in Italian children: ESA Program update**

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Purpose: The main objective of this study was to compare Standing long jump test and Crunning test performance among young Italians in the interest of determining a possible link between the chosen tests in high and low performers.

Methods: Hundred and sixty-six (166) children were enrolled in this study (93 boys and 73 girls), aged 7-12 years. Data were collected at various schools in Southern Italy. Weight of the sample ranged from 20 kg up to 68 kg (mean 34.30 , $SD \pm 9.79$), while height ranged from 119 cm to 170 cm (mean 135.11 , $SD \pm 9.82$). Children were tested twice within the ESA test battery which also incorporates the tests mentioned above.

Results: The data were normally distributed. The T-test showed gender differences in both performances, in Standing long jump test (Girls 110.50 ± 23.41 cm vs. Boys 121.52 ± 30.27 cm) and Crunning test (Girls 8.17 ± 2.6 sec vs. Boys 6.81 ± 2.15 sec), respectively. Pearson's correlation showed a moderate link between the administered test ($R = -.50 - p < 0.0001$) while looking at the overall sample and also in a case of gender stratification (Girls $R = 0.34 - p < 0.0001$; Boys $R = -.54 - p < 0.0001$).

Conclusions: We previously hypothesized that children who perform well on the Standing long jump test will achieve a shorter time when performing Crunning test than their counterparts. Based on our data, this seems to be the case and it is evident across both genders. Crunning test as a novelty test needs more application in order to confirm its validity and reliability.

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PP2-12

Development of gross motor coordination in children: a longitudinal pilot study

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Purpose: Despite the recent renewed interest on the influence of modern life style on motor development, Italian longitudinal studies about motor coordination during childhood are substantially lacking. This research aimed to investigate the changes of motor coordination during three years in a group of children aged from 8 to 12 years old.

Methods: An overall sample of 137 children was involved in the study. They were recruited from primary school classes (III, IV and V levels) and evaluated with the same protocol along a three years period (T0 = 2017; T1 = 2018; T2 = 2019). The average ages for the different groups in the three session of measurements were Gr1 = 8, 9, 10 year old (yo); Gr2 = 9; 10; 11 yo; Gr3 = 10; 11; 12 yo. Anthropometric data (height and weight) were measured to calculate body mass index (BMI). Gross motor coordination was assessed by KTK test (Vandorpe et al., 2011) and reported as raw score (RS). Longitudinal data were collected for each group from the same research staff in all the periods. All children, in the time frame of the study, have been involved in activity games with cognition engagement^{1,2} and none of them was involved in physical activities or organized sports. Descriptive analysis, two way ANOVA for repeated measures were used.

Results: BMI increased significantly among ages ($p < 0.001$). No significant difference was measured between males and females. Average values of motor coordination increased along the ages (Gr1 8-10 yo 193; 202; 213; Gr2 (9-11 yo) 216; 226; 237; Gr3 (10-12 yo) 227; 245 ($p < 0.01$) while the yearly percentage of improvements appears to be quite similar Gr1 (T1-T0 = +4.6%; T2-T1 = +5.5%); Gr2 (T1-T0 = +4.6%; T2-T1 = +4.9%); Gr3 (T1-T0 = +3.5%; T2-T1 = +4.2%).

Discussion: The results show that motor coordination seems to improve regularly in children aged from 8 to 12 year old. This trend is only partially in agreement with previous studies on non Italian children³ since our groups started at higher values but showed a reduced yearly increase. However, our data do not allow to differentiate the different causes: spontaneous improvement due to growth, the “activity games with cognition engagement” during primary school, the lessons of physical education in secondary school to explain this trend.

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PP2-13

Descriptive study on motor creativity in the childhood: a pilot study

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Purpose: The aim of this study has been to provide a descriptive analysis to investigate the possible relation between motor skills and cognitive processes in children. This study has focused more attention on two variables: gross-motor skills and thinking creatively in action and movement.

Methods: Two groups of children aged from 3 to 6 years have been compared with a descriptive research. The pupils attend a early childhood school; the gymnasts regularly participate in a training course in rhythmic gymnastics. The survey tool used to measure the abilities of creative thinking in motion is the Thinking creatively in action movement, TCAM¹. For the evaluation of the gross motor quotient, the TGMD was used instead².

Results: The data, in the elaboration phase, consider the calculation of the total score of the motor creativity of each participant, calculated as the sum of its total fluidity, total originality and total imagination. The raw scores of fluidity, originality and imagination are transformed into standard scores for the various age groups. The partial standard scores are then added together to give the total score. The gross motor data are processed by calculating the gross motor quotient. The results will all be computerized and organized on an Excel environment; the data processing will be illustrated through a descriptive table with average value and standard deviation, and graphic representation with the average values of the different indicators by age group and by group. The correlation between the data of the two tests will provide interesting information about the hypothesis of the study.

Conclusions: The study wants to confirm the hypothesis of the research project, verifying whether the regular practice of motor and sports activities is or is not a factor that contributes significantly to the development of other cognitive abilities that, in the specific case of this work, are linked to children’s creative potential. It is known that creativity is at the basis of the thinking and actions of preschool children, but it is necessary to investigate further if there is a real correlation between the level of motor skills and creative thinking. In fact, this pilot study will be followed by a descriptive survey on a wider sample of children who practice different sports, both individual and team sports, to understand and analyze the correlations between the different sports practiced and creative thinking and compare them with children who do not practice any sporting activity.

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PP2-14**Promotion of physical activity in the childhood from the guidelines of W.H.O. to national policies: comparison among EU, AU and USA**C. D'Anna¹, P. Forte², V. Barra¹, F. Gomez Paloma¹¹Department of Human, Philosophical and Education Science, University of Salerno, ITALY;²Department of Medicine and Health Sciences, University of Molise, ITALY

The regular practice of physical activity during the childhood, as supported by numerous scientific studies, improves the psycho-physical well-being of children and young people. More favorable health parameters were associated with higher levels of physical activity; the advantages in this sense include considerable improvements both from the anatomic-physiological and psychological point of view. The “*Global Recommendations on Physical Activity for Health*” have as main aim to provide national and regional level policy makers with guidance on the dose-response relationship between the frequency, duration, intensity, type and total amount of physical activity needed for the prevention of noncommunicable diseases (NCDs)¹. The recommendations indicate the levels of recommended Physical Activity (PA) for the age groups 5-17 years, 18-64 years and over 65 years. The childhood is that phase of life, in which most of the learning and modifications take place. Guidelines recommend that all young people and children should participate in physical activity, of moderate intensity at least, for 1 hour day.

Purpose: The main purpose of this study is to explore and compare the national government of United States of America (USA), Australia (AU) and Europe (EU) and their political strategies implemented to increase the number of children and young people who regularly participate in sport and to promote physical activity in different educational contexts.

Methods: After defining a global framework of each nation and tracing some general lines of action, a comparative study of the various regulations and policies implemented for the promotion of physical activity will be proposed, focusing more attention on the age group 5-17.

Results: The comparison will concern some elements of greater interest in the promotion of physical activity's field: government policies, fiscal incentives, coordination between different local authorities, school and sports federation, awareness-raising activities. On the one hand we will highlight the main common trends, on the other the peculiarities of the three models adopted in USA, AU and EU.

Conclusions: The analysis of the strengths and weaknesses will allow us to get a synthetic framework in order to reflect on the actions and policies implemented, defining a possible conceptual horizon to refer to.

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PP2-15**Functional Movement Screen™: a functional assessment system in a sample of students from middle school**

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Purpose: The Functional Movement Screen (FMS) was introduced in 1997 as an easily administrable qualitative method to reduce the rate of injury and improve movement performance¹. The aim of this work is to evaluate the use of the Functional Movement Screen™ test to highlight compensatory attitudes in the execution of fundamental movements in a group of children of middle school.

Methods: The sample taken into consideration consists of 289 students (males: n = 168; females: n = 128) from middle school near Turin. The students was 12 years ± 0.5 (height 151.5 ± 9.5 cm, weight 45.8 ± 10.2 kg, body mass index (BMI) of 19.8 ± 3.3). All children included in the study do physical school activities 2 hours a week. The 7 tests are rated from 0 to 3 by an examiner and include the deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and rotary stability. The score of 0 is given if pain occurs during a test, the score of 3 is given if the subject performs the movement correctly².

Results: The average composite FMS™ score in the 289 subjects is 15.67 ± 2.37. The lowest score among the individual tests is 1.89 ± 0.84 of the T.S.P.U., while the highest was obtained in S.M., with 2.80 ± 0.51. Making a gender distinction, we obtain an average composite FMS™ score of 14.91 ± 2.27 in males and 16.64 ± 2.14 in females (p < 0.0001); the test with the lowest score for males is the A.S.L.R., with 1.72 ± 0.56, while in females it is the T.S.P.U.; the highest one for both males and females is S.M., with 2.70 ± 0.61 and 2.92 ± 0.30 respectively.

Conclusions: In the group of students examined, the scores achieved confirm that in the scholastic context it is important that the teacher of motor and sport sciences pays particular attention to core stability exercises with all students and to posture and flexibility with male students.

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PP2-16**Socio-relational behaviors in high-school students: comparison between players from individual sports, team sports and Tchoukball**A. Bortolotti¹, C. Volontè²¹Department for Life Quality Studies, University of Bologna, Italy;²Department of medicine and surgery, University of Insubria, Varese, Italy

Purpose: Practicing sports is a strong educational experience as it can influence both the individual and social development. However, there is a certain degree of variability between sports disciplines in the way they affect the above aspects. This empirical study aimed to assess if

and how different sports involve different socio-relational behaviours. A particular focus is on Tchoukball, a new and not yet very widespread team sport, to verify if this sport can actually contribute building a valid society¹, as assumed by its promoters.

Methods: 72 high-school students (36 M and 36 F) participated to the study. The sample was divided according to the sports practiced by the participants, that is, individual sports, team sports, and Tchoukball. All the students had practiced their sport for at least three years. For Tchoukball, due to the lacking of female players in the school involved in the study, players from the female Italian national team were also involved. Groups were compared about the students' behaviours observed while playing the paradoxical game called "Sitting-ball", that, thanks to its structure, allows to continuously create and break both cooperation or opposition links².

Results: Different socio-relational behaviours, concerning trends to opposition and/or cooperation between players, were observed between participants belonging to the different sports groups. Specifically, Tchoukball players showed an overall higher cooperative behaviours than students of the other groups. No differences were observed between male and female students.

Conclusions: The present findings show some interesting and partially unexpected characteristics related to opposition and cooperation behaviours in different sports' players, highlighting the potential educative values of Tchoukball.

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PP3 PHYSICAL EXERCISE AS PREVENTION AND THERAPY

PP3-1

Careggi wellness project: preliminary results

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Purpose: A correct lifestyle represents a form of primary and tertiary prevention to non-communicable chronic diseases. At Careggi University Hospital it is necessary for health professionals to become effective promoters of good habits: the message provided to patients will in fact be considered less credible if they themselves do not begin to adopt correct behaviours. The purpose of the study is to investigate a selection of anthropometric, fitness, physical activity and dietary characteristics of Careggi Hospital operators.

Methods: 272 employees (190 women and 82 men) were enrolled. Body composition, eating habits, physical fitness and physical activity levels were evaluated. The assessments included: anthropometry, skinfold thickness and bioimpedance; National Institute for Research of the Food and Nutrition questionnaire (INRAN); 6MWT, sit & reach test, handgrip and 30 s chair test; International Physical Activity Questionnaire (IPAQ).

Results: Female employees (51.5 ± 7.9 years, BMI = 24.7 ± 4.5 kg/m²) had a mean waist circumference of 82.1 ± 11.4 cm, with percentages of overweight and obesity of 27.9% and 11.6%, respectively. Percentage values of fat mass ranged between 22.7% and 46.6% with an

average value of 37.4%. Male employees (47.4 ± 10.4 years, BMI = 25.2 ± 3.1 kg/m²) had a mean waist circumference of 91.1 ± 9.2 cm; 43.9% of them were overweight, 7.3% of them were obese. The fat mass was in a range between 16.2% and 36.8% with an average value of 27.3%. Average consumption frequencies were lower than INRAN recommendation for cereals, fresh fruit, vegetables and milk/yogurt, and were higher for sweet foods. Men and women covered a 6 min walking distance of 658.0 ± 90.1 m and 583.2 ± 77.1 m respectively, reaching a heart rate of 105.7 ± 21.6 bpm and 109.3 ± 18.5 bpm. The sit & reach test showed a result of 3.0 ± 7.9 cm for women and 4.9 ± 10.0 cm for men, while limb strength was normal. As regards the analysis of data relating to physical activity, it was possible to observe that on average the recommended levels of physical activity were not reached. Likewise, average daily steps recorded by mobile devices were below the recommended value of 10000.

Conclusions: Lifestyle assessment involves an interdisciplinary approach and the aspects to be considered are numerous. The results of the present study should be considered as preliminary (the employees of Careggi Healthcare are over 5000) and show a high variability between employees. This variability depends on the habits that each operator has in the everyday life, whose possible modification, in order to improve health conditions, requires a personalized approach.

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PP3-2

Lifestyles of the elderly Umbrian population: a pilot project with UNITRE

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Purpose: To investigate the quality of life and lifestyles of the elderly Umbrian population, in order to implement appropriate interventions for successful aging and to prevent functional alterations affecting the people autonomy in Activities of Daily Living.

Methods: 36 subjects were involved in the Project filling out self-report questionnaires used to assess health status and quality of life (EuroQol), physical activity levels (IPAQ) and Mediterranean diet adherence (MED Diet Score). Anthropometric variables (height, BMI), body composition and functional capacities (through Senior Fitness Test battery) were studied.

Results: We observed a situation of overweight (average BMI = 27.4) with fat mass = 30.45% and low total body water 47.64%. We noted a good physical activity levels (36.55 MET/h/week) and health status perceived (71.14/100), a medium adherence to the Mediterranean diet (Score = 7.19) and good functional capacities (2 minutes steps average = 86.73; chair stands average = 14.09; 8-foot up and go test average = 6.47 sec), according to international guidelines and standard ranges for this age.

Conclusions: This pilot phase gave us an overview of a small group of the elderly Umbrian population thanks to a multidisciplinary team work (Doctor, Nutrition Biologist and graduate in Sports Science) aimed at studying lifestyle habits. We propose to expand the sample by extending the project to other UNITRE national offices to implement prevention and health promotion plans among the elderly.

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PP3-3

Physical activity and lifestyles in children with type 1 diabetes

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Purpose: The aim of the research is to analyze physical activity (PA), the PA's perceived barriers (B) and lifestyle in children and youth (6–18 years) with type 1 diabetes (T1D) afferent to the ambulatory of Pediatric Diabetology of Arzignano, Ulss 8 Berica (VI).

Methods: The research involved 26 subjects (10 Females (F)), with the administration of four questionnaires: CLASS, BAPAD-1, PPSE, PAES. Questionnaires were repeated two times, three months later, with the simultaneous detection of pathology dependent parameters.

Results: Glycated Hemoglobin, that is considered the main parameter of the T1D, shows a significant difference between F and males (M), therefore we studied the two genders together and separately.

Overall, F and M show negative correlations between PPSE and B ($r = -0.47$, $r = -0.57$; $p < 0.05$, $p < 0.001$) and between sedentary time and HDL cholesterol. We also found positive correlations between BMI and B to PA. It was near to significant values the negative correlation between MVPA and Glycaemia ($r = 0.38$; $r = 0.059$). In M we found a correlation between MVPA and B that is not dependent from the T1D ($r = 0.50$; $p < 0.05$), while sedentary time is related to general B ($r = 0.55$; $p < 0.05$) and B is dependent from T1D ($r = 0.56$; $p < 0.05$). In F, we found a negative relation both between MVPA and Hemoglobin ($r = 0.8$; $p < 0.01$) and between PPSE and general B ($r = 0.64$; $p < 0.05$).

No differences were found between active and non-active in any of the investigated parameters. In the post measure, an increase in the PA of non-active subjects (+170.1%), who have reached the level of active ones, was noted. Active and inactive subjects spend much time (almost 9 hours) in sedentary behaviors.

Conclusions: The limited correlations between MVPA and the measured parameters, which do not fully confirm literature, are

probably to be attributed to the relatively small number of subjects and to the poor precision of the questionnaire for PA detection. It seems significant to suggest that subsequent studies continue to analyze the data differentiating the analysis for M and F adopting objective PA measures.

PP3-4

Intermittent walking with blood flow restriction is superior to conventional over-ground walking on gait speed in severe multiple sclerosis patients. A pilot randomized-controlled trial

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Purpose: Muscle weakness, low mobility and balance affect the quality of life of patients with severe Multiple Sclerosis (MS). This pilot randomized trial aims to evaluate safety, feasibility, and efficacy of low-intensity interval walking performed with blood flow restriction (BFR) on gait speed and functional capacity in patients with MS.

Methods: A total sample of 54 MS patients at severe disability were screened for possible inclusion in the study (Clinicaltrials.gov NCT03544177). After meeting the selection criteria (EDSS 5.5–6.5) and signed the informed consent, 24 patients were enrolled. The participants were randomized to receive twelve one-hour training sessions over 6 weeks of: bouts of interval walking (predetermined speed paced by a metronome) with BFR bands at the thigh at $< 40\%$ of the systolic blood pressure (BFR-W group, $n = 12$) or conventional over-ground walking therapy (CONV-W, $n = 12$). Physiological parameters and rate of perceived exertion (RPE, 1–10 Borg scale) were continuously monitored during the training sessions. The primary outcome was gait speed, assessed by the timed 25-foot walk test. Secondary outcomes included: walking endurance, balance, strength of the lower limbs, fatigue and quality of life. Tests were performed at baseline, at end of treatment, and at a 6-week follow-up. **Results:** Two patients did not start the treatment for an intercurrent disease. At baseline, the two groups did not differ for any demographic or functional parameters.

Twenty-two patients (58 ± 5 years; 7 males) completed the protocol without adverse events; BFR-W group showed a significantly lower changes of RPE (2 ± 2 vs 4 ± 1 , $p < 0.001$) and heart rate (3 ± 8 vs 7 ± 9 bpm, $p = 0.031$). At the end of treatment both BFR-W and CONV-W significantly improved gait speed (+13% vs +5%, respectively) with between-group difference ($p = 0.003$). Secondary outcomes also improved for both groups, with greater non-significant variations for BFR-W. At follow BFR-W but not CONV-W maintained gait speed values significantly higher respect to baseline (+13% vs +1% respectively) with between-group difference ($p = .041$). The post-hoc power calculation performed on the primary outcome showed a combined power of 92.5%.

Conclusions: Slow intermittent walking with BFR was feasible, safe and at low internal load in severe MS patients. This experimental training was associated to a higher and persistent improvement of gait speed compared to a traditional over-ground walking program.

PP3-5

RULES | Run Less and lift weight to get fitter

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Purpose: The aim of this study is to determine which modality of exercise (RT, ET, CT) could determine a better physical efficiency after BS. A second objective is to evaluate physical fitness, body composition, physical activity levels and energy intake of Bariatric Surgery Patients (BSP) before and after surgery and before and after exercise intervention. A third objective is to find possible muscle strength cut-off values leading which exercise modality better fits those patients.

Methods: Patients will be recruited from the list of patients who underwent Bariatric Surgery (BS), from the Center for the Study and the Integrated Treatment of Obesity-Bariatric Unit, Department of Medicine in the University Hospital of Padova (Italy). Recruitment occurs after medical examination in Obesity-Bariatric Unit and admission to the BS list. Individual physical exercise capacity (VO₂ peak) will be assessed by ergospirometry. Maximal isometric grip strength will be tested with the Handgrip strength test. Muscle strength of the lower limb will be assessed by multi-joint evaluation system.

Expected results: In the experiment 1, we expect to gather enough data to understand population distribution of physical fitness components in obese patients before and after BS. Moreover, at the best of our knowledge, this is the first project that assesses three types of muscle contraction in obese patients before and after BS. In the experiment 2, we expect that all training interventions will improve physical fitness, body composition and quality of life of participants, but the group that perform RT, immediately after intervention, will show better results at T3 for all the outcomes and in T4 for the aerobic capacity and body composition. RT allows to manipulate load in a meticulous manner and in those extremely deconditioned patients that could lead larger benefits.

Conclusions: It is difficult to understand which exercise modality may concur to determine a better clinical outcome and a higher physical efficiency in those patients. With this paper we will try to reply whether modality of exercise (RT, ET, CT) could determine a better physical efficiency after BS.

PP3-6

Prognostic comparison of the FRIEND and Wasserman/Hansen peak oxygen consumption prediction equations in a male cohort of outpatients with cardiovascular disease

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Background: A simple, submaximal 1-km treadmill walking test (1 k-TWT) for the estimation of peak oxygen consumption (VO₂-peak) in outpatients with cardiovascular has been described¹. The

VO₂peak determined by the 1 k-TWT is expressed relative to body weight, and has been shown to be inversely related to survival in cardiac outpatients with preserved and reduced left ventricular ejection fraction^{2,3}. The interpretation of VO₂peak results requires knowledge of a normal response, usually considered with respect to age, gender, body weight, and exercise capacities of healthy volunteers. Reporting VO₂peak as a percent-predicted value has been advocated, and several equations to estimate normal VO₂peak peak are available⁴.

Purpose: To determine the prognostic ability of established percent-predicted equations of peak oxygen consumption (%PRED) estimated by a submaximal walk in a large cohort of outpatients with cardiovascular disease. Design. Population-based prospective study. Setting. Outpatient secondary prevention program in Ferrara, Italy.

Methods: A total of 1491 male patients aged 62 ± 10 years at baseline 85% with coronary artery disease) underwent a moderate intensity (perceptually regulated 11-13 on the 6-20 Borg scale) one-km treadmill walking test (1 k-TWT) to estimate peak oxygen consumption (VO₂peak). %PRED was derived from the Wasserman/Hansen and the Fitness Registry and the Importance of Exercise: A National Data Base (FRIEND) equations⁴, and their ability to predict all-cause mortality was assessed.

Results: There were a total of 177 deaths during a median 9.4-year follow-up. The FRIEND equation provided a higher prognostic value compared to the Wasserman/Hansen equation. Receiver operating curve analysis showed significantly different area under the curve values of 0.72 and 0.69 for the FRIEND and Wasserman equations respectively (p = 0.001). Optimal threshold and Sensitivity/Specificity resulted < 81%, 62/68, and < 66%, 69/69 for Wasserman and FRIEND equations respectively. Mortality rate was higher across decreasing tertile of %PRED, and resulted 23% (n = 114) for the least fit tertile (17.6 ± 4.4 mL/kg/min, %PRED 55% ± 9%), 8% (n = 38) for the intermediate (23.4 ± 3.2 mL/kg/min, 70% ± 3%), and 5% (n = 25) for the fittest (27.1 ± 4.2 mL/kg/min, %PRED 83% ± 7%) (P for trend < 0.0001). Compared to the first tertile, after adjustment for confounders, the mortality risk decreased for the second, and third tertile, with HRs of 0.54 (95% CI 0.342 to 0.87, p = 0.01), and 0.45 (95% CI 0.25 to 0.81, p = 0.008), respectively (p for trend < 0.0001). Each 1 unit increase in %PRED conferred a 3 percent improvement in survival (p = 0.0004).

Conclusions: Percent-predicted VO₂peak determined by the FRIEND equation applied to the 1 k-TWT is inversely and significantly related to survival in cardiac outpatients. These findings are independent from medical history and established risk factors. The FRIEND equation may provide a suitable normal standard when applied to clinically stable outpatients with cardiovascular disease.

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PP3-7**Bioimpedance vector analysis in healthy and osteoporosis older women**

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Purpose: The bioelectrical phase angle (PA), which is unaffected by age and sex, is a predictor of osteoporosis. The present cross-sectional study aimed to elucidate the differences on bioelectrical parameters, including the phase angle (PA) and vector length, between healthy and osteoporosis women measured with bioimpedance analysis following the classical (BIA) and vector (BIVA) approaches.

Methods: The study included 29 women (age 65.5 ± 4.6 years) from an annual health checkup. All participants underwent measurement of bone status by quantitative ultrasound and bioelectrical and body composition parameters by BIA and BIVA. Osteoporosis was diagnosed according to the WHO classification, allowing the participants division into two groups (healthy women, $n = 15$; osteoporosis women, $n = 14$). Bioelectrical resistance (R, ohm) and reactance (Xc, ohm) were obtained with a phase-sensitive 50 kHz bioelectrical impedance analysis device; the length of the vector was calculated as the hypotenuses of individual impedance values, whereas bioelectrical PA was calculated as the arc-tangent of $Xc/R \times 180^\circ/\pi$.

Results: The independent t-test indicated that bioelectrical PA and R were significantly different ($p < 0.05$) between the healthy and osteoporosis women. Additionally, the two sample Hotelling's T^2 test showed that in comparison with the osteoporosis women, the mean vector of the healthy group showed a shift to the left ($p = 0.02$) on the R-Xc graph.

Conclusions: The bioelectric PA and the vector length differ between healthy and osteoporosis women. BIVA identifies these differences and may be useful for monitoring the effect of specific interventions in osteoporosis women.

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PP3-8**Keep your balance as you get older: Hatha Yoga effects in older adults living in a nursing home**

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Purpose: There is an increasing interest in exploring balance and falls prevention programs useful to ameliorate older people's quality of life. Accordingly, the aim of this study was to determine whether Hatha Yoga (HY) and a simple balance exercise (SBE) program lead to improved balance scores in older adults living in a nursing home.

Methods: We recruited 26 older adults, aged from 80 to 85 years ($M = 82.5$, $SD = \pm 2.5$), without psychological disorders, who were capable to walk independently and were medically certified to undertake Yoga and balance exercise practice. They were randomly assigned to either HY practice ($n = 13$), consisting in slow dynamic muscle movements, mindful walking, physical postures-asanas in standing and/or sitting position, breathing and relaxation exercises, or to a SBE condition ($n = 13$), encompassing stretching, walking backwards or sideways, walking heel to toe in a straight line, standing on one leg at a time. Participants in both conditions attended a 20 sessions program (one hour per two sessions a week). Before (T0), during (T1/2) and after the completion (T1) of the two programs, the Tinetti scale was administered to assess participants' balance scores.

Results: RM-ANOVA 2 (conditions) \times 3 (times) showed a significant conditions \times times interaction ($p < 0.001$). Only the group of participants who underwent the HY program showed significant differences between T0 and T1/2 ($p < 0.01$) and between T0 and T1 ($p < 0.001$) with increased balance scores associated with low risk of falls.

Conclusions: Findings showed that HY, compared to a SBE program, can substantially improve balance in older adults, thereby reducing their risk of falls. This effect is likely due to the increased bodily awareness induced by HY exercises.

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PP3-9**Effectiveness of general and combined warm-up on ankle injury prevention in young female basketball players: a randomized controlled trial**

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Purpose: Ankle joint is the most common site of injury in overall athletes including basketball players. Thus, continuous examination of effective warm-up (WU) routines in basketball players is a necessity. WU is a period of preparatory exercise to improve training performance and reduce sports injuries. The aim of this study was to examine if a warm-up focused on ankle joint mobility and body balance could be effective to increase these abilities in order to prevent ankle sprain injuries in young female basketball players.

Methods: A sample of 28 young female basketball players were randomly allocated to either global warm up (GWU) control group (n = 11) or combined warm up (CWU) experimental group (n = 17). All participants performed 7-min of run and sprint. The CWU group performed a single leg stance barefoot with eyes closed, plank forearm position and triceps sural stretching. Participants in GWU performed walking ball handling and core stability using a Swiss ball. WU routines were conducted 3 times per week for 10 weeks used outcome measurements were the Stabilometric platform and dorsiflexion long test.

Results: Twenty-eight young female basketball players completed the study. Participants in the experimental group improved significantly in the range of motion (ROM) in right and left ankle and the center of pressure displacement (CoP). The control group did not show any changes in ankle dorsiflexion and a significant reduction in all body balance parameters.

Conclusions: An 8-minute combined warm-up routine for 10 weeks, including dorsiflexion long position, core stability and barefoot balance exercises seems to be effective in improving ankle dorsiflexion and Cop displacement in young female basketball players. Further studies are strongly needed to verify our findings.

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PP3-10**Prediction equation to estimate cognitive state using physical fitness parameters in older adults**

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Purpose: Ageing is associated with declines in cognitive function and physical fitness. Physical exercise training and physical activity have been shown to have positive effects on cognitive function and brain plasticity. The aim of the study was to establish a practical reference equation to estimate cognitive state using physical fitness tests in older people.

Methods: In this study, 102 participants (age: 73.3 ± 6.7 yrs) were clinically evaluated and characterized by anthropometric characteristics. Participants performed Hand Grip test (HGT), Short Physical Performance battery (SPPB) and general cognitive function were examined using the Mini Mental State Examination (MMSE). For all subjects, a multiple regression analysis was used to predict MMSE from age, SPPB and HG variables. The new equation was cross-validated to determine the accuracy of the prediction equation.

Results: Considering that SPPB and MMSE reference score are not different between genders, only one equation was developed for females and males. Age, SPPB and HG were significantly correlated (p < 0.01) to MMSE score. The developed equation was: MMSE = 19.479 + (1.548 x SPPB) - (0.130 x age) (R² = 0.72 and root mean square errors of 3.6).

Conclusions: This new equation can be used to predict subjects' cognitive state from SPPB results and subjects' age. This equation is not appropriate to evaluate subjects' cognitive performance, where clinical tests should be preferred. However, these outcomes are useful for exercise specialist in order to realize the physical exercise training according not only to the subjects' fitness level but also to the subjects' cognitive performance.

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PP3-11**Improved walking speed is associated with lower hospitalization costs in patients following an exercise-based secondary prevention program. A Propensity score analysis**

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Background: Walking ability is an indicator of health and function in aging and disease, and walking speed (WS) has been recommended as a potential “vital sign”¹. The WS maintained during a moderate and perceptually-regulated 1-km treadmill walking test (1 k-TWT) is a simple tool for cardiorespiratory fitness evaluation², and is inversely related to survival, and all-cause hospitalization in outpatients with cardiovascular disease (CVD)^{3–4}.

Aim: To determine the relationship between the improvement of the WS maintained during the 1 k-TWT and the costs of hospitalization in outpatients with CVD referred to an exercise-based secondary prevention program.

Methods: We studied 649 patients aged 30 to 85 years during 6 years of follow-up. Each patients underwent the 1 k-TWT at the baseline, and regularly every 3 to 4 months. Patients have been encouraged to walk 30 to 60 minutes per day, 3 to 5 times each week, at the same moderate perceived intensity (11 to 13 on the 6–20 Borg Scale) of the 1 k-TWT. The incidence of hospitalization during the first, second, and third year was assessed using below and above median WS value at baseline as a cut point (slow and fast walkers respectively). All-cause hospitalization costs during the fourth, fifth, and sixth year after baseline have been analysed as function of the WS variation between the 1 k-TWT performed at the beginning of the program and 3 years after. The following covariates have been considered as possible confounders: average WS during the 1 k-TWT at the baseline; demographic factors (age, gender, BMI); medical history (acute myocardial infarction, coronary artery bypass graft, percutaneous transluminal coronary angioplasty and valvular repair/replacement); and established risk factors (family history of CVD, smoking status, hypertension, fasting glucose, total and HDL cholesterol). To test whether the costs reduction was associated with WS variation, patients have been stratified into three clinically homogenous groups by propensity score analysis.

Results: Median WS at baseline resulted 4.2 km/h. WS ranged from 1.2 to 4.1 km/h, and from 4.2 to 7.1 km/h for slow (n = 317) and fast (n = 332) walkers respectively. Rate of hospitalization during the 3 years after baseline resulted 42% and 28% for slow and fast walkers respectively ($P_{\text{trend}} < 0.0001$). Average WS at baseline and 3 years after improved from 3.9 to 4.8 km/h in the first (n = 216), from 3.9 to 5.1 km/h in the second (n = 216), and from 2.9 to 5.3 km/h in the third (n = 217) group. Average hospitalization costs per patient were

reduced from 1131 to 301 €, from 798 to 338 €, and from 1057 to 295 € in the first, second and third group respectively ($P = 0.01$).

Conclusions: The WS maintained during the 1 k-TWT is inversely related to hospitalization in outpatients with CVD. Improvement of WS has been associated with long-term reduced costs for all-cause hospitalization independently from medical history and established risk factors. These findings further support walking speed as a simple, easily applied, and clinically useful tool for cardiac patients undergoing secondary prevention.

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PP3-12**Physical activity promotion in the treatment of childhood obesity: an experience in the province of Naples**

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Background: In Italy, the Campania region shows the highest level of childhood obesity. Considering the possible comorbidities associated with obesity, the implementation of effective treatment strategies is needed to control this phenomenon. Educational interventions based on diet and physical activity can be useful to support children with obesity in changing their behaviors.

Methods: A multidisciplinary treatment path for supporting children and adolescents with obesity in the adoption of healthy lifestyles was activated in the II level Center “Diabetes and Obesity in evolutive age” of the Local Health Unit Napoli 3 Sud, in collaboration with the Department of Movement and Wellbeing Sciences of the University of Naples Parthenope. In this context, the movement educator motivates children and their families to daily physical activity; administers field tests such as 6-minutes walk/run test and vertical jump test to make children aware of their physical limitations due to excessive weight; structures and proposes individualized and adapted exercise programs.

Results: Nine-three subjects (51 males, 42 females, mean age 9.2 ± 2.9 years, BMI 29.1 ± 5.9 kg/m², waist/height ratio 0.64 ± 0.09) adhering to the treatment were examined. The data at admission show a reduced aerobic capacity (distance covered 909.2 ± 169.8 m, post-exercise heart rate 160.0 ± 24.9 bpm) and a

reduced muscular strength (jump height 13.0 ± 9.5 cm) which correlate with waist/height ratio as indicator of abdominal adiposity ($r = 0.371$, $p = 0.026$ and $r = -0.309$, $p = 0.003$, respectively). Each subject received a personalized exercise plan associated with a diet plan.

Conclusions: The preliminary results testify the scarce physical fitness of the sample examined. The examinations at follow-up will allow to assess the changes in children behaviors and to evaluate the efficacy of the intervention.

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PP3-13

Spirotiger: a new proposal in subjects affected by low back pain

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Purpose: Low Back Pain (LBP) is a common spine disorder related to muscle imbalances at different levels. In particular, biomechanics of breathing can be negatively modified in people affected by LBP through its connection with postural system. The aim of this study was to determine if a Respiratory Muscles Endurance Training (RMET) using Spirotiger[®] device during posterior kinetic chain stretching improves mobility and pain in subjects affected by LBP. Moreover, a possible link between the diaphragm and hamstring muscles was highlighted.

Methods: Six subjects (main age: 52.3 years ± 14.25) with diagnosis of LBP and "flexion pattern syndrome" (according to O'Sullivan P., Sahrman S. and Colonna S. studies) were included in the research. Participants were divided into a training group (TG, $n = 4$) that perform RMET by Spirotiger[®] during hamstring and glutes stretching and a control group (CG, $n = 2$) that only did stretching. Both groups trained for a total number of 9 sessions during a 4 weeks period. In addition to RMET and stretching, TG and CG performed the same amount of strength exercise of the hip flexors and back muscles to restore the muscles imbalance. Before and after the training time, both groups were tested by quality of life questionnaire (SF-12), numerical pain rating scale (NPRS) and Active Knee Extension Test (AKET) using the IMU sensor Wiva Science[®].

Results: TG improved the SF-12 Physical Component Summary scale of 6.66 points, according to the reduced pain perception on the NPRS for an average of 3.33 points and an improvement of 12.36° in AKET. In CG, it was detected an improvement in the Mental Component Summary scale of 6.26 points, followed by a 2 points reduction in the NPRS and an improvement of 5.17° in AKET.

Conclusions: These results suggest that subjects affected by LBP could benefit from a RMET during stretching posture of hamstrings muscles by reducing pain, improving hip mobility and boosting quality of life. The myofascial link between diaphragm and hamstring

muscles could support the biomechanical hypothesis and make the RMET a new proposal in LBP exercise treatment.

Reference

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PP3-14

Effects induced by 8 weeks of postural and aerobic training in people with low back pain

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Purpose: Low back pain (LBP) is one of the major spine disorders which seriously impairs many daily activities and limits functional skills. The role of exercise in LBP management is well documented, even if the debate about the most effective type of training is still present. The aim of this study is to investigate the effects of an 8 weeks specific training on LBP symptoms, trunk mobility and postural control in adult people suffering from this pathology.

Methods: Twenty people (age: 50-70 years old) were recruited for the study. All participants were untrained and affected from chronic non-specific LBP. Participants were divided into 2 groups composed by 10 people each: Training Group 1 (TG-1) and Training Group 2 (TG-2). Both groups trained twice a week for 8 weeks with a duration of 60-90 minutes per session. TG-1 performed a set of exercises for the prevention and treatment of LBP (Back School Program) and TG-2 performed 30 minutes of aerobic training using bike (intensity: 70% of heart rate reserve) in addition to Back School protocol. All participants were assessed pre and post training to evaluate pain intensity (Numerical Rating Scale – NRS), functional disability (Roland and Morris Disability Questionnaire - RMQ), trunk mobility (Spinal Mouse) and postural control (Nintendo Balance Board[®] and MyPerfectPosture[®] Software - BAL). Spinal Mouse tested thoracic (THR), lumbar (LUM), sacral (SAC) mobility and spine length (LENGTH) of sagittal and frontal plane. BAL evaluated center of pressure during 30" static standing position in eyes open (COP-OA) and closed conditions (COP-OC).

Results: NRS and RMQ significantly improved in both TG-1 and TG-2 ($p < 0.01$) with no difference between groups. In Spinal Mouse evaluation, TG-1 significantly increased THR mobility during sagittal flexion ($p < 0.05$) and SAC during right side bending ($p < 0.01$) while TG-2 significantly increased THR mobility and LENGTH during sagittal standing ($p < 0.05$) and SAC during right side bending ($p < 0.01$) and sagittal flexion ($p < 0.05$). In COP test, both TG-1 and TG-2 evidenced better COP-OA and COP-OC values with significance only in TG-2 for Y axis in OA condition. No difference between groups were observed for all Spinal Mouse and BAL data.

Conclusions: Previous results suggest that combination of aerobic training and Back School Program does not lead to better improvement in pain perception, quality of life, trunk mobility and balance compared to Back School Program alone. Although both kinds of training were effective, TG-1 evidenced better improvement in spine mobility of sagittal plane and postural control. Consequently, these findings suggest that aerobic exercise positively influences the

relation between respiratory system and thoracic mobility in people suffering from LBP.

Reference

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PP3-15

Circadian shift in firefighters, differences on perceived and measured workload

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Purpose: The firefighter activities are characterized by different intensity, often aggravated by extreme environmental conditions, carried out using heavy protective clothing. The service is organized in 12-hour day-time (D) and night-time (N) shifts with 5-member team in both cases. The purpose is to identify the probable differences for these two shifts regarding the level of measured and perceived fatigue, due to different energy expenditure and environmental conditions and to the different subject's task.

Methods: 29 professional male firefighters (42.5 ± 6.0 yr; 66.1 ± 11.7 Kg; 171.8 ± 9.6 cm; 43.8 ± 5.4 ml/min/kg) voluntarily recruited, performed an experimental laboratory session for the determination of $\dot{V}O_{2max}$ and were monitored by an ECG Holter for 6 months during the shift, continuously acquiring: HR, HRv, EE, $\dot{V}O_2$, and at the end of each shift RPE (CR100). The interventions were divided and analyzed on the basis of an increased gravity classification (T1, T2 and T3) and T0 was the time spent at headquarters awaiting intervention, in D classically characterized by various activities (e.g. vehicle maintenance, training).

Results: The firefighters appeared with a medium-low fitness level, not different in terms of their roles. D has significantly ($P < 0.05$) more interventions both in terms of number (+54%, +86% and +138%) and duration (+75%, +37% and +18%) in T1, T2 and T3 respectively. D has an EE (+16%) and an HR (+64%) greater than N. The neuro-vegetative control appears in N more activated for all bands (VLF +13%; LF +8%; HF +14%), the LF/HF ratio (-1.8%) and the perception of effort (-39%) were lower than D.

Conclusions: The results document a greater commitment by the firefighter in D due to more frequent and intense activities and different environmental characteristics (e.g. traffic conditions, temperature). Moreover, the tasks performed during the time spent in the headquarters waiting intervention not present in N, allowed a minor recovery that induced both an increased neurovegetative stress and greater perceived effort. These results suggest to increase the number of subjects per team in D. Moreover, considering an optimal level of fitness as essential in terms of health and ability to respond to the adaptive stimuli required by the working activity for this type of professional figure, it would be necessary to promote the physical training and active lifestyles in fire department, hopefully during the T0 of night shift.

PP4 BIOMECHANICS

PP4-1

Effects of wearing a triathlon wet-suit on the static and dynamic position in water

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Purpose: Swimming speed (V) increases when wearing a wet-suit and this is generally attributed to a decrease in drag (D). However, V is also influenced by propelling efficiency (EP) and wearing a wet-suit could be expected to impede the motion of the upper limbs (and hence to affect EP). The aim of this study was to investigate the effects of wearing a triathlon wet-suit on V and EP and to estimate its effects on D by combining static and dynamic measurements.

Methods: Seven male competitive swimmers (28 ± 10 years, 10.7 ± 7.5 years of experience) performed a 400 m maximal test in a 25 m pool during which average trunk incline and trochanter depth were determined, as well as stroke frequency (SF), stroke length (SL) and swimming speed (V). Based on these data EP and stroke index (SI) were calculated. These experiments were repeated with (WS) and without wet-suit (NS) and data of the 8 laps were averaged. Static measurements (in full inspiration and in full expiration, with and without suit) were performed by aligning the swimmers horizontally and then investigating their rotational motion by means of video analysis. Trunk angle and average angular speed were determined 2 s after "release".

Results: V was significantly larger in WS than in NS (1.30 ± 0.14 vs. 1.25 ± 0.13 m/s) but no differences were observed in SL, EP or SI in the two conditions. In the swimming trial the trochanter depth was 25% lower in WS than in NS and trunk angle was 30% larger. In the static measurements trunk angle and angular speed were 25% larger in full inspiration. No differences were observed in trunk angle and angular speed in full expiration whereas in full inspiration, they were 50% larger in NS than in WS. No relationship was observed between static and dynamic parameters.

Conclusions: The increase in speed when wearing a wet-suit cannot be attributed to differences in EP. Using a wet-suit probably leads to a decrease in D allowing the body to float higher in the water and this compensates for the larger trunk incline in WS compared to NS. Static measurements do not allow to infer dynamic behaviour; this has to be attributed to the large inter-subject variability in the rotational motion after release in the "static" measurements.

PP4-2**Analysis of contact pressure on flat foot: different dance positions**

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Purpose: The aim of this study is to analyze the plantar pressure in several dance positions to compare a flatfoot with a normal foot. A second goal is to investigate how the flatfoot can influence the pressure distribution in medial arch during specific classical dance position to forecast possible injuries.

Methods: 2 subjects (females, 15 years old, 150 cm height, 48.3 kg and 40.8 kg, 9.25-inch and 9.5-inch length of feet) have been investigated: a bilateral flat-footedness subject and a normal feet subject. I-Scan[®] acquisition system (Tekscan Industrial Sensing System, South Boston, USA) was used for the analysis. The sensors used (5101) are based on resistive technology: the resistance change of contact elements gives different pressure values. Three dance positions were valued (sixth and first positions, and fifth position with left foot ahead) in five tasks.

Results: Dynamic monopodal tasks have not shown peculiarities or specific characteristics. Particular trend of pressure is shown in static bipodalic task from full contact to “demi-pointe”, in fact the pressure in the subject with flatfoot is initially lower than in the subject with normal foot, then it increases and finally exceeds the pressure of subject 2 (normal foot). Flat foot line of force follows a linear and vertical trend, from the centre of metatarsus to the area between second and third toes. In normal foot the centre of force moves according to a curvilinear pattern, from the fifth metatarsus to the centre of the forefoot.

Conclusions: During the “static bipodalic task: from full contact to demi-pointe” test, the subject with flat foot shifts her weight from central forefoot area to the lateral one (third, fourth and fifth toes). This condition has been caused by the internal rotation of the tibia. This misalignment can induce the subject with flat foot to miss the ankle-tibial alignment and to reduce the hip external rotation when the dancer goes to demi-pointe.

References

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2. De Mello V et al. (2017) Height of the medial longitudinal arch during classical ballet steps. *Journal of Dance Medicine and Science* 21: 109-114

PP4-3**Passive drag predictors in young swimmers**

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Purpose: Swimming velocity is the interaction result of swimmer's propulsion and drag factors. Swimmers take advantage by reducing as far as possible the drag forces, either in passive (during gliding) and active (while swimming) conditions. The literature clearly reports that passive drag is affected by morphological features and technical attitude of the swimmers, but the best predictor of these features has not yet been highlighted. The aim of this study was to investigate the impact of body composition, morphological features, and technical profile on the young swimmer's passive drag.

Methods: The passive drag of sixty young competitive swimmers (30 M/30 F; age 15 ± 3 years) was measured in the best hydrodynamic glide position using an electro-mechanical device for towing. Body composition and different location of the body mass were assessed using an impedance analyser. Lengths and circumferences of the body and trunk were measured: i) in the standing position as morphological features; ii) in a simulated streamlined position as technique characteristics. Partial correlation coefficients with age as control variable were used to determine the degree of association between assessment variables and passive drag. The total sample was divided into quartiles according to best performance in passive drag and the data variation was analyzed using a two-way Anova. For each type of assessment stepwise linear regression analyses were used to assess the potential relationships with passive drag and to evaluate which group of parameters best characterized passive drag.

Results: The body composition, morphological and technique features were moderately to very largely correlated to swimmer's drag performance and overall the data showed a moderate gender effect. The passive drag level had a significant and near to strong effect ($\eta^2 > 0.55$) on body mass, BMI, chest circumference and streamline chest circumference. The body composition factors, morphological factors, and technique factors explained 56.3%, 68.7% and 65.5% of the variance in passive drag performance, respectively. The body mass was the best overall predictor of passive drag performance and explained 68.7% of the variance.

Conclusions: A similar strong prediction of passive drag performance from body composition, morphological and technique characteristics was demonstrated. The swimmer with best passive drag performance is: i) slim, with lower fat and fat-free mass, ii) short, with lower shoulder breadth and chest circumference, iii) thin, with lower streamline height and streamline trunk diameters.

PP4-4**A three-dimensional analysis of shot putting in elite male Italian athletes**

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Purpose: The aim of this study was to analyze the shot put biomechanics in the best male Italian shot put throwers (ISP) and to compare their technical characteristics with those of world class athletes (WC) described in previous investigations.

Methods: The best six Italian shot putters of the year 2016 (age 20.2 ± 3.6 yrs, PB 18.44 ± 1.26 m) were recorded using three video cameras FULL HD (60 frames/s, 1920x1080 pixel) while competing at the Italian Athletics Championships. For each athlete, the best attempt was considered for 3D analysis, performed using SIMI Motion (Simi Reality Motion Systems GmbH, Unterschleissheim, Germany). A selection of relevant technical parameters was examined.

Results: We observed some meaningful differences between ISP and WC. In particular, ISP showed shorter shot trajectories during the double support phase (DSP) compared to WC (1.29 ± 0.23 cm vs 1.61 ± 0.14 cm, respectively) and overall a lower release velocity (12.25 ± 1.04 m/s vs. 13.73 ± 0.26 m/s, respectively). In addition, at the start of DSP, WC showed a more flexed right knee than ISP (120° to 140° vs 94° to 117°, respectively) and the throwing arm parallel to the ground, unlike ISP that showed an angle of 33° ± 18° between the arm and the ground.

Conclusions: The analysis underlined some technical errors of ISP compared to WC throwers. The inferior performance of ISP compared to WC may be related to a lower release velocity, that previous research^{1,2} identified as the most important parameter for performance. The reduction of release velocity could be linked to shorter shot trajectories during DSP. At the start of DSP, ISP showed a different right arm and knee position as compared to WC, and probably this difference explained the shorter trajectory, the lower release velocity of the shot and, therefore, the lower level performance of ISP. Coaches should be aware that body position at DSP has to be improved in order to extend the shot trajectory and improve release velocity.

References

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PP4-5**In water study of force-velocity and power-velocity relationships for water polo players**

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Purpose: The goal of this study is to derive the Force-Velocity and Power-Velocity relationships of water polo players during the breaststroke kick in water by using video analysis together with a wireless DAQ (Digital Acquisition System – KZ system).

Methods: 14 high-level water polo players participated at the present study developed in two different weeks. To determine the F-V and P-V relationships the players performed an incremental test by using load applied to a suited jacket built to avoid any interference between attached loads and breaststroke performance. The KZ system was placed on the lower back of each player. The test consisted in 2/3 trials of vertical thrust in water at the maximum intensity at increasing loads (up to 25Kg), without use of the arms. The vertical thrusts were acquired at 240fps with a high-performance camera and the results were analyzed with the BioMovie software.

Results: The same day in different trials, the reproducibility of breaststroke kick exercise shows a high correlation with all loads considered in the study: $r = 0.94-0.99$ for average displacement (AD), $r = 0.89-0.98$ for average time (AT), $r = 0.93-0.99$ for average velocity (AV), $r = 0.93-0.99$ for average acceleration (AA). The same concept is applied on trials performed in different days: $r = 0.94-0.99$ for AD, $r = 0.86-0.99$ for AT, $r = 0.95-0.99$ for AV, $r = 0.86-0.99$ for AA.

Conclusions: The high reliability found between two days of measurements and the specificity of the results, suggests that the new method for evaluate the F-V and P-V relationships is suitable for evaluating force and power in athletes performing specific skills as the breaststroke kick.

References

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PP4-6**Evaluation of a hip passive assistive device to support locomotion in patients with impaired gait**

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Purpose: Impaired gait is often associated to several pathologies affecting the neuromotor and musculoskeletal system, which severely impact their quality of life and independence. Robotic devices to enhance gait performance have been proposed as an emerging interesting technology to overcome this issue. Unfortunately, currently these devices have several limitations such as weight, cost, encumbrance, which limit their applicability and daily use. Therefore, the aim of this study was to evaluate the efficacy of a passive wearable device (Exoband) which stores and releases mechanical energy during gait, thus assisting the hip flexors in the later part of gait.

Methods: Seven patients (4 male and 3 female, age 70.1 ± 18.0 yrs, height 1.68 ± 0.06 m, weight 68.5 ± 9.9 kg) with impaired gait due the various diseases (stroke, sclerosis, poliomyelitis, lumbar spinal stenosis) were involved in the study and tested on two separate days. On the first day the patients walked on a 60 m corridor to accomplish a 6 minute walk test, under two conditions in a randomized order: wearing the Exoband (EXO_ON) and not wearing the Exoband (NO_EXO). On the second day the same patients were asked to walk on a 10 m straight walkway for 4 times while trunk dynamic stability was evaluated by means of a portable inertial system (Gyko, Microgate, BZ, Italy), under the same two conditions of the first day (EXO_ON and NO_EXO).

Results: Patients walked significantly more ($p = 0.03$) in the EXO_ON condition with respect to the NO_EXO condition (266.2 ± 119.1 and 252.1 ± 113.3 m, respectively), which resulted in an increase in speed of 5.5%. A significant increase in dynamic stability ($p = 0.03$) was reported in the EXO_ON condition, as highlighted by a -17.5% reduction of the overall breadth of the movement of the trunk.

Conclusions: Patients were able to walk for a longer distance using the Exoband, thus indicating that this device can enhance their walking capacity. Further, the improved dynamic trunk stability is an additional positive sign in these impaired patients, which suggests that the device can be adopted in gait rehabilitation protocols. These findings indicate that the Exoband could be a promising device to assist impaired gait and its simplicity of use can extend its applicability to daily use.

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PP4-7**Inter- and intra-lap variability in stroking parameters during 200-m front crawl swimming**

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Purpose: The arm-stroke cycle in swimming is characterized by temporal technique descriptors: the swimmer adjusted the time spent in each of the four arm-stroke phases (entry-, pull-, push-, recovery-phase) and the model of inter-limbs coordination (IdC) to achieve performance objectives. The aim of this study was to investigate through inertial and magnetic measurement units (IMMUs) how elite swimmers adapt the pattern and variability of their arm-stroke temporal descriptors between (inter-lap) and within (intra-lap) the eight laps of 200 m front-crawl.

Methods: Eight national-level male swimmers performed one 200 m front-crawl at maximal effort in a 25 m pool. Three synchronized underwater cameras (GoPro Hero 4) were placed on a sagittal view to recognize the inter-lap variability of velocity (VEL), stroke rate (SR) and stroke length (SL). Using IMMUs (APDM Opals, 5 units, 128 Hz) and validated algorithms (Fantozzi et al., 2018) the temporal technique descriptors (6 ± 1 cycle x swimmer x lap) were assessed. The algorithms identified the start events of the arm-stroke phases and IdC (time lag between the start of the pull phase and the end of the push phase for each limb). The inter-lap and intra-lap effects for each dependent variable were examined using one-way ANOVAs.

Results: Significant and moderate to strong decreases of VEL, SR and SL for inter-lap comparison were found (mean 1.47 ± 3.55 m·s⁻¹, $p < 0.001$, $\eta^2 = 0.80$; mean 34.4 ± 3.5 cycles·min⁻¹, $p < 0.001$, $\eta^2 = 0.41$; mean 2.58 ± 0.27 m, $p < 0.001$, $\eta^2 = 0.68$, respectively). A stable pattern along the 8 laps of the 200 m for IdC and each stroke phase durations was confirmed by the non significant inter-lap difference ($p > 0.05$). Significant and moderate main effects were found in intra-lap changes for IdC ($p = 0.002$; $\eta^2 = 0.59$) with significant decrease ($p = 0.003$) in the last 2 cycles of the lap ($-19.9 \pm 0.9\%$) compared to the first two ($-22.3 \pm 1.8\%$). Then, the IdC remained stable within the lap (catch-up model) despite a significant decrease in the absolute value during effort. No significant variations were found for intra-lap comparison of each stroke phase duration.

Conclusions: High-level swimmers were able to reproduce the same stroke phases duration and IdC during 200 m front-crawl despite the decrease of velocity, stroke rate and stroke length. Results indicated the IMMU technology is a viable option to recognize the variability of temporal technique descriptors during middle-distance swimming events.

Reference

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PP4-8**Volleyball set: a kinematic comparison between expert and beginner players**

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Purpose: The aim of the present study was to compare the kinematic of four types of set played by advanced (AD) and beginner (BE) volleyball players.

Methods: Five experienced female volleyball players and five novice athletes, with 17 and 5 years of experience respectively, were involved in the present investigation. Each athlete performed five trials of front and back set, high and low style (FH, FL, BH, BL), respectively. A 3D stereo-photogrammetric system consisting of 10 cameras (frequency: 250 Hz) was used. 34 markers were attached on the athletes skin, according to Kadaba et al.¹, in order to identify the trunk, the lower, and the upper limbs. The surface of the ball was covered with flat markers.

Results: No significant differences in timing were detected ($p > .05$), while some differences in the articular angles were found between novices and experts ($p < .05$). The Analysis of Variance for paired data showed the AD had greater capacity to speed up the ball compared with BE players (4.37 ± 0.95 m/s; 4.05 ± 0.73 m/s; $p < .05$). The body position showed a significant different between the AD and BE for the FH ($22.78 \pm 6.54^\circ$ and $28.47 \pm 6.15^\circ$ respectively) and the FL ($25.38 \pm 7.61^\circ$ and $18.73 \pm 5.03^\circ$, respectively).

Conclusions: the present study showed no significant differences in the high ball for the considered categories of players. Significant differences emerged in low sets, especially in the speed of the ball after the release in FL, and in both vertical and horizontal vector components of the BL. Considering the FL stroke, BE seem to use the same technique performed to play the FH, not adapting their technique. Moreover, AD showed a similar position of the body in all 4 types of sets, in order to create a tactical advantage with respect to the opponents. The present study is useful for coaches, players, and physical trainers in creating an elite technical model. The results can help in creating specific training sessions in volleyball.

Reference

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PP4 SPORTS TECHNOLOGY**PP4-9****The effect of technology on adherence to physical activity programs in patients with chronic disease experiencing fatigue: a systematic review**

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Purpose: The beneficial role of physical activity (PA) to manage the health condition of patients with chronic disease is well known. However, adherence to PA guidelines in this group is still low. Technology could represent a significant tool to increase exercise adherence to those particular groups who experience difficulties in adhering to regular and substantial physical activity, and could be supportive in increasing the success of PA programs and interventions. This systematic review aimed at evaluating the effect of physical activity monitoring technology in improving adherence to a PA program in patients with chronic disease experiencing fatigue.

Methods: This systematic review was conducted according to PRISMA guidelines. The literature search was performed in Embase, Medline, and Biosis. We filtered the literature according to the question: “Does monitoring technology affect adherence to physical activity and exercise programs in patients with chronic disease perceiving fatigue?”.

Results: The search resulted in 663 hits; finally, 5 studies were included, with a total number of 171 patients. Study quality was moderate except for one study of high quality. Only two disease types emerged, COPD and cancer patients. PA programs were rather short (from 8 to 13 weeks). Four studies employed pedometers and only one an activity monitor. Three studies based their adherence on steps, the remaining studies focused on active minutes. Adherence was explicitly reported in two studies, and otherwise derived. All studies except one showed high adherence levels (85% week-10, 89% week-8, 81% week-13, 104% week-13, 56% week-12).

Conclusions: The small number of studies identified did not allow to establish whether the use of monitoring technology could improve adherence to PA programs in patients with chronic disease experiencing fatigue, but the current evidence seems to suggest that this is a field warranting further study, particularly into how technology can help to engage patients to adhere to PA programs.

PP4-10**PACE, an app to stimulate physical activity: a pilot study**A. Albergoni^{1,2}, F. Sartor^{2,3}¹Department of Biomedical Sciences for Health, Università degli Studi di Milano, Milan, Italy;²Department of Personal Health, Philips Research, Eindhoven, The Netherlands;³School of Sport Rehabilitation and Exercise Sciences, University of Essex, Colchester, United Kingdom

Purpose: Physical inactivity is a relevant risk factor in the general population leading to several non-communicable diseases. It has been demonstrated that fatigue is a common barrier to physical activity (PA) especially in patients with chronic diseases and elderly. To this regard, smart devices could improve adherence to PA programs or guidelines. In particular, activity pacing is considered a strategy to manage the fatigue and increase PA. Therefore, the aim of this study was to investigate participant's attitude towards pacing with the real pacing behaviours. Moreover, we wanted also to test application's usability, the delivery of PA and exercise program by technology and to identify possible profiles of users.

Methods: This was a pilot study in which 10 physically active participants were enrolled in the study (Gender: 6 males and 4 females; age: 74 ± 2 years old; BMI: 28 ± 2 kg/m²). Participants were tested at baseline (BL) and after 3 weeks (W3) of a moderate physical activity (e.g. walking). Oxygen uptake (VO_{2peak}, K5 Cosmed) was assessed during a 6-Minutes Walking Test (6MWT) to estimate cardiorespiratory fitness. Moreover, the Activity Pacing Questionnaire (APQ), Bandura's Exercise Self-Efficacy (ESE), the Fatigue Severity Scale (FSS), the Short Form-12 Survey (SF-12) and, the Short Questionnaire to Assess Health enhancing physical activity (SQUASH) were also delivered. During the exercise program, participants received a Philips Health Watch and PACE app installed on a tablet to monitor the PA program. Changes between BL and W3 were assessed with un-paired t test. Repeated One-way ANOVA was used to evaluate the questionnaires.

Results: No significant variations in body composition and physiological parameters were found at W3. ESE questionnaire showed a significant effect of time, with a reduction of the total score (PRE vs POST, $p = 0.024$). Walking and exercise adherence showed a not significant time effect. Weekly walking minutes increased significantly (PRE vs POST, $p = 0.039$). Strongest predictors of PA adherence were age, resting heart rate and the 6MWT. PACE app was well tolerated by all participants.

Conclusions: Our research did not show a connection from attitudes towards pacing and the level of adherence. This was not unexpected, because activity-pacing strategies are relevant in the populations perceived fatigue and the fatigue level in these participants was low. This pilot study prompted the use of mobile applications also by in elderly people.

PP4-11**Optimising pacing strategy in cycling during individual time trials: merging 3D rider-bicycle dynamics and bioenergetics**A. Zignoli^{1,2}, P. Menaspà³, A. Giorgi⁴, M. Quod⁵, F. Biral¹¹Department of Industrial Engineering, University of Trento, Trento, Italy;²CeRiSM Research Centre, University of Verona, Trento, Italy;³School of Medical and Health Sciences, Edith Cowan University, Australia;⁴Androni Giocattoli-Sidermec Professional Cycling Team, Medical Staff, Vignola, Italy;⁵Mitchelton-Scott Cycling Team, Brunello, Italy

Purpose: In cycling individual time trials (ITT), the optimal pacing strategy is currently computed with longitudinal models that do not take into account the limits to the lateral accelerations that can be sustained during the turns (e.g.¹). Our goal was to develop a model for ITT that could take into account both vehicle dynamics (including road 3D geometry) and bioenergetics requirements.

Methods: The road geometry of the last 2.5 km of a ITT stage at Giro d'Italia 2018 were extracted using Google Earth path tools and then interpolated with clothoids. Curvilinear coordinates² have been used to model the rider position along the road and the rider-bicycle system dynamics. A critical power model was used to describe the rider's ability to sustain the effort. The optimal pacing strategy problem was formulated as a weighted sum of minimum-time/minimum-effort problem in the framework of an optimal control problem. The solution was found numerically using an indirect method based tool³. Simulated data were compared with GPS and power-output data collected on 8 professional riders.

Results: The model developed in this research was able to predict fluctuations in velocity with good accuracy and simulated data consistently fell within the average SD of the experimental data, i.e. 2.8 km/h (RMSE = 3 km/h). Power-output predictions (RMSE = 72 W) consistently laid outside the average SD of the experimental data (i.e. 77 W) in different portions, with the two signals *in-phase*. This agreement in the timing of power delivery with the experimental data, especially after the turns, was noticeable.

Conclusions: Beside the discrepancies with the absolute values, our predictions were in-phase with experimental data. This result would have been impossible to retrieve by using current gold standard methodologies purely based on point mass longitudinal dynamic models. Predicted velocity was slightly more accurate than predicted power, because: the inertia acted as a filter, the model inaccuracies and the parameter uncertainties. It is therefore concluded that for an accurate calculation of the pacing strategy, it is important to take into account both vehicle dynamics and bioenergetics. The former is important for the limits to the lateral accelerations that the bike-rider system can sustain during the turns, and the latter is important because it limits the maximal power that can be delivered by the rider.

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PP4-12**The validity of FreeMed® Baropodometric Platform for measuring spatiotemporal parameters and walking speed: comparison to an inertial measurement unit system**

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Purpose: The analysis of spatiotemporal parameters of gait is used to identify walking impairments and provide a tailored therapy program for patients. Despite main researches in this field were led with an inertial measurement unit (IMU) sensors, in clinical practice the use of the baropodometric platforms is frequent. To best of our knowledge, the FreeMed® Platform, normally used for postural analysis assessment, has not been yet validated for measuring spatiotemporal parameters and walking speed. The aim of this study was to assess the validity of a baropodometric platform compared to a previously validated IMU-system¹ in healthy adults.

Methods: Participants (24.6±3.8 yrs) without any walking impairments were recruited through web announcement at University of Pavia. Each subject performed 2 trials: walking at self-selected normal and slow speeds. Trials were performed wearing Physilog5 (Gait-up, Lausanne, Suisse) and walking barefoot on the FreeMed® Platform (SensorMedica, Roma, Italy) in a 15-m walkway. Subjects followed these instructions: “Walk to the end of the 15-m walkway at a pace that is normal/slow for you”. Spatiotemporal parameters [cadence(steps/min), stride length(m), gait cycle time(gct; s), right and left stance(ms) and swing(ms)] and walking speed were recorded. Data were analyzed considering only intermediate 5 m of the walkway to avoid acceleration/deceleration during trials. Pearson’s correlation and the Bland-Altman plot were used to determine the level of agreement between the measurements. All analysis was performed using Jamovi software (Ver. 0.9).

Results: Forty adults performed all walking trials (slow speed 0.6±0.1 m/s; self-selected speed 1.1±0.1 m/s, mean ± SD). We found that walking speed, cadence, stride length, and step time variables (gct, right and left stance) show a high level of agreement for both trials (correlation ranges from 0.68 to 0.95). We reported a moderate level of agreement only in swing values for self-selected speed (r = 0.43) and slow speed (r = 0.47).

Conclusions: Results of this validity study confirm that the FreeMed® Platform is a valid tool to assess gait parameters at different walking speeds. The output of the Platform is positively correlated with the output provided by the IMU. Most measures resulted comparable and slow speed validity could help the use of the platform in gait patterns analysis also in pathological condition.

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PP4-13**The ISA method for breast cancer survivors: from research to practice**

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Purpose: the negative side effects of breast cancer treatments can include upper limb lymphoedema. Growing literature indicates that Nordic walking is an effective discipline against several disease symptoms in breast cancer survivors (BCS). The aim of this study was to determine whether introduction to Nordic walking alone is effective against total body extracellular water and upper limb circumferences in BCS compared to its combination with a series of specifically created exercises (i.e. the ISA method).

Methods: 40 breast cancer survivors (51.23 ± 3.04 years) were recruited and randomly assigned to 1 of 2 different training groups.

Results: 10 lessons on Nordic walking technique plus the ISA method significantly reduced both extracellular body water and the extracellular-to-total body water ratio (p < 0.01 for both), and also upper limb circumferences (p < 0.01 for all), whereas just 10 lessons on Nordic walking technique did not.

Conclusions: As the ISA method requires the use of equipment to be applied to Nordic Walking poles during exercises it was important to optimize both design and production of the equipment to facilitate both exercise practice and execution. Therefore, after the experimental phase, we started a partnership with the European University of Design creating a series of practical solution about the upper limb (i.e. ISA cover and Easy fit), the hands (i.e. ISA gloves) and external equipment (i.e. ISA ball, Grip ball and ISA kit) empowering the effects of both ISA method and Nordic Walking practice. The multidisciplinary brainstorming extended the application of both ISA method and developed equipment also to kayaking and canoeing. We are experimenting translational research project moving from research to practice to apply the useful results for BCS health.

PP4-14**Design of a wireless system for real-time performance analysis in Flatwater Kayaking**

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Purpose: On-water measurement systems are widely used to evaluate the effectiveness of the paddling technique by professional kayak

athletes. These devices are able to measure several parameters: kinematic (speed, acceleration, roll and pitch of the boat) as well as dynamic ones (stroke frequency, force acting on paddle and foot brace) using force and inertial sensors properly synchronized. We present a wireless multi-node real-time data logger tailored for flat-water sprint kayaks.

Methods: The system presents a modular hardware architecture, based on a central unit and wireless sensor nodes, which have been designed to be scaled for use on K1, K2 and K4 boats. It consists of a high frequency (20 Hz) GPS receiver, a 6 DoF (3 linear accelerometers and 3 gyroscopes) Inertial Motion Unit (IMU) and 2 conditioned force channels, placed on the paddle and foot brace, for each athlete. Data from all channels are synchronously acquired and processed by a microprocessor unit and sent via a Wi-Fi link to client terminals (PC, tablet or smartphone).

Results: The system allows both kinematic and dynamic analysis of the boat as well as the biomechanical assessment of the crew together with the identification of specific technical flaws.

Conclusions: Athletes and coach can visualise the training data on a suited web page. The system provides real-time feedback on some of the main parameters (time, speed, stroke frequency, force symmetry) and, at the end of the training session. Moreover, these can be wirelessly downloaded to a PC for further deep analysis.

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PP4-15

Acute and chronic effect of self-adapted oral devices on postural control and muscle flexibility during Pilates exercises

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Purpose: Recent studies concerning the effects of the non-customized mouthguards (boil-and-bite) on physical performance, indicate that these oral appliance could improve the maximal muscle strength capacity, force stability and accuracy. An influence on motor activities concerning postural control and balance (such as Pilates) is conceivable. On this base, this study aims to analyze the influence of a specially sport-designed boil-and-bite (BRUX Power) on postural control during the Pilates activity.

Methods: Fourteen amateur sports (age: 39 ± 5 yrs; body mass: 58 ± 6 kg; stature: 164 ± 7 cm; mean \pm SD), Pilates practitioners (3 ± 2 hours/week), participated to this study. After familiarization, participants were asked to perform, in a pre-training session (pre), muscle flexibility (sit-and-reach test, upper limbs circling, lower limbs abduction) and postural control test (hundred with extended legs and front support), with (BITE) and without (CONTROL) a

BRUX-Power bite, in a random order. During the flexibility tests the articular range of motion was measured. In the postural tests the time to exhaustion was assessed. After 4 weeks-training period (post), during which the participants utilized the bite in all the Pilates sessions, the tests were repeated, in the BITE condition. One-way ANOVA for repeated measures was applied to evaluate possible significant differences between the tests. Statistical significance was set at $P < 0.05$

Results: The time to exhaustion in the postural control tests was higher, but not significantly, in the acute condition with BITE, compared to the control condition (105 ± 28 s and 117 ± 29 s in hundred and 121 ± 8 s and 141 ± 12 s in front support in CONTROL and BITE condition, respectively. Mean \pm ES, $P > 0.05$). This trend also occurred, in BITE condition, after the training period, in both tests (117 ± 29 s and 134 ± 19 s in hundred and 141 ± 12 s and 125 ± 13 s in front support in BITE_{pre} and BITE_{post} condition, respectively. Mean \pm ES, $P > 0.05$). No significant differences emerged in muscle flexibility tests, both in acute condition and after training.

Conclusions: Overall, the results suggest that the use of BRUX-Power bite has no significant influence, after a 4 weeks of utilization, on the exercises in which postural control and muscle flexibility are involved.

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SATURDAY ORAL SESSION 3

OP10 PHYSICAL EXERCISE AS PREVENTION AND THERAPY

OP10-1

KEYNOTE A corporate wellness project to increase physical health of employees: the Physical Capacity score (PICs)

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Purpose: People spend a huge part of their life (about 90,000 hours) on-the-job¹. To guarantee high job performance and satisfaction, the workplaces must necessarily be configured as a setting to increase health and wellness. Therefore the first step is to evaluate the physical health of employees. To answer to these needs, the Physical Capacity score (PICs) was developed and tested. The aim of this research is to describe the theoretical, methodological and technological issues related to introduction of PICs.

Methods: The PICs is a composite score indicating an overall level of physical capacity. It is ranged from 0 to 100, with a score of 50 indicating the average level for the general population matched for gender and age of the participant. PICs procedure includes the execution of physical tests in six areas: i) manual dexterity (Tapping test), ii) upper limb strength (Handgrip test), iii) balance (One Leg

Stance test), iv) flexibility (Sit and Reach test), v) lower limb strength (Five Times Sit to Stand test), vi) cardiovascular fitness (YMCA step test). Completing the tests required about 20 minutes. At the end of tests, the PICs was provided describing the areas of strength and weakness. Tailored indications on sports activities, physical exercises and/or physical activities to be carried out to improve the weaker areas were provided. The PICs is now addressed to employees of University of Torino. Tests will be repeated three times per year.

Conclusions: The use of PICs seems to be well accepted and of great interest for participants. The set of functional tests and the value of PICs increase the awareness on individual physical health, highlighting weaker capacities and suggesting countermeasures. Moreover, PICs provides an innovative metrics allowing the comparison of different individuals and tracking in time the effectiveness of intervention. Next step will be to implement an automatic version of the system to allow the administration of the same tests without the presence of operator.

Acknowledgments: This work was supported by University of Torino with the project “Wellness@work for UniTO”

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OP10-2

Physical fitness evaluation in school children from Campania: focus on health

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Purpose: Physical fitness (PF) is considered an important health hallmark at all ages, instrumental to prevent or manage many cardiometabolic pathologies associated to adulthood and old age. Here we investigated the PF components (body composition, strength, flexibility and cardiorespiratory fitness) in school children from Campania region by means of the Eurofit battery tests, comparing them with national/international data, and providing upgraded percentile reference values.

Methods: 608 children (380 boys, 228 girls, 10-14 yrs old) were recruited in Campania schools, gyms and sports centers. All of them were submitted to anthropometric measurements (weight, height, BMI) and to the physical tests included into the Eurofit battery, except for the handgrip strength test. Children’s parents gave their informed written consent.

Results: PF improved with age in both genders; in particular, all measurements revealed that boys performed better than girls ($p < 0.05$), except for Sit and Reach Test. Overweight accounted for 28% in our sample ($BMI > 85^{\text{th}}$ percentile). Such condition specifically impaired the performance of overweight boys compared to normal weight subjects in the bent arm hang test (5.5 ± 4.5 sec vs 7.2 ± 4.6 sec; $p < 0.05$), standing long jump test (140.6 ± 26.0 cm vs 157.4 ± 25.0 cm; $p < 0.05$), and 20 m shuttle run (6.1 ± 2.4 steps/min vs 6.9 ± 3.3 steps/min; $p < 0.05$); however, the 20 m shuttle run test performance resulted significantly associated with sport practice in boys according to the multiple linear regression model ($p < 0.05$), regardless of BMI. Upgraded percentile curves were defined.

Conclusions: This study confirms an inverse relationship between overweight and PF. In addition, sports practice positively affects the endurance fitness in boys, regardless of BMI. The upgraded percentile curves show a higher PF in boys compared to girls across age for almost all components. These data could contribute both to establish upgraded normative reference values in Italian school-age children, and to early detect health related issues in school-age population, allowing to plan prompt preventive interventions.

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OP10-3

Lifestyle assessment in different work environments

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Purpose: An unhealthy lifestyle reduces physical function, thus causing an early exit from the labor market and leading to a disability pension. It has been shown that an appropriate initiative to promote a healthy lifestyle in the workplace has increased health, increased productivity and had a good cost-effect ratio. The aim of this study was to assess of the lifestyle of employees of an international company of household items and a university hospital company.

Methods: From the household company 291 (170 female and 121 male, aged 40.96 ± 8.8 years) and from Hospital 272 (190 women and 82 men, aged 51.5 ± 7.9 years) employees were enrolled in the study. Subjects underwent body composition analysis and were required to complete two questionnaires (International Physical Activity Questionnaire and National Institute for Research of the Food and Nutrition).

Results: The subjects of household company were in an overweight condition ($BMI = 25.1 \pm 4.3$ kg/m²), in particular males ($p < 0.001$). Products based on cereals were consumed about once a day, fresh meat 3.1 ± 1.9 times per week, fresh fruit (5.7 ± 4.1) and vegetables (6.2 ± 3.6) less than one serving a day. Vigorous physical activity was performed for 39.43 ± 95.56 min/week, moderate physical activity for 66.66 ± 196.63 min/week, and the number of daily steps was 9549.0 ± 5238.2 .

Also at the university hospital male employees were in an overweight condition (25.2 ± 3.1 kg/m²), while females were at the upper limit of normal weight ($BMI = 24.7 \pm 4.5$ kg/m²).

Products based on cereals were consumed about once a day, fresh meat 2.9 ± 1.9 times per week, fresh fruit (8.2 ± 5.3) and vegetables (8.0 ± 4.4) more than one serving a day. Vigorous physical activity was performed for 45.9 ± 93.7 min/week, moderate physical activity for 79.9 ± 152.8 min/week, and the number of daily steps was 7160.9 ± 3506.0 .

Conclusions: There are differences in the lifestyle between the two work environments. Job duties can have an influence on the daily habits and consequently on the body composition. Workplaces have great potential to change personal lifestyle choices and a preliminary assessment should be performed in order to propose a tailored intervention. Interventions to improve the lifestyle require an approach that considers not only the characteristics and habits of the workers, but also the organizational determinants that act as a barrier or facilitator for a successful implementation.

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OP10-4

Associations between physical activity level and quality of life and cognitive performance in elderly individuals with multi-year dancing activities

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Purpose: It is well-acknowledged that mental and physical decline associated with aging can be prevented and/or reduced with regular physical activity (PA). Dancing combines cardiovascular, cognitive and coordinative demands, providing a popular leisure PA among elderly. This study examined the impact of multi-year (at least 10 years) amateur ballroom dancing on cognitive and motor abilities and PA level, in older adults (aged 65 to 80 years).

Methods: Nonprofessional senior dancers (SD, N20) were compared with a nonsedentary control group (CG, N18), who was equivalent in age, gender, education and lifestyle and had no record of dancing or similar activities. Participants were assessed with health related quality of life (HRQoL) and cognitive questionnaires: 36 Health Status Survey (SF-36v2), Montreal Cognitive Assessment (MoCA) and Cognitive Reserve Index questionnaire [CRIq]; they underwent Preferred Walking Speed (PWS) motor test and their PA level was assessed using a multi-sensor activity monitor (MVPA).

Results: Participants presented a good SF-36v2 physical component (PCS, 49.2 ± 7.8) and a very good mental component summary (MCS, 52.5 ± 8.1)¹, a quite good total MoCA score (24.2 ± 2.8)², and a “medium” total CRIq score (112.4 ± 16.7)³. The average PWS (1.3 ± 0.8 m/s)⁴ and their daily MVPA (66.2 ± 57.2 min/day) were high. Differences neither in the three cognitive questionnaires nor in PWS and PA level were observed between groups ($p = ns$).

Conclusions: Ballroom dancing allows mental and physical HRQoL, normal cognitive functioning and good cognitive reserve, notable physical function and PA level, able to contrast the mental and physical decline associated with aging.

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OP10-5

Influences of physical level and chronotype on sleep during aging

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Purpose: Aging is a physiological process, which can also affect sleep quality. With advancing aging, sleep quality may be also compromised by more accentuated morning preferences. Physical activity may improve sleep parameters due to its broad-spectrum action on different physiological variables. The present study evaluated the action of physical habits and chronotype on sleep parameters in elderly.

Methods: The recruitment enrolled 100 Italian elderly (70.9 ± 6.3 years) that completed the Morningness-Eveningness Questionnaire (MEQ), the International Physical Activity Questionnaire-Short Form (IPAQ-SF) and the Pittsburgh Sleep Quality Index (PSQI) for the assessment of chronotype (evening- [E-], intermediate- [N-], morning- [M-] types), physical activity and sleep quality, respectively.

Results: PSQI final score for active subjects (5.3 ± 3.1) described a better sleep quality compared to inactive subjects (6.2 ± 3.4). The worse sleep quality for inactive subjects was associated with higher use of sleep medications ($p = 0.003$) and much more sleep disturbances ($p = 0.003$) and daytime dysfunctions ($p = 0.006$). As regard chronotype, N-types sleep better compared to M-types. This trend is visible also in the female stratification, with active N-type (3.9 ± 3) collecting lower PSQI value compared to active M-types (6.2 ± 3 ; $p < 0.05$). Active M-type females make significantly less use of sleep medications ($f = 0.05$; $p = 0.02$) and had less sleep dysfunction ($f = 0.03$; $p = 0.03$) compared to inactive M-type females. Active N-types female reported less daytime dysfunctions ($f = 0.03$; $p = 0.03$) compared to inactive ones. Among males, active M-types reported significantly less disturbances compared to inactive M-types ($f = 0.05$; $p < 0.05$).

Conclusions: In general, inactive and M-types subjects sleep worse with respect to active and N-types, respectively. Inactive subjects had also more sleep disturbances and make greater use of sleep medications than active subjects did. An active lifestyle could be considered a useful tool to improve sleep habits and reduces sleep problems during aging.

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OP11 PHYSICAL EDUCATION AND SPORTS PEDAGOGY

OP11-1

KEYNOTE Observation of teaching styles in physical education in high school. How to teach motor competencies?

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Purpose: Reproduction and production teaching styles¹ in physical education are essential for promoting different ways of learning². Production styles favor variable, creative and transferable motor responses, developing perception of competence, intrinsic motivation and metacognition. Objectives: a) experiment a list of descriptors of teaching styles; b) analyze the teaching styles mainly used by teachers.

Methods: The sample consists of ten PE teachers from the high school, 5 males (age, $M \pm SD$: 35.20 ± 4.08) and five females (age, 32.60 ± 2.07). Each teacher carried out 8 lessons for group-class.

Sample				
Gender	Teacher (N)	Age (M \pm DS)	Lessons (hours)	Classes
Male	5	35.20 ± 4.08	40	5 (first)
Female	5	32.60 ± 2.07	40	5 (first)

A list of descriptors has been predefined to identify each teaching style. In the study, the behaviors of each teacher were observed during 8 lessons of the same class group (one month) and each learning episode and teaching style used in each class was added³. The descriptive statistics ($M \pm SD$) was made on the results that emerged. Each lesson has been videotaped.

Results: It emerged that each teacher, in each class group, used predominantly *reproduction* styles over *production* ones. The learning episodes performed with reproductive teaching styles in males ($M \pm SD = 27.00 \pm 5.91$) with respect to production styles ($M \pm SD = 2.60 \pm 1.81$) were recorded. Females also used predominantly reproduction styles ($M \pm SD = 23.8 \pm 5.11$) with respect to those of production ($M \pm SD = 6.40 \pm 2.30$).

Conclusions: Defining the descriptors of the teacher's behavior allows you to: (a) reconstructing the methods of proposing motor tasks; (b) the learning methods of the mainly stressed students; (c) the methods in which didactic mediation is carried out for the development of psychological and social factors in developmental age. Proposing motor activities through directive styles can condition learning processes, limit the variety of motor responses and the intrinsic motivation of the students.

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OP11-2

The promotion of active lifestyle within the society of captives: is sport a valuable tool for the education and rehabilitation of the inmates?

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Purpose: Contrasting inactivity and promoting well-being is usually the first reason given when encouraging sports-based programs within the prison population. In addition, the education of the body is supposed to be an integral part in the rehabilitation process and to have a significant role in the daily life of the prisoners as well as significant consequences for resettlement on release. However, studies examining the impact of such a kind of programs have been described as limited¹, embryonic² and weak³.

Methods: The study sought to analysis a sport-based intervention for inmates living in the prison of Cassino. The study design involved the use of the most significant change method (MSC)⁴. It was based on a qualitative, participatory approach, with all the main stakeholders (prisoners, prison's staff, coaches and volunteers) involved in all aspects of the evaluation process. In line with the methods, the data came from narrated stories that were analysed by a Panel of program implementers and policy and management stakeholders. Twenty beneficiaries were purposely selected in order to set a sample that was representative of the group involved in the program.

Results: The most significant change felt by the beneficiaries was the perception of a better level of health and fitness. Specific themes aspects were: reducing health risks, increasing general physical fitness, reduction in depression, anxiety, stress and hopelessness – especially for those inmates with a long duration of the sentence. Changes related to the rehabilitative process were the development of pro-social identities and the opportunity to establish positive networks with individuals and organisations external to the prison in the view to have a good settlement on release. This can be partially linked with the concept of “desistance” from crime that refers to ‘a change in the person's pattern of behaviour from involvement in crime to non-involvement in crime.

Conclusions: The study showed the importance of drawing the rehabilitation process into an establishment's wellbeing strategy. The evidence indicated that a sports-based program, under certain conditions, can contribute to a positive social change among inmates.

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OP11-3

The children's right to move: Towards a phenomenology of everyday active habits

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Purpose: The aim of the presentation is to propose and discuss the children's movement as a right.

Methods: A review of the most relevant international documents and scientific papers discussing or citing the rights-based approach to sport, physical activity, and movement as all-encompassing concept has been carried out with the aim to analyse conventions, charts, and declarations. These documents and papers have been compared with data from several sources. Thereafter, a usual day of an 8-year-old child is described through a phenomenological approach. The description emphasizes the possibility of the child to be, or not to be, active in everyday routines. This decision has been taken, from one side to highlight the complexity of the phenomenon and the relevance of the choices of the adults (parents, relatives, teachers, trainers, animators) in promoting the movement, from the other side to highlight the significance of geographical and sociocultural variables influencing the possibilities to be active in everyday life.

Results: The rights-based approach to physical activity had been used in relation with the right of disabled people and women to practice sport. Even if used in few international documents and rarely in scientific papers, more recently, the concept of right to move, including play, has observed a growing attention through the interpretations based on the capabilities approach and, secondary, on unperceived rights thus unfolding the connection between the right to move and the possibility to choose.

Conclusions: Considering the movement as a right, leads to a radical shift of attention from organized sport and physical activities towards everyday active habits. This change, focussing on children's real or potential lives, requires a true human-centered phenomenological approach aiming at transdisciplinary studies.

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OP11-4

Effects of 12-week extracurricular multilateral training on body image perception among youth

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Purpose: Body image is closely linked to psychological well-being during adolescence. Physical activity is effective for improving body image disturbance and to date limited body image interventions were undertaken through physical education. Therefore, the aim of this study was to investigate the effects of a supervised 12-week

extracurricular multilateral training intervention on body-image dissatisfaction and body-size self-perception.

Methods: 100 students, aged 14-15 years, were assigned to multilateral training group (MG, n = 50; 25 M, 25F) that did not practice any extracurricular physical activity in the period before the study, or Control group (CG, n = 50; 25 M, 25F) that regularly practiced team sports outside the school hours for at least 3 years. At baseline and after 12 weeks, anthropometric measurements and two standardized psychological tests to assess the degree of personal satisfaction towards their body were administered (i.e., Body uneasiness test (BUT) and contour drawing rating scale (CDRS)).

Results: After multilateral training intervention, significant differences in the total MG for body weight (-1.36 ± 2.03 kg, $p < 0.0001$), BUT (-0.54 ± 1.49 , $p = 0.032$) and CDRS (-1.26 ± 3.92 , $p = 0.037$) scores were detected. Females of the MG showed significant improvement in body weight (-1.49 ± 2.22 kg, $p = 0.003$) and BUT (-0.76 ± 1.56 , $p = 0.040$), whereas males showed improvement in body weight (-1.24 ± 1.85 kg, $p = 0.003$) alone. CG showed no significant changes ($p > 0.05$).

Conclusions: Findings suggest that a multilateral approach, consisting in supervised exercises aimed to develop conditional and coordinative motor abilities, could increase the satisfaction with their bodies in adolescents. However, girls always showed higher scores than boys and this indicates greater dissatisfaction and uneasiness with their bodies. Thus, to aid positive psychological health in adolescents, extracurricular activities such as multilateral training should be considered by physical educators.

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OP11-5

The trends of screen-time and motor coordination in adolescent: a preliminary study

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Purpose: Evidence suggested that screen-time based on sedentary habits (smartphone, laptop, tablet, electronic device, etc.) was associated with poorer health outcomes among adolescents¹. The prevalence of these habits was constantly increasing, with over 50% of adolescent exceeding the public health screen time recommendation of 2 h/day or less. The aim of the study was to assess the trend of screen-time and motor coordination in adolescents of 15, 17 and 19 years.

Methods: 130 adolescent (15 years-old = 31; 17 years old = 35; 19 years old = 30) were involved in this pilot study. The screen time was assessed with a blind questionnaire that indicates the time of use of the electronic device during the day but not associated with the subject. Furthermore, motor coordination was assessed with the KTK test (Raw score - RS).

Results: Results suggest a difference in RS for gender (M = 279.73; F = 268.40; $p = 0.005$) and age (15 = 261.19; 17 = 275.09;

19 = 285.54; $p = 0.016$) with a significant increase of motor coordination between 15 and 19 years ($p < 0.001$) and between 17 and 19 years ($p = 0.016$). Furthermore, screen time is different for gender ($M = 9.06$ hours; $F = 11.36$ hours; $p = 0.003$) and there is a significant interaction of age for sex ($p = 0.004$). Finally, the screen time decreases significantly between 15 and 17 years ($15 = 13.61$ hours; $17 = 10.16$ hours; $p = 0.003$), and between 15 and 19 years ($15 = 13.61$ hours; $19 = 9.65$ hours; $p < 0.035$).

Conclusions: The research is placed in a field of study poorly addressed by the scientific literature, especially in Italy. Preliminary results suggest an increase in motor coordination (RS) and a decrease in screen-time (blind questionnaire) during the adolescence. The trend of RS and that of screen-time suggest that the two factors could be negatively related, but more investigation will be needed to interpret this relation.

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OP12 BIOMECHANICS

OP12-1

KEYNOTE Influence of age on muscle active stiffness

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Purpose: This work was aimed to study the possible age related modification of the relationship between muscle-tendon unit active stiffness (AS) and the rate of torque development (RTD) during static contractions.

Methods: The tibialis anterior of 20 young (Y, age 20-25) and 20 old (O, age 65-70) subjects was stimulated at the main superficial motor point with three tetanic trains at 35 Hz for 3 s (stimulus duration 100 μ s). The torque output was recorded by a load cell; the muscle shortening was indirectly measured detecting the muscle surface displacement by an optical laser distance sensor. The signals were filtered (0-50 Hz) and sampled at 1000 Hz. Out of the three tetani the one showing the best force production was chosen and analysed for each subject. Each sample was scaled to the torque or laser signal at 200 ms. As a consequence the calculated parameters were relative (%) to the signals' 200 ms value. Maximal %RTD was the highest value of the moment-time curve slopes over the 0-50; 0-100; 0-150 and 0-200 ms time windows. AS. The area under the % laser signal-%torque curve was considered as a measure of the AS value (the lower the value the lower the stiffness). Statistical analysis. T- test was used to compare Y and O in both %RTD and AS. Furthermore, Pearson correlation was used to compare RTD and AS.

Results: Maximal %RTD: 590 ± 114 (O) and 479 ± 133 (Y); the difference was statistically significant ($p = 0.007$). AS: 4196 ± 551 A.U. (O) and 3614 ± 680 A.U. (Y); the difference was statistically significant ($p = 0.005$). Pearson analysis: the two variables resulted positively correlated ($cc = 0.541$, $p < 0.001$).

Conclusions: The more efficient torque conversion of the muscle shortening suggests that the muscle tendon complex in O is stiffer and

may mitigate the already described negative effect of age on the absolute and relative RTD during voluntary contraction¹. Eventually, impaired muscular neural drive seems to play a major role in worsening of the voluntary muscle action with age beyond the higher AS of aged subjects.

Reference

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OP12-2

Can a medially stabilized TKA design approach a natural knee kinematics?

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Purpose: Physiological kinematics is very difficult to restore after total knee arthroplasty (TKA). The aim of our study is to evaluate, through dynamic RadioStereometric Analysis (RSA), the in vivo kinematics of the knee after implantation of a Medial Stabilized prosthesis during sit to stand and lunge movements.

Methods: 18 patients (72.1 ± 7.4 years old) were evaluated by dynamic RSA 9 months after TKA. The kinematic evaluation was carried out using the dynamic RSA tool during the execution of sit to stand and lunge movements. The kinematic data were processed using the Grood and Suntay decomposition and the Low Point.

Results: During the sit to stand, the kinematic analysis showed the presence of a medial pivot, with a significantly greater ($p = 0.0216$) anterior translation of the lateral condyle (3.9 ± 0.8 mm) than the medial one (1.6 ± 0.8 mm) associated with a femoral internal rotation ($4.5^\circ \pm 0.9^\circ$). During the lunge, in the flexion phase, the lateral condyle showed a larger posterior translation than the medial one (6.2 ± 0.8 mm vs 5.3 ± 0.8 mm) associated with a femoral external rotation ($3.1^\circ \pm 0.9^\circ$). In the extension phase, there is a larger anterior translation of the lateral condyle than the medial one (5.8 ± 0.8 mm vs 4.6 ± 0.8 mm) associated with femoral internal rotation ($6.2^\circ \pm 0.9^\circ$).

Conclusions: The kinematic data of the investigated prosthesis is similar in both motor tasks. The MS prosthesis simulates in vivo the physiological kinematics of the knee described by Freeman and Pinskerova¹. It allows greater AP translation of the lateral compartment associated with a medial pivot during flexion in weight-bearing conditions. The finding of outliers in the VV and IE rotations analysis highlights the importance of a correct soft tissue balancing in order to allow the prosthetic design to manifest its innovative features.

Reference

1. Freeman MA, Pinskerova V (2005) The movement of the normal tibio-femoral joint. *Journal of Biomechanics* 38: 197-208

OP12-3**The mechanics of human bipedal locomotion on hands**

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Purpose: The aim of this study was to explore the mechanics of a non-conventional bipedal locomotion like hand walking in relation to the ‘normal’ upright walking.

Methods: Seven female subjects (23 ± 1 year old, 1.63 ± 0.05 m height, 58.7 ± 3.7 kg mass; mean \pm SD) with a background in gymnastics took part in the study. Before data collection an adequate number of familiarization sessions was performed. Subjects were asked to locomote on a treadmill at 0.28 and 0.42 m/s by walking on feet or on hands (in a bipedal way: the subject was upside-down and only hands touched treadmill belt). Three-dimensional body motion was sampled by an 8-camera system (Vicon) at 100 Hz to compute the body center of mass (BCoM) position with a 11-segment model. From BCoM and segments 3D trajectories the work to accelerate and raise BCoM (Wext) and the work to accelerate limbs with respect to BCoM (Wint) were calculated and added to obtain the total mechanical work (Wtot) needed to locomote². Recovery, the ability of the moving system to save energy by behaving like a pendulum-like system, was calculated according to Cavagna et al¹.

Results: When locomoting at the same speed, hand walking relies more on stride frequency than stride length, with twofold higher values compared with walking. Duty factor is similar in the two gaits, whereas double contact time is markedly shorter in hand walking. The BCoM trajectory in hand walking shows a twofold vertical excursion and higher mediolateral sway than walking that causes an increase in vertical and lateral work, which ultimately increase Wext. Hand walking Wext, Wint and Wtot values are almost three times higher than walking. Kinetic and potential mechanical energies are similarly out of phase in the two conditions, then Recovery is similar; when also the lateral energy is included, hand walk showed a 30% increase in Recovery, highlighting a mediolateral pendular exchange.

Conclusions: Hand walking is a pendulum-like locomotion as the ‘normal’ upright walking, but subjects need to perform more vertical and lateral mechanical work to move forward. This three times higher mechanical work performed with non-locomotory limbs, along with discomfort, makes hand walking a demanding (and prohibitive) gait.

References

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2. Minetti et al. (1993) Mechanical determinants of gradient walking energetics in man. *Journal of Physiology* 472:725–735

OP12-4**Posterior stabilized rotating platform total knee arthroplasty design partially restores normal knee kinematics during two tasks: sit to stand and lunge**

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Purpose: The purpose of the present study is to compare the kinematical behavior of TKA Rotating Platform (RP) design during an activity of daily living (Sit-To-Stand - STS) and a high demanding task (Lunge) using Dynamic RSA. The kinematical behavior of the TKA is not expected to be different during the two motor tasks. Detecting TKAs kinematical patterns is important in order to attempt to forecast long-term survivorship pattern and clinical outcomes.

Methods: A cohort of 25 patients were recruited and evaluated. 9 months after the implantation of PS RP TKA, patients were examined using model-based Dynamic RSA during two motor tasks. The kinematic parameters were obtained through Grood and Suntay decomposition. The Pearson’s coefficient was used to assess the correlation between STS and the extension phase of the lunge. Correlation is considered statistically significant if $p < 0.05$.

Results: All 25 patients performed STS, 3 did not perform lunge. Antero-Posterior translation: femur anteriorly translates from 80° to 30° of flexion (6 ± 0.5 mm; significantly correlated). From 30° of flexion to full extension there is no significant correlation. Internal-External rotations: femur internally rotates from 80° to 30° of flexion ($4 \pm 0.5^\circ$; significantly correlated). From 30° of flexion to full extension there is no significant correlation. Low-point contact positions of medial and lateral femoral compartment: no differences between medial and lateral compartment neither during STS nor lunge extension.

Conclusions: STS and Lunge extension are highly correlated. LP demonstrated that the TKA did not fully restore the screw home mechanism. This is due to the polyethylene inlay characteristics. Most of the rotation occurs between the rotating inlay and the tibial component, while the femoral compartments move with the same trend. This specific TKA RP design is able to partially restore normal knee kinematics both in activity of daily living and high demanding task.

Reference

1. Freeman MA, Pinskerova V (2005) The movement of the normal tibio-femoral joint. *Journal of Biomechanics* 38: 197-208

OP12-5

The effects of Tai Chi Chuan practice on gait and cognitive abilities

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Purpose: Tai Chi Chuan (TC) is a traditional Chinese mental and physical exercise, characterized by slow, rhythmic and coordinate movements, breathing control, mental focus and body weight shifting¹. Previous studies have examined the efficacy of TC in healthy older adults, focusing on motor function-related outcomes (flexibility, strength, mobility and balance) rather than gait-related parameters. Furthermore, it is unclear whether TC would improve cognitive functions. The aim of the study was to evaluate the effects of TC on gait parameters and cognitive ability, in healthy adults practitioners compared to naïve healthy controls.

Methods: 14 advanced TC practitioners and 14 age-gender-BMI matched naïve healthy controls were enrolled. All subjects underwent to neuropsychological (NP) evaluation assessing cognitive functioning (visual spatial memory, verbal fluency, executive functions). Moreover 3D-Gait analysis (3D-GA) assessment of walking was performed by using a Stereophotogrammetric system (Qualysis, 120 HZ), after placing fifty-nine passive markers. Gait analysis results were categorized as range of motion, velocity and stability parameters, for the latter the coefficient of variability (CV) was calculated. The range of motion of thigh, knee and ankle was normalized for the 100% of gait cycle². The means and standard deviations of outcome measures were calculated, after normalizing the value of each parameter for the body mass index (BMI).

Results: Our results showed a better cognitive ability of TC when compared to naïve controls as suggested by a better performance in the visual-spatial memory (evaluated through Corsi test) ($p < 0.05$). 3D-GA showed an increase of stance time ($p < 0.05$), a decrease of double limb support time (DBL) ($p < 0.01$) and an increase of the ratio DBL/SLS (Single Limb Support time) ($p < 0.001$). We also found an increase of ankle plantar flexion during initial contact and load response ($p < 0.05$), an increase of ankle dorsal flexion during mid and terminal stance phases and an increase of knee flexion during initial contact and load response ($p < 0.05$).

Conclusions: The study shows that TC practice improve gait performance. These results are supported by reduction of DBL time that indicate a better gait stability and a reduction of fall risks. In addition our results suggested that TC practice is a good strategy to improve the visual-spatial ability.

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OP13 SPORTS TRAINING AND TESTING

OP13-1

KEYNOTE Can machine learning techniques inform maximal vs submaximal classification in cardiopulmonary exercising testing?

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Maximal oxygen consumption (VO_{2max}) provides an integrative measure of the function of cardiovascular, respiratory and neuromuscular systems and an index of aerobic performance. Yet, uncertainties remain on our ability of establishing a true VO_{2max} during a RI test¹.

Purpose: We applied machine learning techniques to the analysis of cardiopulmonary exercising test data (CPET), with the aim to verify the performance of a classifier to discriminate maximal ($_{max}CPET$) and submaximal ($_{sub}CPET$) tests.

Methods: This retrospective study was conducted on a database of 204 maximal (i.e. verified plateau) CPET. We extracted subject's demographics and anthropometrics along with 10-s averages of: VO_2 , VCO_2 , VE, RF, $PetO_2$ and $PetCO_2$. 50% of the tests was truncated 60 or 120 or 180 s before the end, to create a sample of $_{sub}CPET$. Then the dataset was partitioned in training (80%) and test (20%) sets, the latter entirely unseen during training. The applied neural network is composed by 3 sequential convolutional layers followed by a fully connected layer. We evaluated the model's classification accuracy (number of the correct predictions/total number of predictions), sensitivity (proportion of $_{max}CPET$ correctly classified as $_{max}CPET$) and specificity (proportion of $_{sub}CPET$ correctly classified as $_{sub}CPET$).

Results: The model was able to distinguish $_{max}CPET$ from $_{sub}CPET$ with an accuracy of 63%, 88% and 84% in the test set truncated at 60, 120 and 180 s respectively. Sensitivity was 69, 92 and 88% and specificity 56, 84 and 80% in the test set truncated at 60, 120 and 180 s respectively.

Conclusions: This proof of concept confirmed the feasibility of applying machine learning algorithms to the problem of maximal/submaximal CPET discrimination. The use of larger datasets and the inclusion of relevant variables such as respiratory exchange ratio and heart rate to train the model are likely to improve its accuracy, sensitivity and specificity.

Acknowledgements: We are grateful to the Fondazione Cassa di Risparmio of Trento and Rovereto (CARITRO) for partially funding this research.

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OP13-2

A new inventory to assess handedness in basketball players

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Purpose: Left handers are believed to have some tactical advantage in interactive sports, as basketball. Aims of this study were to assess handedness in basketball players and to verify the influence of competitive level and game role in laterality.

Methods: A new inventory was proposed to assess the handedness in basketball tasks. The study was carried out on a sample of Italian male basketball players and controls. Handedness in daily gestures was assessed by means of Edinburgh Handedness Inventory (EHI) in all subjects; handedness in basketball tasks was assessed by means of the new inventory in basketball players. Comparisons among laterality by groups (athletes vs controls; athletes by competition level and game role) were carried out.

Results: Players and controls were similar in handedness in daily gestures; players performed some sports tasks with left hand or mixed hands, also when they were right-handed in everyday life, and more frequently in the highest level and in some roles (point guard and small forward).

Conclusions: The new inventory can be used to assess handedness in basketball tasks. Hand preference in basketball tasks could change as a consequence of professional training.

OP13-3

Ecological and construct validity of a repeated sprint test in Parkour

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Purpose: Aim of this study was to assess a new Parkour-specific repeated sprint ability test (PRSA) for repeated sprint ability while facing obstacles and for PRSA between-day reliability, sensitivity, and minimal detectable change.

Methods: Thirteen Parkour players (age 25 ± 5 yrs) performed in a counterbalanced random order eight tests: PRSA, hand-grip, core-stability, long-jump, pull-up, vertical-jump, anaerobic capacity, and VO₂max field test in two separate sessions (to assess the Intra-class Correlation Coefficient [ICC]). According to the four competition-common fundamentals in the gate, PRSA was a 15-m, 10-time (at last RPE was took (Rate of Perceived Exertion as a value of the 6–20 Borg-scale)), maximal-speed trial, with a 15-sec recovery (in-between) jogging way back following order: monkey vault, front flip, precision and roll. Principal Components Analysis (PCA) was performed in order to identify the principal component summarizing the 23 considered variables. Sensitivity of the test was assessed by calculating smallest worthwhile change (SWC) and standard error of

measurement (SEM). Significance for all the statistical tests was accepted at $P \leq 0.05$.

Results: PRSA total and peak time, and RPE were significantly correlated with the majority of core stability tests: left side plank, right side plank, quadriceps, and total points ($r = -0.79/0.59$ and $P = 0.001/0.035$). Total time was significantly correlated with jumps and pull-up tests: squat jump, countermovement jump, standing long jump, leaping long jump, and total points ($r = -0.87/0.57$ and $P = 0.002/0.041$). In addition, PRSA total and peak time correlated with anaerobic capacity ($r = 0.78$ and $P = 0.002$, and $r = 0.82$ and $P = 0.001$, respectively) and with VO₂max ($r = 0.78$ and $r = 0.78$, respectively, $P = 0.002$). Twenty-three variables PCA led to extraction of four significant components, which explained 90.2% of 23 variables' total variance. Finally, PRSA test (i.e., total and peak time) showed high reliability and sensitivity (ICC 0.991–0.998, SWC 0.29–0.68%, and SEM 0.07–0.32%).

Conclusions: Considering the strong ecological validity, PRSA is valid specific field test for Parkour players. In addition, thanks to its high reliability and sensitivity, this test is suitable for monitoring, evaluating, and programming training processes for Parkour practitioners in repeated sprint ability involving and crossing obstacles.

OP13-4

Correspondence between MLSS and RCP in menopausal women

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The heavy-to-severe boundary of exercise intensity defines the upper limit of exercise tolerance. While the Maximal lactate steady state (MLSS) is considered the gold standard, more time-efficient methods, such as the respiratory compensation point (RCP), are commonly used for fitness monitoring and exercise prescription. However, the interchangeability among “threshold” indexes remains controversial. Importantly, no studies have specifically focused on post-menopausal women in which an individualized prescription is paramount to maximize health benefits.

Aim: to test the hypothesis that MLSS and RCP occur at the same absolute and relative metabolic intensity in healthy postmenopausal women.

Methods: 15 postmenopausal women (55 ± 4 years; 5 ± 3 years from menopause; 60 ± 9 kg; 164 ± 6 cm; 36 ± 6 ml·kg⁻¹·min⁻¹ VO₂max) performed the following tests on a cycle ergometer: *i*) 2-5 30-minute constant-load trials for the identification of MLSS (i.e. the highest workload compatible with a constant blood lactate concentration ([LA]); *ii*) a ramp incremental test for the identification of maximal parameters and RCP (standard technique, based on ventilator and gas exchange parameters). The absolute (Ab) and relative (%) to maximal metabolic intensity (i.e. VO₂), heart rate (HR) and power output (PO) at MLSS and RCP were compared by paired t-test and correlation analysis.

Results: [LA] at MLSS was 4.95 ± 1.87 mmol·l⁻¹, comparable with the values of adult males. MLSS and RCP occurred at an identical Ab and % VO₂ (1724 ± 281 vs 1705 ± 210 ml·min⁻¹ $p = 0.98$; 80 ± 8 vs $81 \pm 5\%$ VO₂max $p = 0.95$) and Ab values were highly and significantly correlated ($r = 0.82$ $p < 0.001$). Ab and % HR at MLSS and RCP were not significantly different (152 ± 7 bpm vs 150 ± 11 $p = 0.52$; 88 ± 4 vs $89 \pm 7\%$ HR_{max} $p = 0.50$) and Ab values were significantly correlated ($r = 0.77$ $p < 0.001$). On the contrary, the Ab and % PO associated with MLSS was significantly lower than that at

RCP (110 ± 22 vs 122 ± 19 p < 0.001; 63 ± 7 vs $71 \pm 6\%$ PO_{max} p < 0.001) while significantly correlated ($r = 0.87$ p < 0.001).

Conclusions: In agreement with previous studies of our group conducted in different populations, our current data confirm that RCP and MLSS occur at an identical absolute and relative metabolic intensity and HR in post-menopausal women. Our data support the hypothesis that MLSS and RCP manifest as a result of an identical underlying physiological phenomenon. Provided that they are expressed as metabolic intensity and/or HR, both indexes accurately demarcate tolerable from intolerable exercise intensity.

OP13-5

Validation of a single 3-min submaximal test to predict maximum lactate steady state

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Maximum Lactate Steady State (MLSS) demarcates heavy/sustainable from severe/unsustainable exercise intensity and is used for evaluation/monitoring of exercise capacity and for training design and exercise prescription. The standard measuring technique requires a physically demanding and time-consuming protocol (3-5 constant-load trials to exhaustion) which may not be applicable in all contexts and populations. A recent pilot study from our group demonstrated in a young, male population that MLSS is accurately and precisely predicted based on blood lactate (LA) accumulation at the third minute of a single submaximal non-exhausting cycle ergometer exercise.

Aim: To validate the above simple, submaximal and time-efficient approach for MLSS estimation in a larger, heterogeneous population.

Methods: 59 healthy adults (40♂, 19♀, 41 ± 18 years (range 19-78), BMI 24 ± 2 (19-30), VO_{2max} 46 ± 11 ml⁻¹kg⁻¹min⁻¹ (25-68)) performed 3-5 constant-power trials to fatigue on a cycle ergometer. The workload corresponding to MLSS was identified through 2-3 30-min constant power output trials. During each trial, LA accumulation (LA_{3min}) was calculated as the difference between 3-min and resting values. Multiple linear regression was computed to estimate %MLSS corresponding to a given power output from subjects' age and LA_{3min}. The estimated MLSS (estMLSS) was compared to the measured one (valMLSS) by paired t-test, correlation, and Bland-Altman analysis.

Results: The group mean value of valMLSS was 187 ± 51 watt, not significantly different from (p = 0.48) and highly correlated with ($r^2 = 0.88$) estMLSS (186 ± 53 watt). The average difference (bias) between valMLSS and estMLSS was 0.76 watt (not different from zero) with an imprecision of 18.6 watts.

Conclusions: The simple, submaximal, time- and cost-efficient 3-minute submaximal test proposed in our study accurately and precisely predicts MLSS in a large and heterogeneous healthy adult population. This newly developed method offers a practical and valid alternative to traditional, time consuming and physically demanding methods favoring the generalized applicability of measures of MLSS.

SATURDAY ORAL SESSION 4

OP14 SPORTS TRAINING AND TESTING

OP14-1

KEYNOTE Physiological responses during three different High-Intensity Interval Training programs in active university students

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Purpose: High-Intensity Interval Training (HIIT), in a variety of forms, is today widely used to improve cardiorespiratory and metabolic function of moderately- or well-trained subjects. The aim of this study was to examine physiological and metabolic responses to three different short-bout HIIT regimes in young active subjects.

Methods: Twenty healthy active university students (age: 22.80 ± 2.76 years, height: 178.85 ± 8.64 cm, body mass: 72.51 ± 11.47 kg) were enrolled in this study. They performed one incremental treadmill test to determine the VO_{2max} and maximal aerobic speed (MAS). Then, each participant performed, on separate days, in a randomized order: 1) 15 repetitions of bouts of 10 s at 40% MAS and 10 s at 120%MAS (10-10); 2) 15 repetitions of bouts of 15 s at 40% MAS and 15 s at 120%MAS (15-15); 3) 15 repetitions of bouts of 20 s at 40% MAS and 20 s at 120%MAS (20-20). Peak oxygen consumption (VO_{2peak}), volume of carbon dioxide (VCO₂) and heart rate (HR) were continuously monitored during each session. Respiratory-exchange ratio (RER) and blood lactate concentration ([La]) were measured after the end of exercise. The psychophysiological stress was evaluated by the whole-body rating of perceived exertion (RPE), measured by the Borg's CR 10 scale.

Results: The results showed significantly lower VO_{2peak}, VCO₂ and blood lactate values in 10-10 protocol, than either in 15-15 or in 20-20 protocol (always p < 0.001). Maximal HR values were the lowest in 10-10 (p < 0.0001), followed by those in 15-15, which, in turn, were lower than those in 20-20 (p < 0.01). RER values recorded in 10-10 protocol were significantly lower than those obtained in 20-20 session (p < 0.05). Similarly, RPE values measured at the end of 10-10 session were the lowest (always p < 0.01), followed by those of 15-15 protocol, that were, in turn, lower than those obtained after the 20-20 regime (p < 0.05).

Conclusions: Under our experimental conditions, 15-15 and 20-20 HIIT regimes induced significantly higher VO_{2peak}, RER and ([La]) values, compared to those recorded during 10-10 protocol, whereas maximal HR and RPE were lower during 15-15 and 10-10 compared to 20-20. These results suggest that 15-15 is the most effective short HIIT modality for young active subjects to determine acute cardiorespiratory and metabolic responses, combined with a sustainable perception of effort, also in view of a RPE-based prescription of exercise intensity.

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OP14-2

Heart rate-index estimates aerobic metabolism in professional soccer players

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Purpose: Soccer includes a mix of aerobic and anaerobic activities, and heart rate (HR) monitors remain one of the main methods to track internal load and aerobic metabolism during the game. To improve HR measurements reliability, a preliminary laboratory test is needed and when this is not possible HR should be expressed using indexes (e.g. net HR). This study aimed at: *i*) validating in highly trained soccer players the relationship with metabolism (VO_2) of a recently developed HR index (HR_{index}) *ii*) comparing $\text{HR}_{\text{index}}/\text{VO}_2$ relationship vs the most common HR indexes and *iii*) testing the agreement between measured and estimated VO_2 values using HR_{index} .

Methods: 184 professional soccer players of the Belgian First Division performed an incremental running test on a treadmill while VO_2 and HR were recorded (QuarkB², Cosmed, Italy). 30-s averages for HR and VO_2 were calculated at the end of each step. HR_{index} was calculated (actual HR/subject's resting HR), and its relationship with VO_2 was compared with the relationships with metabolism of actual HR, net HR, and % of HR reserve. Finally, HR_{index} was used to predict $\text{VO}_2 = ((6 * \text{HR}_{\text{index}} - 5) * 3.5)$; finally, measured and estimated VO_2 were compared by 2 W RM-ANOVA (speed and method) and Bland-Altman analysis.

Results: HR_{index} relationship with metabolism explained 85% of the variability in data, where the other parameters showed a lower performance of 77% for actual HR, 83% for net HR and 84% for HR reserve. Measured and estimated VO_2 were not significantly different ≤ 14 km/h ($p > 0.05$), whereas at speeds ≥ 14 km/h measured VO_2 was higher than estimated VO_2 ($p < 0.05$). Finally, measured and estimated VO_2 were highly correlated ($R^2 = 0.85$, $p = 0.00$), and showed no significant bias (bias = -1.03, $z = -0.69$, precision = 3.75 ml/kg/min).

Conclusions: We validated the $\text{HR}_{\text{index}}/\text{VO}_2$ relationship in professional soccer players. HR_{index} showed better agreement with metabolism than the other HR parameters and allowed to estimate VO_2 . At very high-intensity HR_{index} underestimated VO_2 values, future studies should test this in real game conditions. HR_{index} could offer a time-efficient and easy-to-use “field” method to monitor aerobic metabolism in soccer and could give insight into the demands of the game.

OP14-3

Training differences between endurance athletes and sprinters in cross-country skiing

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Purpose: Sprint (≤ 1.3 km) and distance-skiing (≥ 15 km) performance rely heavily on aerobic capacity. However, in sprint skiing, anaerobic capacity contributes significantly. The purpose of this study is to investigate the differences in endurance and sprint athletes' training in the Cross-Country skiing.

Methods: Five Italian elite male cross-country skiers participated at this study. They all competed at international level and Olympic Games. The training programs of the five athletes were collected from the 2012/2013 season until the 2016/2017 season. Different parameters were analysed: training hours, number of sprint and distance races, number of training units conducted at five different intensity levels (L1, L2, L3, L4, L5) and the number of strength sessions.

Results: A significant difference was found between sprinter and distance athletes in the competitive period ($p = 0.02$) in training's hour per month. Significant differences were found in the number of sprint and endurance races in the year (December $p = 0.03$, February $p = 0.02$, and period 3 $p = 0.00005$). The differences concerning the number of strength training sessions per month were found in May ($p = 0.002$), June ($p = 0.01$), period 1 ($p = 0.006$), September ($p = 0.03$), October ($p = 0.02$) and December ($p = 0.03$).

Conclusions: From the results of the present study it can be concluded that the training methodology of Italian sprint and distance skiers is similar. However, the distance athlete conducts more medium intensity training sessions (L3), while the sprint skiers performs more strength and anaerobic intensity training sessions (L5).

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OP14-4**Continuous training vs. two different high-intensity interval training regimes: comparison of physiological effects and internal training loads in young elite rowers**

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Purpose: The continuous training at moderate intensity (CT) and high-intensity interval training (HIIT), in a variety of forms, are both widely used for training young rowers. The aim of this pilot study was to compare physiological effects and internal training loads of CT with those of two different HIIT concepts: long bout HIIT (HIIT-L) and short bout HIIT (HIIT-S).

Methods: Nine national-level adolescent rowers (age: 15.70 ± 0.70 years, height: 179.78 ± 5.29 cm, body mass: 68.79 ± 8.15 kg) performed a 1.500 m all-out exercise on a rowing ergometer, to determine the maximal oxygen uptake (VO₂max) and the maximal power output (P_{max}). Then, each participant performed, on separate days, in a randomized order, one CT session (25 min at 60%P_{max}), one HIIT-L session (4 repetitions of 4 min at 90%P_{max} interspersed with 3 min recovery at 30%) and one HIIT-S session (25 repetitions of 30 s at 100% P_{max} interspersed with 30 s recovery at 20%). Peak oxygen consumption (VO₂peak), volume of carbon dioxide (VCO₂) and heart rate (HR) were continuously monitored during each session. The respiratory-exchange ratio (RER) and blood lactate concentration ([La]) were measured at the end of each session. The psychophysiological stress was evaluated by the whole-body rating of perceived exertion (RPE), measured by the Borg's CR 10 scale.

Results: The results of the statistical analysis showed that VO₂peak and VCO₂ values measured during CT were significantly lower than those of HIIT-L (always p < 0.01). All participants reached 97%, 88% and 81% of VO₂max during HIIT-L, HIIT-S and CT respectively. HRmax values during CT were the lowest (p < 0.01), followed by those of HIIT-S, which were lower than those of HIIT-L (p < 0.001). Blood lactate values at the end of CT were the lowest (always p < 0.01), followed by those measured after HIIT-S, that were, in turn, lower than those at the end of HIIT-L (p < 0.001). The same significant trend was observed for RPE values under the three experimental conditions (always p < 0.001). RER values did not differ among the three training modalities.

Conclusions: These results suggest that the HIIT-L elicited greater enhancements of cardiorespiratory and metabolic functions, with significantly higher RPE values, compared to either CT or HIIT-S. This pilot study demonstrates that a Long HIIT regime can represent the most effective mean, compared to either CT or HIIT-S, for young elite rowers to improve their physiological functions and, in turn, the physical performance of athletes.

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consumption, heart rate and lactate responses in adolescents. *European Journal of Applied Physiology* 110: 17-26

OP14-5**The effects of smell on running performance**

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Purpose: Pleasant odours can induce positive physiological and psychological effects in humans, like reducing pain perception and improving mood. It is still not known whether smell could have beneficial effects also in the motor domain, for instance on resistance to fatigue. The aim of this study was to investigate the interaction between pleasant odours and fatigue tolerance in running time to exhaustion test.

Methods: Twenty healthy non-smokers volunteers (19.5 ± 1.1y; 171 ± 9 cm; 64.2 ± 10.2 kg; 47.7 ± 6.0 ml/min/kg) performed 5 different sessions: a 30 min familiarization run on a treadmill; an incremental CPET ramp test; 3 randomized experimental Time to Exhaustion (TTE) running sessions (neutral air, sweet odours and green odours) at 105% of VT2. Heart Rate (HR), rate of perceived effort CR100-RPE and the subjective level of activation at the ITMAS questionnaire were evaluated.

Results: In general, participants reported a lower rate of perceived effort with the green odour, compared to the neutral (Z = -2.58; p = 0.01) and sweet odours (Z = -2.83; p = 0.005). By dividing the sample according to the median TTE at baseline, two groups with different capacity levels were obtained (High group, HG with TTE > 454 sec and Low group, LG with TTE ≤ 454 sec). We found that the HG had higher TTE than the LG in the neutral, sweet and green odours conditions (Z = -1.96; p = 0.05). More interesting, LG showed an increase of TTE in the sweet condition compared to the HG and compared to the green condition. The ITMAS showed higher scores in the LG compared to the HG in the subscale Confusion, Vigor and Tension. In the LG the resting HR was 10% lower in the green odour condition compared to neutral condition (Z = -2.499; p = 0.012).

Conclusions: Exposing a subject to a green odour before a strenuous exercise seems to allow a lower rate of perceived effort. Moreover, in untrained subjects (LG group) and in the sweet condition, there was an improvement in physiological (TTE) performance. These findings could lead to consider the use of olfactory stimulations before and during physical activity especially in recreational runners in order to create a positive, encouraging environment and avoid abandoning physical activity.

OP15 MOTOR CONTROL AND LEARNING

OP15-1

KEYNOTE Changes in muscle fiber conduction velocity after anterior cruciate ligament reconstruction

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Purpose: Persistent quadriceps weakness is common after anterior cruciate ligament reconstruction (ACLR). The main underlying factor is the arthrogenic muscle inhibition (AMI) caused by alterations in joint receptor discharges, spinal reflex excitability and cortical activity¹. The differential neural changes potentially occurring in both vastus lateralis (VL) and medialis (VM) have been poorly investigated. This study examined muscle fiber conduction velocity (MFCV) and its rate of change with respect to force to provide information about the progressive motor unit recruitment² occurring in VL and VM of athletes with ACLR.

Methods: The reconstructed (RL) and the contralateral leg (CL) of 8 soccer players with ACLR (23.8 ± 2.7 y; BMI: 23.37 ± 1.09 kg·m⁻²; time after surgery: 7.9 ± 3.8 months) were tested independently during isometric knee extension at 45° of knee flexion. The myoelectric signals of both VL and VM were recorded bilaterally through high-density surface electromyography (HDsEMG) during maximal (MVC) and linearly increasing ramp contractions at 70% of MVC. MFCV was estimated from multichannel surface EMG signals³ and the regression between MFCV and force was investigated for both muscles.

Results: MVC was lower in the RL than in the CL (682.2 ± 191.3 vs 854.0 ± 133.0 N; $P < 0.05$). Similarly, maximal MFCV during the ramp was lower in the RL than in the CL for both muscles (VL: 4.75 ± 0.2 vs 5.29 ± 0.2 m·s⁻¹; VM: 5.10 ± 0.3 vs 5.50 ± 0.3 m·s⁻¹; $P < 0.001$). MFCV was correlated with force in both legs ($R^2 = 0.91 \pm 0.02$) and muscles (VM: $R^2 = 0.91 \pm 0.04$; VL: $R^2 = 0.91 \pm 0.04$). The slope of the regression lines between MFCV and force was lower in both muscles of the RL with respect to the CL ($P < 0.05$). Conversely, the initial value of MFCV did not differ between legs and muscles ($P = 0.6$).

Conclusions: These preliminary results might indicate a decreased recruitment of high-threshold motor units, a lower motor unit firing rate as well as alterations in sarcolemmal excitability⁴ in both VL and VM of the RL, as a result of the persistent quadriceps inhibition after ACLR.

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OP15-2

Understanding the underlying mechanisms of Quiet Eye: the role of microsaccades and pupil-size during fixation

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Purpose: In sport, expert players keep a steady final fixation at a specific location just before the movement initiation, the so called “quiet eye” (QE). Expert players exhibit longer quiet eye duration (QED) which is characteristic of successful attempts. However, it is not yet clear if the QED per se causes these improvements in performance and how these benefits happen. This research aims to better understand the causal mechanisms of QE, investigating the effective role of microsaccades and pupil-size during the final fixation that precedes the final movement initiation.

Methods: We recorded the gaze behaviour in 10 expert goalkeepers. Subjects were instructed to predict the ball future direction during a penalty kick. Response accuracy, reaction time, fixations, microsaccades, saccades and pupil-size were recorded to analyse the oculomotor coordination. Additionally, participants wore 2 inertial sensors for analysing the final movement necessary to intercept the ball.

Results: Experts exhibited more correct than incorrect responses (59% vs. 41%) and the reaction time of the final movement to intercept the ball was longer during correct than incorrect responses (4.7 vs. 4.6 sec; $p = 0.004$). Microsaccades amplitude and peak velocity showed lower values during correct than incorrect ball interception ($p < 0.05$). Pupil-size values increased proportionally with the approaching of the end of the penalty action ($r = 0.85$), reaching highest value at final movement initiation. Moreover, this value increases as increase the number of correct ball interception, reaching a value of $r = 0.94$ when goalkeepers did 100% of correct responses.

Conclusions: Exercise enlarges pupil diameter and the magnitude of dilation is positively correlated with the approaching of the decisive movement of the action. Pupil diameter increased with the approaching of the salient moment, indicating an increase in mental effort, or allocation of attentional resources necessary to intercept the ball. Attention allocated to a fixation point could result in a “suppression” (reduced microsaccade amplitude and velocity) of the oculomotor system, suggesting that actively fixating on a location results in attention allocated to that point (QE) and not to peripheral locations.

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OP15-3**Reproducibility of muscle fibre conduction velocity during linearly increasing force contractions**

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Purpose: Muscle fibre conduction velocity (MFCV) represents the propagation speed of action potentials along the muscle fibres. MFCV is associated to the fibre diameters¹ and provides indications on the electrophysiological properties of the fiber membrane². Therefore, MFCV may be adopted to assess structural and/or functional adjustments of fibre properties following training interventions and/or to monitor neurological disorders³. In this study we assessed between-session reliability of MFCV estimated from surface electromyography during voluntary isometric contractions.

Methods: Following familiarization, ten healthy male volunteers (age, 25.8 ± 3.4 years; height, 1.79 ± 0.1 m; weight, 73.3 ± 8.0 kg) attended two identical testing sessions (S1 vs S2), four weeks apart. Each measurement session involved the recording of voluntary force during maximal (MVF) and linearly increasing submaximal ankle dorsiflexions (35-50-70%MVF). High-density surface EMG (HDsEMG) signals were recorded from tibialis anterior muscle. MFCV was estimated with a multichannel maximum likelihood algorithm⁴ in 250 ms epochs. Within-subject coefficient of variation (CV_w) and intra-class correlation coefficient (ICC) were adopted to compare between-session absolute and relative reproducibility, respectively.

Results: MVF displayed CV_w of $3.4 \pm 3.6\%$ and an ICC value of 0.918 with no difference between testing days ($P = 0.422$). The initial value of the regression line between MFCV and force (%MVF) showed CV_w of $2.6 \pm 1.9\%$ and an ICC value of 0.962, while a CV_w of $11.9 \pm 3.2\%$ and an ICC of 0.937 were observed for the rate of change of MFCV. Both variables showed no differences between the two testing sessions (Intercept: S1, 3.43 ± 0.39 m·s⁻¹; S2, 3.39 ± 0.43 m·s⁻¹, $P = 0.431$; Slope: S1, 0.012 ± 0.004 m·s⁻¹·%MVF; S2, 0.012 ± 0.005 m·s⁻¹·%MVF, $P = 0.696$).

Conclusions: During linearly increasing ankle dorsiflexion contractions, MFCV shows very high reproducibility values and acceptable within-subject coefficient of variations.

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OP15-4**Action observation training and motor fatigability**

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Purpose: During physical practice people may experience motor fatigability that causes deterioration to the motor performance and changes in the primary motor cortex activity¹. In the last years in the fields of sport and rehabilitation, cognitive techniques, such as action observation (AO), were proposed as training methodologies to improve the efficacy of conventional trainings. At present, it is not known whether AO causes fatigue. The aim of this study was to evaluate whether AO training induced motor fatigability in healthy subjects.

Methods: 20 healthy young adults were required to perform a movement execution (ME) and an AO trainings, in 2 different days. During training they either executed (ME) or observed (AO) a sequence of finger-opposition movements paced by a metronome (2 Hz), 1 min long, repeated 8 times, interleaved with 10-sec rest. Kinematic (percentage of correct sequence-%CORR, coefficient of variation of movement rate-CVrate, percentage of movements in advance with respect to the metronome beat-% ADV_MOV), and neurophysiological (motor evoked potential-MEP amplitude) data were acquired before (PRE), immediately (POST0) and 60 min (POST60) after the end of the trainings.

Results: The %CORR significantly decreased immediately after ME (PRE vs. POST0, $p < 0.05$) but not after AO. No significant effects were observed at POST60. Post-exercise depression in MEP amplitude was observed only immediately after ME (PRE vs. POST0, $p < 0.01$), but not after AO, and significantly lower MEP values were reached at POST0 after ME than after AO (ME vs. AO, $p < 0.01$).

Conclusions: Results suggested that AO did not evoke motor fatigability. For this reason AO might be used in combination with physical practice with the aim to boost motor learning without causing fatigue. This feature indicates AO as training methodology particularly suitable for those people who suffer from fatigue, such as the elderly or people with neurodegenerative disease.

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OP15-5**Biological maturation affects standing balance in young soccer players**

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Purpose: Biological maturation presents sudden and rapid modifications that can influence the sensorimotor functions, in particular when the peak height velocity (PHV) is approaching. Standing balance is a fundamental skill that can be strongly affected by PHV¹. We examined the influence of biological maturation on the performance of static standing balance.

Methods: Two-hundred and 38 young healthy soccer players (U9 to U17) were evaluated. After anthropometric measurements, subjects stood barefooted on a baropodometric platform, and were recorded at 20 Hz during two 30-s tests (eyes open/closed). Subjects were split into six groups based on the Maturity Offset (MO, y), from MO < -2.5 y to MO ≥ 1.5 y, representing the estimated time to/from the calculated PHV². The body center of pressure (CoP) sway area and velocity were calculated, along with the standard deviation (SD) of the antero-posterior (AP) and medio-lateral (ML) CoP trajectory. Differences between MO groups were tested using a 2-w ANOVA with repeated measures.

Results: The sway area decreased as the MO increased, in particular in MO < -1.5 y was higher than in MO > 0.5 y (p < 0.001). CoP velocity presented a similar pattern (p < 0.001), with a marked decline in groups with MO > 0.5 y. AP SD was higher before PHV. In two groups (-2.5 ≤ MO < -1.5 y and -0.5 ≤ MO < 0.5 y) open and closed eyes conditions differed. The youngest group (< -2.5 y) had a higher ML SD than groups with MO > 0.5 y.

Conclusions: Biological maturation in young soccer players is associated with changes in standing balance control. The reductions of CoP sway area, velocity and SD as the MO increases represent the improved efficiency of the postural control system.

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OP16 SPORTS AND EXERCISE PHYSIOLOGY**OP16-1****KEYNOTE Ultrasound evaluation of diaphragm functionality: relationship with standard and imaging approaches**

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Purpose: Diaphragm is the principal respiratory muscle involved in quiet and deep breathing. Similarly to other skeletal muscles it can develop structural and functional modifications in response to specific muscle trainings or as a consequence of severe diseases. Different techniques are available to evaluate diaphragm function. Spirometry, maximal inspiratory and expiratory pressure (MIP and MEP, respectively) and maximal voluntary ventilation (MVV) are standard tests. Ultrasound (US) images have been introduced to determine the amplitude of diaphragm excursion during voluntary breathing as an additional indicator of diaphragm functionality. The neuromuscular aspect is assessed by measuring the compound motor action potential (CMAP) of the diaphragm during phrenic nerve stimulation (PNS). Nowadays, the relationship of US measurements have been investigated with only few traditional indicators. Moreover, no study evaluated the feasibility of US measurement during PNS. Therefore, aim of this study was two-folds: i) to explore the existence of possible correlations between US measures and traditional pulmonary function variables and ii) to evaluate the applicability of a combined US and PNS technique in assessing diaphragmatic function.

Methods: Twenty-seven healthy students (17 male; age: 23 ± 5 yr; body mass: 72 ± 11 kg; stature: 1.7 ± 0.1 m, mean ± standard deviation, SD) participated to the study. Forced vital capacity (FVC), vital capacity (VC), MVV, MIP and MEP were assessed. The amplitude of diaphragm excursion during deep breathing was also determined (A_DB). During PNS the amplitude of diaphragm excursion (A_PNS) obtained by US were recorded simultaneously with CMAP. Besides the relation with CMAP, associations between US measurements (A_PNS and A_DB) and standard pulmonary tests were determined using Pearson's product moment correlation coefficient (r).

Results: A_PNS showed a slight correlation with only CMAP (r = 0.37; p = 0.05). A_DB correlates with MVV (r = 0.45; p < 0.05) and with MIP (r = 0.38; p = 0.048). The correlation with FVC and VC are near to significant values (p = 0.07 and p = 0.08, respectively).

Conclusions: The simultaneous acquisition of US during PNS may provide a mechanical counterpart of the electrical activation of diaphragm. Moreover, US images collection during deep breathing seems to be a valid approach to evaluate diaphragm strength capacity, therefore it could be a convincing indicator to assess changes in diaphragm function.

OP16-2**The effect of local muscle fatigue on temporal expectation**

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Purpose: Accurate temporal estimations appears to be particularly important for sportive competition. This ability, referred as temporal expectation, seems to depend on an internal action simulation, based on the subjective sensorimotor representation. A common condition capable to alter this function, in which athletes are regularly facing, is muscle fatigue. The aim of this study was to verify the effects quadriceps femoris' muscle fatigue on temporal expectation task showing an action (a male running upon a track) in which lower limb muscles are involved.

Methods: Twenty subjects performed a temporal expectation task (exploiting the temporal occlusion technique) before (pre) and after (post) a muscle fatigue protocol (fatigue condition), and a control condition consisting in a rest period of the same duration. Maximal voluntary isometric contraction (MVIC) was measured before and after the two conditions and the decrease of MVIC was calculated. Furthermore, absolute error (AE), percentage of anticipatory responses (PAR) and coefficient of variation (CV) extrapolated by temporal expectation task were analysed.

Results: A significant decrease in MVIC was observed after the muscle fatigue protocol ($p < 0.01$). A positive trend between the decrease in MVIC and AE (measured at post) was found. No additional differences were detected between the two groups in the other temporal expectation task measures (PAR and CV).

Conclusions: The experimental protocol successful induced a muscle fatigue condition. The results of temporal expectation task suggest that localized muscle fatigue could alter the ability of temporal estimation.

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OP16-3**A passive stretching bout did not affect strength, EMG activity, central and peripheral patterns in the antagonist muscles**

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Purpose: Passive stretching (PS) is known to induce strength loss and to decrease the stretched muscle electromyographic (EMG) activity¹.

Such a strength loss is accounted for neural inhibition². However, whether or not the antagonist muscle might benefit from the stretching-induced agonist inhibition is still unclear. Therefore, we investigated the PS effects on muscle strength, EMG activity and neural inhibition in both the antagonist and agonist muscle.

Methods: Sixteen healthy men volunteered for the present cross-sectional study. Maximal voluntary contraction (MVC), EMG root mean square (RMS) was measured before, immediately after and 5 min and 10 min after a PS bout on both the stretched (SM) and antagonist muscles (AM) (plantar and dorsal flexors respectively). Additionally, by the same cadence, voluntary activation and potentiation were measured using the interpolated-twitch technique, as a marker of central and peripheral neural inhibition respectively.

Results: In AM, compared to PRE, MVC was similar at POST [+ 2%(-8/12) ES: 0.03(-0.71/0.77)], POST₅ [+ 7%(-5/20) ES: 0.26(-0.49/0.99)] and POST₁₀ min [+ 5%(-10/20) ES: 0.07(-0.67/0.81)]. In SM, compared to PRE, MVC decreased and remained lower up to POST₁₀ [-13%(-26/-0) ES: -0.64(-1.23/-0.04)]. In AM, compared to PRE, EMG RMS was similar at POST [0.04 mV (-0.11/0.19) ES: 0.15(-0.55/0.84)], at POST₅ [-0.01 mV (-0.16/0.15) ES: -0.003(-0.73/0.66)] and POST₁₀ [0.31 mV (-0.166/0.288) ES: 0.14(-0.55/0.83)]. In SM, compared to PRE, EMG RMS decreased and remained lower up to POST₁₀ [-0.35 mV (-0.52/-0.19) ES: -1.29(-2.06/-0.43)]. In AM, compared to PRE, VA was similar at POST [+ 2.9%(-5.0/11.0) ES: 0.44(-0.32/1.18)], POST₅ [+ 2.2%(-4.0/8.5) ES: 0.32(-0.43/1.06)] and POST₁₀ [+ 4.0%(-0.3/8.3) ES: 0.68(-0.10/1.42)]. In SM, compared to PRE, VA decreased and remained lower up to POST₁₀ [-4.7%(-0.6/-8.9) ES: -0.93(-1.69/-0.13)]. Potentiation did not change in both AM and SM.

Conclusions: AM did not benefit from PS bout performed on SM. This last experienced strength and EMG activity loss, mainly accounted for an inhibition of central neural factors.

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OP16-4**Central and peripheral fatigue during an incremental isometric task in active octogenarians vs. young individuals**

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Purpose: Even in absence of disease, very old age is associated with modifications within the neuromuscular system that impact quality of life. However, force and fatigue remain understudied in the 9th decade of life. We aimed to evaluate central and peripheral fatigue during an isometric task in active very old (> 80 yr) vs. young adults.

Methods: 24 very old (VOA; 82 ± 1 yr, 11 women) and 30 young (YA; 24 ± 3 yr, 15 women) adults performed a quadriceps intermittent fatigue test consisting in sets of 10 isometric contractions (5-

on/5-s off), with 10% of the maximal force (F_{\max}) increase for each set until exhaustion. Force, voluntary activation and twitch characteristics were evaluated using Femoral Nerve Magnetic Stimulation. Spontaneous physical activity (steps per day) was monitored using a wearable accelerometer.

Results: Contractions number was similar between groups (63 ± 8 vs. 61 ± 8). YA were stronger than VOA (602 ± 158 N vs. 352 ± 104 N; $P < .001$). F_{\max} reduction was greater in YA compared to VOA ($\%F_{\max}$ at exhaustion compared to baseline: $73 \pm 9\%$ vs. $78 \pm 8\%$; $P = .04$). Voluntary activation (VA) at baseline was higher for YA ($94 \pm 5\%$ vs. $88 \pm 12\%$; $P = .03$), remaining unchanged after the test ($94 \pm 4\%$ vs. $85 \pm 12\%$; $P < .001$). Peak twitch (Pt) amplitude was reduced only in the YA ($\%Pt$ at exhaustion compared to baseline: $71 \pm 20\%$ vs. $88 \pm 22\%$; $P = .008$). Physical activity was higher in YA compared to VOA (11595 ± 2377 vs. 9114 ± 2031 steps \cdot day $^{-1}$; $P < 0.001$).

Conclusions: Performing the same relative amount of isometric work, peripheral fatigue was higher in YA than VOA. This could be explained by higher absolute force levels produced by YA. Reduced VA evidenced that, other than the loss in muscle mass, central factors play an important role in the lower force production capacity of octogenarians.

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OP16-5

Electromyographic activity of vastus lateralis in overloaded eccentric leg press exercise

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Purpose: Eccentric exercise is a powerful stimulus for inducing neuromuscular adaptations. This study sought to investigate the activity of the vastus lateralis (VL) muscle during concentric-eccentric exercise using a new concept leg press machine enabling a variable overloading in the eccentric phase.

Methods: Ten young male (aged 23.3 ± 2.06 years, height 183.0 ± 4.9 cm, body mass 77.8 ± 5.2 kg) familiar with resistive exercise were recruited for this study. Tests were performed on a Leg-press Biostrength (Technogym s.p.a.-Italy). The load was set to 70% and 80% of one repetition maximum (1-RM). The participants performed 2 sets of 6 repetitions at each relative load ($\%1RM$) with (ECC+) and without (ISO) an eccentric overload equivalent to 150% of the concentric load. A metronome was employed to maintain the selected cadence. Sets were separated by a 5-minute rest. The surface EMG activity of VL was recorded and integrated (RMS) using a Biopac system (MP100, Biopac INC, USA).

Results: Results showed a higher activation (29% and 32%, respectively) of both 70% 1-RM ($p < 0.01$) and 80% 1-RM ($p < 0.001$) in the ECC+ condition with respect to ISO condition. No statistically significant differences were detected between concentric and eccentric phase in both ECC+ conditions.

Conclusions: Training with a 150% eccentric overload provides a ~30% greater motor unit recruitment of the VL muscle in leg press

exercise. Moreover, the results show that the eccentric overloading provided by the Biostrength machine enables training at the same level of neural activation of the concentric phase. Hence the derecruitment of motor units, normally observed during the eccentric phase when using conventional training machines, is prevented by the Biostrength machine; this observation seems particularly important for maximizing neuromuscular responses to strength training.

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OP17 PHYSICAL EXERCISE AS PREVENTION AND THERAPY

OP17-1

KEYNOTE Restless leg syndrome in peripheral artery disease: prevalence, association with muscle deoxygenation and benefits from low-intensity exercise therapy

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Purpose: Restless leg syndrome (RLS) including nocturnal leg cramps is a symptom common to various chronic diseases, affecting the sleep quality and causing distress and limitation in daily activities. We aimed to assess the prevalence of RLS in peripheral artery disease (PAD), the factors related to its presence and the impact of a low-intensity exercise program in a cohort of patients.

Methods: We enrolled 307 consecutive PAD patients at Fontaine's stage II referred to the vascular rehabilitation program at University Hospital of Ferrara between 2015 and 2018. At the entry presence and frequency of RLS was checked through direct questions. Then patients underwent assessment of anthropometrics, risk factors and comorbidities, medications, ankle-brachial index (ABI), exercise capacity via an incremental treadmill test assisted by near-infrared spectroscopy to determine degree of deoxygenation at calf¹ and 6-minute walking test (6MWT).

Patients received the Test in-Train out pain-free exercise program^{2,3} based on home-based interval walking exercise (walk:rest ratio 1:1) at slow, (progressively increasing) speed paced by a metronome. At every subsequent visit (5-8 weeks later) presence of RLS and execution of the program were investigated, and ABI and 6MWT measurements were performed. Discharge from the program occurred after 6-8 months.

Results: A total of 105 patients at baseline presented RLS (35%) with a significantly higher prevalence observed for females (45%; $p = 0.043$) but without differences for BMI, use of diuretics, comorbidities or ABI. Patients with RLS showed significantly lower functional capacity ($p = 0.040$ for 6MWT) and higher calf deoxygenation for both limbs ($p < 0.001$). Eighty-seven patients (83% of

RLS group) reported disappearance of RLS after mean 69 ± 48 days (2 ± 1 visits) of exercise. Compared to non-responders, this subgroup, showed higher adherence to the prescription (94 vs 71% of training sessions executed; $p < 0.001$), hemodynamic improvement (ABI increase 0.05 vs. 0.00; $p = 0.042$) and performance recovery (80 vs 34 m gained in 6MWT).

Conclusions: RLS was frequent in PAD and significantly rapidly reduced by constant execution of low-intensity pain-free walking. This type of exercise by favoring peripheral hemodynamics and muscle aerobic adaptations may reduce deconditioning and increase mobility in PAD patients.

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OP17-2

Effects of adapted physical exercise on dual-task ability and frailty in people with chronic diseases: preliminary results of the “Palestra Salute” (Piedmont Region)

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Purpose: on the basis of a recent law proposal (n° 231), the first “Palestra Salute” (PS) in the Piedmont Region has been realized. The PS is a setting where people affected by chronic diseases can perform adapted physical exercise (PE) conducted by trainers with a Master Degree in Adapted Physical Activities. The aim of this study is to test the effectiveness of PE implemented in the PS on dual-task ability and frailty in people affected by chronic diseases.

Methods: a group of people (N = 54; 79% of women; mean age 65 ± 10 years) affected by metabolic and/or musculoskeletal diseases were involved. The program of PE (twice a week for 16 weeks) was structured in three areas of intervention: a) cardiorespiratory, ii) neuromuscular, iii) core stability and balance. The Timed Up and Go test (TUG) with its variants in dual-task (manual TUG – while carrying a glass of water; and cognitive TUG – while counting backwards by three) and the Tilburg Frailty Indicator (TFI) were used to measure dual-task ability and frailty, respectively. Tests were executed before and after the period of training.

Results: Wilcoxon signed-rank test showed that PE training improved the performance in TUG ($Z = -2.86$, $p < 0.01$), Manual – TUG ($Z = -3.62$, $p < 0.01$), Cognitive – TUG ($Z = -2.86$, $p < 0.01$) and reduced frailty ($Z = -2.17$, $p = 0.03$). Specifically, if we consider the subgroup of frail participants (n = 35, 65%), the PE produces a significant improvement in the TUG ($Z = -2.49$, $p = 0.01$) and all its variants (Manual – TUG: $Z = -2.93$, $p < 0.01$; Cognitive – TUG: $Z = -2.85$,

$p < 0.01$); whereas, considering the subgroup of robust participants, only the Manual – TUG improves ($Z = -2.20$, $p = 0.03$).

Conclusions: these preliminary findings indicate the effectiveness of an adapted physical exercise on dual-task ability and frailty in people affected by chronic diseases. In particular, frail people seem to benefit more from PE than robust people in terms of TUG performances. Probably, people with a high level of functioning need a longer training to improve an already good performance.

Acknowledgments: This work was supported by Fondazione CRT with the project “Esercizio fisico, consapevolezza e stili di vita”

OP17-3

Walking either guided or suggested is effective in reducing blood pressure in hypertensive subjects

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Purpose: Aim of this study is to observe the effects of a 6-month walking program, either guided or recommended, on the blood pressure of hypertensive subjects.

Methods: Participants had to be > 40 years old, a systolic pressure > 140 mmHg and to declare a sedentary lifestyle. Blood pressure, weight, BMI, waist circumference and walking speed were assessed at enrolment. The subjects could decide to enter in a group guided by exercise physiologists (WG, n = 93) or in a group in which walking was only recommended (CG, n = 99).

Results: At baseline subjects were > 55 years, SBP > 140 mmHg and BMI > 25. All variables considered in the two subgroups were superimposable. Walking time was significantly longer in WG than in CG (300 vs 120 min/week). Seventy subjects completed the WG and 88 the CG programs. In both subgroups a highly significant decrease of anthropometric variables were observed. Systolic and diastolic pressure decreased in the WG by 7.5 ($P < 0.0001$) and by 1.9 mmHg ($P = 0.039$) respectively and in the CG by 4.1 ($P < 0.0001$) and 2.1 mmHg ($P = 0.005$), respectively. The decrease in SBP was higher in WG than CG ($P < 0.0001$). Sixteen-months after the end of the study, 77% of the WG subjects and 34% of the CG declared to maintain walking habit.

Conclusions: Both walking programs resulted in clinically significant reductions of systolic and diastolic blood pressure with a reduction of SBP significantly higher in subjects who choose the guided walking program. WG was also more effective in maintaining long-term walking habit.

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OP17-4**Effect of High Intensity Interval Training on familial hypercholesterolemia: a case report intervention**

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Purpose: Objective of the study is to evaluate the effects of two consecutive high intensity trainings on the hematic levels of LDL, HDL, ApoB, triglycerides, and on body composition, in a subject with Heterozygous familial hypercholesterolemia (HeFH).

Methods: The participant was a physically active female (26 years old; 60 kg body weight). She regularly trained and followed a specific diet without drug therapy, since she was 19 years old (the date of HeFH diagnosis). However, before the intervention proposed in this study, the total cholesterol was > 220 mg/dl. The participant underwent 12 weeks of high intensity training composed by 8 weeks of High Intensity Interval Training (HIIT) on treadmill for 3 times/week (80-60% HRmax, 1-1 minute, 8 repetitions), and then 4 weeks of HIIT + High Intensity Circuit Training (HICT) consisting of 12 calisthenics exercises performed 3 times (30 seconds exercise – 10 seconds rest). Hematic levels of LDL, HDL, total cholesterol, ApoB, triglycerides, and body composition (assessed via bioimpedentiometry) were measured at the beginning of the intervention, after 8 weeks and at the end of the study.

Results: After 8 week of intervention the total cholesterol changed from 225 to 182 mg/dl (LDL: from 158 to 114 mg/dl). The ApoB also has been reduced from 113 to 91 mg/dl. No change was obtained on body composition and on the triglycerides' levels. At the end of the intervention, no further important changes were obtained concerning ApoB and total cholesterol (though an increment of HDL was obtained from 48 to 63 mg/dl), but a significant reduction of triglycerides was instead observed (from 85 to 52 mg/dl).

Conclusions: This case report support the effectiveness of the HIIT in reduction the level of ApoB and total cholesterol in subjects with HeFH. The 8 weeks of treadmill HIIT intervention were enough to reduce total cholesterol and LDL hematic levels. On the contrary, the results suggest that exercises with a higher muscular load are required to obtain a reduction of triglycerides. No previous studies were found in literature that investigate the effects of HIIT on this HeFH.

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OP17-5**Early exercise prescription after acute coronary syndrome. A new model from bedside to the community**

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Purpose: Physical inactivity is a major risk factor and negative prognostic index of cardiovascular disease. It is necessary to define effective strategies to direct patients after an acute coronary syndrome (ACS) to physically active lifestyle. The aim of this study was to examine efficacy, feasibility and long term adherence of a new physical activity prescription, adapted to patients (pts) early after ACS.

Methods: 34 pts, mean age 67 years, hospitalized for ACS, were enrolled consecutively and randomized 2:1 in treatment (TR) group (n = 23) or in control (CT) group. All pts were evaluated before discharge from hospital (T₀) through Quality of Life (QoL) SF12 questionnaire, determination of physical activity during free time, six-minute walking test (6MWT). All pts were orally advised about the importance of changing life-style as recommended by current international guidelines. At T₀, pts in the TR group performed a 500-m moderate and perceptually-regulated (11-13 on the 6-20 Borg scale) treadmill walking test (500-m TWT) to estimate peak oxygen uptake (VO₂peak). A home-based physical activity based on walking, was provided to pts in the TR group: it was recommended to maintain the level of perceived intensity of effort as indicated during 500 m-TWT. These pts also received a reinforce phone-call at 2 and 4 weeks (T₁ and T₂), that allowed monitoring the adherence to the programme. All pts were finally evaluated 8 weeks after enrollment (T₃) through the same tests performed at T₀.

Results: Pts of the TR group at T₃ reported significative improvement, compared to T₀, in 6MWT (+79 m, p < 0.001), QoL (expressed in the items of SF12), usual physical activity during free time (+13MET/h/week, p < 0.001), VO₂peak (+4 mL/kg/min, p < 0.001). Compliance to the programme resulted optimal since all TR group pts continued the planned physical activity for all the follow-up.

Conclusions: Results of this study on efficacy, feasibility and compliance of a new model of secondary prevention programme, suggest the importance of implementing programmes of tailored physical activity schedules, based on walking, that can be safely started soon after clinical stabilization of ACS.

SUNDAY ORAL SESSION 1

OP18 PHYSICAL EXERCISE AS PREVENTION AND THERAPY

OP18-1

KEYNOTE Exercise, nutrition and psychological intervention in oncology: the FORCE (Focus On Research and Care) project

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Purpose: Cancer patients usually experience symptoms that include anxiety, depression and distress and weight gain and lack of physical activity are associated to an increased risk of recurrence and mortality. Lifestyle can profoundly affect quality of life, treatment-related symptoms, prognosis and treatment benefit. The aim of this project is to evaluate the impact of a comprehensive lifestyle intervention on oncological patients' outcomes.

Methods: The FORCE team is composed by oncology-trained kinesiologists, dietitians, and psychologists, coordinated by a medical oncologist. The team provides: *i*) functional assessment and personalized physical exercise (EX) program; *ii*) nutritional screening, assessment, and tailored counselling; *iii*) psychosocial distress and anxiety assessment and control, using cognitive-behavioral techniques. Specific methods of assessment will be applied to evaluate the project value.

Results: Our preliminary survey on EX demonstrate that only 10% out of 405 of cancer patients are sufficiently active, while 80% would be willing to start a supervised EX program. Patients reported that they prefer receive EX information by an oncologist (57%) followed by physiotherapist (29%), with a face to face approach (71%). Patients reported that they prefer train in group (39%), followed by an individual program to perform at home (27%) and an individual program with a personal trainer (25%). The preferred composition of EX group was with "other cancer patients" (27%). Moreover, our retrospective studies on non-small cell lung cancer (NSCLC) demonstrate that malnutrition and muscle wasting have a detrimental impact on cancer outcome. Our research on psychological aspects showed that cognitive-behavioral therapy could be effective on anxiety, depression and distress management in breast and NSCLC. Based on these premises, we are planning to prospectively evaluate whether an integrated lifestyle intervention (nutritional support, EX, psychological intervention), carried out by the FORCE team, modifies cancer outcomes.

Conclusions: This project is unique in fact it combines a comprehensive approach to patients' well-being with a rigorous scientific method aimed to increase the scientific evidences for non-pharmacological approach. EX can play an important role, especially within an interdisciplinary approach, during and after oncological treatments and our preliminary results indicate that a specific EX program is needed to increase the EX levels in patients.

OP18-2

An 8-week exercise intervention improves self-efficacy, fatigue and physical fitness in lymphoma patients

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Purpose: Lymphoma patients experience a psychological and physiological decline that could be reversed by exercise. However, little is known about the effects of the exercise on psychological and physical fitness variables. Therefore, the purpose of this longitudinal study was to assess self-efficacy, fatigue and physical fitness before and after 8-week exercise intervention.

Methods: Thirty-six participants (54.4 ± 19.1 years) met all the eligibility criteria and were assigned to an intervention group that performed a supervised exercise program (~ 60 min, 2d-wk-1). Each session included a combined progressive training of cardiorespiratory, resistance, flexibility and postural education exercises. Self-efficacy and fatigue were measured with the Regulatory Emotional Self-Efficacy scale and 0–10 rating scale, respectively. Physical fitness was assessed with the body mass index, lower back flexibility, static balance, muscle strength and functional mobility. **Results:** Adherence to exercise was high (91.2 ± 4.8%) and no major health problems were noted in the patients over intervention period. At baseline, significant differences were found between Hodgkin's lymphoma and non-Hodgkin's lymphoma by age and all dependent measures ($p < 0.05$). Fatigue significantly decreased, and the perceived capability to regulate negative affect and to express positive emotions improved after exercise ($p < 0.001$). Significant improvements were found for body mass index, trunk lateral flexibility, monopodal balance, isometric handgrip force and functional mobility ($p < 0.001$). Fatigue was significantly correlated with handgrip force ($r = -0.56, p < 0.001$) and functional mobility ($r = -0.69, p < 0.001$).

Conclusions: The supervised exercise program improved psychological and physical fitness without causing adverse effects and health problems. Therefore, exercise to improve fitness levels and reduce perceived fatigue should be considered in the management of lymphoma patients.

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OP18-3**Alzheimer's disease: the role of exercise in maintaining cognitive skills while enhancing vascular function**

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Purpose: To investigate exercise-induced effect on cognitive and vascular functions in people with Alzheimer's Disease (AD) and compare it with the standard cognitive therapy.

Methods: Thirty-nine people with AD (79 ± 8 years; 18.7 ± 5.0 MMSE) were recruited and randomly assigned to Cognitive Treatment (CT, $n = 19$) or Exercise Treatment (EX, $n = 20$). All subjects performed 72 treatment sessions lasting 90 minutes, 3 times a week. EX included: moderate to high intensity aerobic and strength training. CT included multi-modal stimuli (visual, verbal, auditory). Before and after the 6-month treatment global cognitive function was measured by means of Mini-Mental State Examination (MMSE) and Cognitive section of the Alzheimer's Disease Assessment Scale (ADAS-Cog). Vascular function was measured by means of Flow-Mediated Dilation (FMD, %) and Passive-Limb movement (PLM, calculating the variation in blood flow: Δ Peak; and Area Under the Curve: AUC) tests. A blood sample was also taken and analyzed for Vascular Endothelial Growth Factor (VEGF).

Results: MMSE and ADAS-Cog did not change after CT nor EX and post-treatment between-groups (BG) difference (Diff. of means) were not found. EX group did not exhibit any change in vascular function while EX group significantly increased FMD% (3.64 , $p = 0.003$; BG Diff. of means: 4.615 , $p < 0.001$), Δ peak (135.88 , $p = 0.004$; BG Diff. of means: 160.46 , $p < 0.001$) and AUC (38.16 , $p = 0.050$; BG Diff. of means: 62.36 , $p = 0.002$). VEGF increased significantly in EX group only (8.97 , $p = 0.047$; BG Diff. of means: 12.7 , $p = 0.004$).

Conclusions: Results from this study show that both, EX and CT help in maintaining cognitive function in people with AD. However, only exercise seems to offer the appropriate stimuli to improve also vascular function in this population. Importantly, exercise has a *polyhedral* and *multi-situ* action since the whole organism, brain included, must respond adaptatively when activated during exercise. Most of the exercise-induced responses include upregulation of growth factors at muscular, vascular and cerebral level as well.

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OP18-4**Why physical activity improves quality of life in multiple sclerosis patients: correlation between fatigue and functional parameters**

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Purpose: The study aims to evaluate the level of correlation between two disabling psychological impairments in Multiple Sclerosis patients (pwMS), such as perceived fatigue¹ and depression², and several functional parameters. These data should help to understand how functional impairments can influence psychological symptoms and try to suggest a new treatment strategy involving physical activity, able to improve the Quality of Life in these patients.

Methods: After a preliminary screening completed by a specialized Neurologist, 36 patients were enrolled and performed a series of neuro-psychological (Fatigue Severity Scale, Patient Health Questionnaire-9, Multiple Sclerosis questionnaire of life) and functional tests (Time up and go, 10 meters walking test, Handgrip Test, Six minutes walking test, Berg Balance Scale). The correlation between these variables was determined by means of Pearson's correlation coefficients.

Results: strong correlations were found between fatigue and walking endurance ($\rho = -.387$, $p = .024$), strength ($\rho = -.341$, $p = .04$) and for the first time with balance ($\rho = -.404$, $p = .015$) and Quality of Life (Physical score $\rho = -.731$, $p = .000$; Mental score $\rho = -.641$, $p = .000$); instead our data showed that depression has a strong relation with fatigue and Quality of Life.

Conclusions: This study confirms and provides new information about which functional parameters influence fatigue and depression in Multiple Sclerosis patients³. It highlights that a good management of pwMS should include a type of physical activity able to restore all muscular districts in order to decrease the sensation of fatigue, depression and consequently improve the quality of life of these patients.

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OP18-5**Multiple Sclerosis: Adapted Physical Activity and spirometric values**I. Fracca¹, D. Boscaro², M. Lanza³¹Studio Prevenzione e Salute di Fracca Dott.ssa Ilenia – Arzignano (Vicenza);²Master in Preventive and Adapted Physical Activity, University of Verona;³Department of Neurosciences, Biomedicine and Movement Science, University of Verona

Purpose: Literature shows that, in people with multiple sclerosis (MS), the respiratory function is compromised, favouring the reduction of endurance and leading to a worse quality of life¹. The aim of our research, therefore, is to evaluate the effect of an adapted physical activity (APA) training on spirometric values and endurance performance on people with MS.

Methods: The study included 15 participants affected by recurrent remittent multiple sclerosis (RRMS), divided into 2 groups: 8 subjects took part in the exercise experimental group (EG) (EDSS = 4.80 ± 1.03) and 7 in the control group (CG) (EDSS = 4.20 ± 0.45). Both groups were homogeneous for EDSS, initial values of spirometry and endurance test but not for BMI. The EG held 10 APA sessions in 12 weeks (once a week). Each session included 10 minutes of dynamic stretching, 15 minutes of warm up, 20 minutes of postural and resistance exercises, 5 minutes of mobilization of the rib cage and finally, 10 minutes of static stretching. “Six minutes walking test” (6MWT) and spirometry were performed before and after the training period. T tests and Two way Anovas for repeated measures were adopted for statistical analyses.

Results: Spirometrics values resulted lower than normality in both groups. We have not found pre-post differences in the spirometric parameters. There were significant improvements in the 6MWT ($p < 0,01$), with a significant positive trend in the exercise group (Pre = 357,8 ± 129,8; Post = 395.2 ± 143,9; $\Delta\%$ = 10,45%; $p < 0,01$) while the control group did not change.

Conclusions: 6MWT improvements highlight the importance of physical exercise in SM. For pulmonary parameters no significant interactions were found perhaps due to limited training volume and/or due to the irreversibility of lung damage.

Acknowledgments: This study was made possible by the voluntary participation of People with MS and the collaboration of Studio Prevenzione e Salute di Fracca Dott.ssa Ilenia.

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OP19 PHYSICAL EDUCATION AND SPORTS PEDAGOGY**OP19-1****KEYNOTE The IMPACT (Identifying and Motivating youth who mostly need Physical ACTivity) project in Europe: aims, strategies and results of the pilot study**A. Carraro¹, E. Gobbi², P. Sarrazin³, G. Demirhan⁴, M. Torregrossa⁵, J.L. Duda⁶, A. Papaioannou⁷¹University of Bozen, Italy;²University of Padua, Italy;³University of Grenoble-Alpes, France;⁴Hacettepe University, Turkey;⁵Universitat Autònoma de Barcelona, Spain;⁶University of Birmingham, UK;⁷University of Thessaly, Greece

Purpose: Many European adolescents do not meet the World Health Organization’s recommendations for at least one hour of daily physical activity (PA)¹. Physical Education (PE) is the ideal setting to motivate inactive students to adopt regular PA. The IMPACT project, co-founded by the Erasmus + Programme of the EU, aims at the development of educational material for PE teachers that might facilitate the promotion of students’ PA. To test its effectiveness, an on-line composite survey for students has been developed. The purpose of this pilot study was to establish construct validity and measurement equivalence across six European countries of the IMPACT survey.

Methods: Participants (N = 2271) were PE students from France (n = 219 males, n = 224 females), Greece (n = 145 males, n = 134 females), Italy (n = 190 males, n = 167 females), Spain (n = 238 males, n = 229 females), Turkey (n = 254 males, n = 233 females) and UK (n = 64 males, n = 74 females). Their mean age was 13.70 (SD = 1.55). participants responded to a battery of widely-used questionnaires assessing PA, motivational climate in PE, basic needs satisfaction, achievement goals, behavioral regulations, positive and negative affect in PE, enjoyment in PE, self-efficacy, perceived behavioral control, intentions, attitudes and social support towards participation in PA, self-monitoring and planning of PA, and vitality. **Results:** Confirmatory Factor Analyses (CFAs) supported the factorial validity of the measures in each country. All scales had Cronbach’s alphas above .70 across all countries. Multi-group CFAs supported configural and metric equivalence across the six countries. All scales contributed significantly in the explanation of variance of motivational outcomes, explaining in total 46% of out-of-school PA, 42% of vitality, 74% of positive affect in PE and 52% of negative affect in PE.

Conclusions: Findings were in line with hypotheses based on trans-contextual models of motivation and PA, supporting the construct validity of these measures and their subsequent use in the main IMPACT studies. Application of this tool is further useful to help PE teachers identifying inactive students, policymakers to identify schools with high levels of inactivity, and researchers to investigate students’ PA and PE.

Acknowledgments: We are very grateful to all the Colleagues of the IMPACT Team for their valuable effort in the project.

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OP19-2**Executive function and soccer in preschool children: a pilot study**V. Biino¹, M. Giuriato¹, G. Bonatti¹, F. Schena¹¹Department of Neurosciences, Biomedicine and Movement Sciences, University of Verona, Verona, Italy

Introduction: Executive Functions (EFs) are top-down mental processes needed when we have to pay attention or to be concentrated in a particular situation or when relying on instinct or intuition would be reckless, insufficient or impossible. EFs can be improved at any age, during the whole lifetime. Bilingualism appears to accelerate EFs development during childhood and preserve EFs longer during aging; its major advantage seems to be the improvement of speed of processing. Also structured motor activity needing thought, precise attention and fast response to unexpected events, as required in playing soccer, could help to improve EFs. The aim of this study was to evaluate EFs and motor coordination (MC) in a group of children, aged 4 and 5 years old, in a pilot study based on game centred soccer school, where playing and bilingualism were the main factors of the project.

Method: 37 children of 4-5 years were involved in the study. Executive function it was evaluated with the TRAIL-P test (4 tasks: control, flexibility, inhibition, and flexibility + inhibition), the test it was assessing the execution time (ET) and the number of error (ER). Furthermore, motor coordination was evaluated with the KTK test. All children repeated the test three time (t1; t2; t3). Between t1–t2 the children played soccer, instead, between t2–t3 they experienced soccer and English at school.

Results: The results of TRAIL-P suggested a significant difference only in ET. Post-hoc revealed a significant difference between t2–t3, but not between t1–t2. Furthermore, significant differences were found in motor coordination among ages and gender: 4y female t1 72 ± 14; t2 97 ± 13; t3 105, 87 ± 18,8; male t1 = 67 ± 24; t2 82 ± 16; t3 93, 5 ± 21 p < 0.01; 5 years female t1 91 ± 7, t2 120 ± 23 t3 124 ± 37; male t1 89 ± 7; t2 131 ± 16; t3 138 ± 18, P < 0.01.

Conclusion: Results shown that children can improve the time of execution of the trials of cognitive tests. The decrease of the time of execution indicates an improvement of the EFs examined, which can be related to the typical requests of soccer (reaction speed) and of teaching of English (improvement of the ability of processing). This suggests that combining a second language and playing soccer could be useful to ameliorate some EFs. Indeed the improvements of MC has to be considered in the light of the natural changes of coordination during the whole evolution age.

OP19-3**Children's attention performance in running (closed) and racket (open) sports**V. Bonavolontà¹, M.C. Gallotta¹, S. Iazzoni¹, G.P. Emerenziani², C.F. Buzzachera³, L. Guidetti¹, C. Baldari⁴¹Department of Movement, Human and Health Sciences, University of Rome "Foro Italico", Rome, Italy;²Department of Experimental and Clinical Medicine, University of Magna Graecia of Catanzaro, Italy;³Department of Physical Education, North University of Parana, Londrina, Brazil;⁴ Campus University, Novedrate, Italy

Purpose: First, to investigate the influence of different sport training experiences (open skill sport – racket and closed skill sport – running) on attentional performance of preadolescent children (8–13 years of age). Second, to investigate the acute effects of an open or a closed skill training session on children's immediate and delayed attention.

Methods: Thirty-six children divided in two groups of training session (open skill sport session – racket and closed skill sport session – running) were involved. Children's attentional capacity before, immediately after and 50 minutes after each own specific training session were measured, using the d2-R test of attention.

Results: Children's attention scores were higher when engaged in open skill sport training than in closed skill sport training. Children of open skill sport significantly improved their concentration performance (CP) (143.64 ± 5.89 vs 172.23 ± 8.90 vs 178.71 ± 8.31; p ≤ 0.01) and decreased the percentage of errors (E%) (7.70 ± 1.04 vs 3.65 ± 1.40 vs 3.84 ± 1.29; p ≤ 0.01) across the time, while children of closed skill sport significantly worsened their CP (88.47 ± 5.85 vs 98.35 ± 8.83 vs 64.70 ± 8.25; p ≤ 0.001 vs 50' post) and E% (14.47 ± 1.03 vs 14.31 ± 1.39 vs 23.67 ± 1.28; p ≤ 0.001 vs 50' post) across the time. Finally, only boys of open skill sport significantly improved their E% across the time.

Conclusions: Open skill sport experience positively affects children's attentional performance. Specifically, attentional performance significantly improved only in children involved open skill training session, when compared to closed skill training session.

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OP19-4**The efficacy of The Daily Mile on 1500 children: a quasi-experimental study**

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Purpose: Recently physical activity breaks have been adopted to increase physical activity level in educational settings. Among these interventions *The Daily Mile* is a new and innovative method allowing children during class time to run or to walk outside the school for 15 min at their self-selected pace. Such a method is actually included in Italian guidelines of physical activity¹. The aim of this study was to investigate the impact of *The Daily Mile* intervention on physical functions and feasibility in a school context.

Methods: Sixteen schools including 1444 children (47.4% female; mean age = 8 ± 1 years) and 80 classes were included in the study. Classes were divided into an intervention group (N = 55, 46.9% female), following *The Daily Mile* throughout the school year and a control group (N = 25, 48.7% female) continuing the usual daily school activity. Data on 6-min run test, body mass index (BMI), and roundness index were collected at baseline, after 4 months and at the end of the school year after 8 months. Moreover, teachers involved in *The Daily Mile* filled a survey for investigating the perceptions on its feasibility in school context.

Results: Intervention group showed an improvement (F = 16.725, p < 0.001) in 6-min run test both after 4 months (about 2%) and at the end of *The Daily Mile* (about 5%). Overall, teachers were satisfied of *The Daily Mile* considering it an educational and formative intervention and a fun and stimulating activity for children even if sometimes its performance was difficult (e.g., weather conditions).

Conclusions: Results underline that *The Daily Mile* increases children's physical fitness and may reduce their daily sedentary. Furthermore, teachers consider *The Daily Mile* a suitable intervention, because it is easy and safe and is a simple and inexpensive program for promoting a healthy lifestyle among children.

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OP19-5**Academic achievement and lifestyle habits of primary school children**

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Purpose: To examine the relationship between children's academic achievement and anthropometric variables, physical activity level, sedentary time, fitness level (aerobic fitness, strength and flexibility),

gross motor coordination, attentional performance, fruit and vegetable consumption and meal frequency.

Methods: One hundred and sixty one primary school children (8–11 years of age) of the third, fourth and fifth grade were tested in terms of their academic achievement (mathematics and Italian language skills), anthropometric parameters (weight, height, body fat percentage, BMI), motor ability (cardiovascular endurance, muscular strength, flexibility, gross motor coordination), attentional performance (speed, concentration, accuracy, control), lifestyle habits (physical activity level, sedentary time) and eating habits (meal frequency, food consumption).

Results: Cardiovascular endurance, muscular strength, gross motor coordination and physical activity level significantly correlated with mathematics skill (p < 0.01) while cardiovascular endurance, muscular strength, gross motor coordination, physical activity level and dinner meal frequency significantly correlated with Italian language skill (p < 0.01). The application of the multiple regression analysis indicated that physical activity level, gross motor coordination and cardiovascular endurance predicted mathematics skill, although the percentage of variance it could explain was moderate (17%). Moreover, the multiple regression analysis indicated that physical activity level, cardiovascular endurance and muscular strength predicted Italian language skill, although the percentage of variance it could explain was moderate (21%).

Conclusions: Motor ability and lifestyle habits may have a beneficial influence on academic achievement in children.

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OP20 BIOMECHANICS**OP20-1****KEYNOTE Nordic Walking poles, effective tools to improve gait stability**

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Purpose: Nordic walking (NW) has been shown to increase exercise intensity with no increase of locomotion speed and perceived exertion when compared to walking. Effects on kinematics include longer stride and higher self selected speed. The aim here was to verify if the

use of walking pole may have an effect on walking stability and if this is technique dependent.

Methods: Ten male subjects with at least 2 years of experience in NW volunteered for the study. Motion of whole-body segments and poles was recorded during Walking (W) and NW with two different techniques: the one suggested by INWA (NW) and a modified one with no shoulder flexion-extension movement, large elbow movement and poles kept more vertical during poling (NWvert). The techniques were performed on a treadmill at 5.5 km/h. Gluteus Medius muscular activation (EMGglu) was recorded by means of a surface electromyography system and RMS value averaged over gait cycles and normalized by MVC. Medio-lateral margins of stability (MOS_{ml}) have been calculated through the position and the motion of body COM and the base of support¹, that was determined including the tip of the poles. MOS_{ml} values have been calculated at heel strike (@HS) and averaged over the whole gait cycle (AVG).

Results: A significant effect of locomotion was found for $MOS_{ml}@HS$, ($p = .0007$), with W significant lower than NW and NWvert (0.085 ± 0.011 m; 0.138 ± 0.038 m and 0.116 ± 0.036 m respectively). A significant effect of locomotion was found also for MOS_{ml_AVG} , ($p < .0001$), with W significant and much lower than NW and NWvert (0.008 ± 0.005 m; 0.093 ± 0.014 m and 0.081 ± 0.017 m respectively). EMGglu was found to be significant lower for NWvert ($7.4 \pm 2.1\%$) than for NW ($8.4 \pm 3.3\%$) and W ($10.2 \pm 2.8\%$).

Conclusions: Previous investigation found that NWvert elicits lower exercise intensity than NW². Here we demonstrated that both NW and NWvert provide better stability and that NWvert lowers the need to activate pelvis stabilizer muscle. The use of the poles could be beneficial for stability even when the NW technique adopted is not optimal.

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OP20-2

Motor ability and lower limbs kinematics in young football players: an inertial sensors-based kinematic evaluation

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Purpose: To date, there is lack of kinematic assessment on field. The aims of the present work were to evaluate the lower limb kinematics in young football players during ordinary training and to verify if kinematics patterns are influenced by motor abilities.

Methods: Fourteen healthy young football players ($10y \pm 2$ m) were enrolled. Every subject was asked to perform two different activities: the Harre test, to evaluate the children motor ability, and typical movements performed in football training in a pre-defined path. The path consisted of 5 tasks: lateral shuffle (LS), vertical jump (VJ), low skip (SK), 2 changes of direction (CD) at 90°, right and left, shot on goal (SH). Children received few indications on how to perform the path in order to let them move in the most natural way. For the Harre

test, the time elapsed was measured. For the path, motion data were collected through a set of 7 inertial sensors placed on feet, lower legs, upper legs, and pelvis. Kinematic data of lower limb joints were acquired for all the tasks performed.

Results: Based on the results of the Harre test, the children were divided in 2 groups ($p = 0.0012$): in Group A the ones who took more time to complete the test (lower coordination); and in Group B the ones who took less time to complete the test (higher coordination). During all tasks performed, subjects of Group A presented a reduced flexion angle of all lower limb principal joints with respect to Group B. For example, in the VJ the flexion angle of the Group A was $37.3^\circ \pm 12.4$, $56.6^\circ \pm 16.5$ and $17.7^\circ \pm 8.5$ respectively (hip, knee and ankle) while flexion angle of Group B was $53.5^\circ \pm 18.8$, $73.5^\circ \pm 21.8$ and $34.9^\circ \pm 18.2$.

Conclusions: The flexion angle values are slightly affected by motor abilities. The young players of Group A adopted a “stiffer” kinematic strategy to perform the tasks compared to the ones Group B, thus resulting in more reduced movements and less performing task, as reported by the trainer. Improving motor coordination could help to increase performances and avoid risky kinematic patterns during the game, as low knee flexion coupled with high ankle extra rotation, typically found in non-contact injuries.

OP20-3

Biomechanical comparison between round-off back and round-off back handspring in young gymnasts

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Purpose: Whereas males generally perform a round-off back (RB) before the following element, females are instructed to perform a round-off back handspring (a round-off followed by a handspring: H). The aim of this study was to investigate the reason of this difference by comparing the kinematics and dynamics (at ground contact) of RB and H, both leading to a vertical jump.

Methods: Kinematic (18 markers; Vicon system, Oxford, sampling rate 100 Hz) and dynamic (Kistler, Switzerland, 1000 Hz) data were recorded simultaneously in 9 young female gymnasts (age 15.0 ± 2.6 years; body mass 55.1 ± 7.4 kg; stature: 1.61 ± 0.06 m; 10.4 ± 2.7 years of practice). The following parameters were analysed: resultant speed and maximal height of trochanter during RB, H and the (final) vertical jump, trunk angle and mean angular speed during RB and H, antero-posterior and vertical forces at ground contact (GRF).

Results: We observed that: *i*) mean trunk angular speed during H is larger than during RB ($p < 0.001$); *ii*) there are no differences in mean and peak vertical GRF between RB and H; *iii*) antero-posterior (braking) force is greater in H whereas the propulsive force is greater in RB (albeit not significantly); *iv*) trunk angle at take-off is lower in H compared to RB ($p < 0.01$); *v*) trochanter reaches a higher “relative” vertical height in H than in RB ($p < 0.05$).

Conclusions: Based on these results, the handspring could be considered as an effective “anticipatory movement” for increasing the performance of the following element (a simple vertical jump in our case). The lack of difference in GRF between RB and H could be attributed to the stiff surface of the laboratory and to the fact that gymnasts were performing the jump barefoot (e.g. to an insufficient habituation to our experimental conditions).

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OP20-4

The acceleration in the tackle as an index of performance in elite junior rugby athletes

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Purpose: The acceleration at contact and while quickly regaining the standing posture are efficient parameters of the tackler's performance. The aim of this study was (1) to investigate both the 3D and 2D accelerations of a group of rugby players while performing a tackle directly on the field and (2) to use them as an index of performance.

Methods: Twenty-two male elite athletes of the U18 team of the FIR Academy participated in the study, after appropriate informed consent. They were randomly divided into 2 groups: the front-on tackle and the side-on tackle group. Players performed 6 tackles with the assigned tackling technique, 3 repetitions respectively at the knee and the hip level. Four commercial cameras and a plantar pressure insole system were used to record the tackles, and double sided tape markers were attached following a simplified version of the protocol in Sawacha et al. (2012). An automatic-tracking approach was used to determine the center of mass acceleration CoMA both in a 2D and 3D reference systems. The tackle task was divided into 3 different phases: start-contact, contact-ground, ground-ball retrieve. 2D and 3D accelerations were compared in correspondence of the left and the right foot peaks of the GRF. The Kruskal Wallis test ($p < 0.05$) was used to compare the two groups, and the two tackling heights.

Results: Significant differences were observed on the peak CoMA between the two tackling techniques on the longitudinal axis while no differences were detected on its occurrence within the tackle phase.

Conclusions: The acceleration showed to efficiently portray differences in tackling performance across athletes and adopted techniques. Coaches staffs could use this parameters to evaluate tacklers' performances and optimize their training.

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OP20-5

Cyclic cadence variability as new technique to assess movement motor control and set bicycle measures

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Purpose: At the present time there are few accepted techniques or inexpensive devices to set bicycle measures, which is largely based on the biomechanics technician's "eye". Cyclic variability of phasic movements reflects internal processes functioning in all feedback-controlled systems. In cycling, when asked to pedal at a set cadence, each cycle time slightly differs to one another. This project aimed to evaluate the pedaling cadence variability (PCV) at 60 rpm, according to different maximal workload (MWL) percentages both in a proper and poor mechanical setting, as a new low-cost technique to set bike measures.

Methods: 16 subjects were recruited and their MWL was evaluated by a maximal workload test. Then, we had them pedal at 0%, 20%, 40%, 55%, 70%, 85% of their MWL at 60 rpm in condition A (cycle-ergometer properly set on their anthropometric measures) and B (seat 15 cm lowered, poor mechanical setting). Subjects were helped by a beep sound at 1 Hz. Series of cycle-by-cycle times were collected by using Arduino Uno board. The standard deviation of each series was considered as indicative of PCV. Data were then analyzed by a two-way ANOVA (workload, condition).

Results: PCV values (A-B respectively, msec: 36.69 ± 10.06 , 42.21 ± 11.3 , $P < 0.05$ at 0%MWL; 28.64 ± 6.98 , 31.09 ± 7.82 , $P < 0.05$ msec at 20%MWL; 20.38 ± 4.29 , 22.88 ± 5.5 , $P < 0.05$ at 40%MWL; 18.87 ± 3.51 , 19.74 ± 4.73 , $P = 0.3$ at 55%MWL; 24.11 ± 7.41 , 29.71 ± 11.06 , $P < 0.05$ at 70%MWL; 60.93 ± 10.51 , 49.52 ± 11.84 , $P < 0.05$ at 85%MWL) showed a U-shaped feature of PCV by increasing the workload, for both A and B mechanical settings. The lowest PCV value was found at 55%MWL, for both conditions. PCV was always higher in condition B than A, except at 55%MWL where no difference was found. Subjects associated lower PCV values to greater feeling of comfort while pedaling.

Conclusions: According to the literature, data suggest a greater motor control with lower PCV. Other studies concerning movement ergonomics also related better feelings of comfort to a greater movement motor control. The lowest PCV value at 55%MWL (at 60 rpm) might be explained by an "accompanying" effect of the workload itself that leads to lower movement adjustments. A poor mechanical setting consisted in greater PCV, except at 55%MWL (at 60 rpm) for the alleged accompanying effect. The U-shaped PCV feature is expected to shift by changing the %MWL. Biomechanics technicians might use the PCV analysis technique to base the bike setting, especially for time-trial races.

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OP21 SPORTS TRAINING AND TESTING

OP21-1 KEYNOTE

Integrated approach to monitor training in elite rugby union players: internal load, time motion analyses, and neuromuscular responses

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Purpose: The aim of the present study was to verify if the practice of tackles in rugby union training affect players' internal training load (ITL) and acute strength loss.

Methods: Nine male Italian *Serie A* rugby union players (age: 21 ± 2 yrs) were monitored during 17 training sessions (with tackles, WT, 6 sessions; with no tackles, NT, 11 sessions). In particular, heart rate monitors (Team Pod, Firstbeat) and GPS (Spin_GNSS_50 Hz, Spinalta) devices were used to quantify the ITL (Edwards' method) and external training load (total distance, time spent > 20 W/min). In addition, the sessions were video-recorded to analyze the work-to-rest ratio (W/R). Before each session (PRE) the Well-being Questionnaire (WB; McLean et al., 2010) was filled in by players. After each session (POST) rating of perceived scale (RPE; Foster et al., 1995) was used to quantify ITL also according to Session-RPE method. Players' concentric peak force (countermovement jump, CMJ; plyometric push-up, PPU) was recorded at PRE and POST with a force plate (9286AA Kistler) to consider their delta values. Linear mixed models were used to verify if players' ITL was influenced by practicing tackles, and if peak force PRE-POST deltas of CMJ and PPU were affected by practicing tackles.

Results: Both Edwards' (estimated mean, EM; standard error, SE; WT: EM = 214, SE = 12; NT: EM = 194, SE = 11; $p = 0.01$) and session-RPE (WT: EM = 379, SE = 22; NT: EM = 277, SE = 16; $p < 0.001$) ITLs resulted higher in WT than in NT sessions. However, no effect between the two observed types of session emerged for the PRE-POST deltas related to CMJ (WT: EM = -107, SE = 63; NT: EM = -94, SE = 48) and PPU (WT: EM = -19, SE = 33; NT: EM = 37, SE = 25) peak force.

Conclusions: Although the practice of tackles in elite rugby union training increases players' ITL, no influence on the acute strength production of upper- and lower-limbs is determined.

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OP21-2

Effects of visual training in junior tennis players. A randomized controlled trial

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Purpose: Tennis is an open-skill dynamic sport in which players over a limited period of time have to process and integrate complex visual information. Therefore, the aim of this study was to assess the effects of 12 weeks visual training (VT) in junior tennis players.

Methods: This was a two-arm parallel-group randomized-controlled trial in which 18 players were randomized to either an experimental group (EG: $n = 10$; age: 15 ± 1 years; height: 1.67 ± 0.01 m; body mass: 52 ± 11 kg) that performed VT or a control group (CG: $n = 8$; age: 15 ± 1 years; height: 1.70 ± 0.01 m; body mass: 52 ± 12 kg) that was involved in a standard training for 3 sessions a week for 12 weeks. Players were tested at baseline (T0) and after 12 weeks of training (T12) for accuracy, speed, two-signal and four-signal reaction with Motor Brain application. Moreover, sweet spot, speed and time course between split steep and shoulder rotation during forehand, backhand, 1st and 2nd serve and return to serve were evaluated.

Results: At T12 no significant variations for accuracy, speed, two-signal and four-signal reaction with Motor Brain application were found. Significant improvements in sweet spot ($p = 0.032$; ES: 2.1 ± 0.3 , most likely) and speed ($p = 0.002$; ES: 1.8 ± 0.4 , very likely) during second serve were found. Moreover, the time course between the split step and shoulder rotation in forehand ($p = 0.0008$; ES: $\geq 2.0 \pm 0.3$, most likely), backhand ($p = 0.001$; ES: $\geq 2.0 \pm 0.5$, most likely), and return to serve ($p = 0.001$; ES: 1.7 ± 0.2 , very likely) improved significantly.

Conclusions: These results suggest that VT was effective to improve on-court motor tasks performance in junior tennis players.

OP21-3

Neuromuscular responses to different strength training for the quadriceps: mono vs. multi-articular exercise

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Purpose: The aim of this study was to investigate the effects of two strength training exercises (mono vs. multi articular) in terms of neuromuscular adaptation and muscle behaviour of the quadriceps muscle. Moreover, we also investigated the possible transfer between these two exercises.

Methods: Twenty subjects were randomly allocated in two groups who performed 10 weeks of strength training (dynamic exercise) with squat exercises (SQG) or with leg-extensions (LEG); 1 RM was assessed in both groups before and after training. Muscle architecture of the quadriceps muscles, EMG activity, maximum force production and fascicle behaviour were evaluated pre- and post-training in both

groups. Finally, the Force-Length relationships were determined during isometric (static) contractions before and after training in both groups.

Results: IRM increased in both groups, but SQG showed a larger improvements of maximum strength capacity. Muscle thickness showed a significant increase in both groups, whereas pennation angle and fascicle length increased for SQG only. The F-L relationships (isometric contractions) showed an increase in terms of force for both groups, in SQG also in terms of fibre length; during these experiments, maximum isometric EMG amplitude increased in both groups but a larger improvement was observed for SQG compared to LEG ($P < 0.01$). During the dynamic contractions, a significant reduction in EMG amplitude was observed in both groups after training ($p < 0.05$), especially for SQG ($P < 0.01$); fascicles behaviour showed significant changes only during the concentric phase of the squat exercise (in SQG). Finally, the changes induced by SQG training had positive effects also on leg extension whereas LEG training did not induce significant improvements in the squat exercise.

Conclusions: In both groups, training induced positive effects in terms of EMG activity and force production, but only in SQG significant changes in the F-L relationships and on muscle geometry were observed. Finally, only the SQG training group had the possibility to transfer the acquired skills to the other (leg extension) exercise.

OP21-4

Effects of iso-inertial eccentric-overload training on fencing performance in elite athletes

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Purpose: The iso-inertial training method owes its efficacy to an optimal individualized eccentric overload. The aim of the study was to assess the effects of a 6-week training program using a flywheel inertial device on explosive and reactive strength, lunge and Advance-Advance-Lunge performances in fencing.

Methods: Fifty-eight male elite fencers were randomly assigned either to the Experimental Group (EG; $n = 29$; age 17.34 ± 1.87 years), who received two inertial eccentric-overload training sessions in addition to their traditional training and a Control Group (CG; $n = 29$; age 17.62 ± 2.65 years) who performed the traditional training. Pre and post intervention testing sessions served to assess anthropometric parameters, explosive and reactive lower limb strength, hamstring muscles eccentric strength, and the execution time and distance covered in performing the two fencing specific movements. The differences between the post-intervention and the pre-intervention scores were calculated (Δ Score).

Results: The MANOVA showed significant differences between the two groups ($F_{13,32} = 3.163$; $p = 0.004$; $\eta^2_p = 0.562$) with significant higher improvements in lunge distance ($p = 0.006$), and advance-advance-lunge distance ($p = 0.00005$) than CG. No significant differences between groups, but significant differences between pre and post assessments, were found in the vertical jumps. Results did not show significant differences in anthropometric measures.

Conclusions: These results confirmed the positive effect of iso-inertial training. The possibility of iso-inertial device to overload multidirectional movements in specific sport conditions, leads to higher performance improvements than a conventional fencing training. The iso-inertial device used in novel modality, backward and in front of the athlete, allowed overloading both the front and rear leg in concentric and eccentric modalities.

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OP21-5

Effect of pre-season training phase on salivary cortisol, maximal oxygen uptake, and countermovement jump test values in young soccer players

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Purpose: Considering that the performance capacity of a young players is closely related to the maturity status (Malina et al. 2005, Philippaerts et al. 2006), the aims of this study were to investigate 1) the effect of Pre-Season phase (PSP) training on stress hormone, Maximal Oxygen Uptake (VO_{2max}), and explosive strength in youth soccer players and 2) the impact of the experience of the coach and his methodology of training on these parameters.

Methods: Salivary Cortisol (sC), VO_{2max} by intermittent tests, and countermovement jump test (CMJ) modifications of 35 youth soccer players (age: 14 ± 0 yrs; BMI: 20.8 ± 1.8 k/m^2) from two Italian teams (“Lupa Frascati” -LF-: 15, 57.6 ± 9.7 kg, 1.7 ± 0.1 m, 20.5 ± 2.0 m/kg^2 ; “Albalonga” -AL-: 20, 62.0 ± 8.0 kg, 1.7 ± 0.1 m, 21.0 ± 1.7 m/kg^2), which play in the same youth Italian regional category (“Giovannissimi”), were compared. $p < 0.05$ was selected throughout the study. A 2 (pre vs. post) x 2 (LF vs. AL) factors, ANOVA with repeated measures on time was applied to all variables. When significant effects were established, unpaired Student’s *t*-test was used to assess differences between clubs and paired *t*-test to compare pre-season vs. post-season values.

Results: A significant main time effect in sC ($F_{(1,31)} = 32.1$; $p < 0.01$) and VO_{2max} ($F_{(1,28)} = 64.4$; $p < 0.01$) was found. A significant time*clubs effect was observed in sC ($F_{(1,31)} = 9.7$, $p < 0.05$), CMJ ($F_{(1,28)} = 26.5$, $p < 0.01$), and VO_{2max} ($F_{(1,28)} = 8.5$, $p < 0.01$). Between clubs, differences ($p < 0.05$) in sC ($F_{(1,32)} = 8.5$, $p < 0.01$) were found.

Conclusions: One of the main goals of the pre-season training phase, is to develop strength and conditioning fitness in preparation for the

imminent competition season (Jeong et al. 2011) with multiple sessions of training often performed in the same day and within 24 hours of one. Considering that during PSP the time to simultaneously develop physical, technical and tactical qualities is often limited, an efficient method to distribute the training load of these capabilities is important in youth soccer players.

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SUNDAY POSTER SESSION

PP5 SPORTS TRAINING AND TESTING

PP5-1

Kiron ARGEA® mud packs accelerate recovery following a high-volume workout for lower-body in resistance trained men

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Purpose: The aim of this study was to compare the effects of ARGEA® mud packs, including menthol and other essential oils, on the recovery response following a high-volume squat protocol. Recently, significant positive effects of menthol gels were reported on the recovery phase following sprint training¹.

Methods: Ten resistance-trained men (mean ± SD: age = 25.3 ± 6.1 years; body mass = 79.1 ± 10.6 kg; height = 178.9 ± 7.5 cm) performed a high-volume exercise session for lower body (squat: 8 sets of 10 reps at 70% of 1RM and leg extension: 4 sets of 10 reps at 70% of 1RM). All the participants used Kiron ARGEA® (AR) or a placebo (PL) in randomized counterbalanced crossover design. AR or PL were applied on the skin surface above the quadriceps muscle of both legs for 2 h, two times/day.

Results: Muscle performance (countermovement jump [CMJ], isokinetic leg press at 75 cm/s and 25 cm/s [ISOK75 and ISOK25, respectively], isometric squat [ISQ]) and morphology (muscle thickness of vastus lateralis [VLMT]), were measured before exercise (baseline [BL]), and at 15-minute (15P), 24-hour (24P), and 48-hour (48P) post-exercise. In addition, muscle soreness was assessed at the same time points using a visual analog scale (VAS). No significant interactions ($p > 0.05$) between the trials were noted for CMJ, ISOK75, ISQ and VLMT. A significant interaction between trials was noted for ISOK25 ($p = 0.022$) and for VAS ($p = 0.001$).

ISOK25 were significantly ($p < 0.01$) reduced from BL at 15P, 24P and 48P in PL, whereas changes were significant ($p < 0.05$) at 15P and 24P only in AR.

Conclusions: The present results indicate that AR may enhance the recovery rate of slow strength components after high-volume exercise. In addition, muscle soreness was attenuated by AR. Muscle morphology and force expressed at high speed do not appear to be influenced by AR.

Acknowledgements: This study was made possible by donations of mud and placebo from Kiron Wellness Lab srl (Bologna, ITALY)

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PP5-2

Whole-body exercise program over the stand-up paddle board: acute effects on static balance

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Purpose: Stand-up paddle board (SUP) is a kind of surfboard used for the sport of stand-up paddle boarding. A high level of balance and trunk muscle endurance is required to maintain a standing position on a board¹. Several studies report that positive chronic adaptations on static and dynamic balance improve sports performance and reduce the risks of injuries². However, few studies have investigated the acute effects on balance. The aim of this research is indeed to evaluate the acute effect on static balance of a ten-minute whole-body exercise performed on an unstable surface.

Methods: The static balance of nine trained college students (7 M/2 F; age 24.1 ± 2.2; 3 sessions/week) has been measured three times using a static balance test (BT³): i) before (T1), ii) 1-min of passive recovery after (T2) and iii) 30-min of passive recovery after (T3) a 10 minutes of whole-body exercise over a SUP. Ten minutes of continuous balance and core stability exercises⁴ performed on unstable paddle board was used as low-intensity whole-body exercise (mean 128 ± 19 bpm). The BT was a flamingo test performed on a Wii Balance Board (30 seconds for each leg). The sway path was the only dependent variable of our experimental design. The intra-subject repeatability of sway path was checked with ICC (always above 0.95). To analyse the time effect, a repeated-measures ANOVA was used. Simple pairwise multiple comparisons were performed with Bonferroni procedure. Means were considered significantly different at $p < .05$.

Results: ANOVA shows a significant and moderate main time effect ($\eta^2 > 0.48$) on sway path. T1 (mean sway path 31.1 ± 7.3) and T2 (mean sway path 32.9 ± 8.3) were significantly higher than T3 (mean sway path 27.1 ± 4.9) in pairwise comparisons.

Conclusions: Whole-body exercises on an unstable surface like a water paddle board improve static balance. Results of acute effects suggest that this improvement is reached after 30 min of passive recovery. Therefore, the use of unstable tools could improve performance in sports where balance plays a key role. Furthermore, 30-min seems the optimal recovery time to attend after warm-up when the static balance needs to be optimized.

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PP5-3

Post-activation potentiation in water and land environment: arm power output increase after isometric chest-press

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Purpose: Post-activation potentiation (PAP) can be defined as an acute enhancement of muscle function following an intense muscle activity. There is overall consistency in the literature about the power output improvement after sub- or maximal voluntary contractions (MVC). However, the optimal timing between MVC and positive response is not clear, especially when the activation is performed in the aquatic environment. Then, the aims of this study were: i) investigate the effects of PAP after isometric MVC using an upper limbs push, ii) compare the same protocol between the water and land environment.

Methods: Ten well-trained collegiate students (male, 24.7 ± 1.8 years, 3 training sessions/week) have performed three isometric MVC for 5 s using a load cell (Globus, Italy) to simulate the chest-press exercise (activation). Each isometric push was separated by 30 s of passive recovery. Six bench-throw power trials (BT) were conducted before the activation and at five pre-determined rest intervals (2-, 4-, 6-, 8-, 10-min) after activation using a load of 30% of 1RM. At the same time in the following day, the same protocol was performed in water environment in a randomized and counterbalanced order. BT were recorded at a sampling rate of 200 Hz and the power outcomes are indirectly calculated as time required to produce work (force x distance / time). Kinovea software was used for data analysis. To exclude any activation effect on the BT power, BT protocol was repeated one time without the activation and checked with a repeated-measures ANOVA (no main significant effect). The intra-subject reliability for activation and for BT were evaluated using ICC (always above 0.91). To examine the differences, a 2 environment (water, land) x 6 time (before, 2-, 4-, 6-, 8-, 10-min) repeated-measures ANOVA was used. Pairwise multiple comparisons were performed with Bonferroni procedure. Statistical significance was fixed at $P < .05$.

Results: For BT power, ANOVA revealed main significant effects of time, but not of environment and environment x time interaction. BT power increased in general after activation but the pairwise comparison showed significant differences only for time before (322.4 ± 16.5 W) vs time 6 (366.3 ± 10.1 W).

Conclusions: An isometric activation may acutely enhance bench-throw power. This result is maximized 6-min after the isometric activation. Furthermore, the environment where it is performed (water or land) doesn't affect the power outcomes. Our findings have useful practical implications in the warm-up protocol before power performance events.

PP5-4

Fouls and yellow cards in the UEFA Champions League 2017-18

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Purpose: In soccer, the fouls and cards showed by referees during a match may reflect the aggressive behaviors of the players. This study aims to analyze the distributions of fouls committed by players in the 2017-18 UEFA Champions League, comparing positional roles in both home and away games.

Methods: Fouls and yellow cards in matches of the qualification phase of the 2017-18 UEFA Champions League were collected from the UEFA website, and then recorded in a spreadsheet for analysis. Data from 32 teams and 599 outfield players were collected. Fouls per hour (FH) and yellow cards per hour (YCH) were calculated and used for the subsequent analyses.

Results: Mean \pm standard deviation fouls and yellow cards per hour of play were 0.79 ± 0.67 and 0.12 ± 0.83 respectively. The comparison between positions showed a trend towards a significant difference between defenders and midfielders (0.70 ± 0.55 and 0.86 ± 0.72 respectively, $p = 0.051$) for FH, and significant differences ($p < 0.01$) for YCH between defenders (0.11 ± 0.24), and attackers (0.04 ± 0.14) and between midfielders (0.18 ± 0.38) and attackers (0.08 ± 0.14).

A significant difference for FH between defenders (0.70 ± 0.55) and midfielders (0.86 ± 0.70) was observed in away games ($p = 0.013$).

Conclusions: The present findings show a higher foul rate in midfielders than attackers and defenders in UEFA Champions League games. On the contrary, defenders received more yellow cards than midfielders and attackers. These results can be explained by the greater distance covered by midfielders in comparison with the other positions and by tactical circumstances. Concerning yellow cards, it can be argued that defenders tend to commit fouls especially in situations that could lead the opposing team to score. The lower rate of fouls committed by defenders of away teams reflects previous studies, reporting a referee bias in favor of the home team.

PP5-5

Continental championships and summer Olympic Games in the same year: an opportunity or a critical issue?

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Purpose: The OASPORT site in May 2016, published an article¹ in which the author asked if, in the same year of the Olympic Games, the European Swimming Championships could influence the athletes' performances. In case major competitions are scattered over the year or the gap between them is too long (i.e. April-May and October-November), we need to follow a double periodization pattern². The situation in which two important events are so close that double periodization is not possible is more complex and a subject of debate.

In the study the results of the athletes of two sports (Track and Field and Swimming) which in 2016 had E. C. and O. G. were taken into consideration.

Methods: 754 athletes (53% female) were selected for this study. 448 athletes of Track and Field and 306 athletes of swimming who participated in both the European Championships (E.C.) and the Olympic Games (O.G.). The average age of the sample was 28 years \pm 1. The technical performances have been converted into the technical scores of the 2017 IAAF Scoring Tables and FINA Point Scoring 2018.

Results: Considering the whole sample, the results led to say that 51% of the athletes achieved a better performance at the O.G., 47% a worse result and only 2% managed to confirm the same performance they had during the E.C. In Track and Field, athletes with a better performance than those with a worse performance are equal to 49% each, while 2% obtained the same result at the O.G. compared to the E.C., In Swimming 55% of athletes improved, 44% worsened and 1% achieved the same performance at the O.G. compared to the E.C. It is interesting to note that 30% of the athletes on the podium at the O. G. did not participate or did not get medals to the E. C..

Conclusions: Data analysis does not offer a definite answer, but it is assumed that most of the highly qualified athletes choose not to compete in the European championships or prefer to use them as an intermediate course to finish the preparation for the O. G..

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PP5-6

Marathon performance trend in Italy: a comparative longitudinal study

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Purpose: The Marathon is a fascinating discipline, not only for what concerns the purely sport aspects, the legend of the Filippide emerodromo or the dramatic epilogue of London 1908 for Dorando Pietri, two episodes above all. The increase in the number of participants and the evolution of performance in endurance sports¹ makes the study of performance in Italy extremely interesting. Analyzing the Italian charts of 1987, we find an athlete with 2h10'15 in the first place, in 2017, the fastest ran in 2h10'56", in 10th place we pass to almost 5' difference and in 20th place the difference is close to 7'.

Methods: The first twenty Italian performances in the men's and women's marathons were considered from 1987 to 2017. The rankings of the 1st result in each year and the average of the top 20 ranked in the annual rankings in Italy (FIDAL) and in the World were considered (IAAF). Performance has been reduced to average speed in order to build the trend over the years.

Results: The analysis of the results shows a constant evolution in the world of men and women, both considering the best performance and the average of the first twenty results. The trend of Italian athletes shows the opposite at the male level, a decrease can be noted both concerning the average of the first twenty results ($r = 0.82$) and the best annual performance ($r = 0.41$). At the female level, instead, there is an increase for what concerns the best annual performance and a tendency to stability with respect to the average of the first twenty.

Conclusions: It is possible that the tendency to decrease performance in men is due to the difficult period of Italian athletics, which struggles both at the top level and at the medium-high level. The

tendency towards improvement and stability of the performance for the female gender can be attributed to the opening up to women of military sports groups. This has allowed the increase in the number of professional athletes and the improvement of their average performance.

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PP5-7

Different responses on upper- and lower-body neuromuscular function following rugby union training sessions: the effect of physical contacts

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Purpose: Rugby union is an invasion team sport with a high number of collision events. Repeated exposures to high-intensity collisions may cause post-match reductions in upper- and lower-body neuromuscular function¹. However, few studies evaluated the effect of physical contacts during training session². Thus, the aim of this study was to investigate differences on upper- and lower-body neuromuscular function between contact and non-contact training session.

Methods: Seventeen training sessions (11 sessions without and 6 with physical contacts) of nine rugby union players (mean age = 21 \pm 2 years) were evaluated. Data on neuromuscular function, including plyometric push-up and countermovement jumps recorded on a force platform, were collected 15 minutes before and immediately after each training session. Eighteen parameters were calculated from such force signals using inverse dynamics. Linear mixed model was used to investigate differences in upper- and lower-body neuromuscular function following the training session.

Results: A decrease in plyometric push-up jump height and peak concentric power was observed in contact compared to non-contact trainings [ES = 0.29 95% CI (0.01, 0.57); ES = 0.33 95% CI (0.04, 0.62) respectively] while countermovement jumps peak eccentric power was lower in non-contact compared to contact training [ES = -0.4 95% CI (-0.69, -0.1)].

Conclusions: Different fatigue responses were observed between non-contact and contact training sessions. Practitioners and coaches should consider this aspect to appropriately schedule training sessions.

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PP5-8**Analysis of women's junior performance in Italian volleyball**

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Purpose: The aim of the present study was to investigate the relationships between key performance indicators (KPI) in teams participating in the women's national volley championships, from the under 14 to the under 18 age categories. It was hypothesized to find differences with the performance model of adults, in which the attack is fundamental. We expect to find that other variables are more related to the victory in the competition than the attack.

Methods: 564 volleyball matches of the 2017/2018 season have been analyzed. For each game and team, the following variables were collected: SERVICE POINT (S#), SERVICE ERROR (S =), POSITIVE RECEPTION (R +), NEGATIVE RECEPTION (R-), RECEPTION MISTAKE (R =), ATTACK POINT (A#), BLOCKED ATTACK (A/), ATTACK ERROR (A =). Descriptive statistics have been compiled divided by category: U14, U15, U16 and U18. The intra-operator variability has been calculated by the α -Cronbach for the eight variables and the results are in the range between 0.84 and 0.98. Differences between matches were assessed running an ANOVA for each variable.

Results: The differences between U14 and the other categories for S# and S = ($p < .01$), R = and R + ($p < .01$) were significant. U14 and U15 showed significantly different results from the other two categories for R- ($p < .01$). A# was significantly different between U15 and U16 versus U14 and U18, $p < .05$.

Conclusions: It is appreciable a significant difference between the U14 group and the other categories with regard to batting and reception. This could be due to the different height of the net which greatly influences these two fundamentals (2.15 cm in U14 group vs 2.24 cm in others). This difference is also seen in the A# variable. The U14 have very high values in percentage in attack that will be able to replicate only in U18 group, while in U15 and U16 categories there is a clear decline of performance with respect to this variable. Given this evidence, a revision of the service rule in the U14 championship or the net height is clearly necessary.

Reference

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PP5-9**Effects of an 8-week core training program on performance in adult male soccer players**G. Belli¹, F. Zucchini²¹Department for Life Qualities Studies, University of Bologna, Italy;²MEV Lab, Modena, Italy

Purpose: Core stability and strength exercises are commonly included in soccer training programs in order to improve performance and prevent injuries. Previous researches highlighted the importance of these components to enhance neuromuscular control and athletic performance in both professional and amateur teams. The aim of this study is to analyze the effects of a specific core training protocol on

trunk, upper and lower body strength, dynamic balance and speed in regional league soccer players.

Methods: Nineteen players from a local male team were included in the research during the off-season period. They were divided into a Training group (TG, $n = 11$, age 22 years, weight 71.2 ± 4.8 kg, height 174 ± 5.8 cm) and a Control group (CG, $n = 8$, age 22 years, weight 73.2 ± 4.1 Kg, height 176 ± 6.3 cm). TG was submitted to an 8-week core training protocol while CG performed recreational activities (run, bike, futsal). Training program was focused on 7 exercises (4 core stability/endurance/strength and 3 upper / lower body functional exercises) executed 2 times a week with specific load progression and different tools. Performance level was evaluated before and after training period using Standing Long Jump Test (LJ), right and left Medicine Ball Throw test (MB-R and MB-L), Curl Up Test (CU), right and left Y Balance Test (Y-R and Y-L) and Illinois Agility Test (ILL) in all players.

Results: All groups showed different performance scores with better improvements in the core training group. In particular, TG significantly increased LJ (+6.74%, $p < 0.01$), MB-R and MB-L (respectively +8.84% and +9.50% $p < 0.01$), CU (+75%, $p < 0.01$), Y-R and Y-L (respectively +8.67% and +7.66%, $p < 0.001$). CG slightly increased LJ, MB-R and MB-L, CU, Y-R and Y-L, even if not significantly ($p > 0.05$). TG and CG comparison showed significance in Y-R and Y-L ($p < 0.05$), while LJ, CU, MB-R and MB-L scores were close to significance ($p = 0.05$). No significant differences were observed in ILL in both groups.

Conclusions: The TG improvements in LJ, MB-R / MB-L, CU and Y-R / Y-L tests highlight the effect of core stability and strength exercises on neuro-muscular control, strength level and force-transfer between lower body-trunk-upper body. Therefore, a specific and progressive training protocol with focus on core region and functional movements could be a good way to preserve player's athletic performance during the off-season.

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PP5-10**Ball-carrying sprint ability in elite female rugby union players: backs vs forwards**L. Beratto¹, M. Ponzano², S. Di Guida³, F. Abate Daga⁴, M. Gollin^{1,5}¹Adapted Training and Performance research group, School of Exercise and Sport Sciences, University of Turin, Italy;²Department of Kinesiology, University of Waterloo, Canada;³CUS Torino Rugby, Turin, Italy;⁴Department of Medical Sciences, Internal Medicine and Hypertension Division, AOU Città della Salute e della Scienza, University of Turin, Italy;⁵Department of Clinical and Biological Sciences, University of Turin, Italy

Purpose: Rugby is characterized by intermittent, high intensity physical and technical gestures, in which players run at high speeds and engage in physical contacts. Running at high speed while carrying the ball is important for scoring a try, realizing precise passes and keeping possession of the ball. According to match roles, rugby players are grouped into forwards and backs. The differences between playing positions should be analysed because several factors, such as

anthropometric characteristics, maximum running speed and strength, are different between roles and thus may influence the performance. The aim of this study is to analyse ball-carrying sprint ability and speed momentum in elite female rugby union players playing in different positions.

Methods: Twenty-three elite women rugby union players recruited from the same team participated into this study. Sprint tests (10 m, flying 20 m and 30 m) were performed with and without carrying the ball. Sprint momentum ($\text{kg}\cdot\text{m}\cdot\text{s}^{-1}$) was obtained by multiplying athlete's body mass for the respective velocity during the sprint test.

Results: Data from 23 female elite rugby union players (backs $n = 9$: age: 23 ± 4 years, weight: 64 ± 8 kg, height: 163 ± 5 cm; forwards $n = 14$: age: 24 ± 6 years, weight: 77 ± 16 kg, height: 164 ± 6 cm) were analysed. The results showed significant differences (forwards vs backs) in 30 m ($p = .02$) and flying 20 m ($p = .02$) sprint tests without ball. Significant differences emerged from sprint tests carrying the ball (10 m, $p = .03$; flying 20 m, $p = .009$; 30 m, $p = .01$). No significant variations were observed in speed momentum.

Conclusions: The main finding of this study is that backs female players achieve higher velocities than forwards in all the distances except from 10 m without ball. These results are in line with a previous study performed on elite male players. Speed momentum does not vary depending on players' role in elite female rugby union.

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PP5-11

Age-related effect on strength and agility in pre-pubertal footballers

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Purpose: Football is a multi-directional and intermittent sport that requires high technical abilities, tactical awareness, and a high level of physical conditioning¹. It has been demonstrated that stronger athletes are also faster during sprint performance². The aim of this study is to investigate the effect of age on lower limb muscle strength and agility in pre-pubertal football players.

Methods: 56 Under 10 and 72 Under 12 players were recruited from different local soccer schools. Lower limbs muscle strength was estimated based on long jump test scores while time needed to complete the hexagon test was used to evaluate agility³.

Results: Demographic and anthropometric characteristics were: age 9 ± 1 years, height 136.7 ± 6.1 cm, weight 34.9 ± 9.2 kg, BMI 18.5 ± 3.9 , and age 11 ± 1 years, height 153.2 ± 9.2 cm, weight 48.6 ± 11.9 kg, BMI 20.5 ± 3.8 for U10 and U12 groups, respectively. Data shows higher values of both strength ($p < 0.0001$; +24%) and agility ($p < 0.0001$; -35%) tests in the U12 group

compared to the U10 group. In addition, BMI and long jump scores are negatively correlated ($r = -0.19$, $p = 0.032$) while BMI and Hexagon tests are not significantly associated.

Conclusions: Older and more experienced children have better strength and agility abilities. Specific training programs are needed to improve physical abilities and avoid weight gain that might lead to higher BMI values and a consequent worsening in muscle strength.

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PP5 SPORTS NUTRITION

PP5-12

Nutritional supplement practices of beach volleyball players of the Italian National Championship: a cross-sectional study

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Purpose: The ingestion of some nutritional supplements can enhance sport performance, but often scientific evidences for specific disciplines are missing. The purpose of this cross-sectional study was to evaluate the supplementation practices of high-level beach volleyball athletes participating in the Italian National Championship.

Methods: 88 athletes participated in the study. Socio-demographic characteristics, nutritional supplement use, motivations for use and sources of information were collected using an anonymous pre-tested online questionnaire. Latent class analysis (LCA) was used to highlight a profile of athlete from supplement items. Chi-square test was used to compare different variables.

Results: Most frequently used supplements were vitamins, calcium, iron, protein, amino acids, carbohydrate, caffeine, glutamine and creatine. LCA showed 3 different classes of athletes characterised by different behaviours in supplement consumption: no supplements (LC₁), all supplements included in the study (LC₂), only some classes of supplement (LC₃). Nutritionists were the main sources of information for the supplements, followed by internet and teammates. Most athletes use supplements to improve performance and recovery and to prevent nutritional deficiencies.

Conclusions: Our data showed that a large number of athletes do not take any supplementation, but another class reported to take almost every supplement listed in the study. Greater reliance by athletes on nutritionists providing evidence-based support could influence the supplements selection, thus improving the effects on performance and health.

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PP5-13

Effects of endurance training protocol and Friliver® performance supplementation on gut microbiota phyla

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Purpose: The gut microbiota is now widely recognized to be a functional and dynamic interface between host genetics, environmental and lifestyle choices. Exercise is a possible modulator of intestinal microbiome composition since some investigation reported that it is associated with increased biodiversity and representation of taxa with beneficial metabolic functions¹. The objective of the present study was to evaluate the effects of an endurance training protocol and of a commercially available branched-chain amino acids-alanine-carbohydrate based sports supplement on gut microbiota phyla composition.

Methods: Eighteen healthy normal weight sedentary male subjects performed 36 indoor cycling training sessions over a 9-week period. SU arm was supplemented with Friliver® Performance (Dompé Farmaceutici Spa), whilst PL one took a Placebo. Fecal sample were collected at baseline and after 9-week training. For 16S rDNA sequencing, total microbial DNA of the samples was extracted using the QIAamp PowerFecal DNA Kit (Qiagen) following the manufacturer's protocol. The 16S rRNA V3 and V4 amplicons were sequenced by Biomolecular Research Genomics SRL. The Bioinformatic Standard analysis (taxonomic analysis) of the "16S NGS" service provides for a report for each sample indicating the abundance relative of each taxonomic group. In order to verify changes in gut microbiota phyla in balanced PL and SU arms, MANOVA for paired data has been performed; pre_post training phyla quantification were within factor and group membership was between one.

Results: The results showed there was a significant increase (+31.5%) of Bacteroidetes ($p < 0.001$) and decrease of Firmicutes (-21.1%; $p < 0.01$) and Euryarchaeota (-79.7%; $p = 0.04$) phyla during 9-week training with no differences between PL and SU groups. Interaction analyses showed a significant changes only in Proteobacteria level (+47.9% in PL; -62.4% in SU; $p = 0.03$).

Conclusions: These preliminary data showed that the endurance training protocol led to a different Bacteroidetes / Firmicutes ratio and a decrease of Euryarchaeota without differences between PL and SU groups. A decreased in Proteobacteria in SU group occurred, in agreement with the results reported by Yang et al.².

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PP5-14

Doping factors in team sports; parallel analysis among athletes and coaches

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Purpose: Doping is one of the most dangerous and health-threatening behaviors in contemporary sport. Apart from hazardous, even deadly consequences, doping undermines the integrity of the sport. Coaches authorities and direct and intensive everyday contact put them in the ideal position to influence athletes decision-making directly or indirectly. The aim of this investigation was to evidence and compare doping tendencies and doping-related factors in team-sport athletes and their coaches.

Methods: Study included 346 competitive team sport athletes (138 females), and 63 coaches from Kosovo (8 females). The data was collected through previously validated questionnaires, which included questions on sociodemographics, sports-related factors, and doping-related factors. The differences between coaches and athletes were identified by Kruskal Wallis and Chi-square test.

Results: Significant differences were detected for: (i) trust towards doping (Chi = 50.80 $p < 0.01$; athletes show lower trust on coaches/doctors), (ii) main source of information on doping and nutrition (Chi = 65,30 $p < 0.01$; coaches were more likely to declare formal education as the main source of information), and potential doping behavior (KW = 6.99 $p < 0.05$; athletes have more positive attitudes towards doping). Meanwhile the differences between coaches and athletes for (i) occurrence of doping in their sport, (ii) opinion about the main problem of doping in sports (fair-play vs. health-hazard), (iii) and opinion about penalties for doping-offenders were not established.

Conclusions: The lower doping tendencies in coaches points out the fact they make perfect candidates for implementation of doping preventive programs in sports. Therefore, coach's competencies in this field should be monitored and improved, especially knowing that our results indicate athletes low trust towards coaches when it comes to doping-related issues.

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PP5-15**Effects of 4 weeks of time restricted feeding on performance, metabolism and blood outcomes in elite cyclists**

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Purpose: Extended episodes of fasting are ingrained into most species' natural life. Recently, the effects a particular kind of short term fasting (up to 16 hours) called times restricted feeding (TRF) has been investigated on resistance training athletes; no data are available, instead, on endurance athletes. We sought to investigate the effects of 4 weeks of TRF 16/8 (with windows of 16 hours of fasting and 8 hours of feeding) on elite cyclists.

Methods: 16 elite and under 23 cyclists were randomly assigned to TRF group or to traditional meals pattern/control group (CTRL). The TRF group consumed 100% of its estimated daily energy needs in an 8-hour time window: from 10:00 AM to 6:00 PM whilst the CTRL group consumed 100% of its estimated daily energy needs in 3 meals between 7:00 AM and 9:00 PM. During the experimental period training loads were similar in the two groups. Athletes were tested before and after 4 weeks. Fat and lean body mass were measured by bioelectrical impedance analysis (BIA), VO_{2max} and basal metabolism were measured through indirect gas analyzer. In addition, blood counts, free testosterone, SHBG, IGF-1, IL-6, TNF alpha, VES, PCR, total cholesterol and triglycerides, TSH, free T3, insulin, adiponectin, cortisol were measured.

Results: After 4 weeks, there was a significant decrease of body weight (TRF: $-1.26 \text{ kg} \pm 1.57$ vs. CTRL: $+0.22 \pm 0.96 \text{ kg}$, $p = 0.038$) and fat mass in the TRF group ($p = 0.0093$) compared to CTRL group with no differences in lean body mass. Performance tests showed no significant differences between two groups even though there was a significant increase in the Peak Power Output / body weight ratio ($p = 0.024$) in the TRF group due to weight loss. Free testosterone and IGF-1 decreased significantly ($p = 0.004$ and $p = 0.048$ respectively) in the TRF group; leukocyte count decreased more in the CTRL group ($p = 0.039$). We measured a significant higher increase in lymphocytes counts in TRF group ($p < 0.001$) and a similar decrease of neutrophils in both groups ($p < 0.001$), thus the neutrophils to lymphocytes ratio (NLR) decrease significantly ($p = 0.003$) in TRF group. No significant changes in others blood chemistry values in the two groups were observed.

Conclusions: Our results suggest that a TRF program in which every day meals are consumed in an 8-hour time window cause fat loss whilst maintain lean mass and performance indexes, improving Peak Power Output / body weight ratio. The changes of white blood cells parameters worth further investigation.

PP5-16**Carbohydrates consumption pre exercise attenuate bone resorption marker in young female gymnasts**

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Purpose: Bone mineral density (BMD) is modified by environmental factors like diet, nutritional status and exercise. Athletes have higher bone turnover than sedentary individuals but prolonged exercise might result in a negative remodeling balance and compromise skeletal health. Strenuous exercise and fasting may induce osteoclastic activity that is not necessarily accompanied by a compensatory increase in osteoblastic activity. The purpose of this study was to understand if there is specific nutrition to allow best performance and reduce bone resorption that occurs after exercise in athletes.

Methods: A group of 28 gymnasts aged between 9 and 14 years old (13 ± 1.71) playing artistic gymnastics for at least 6 years at a pre-competitive level were enrolled in our study. Subjects were evaluated by anthropometric measurements (weight, height, BMI, % FM, % Lm, % W, % BM) and by self-report questionnaires (ESPQ, Energy Self-Perception Questionnaire) at the end of a training session. The subjects were divided into a sandwich group (SG) with carb-based snacks, and a cereal group (CG) with the other carb/protein based snacks. The different isocaloric meals of 330 kCal had the follow composition: SG 40.6 g carbs, 13.85 g pro, 4.7 g fats and GC with 68 g carbs, 7 g pro, 2 g fats. Food was administered 90 minutes before a 90-min high-intensity training session. To check the energy status of athletes after taking the two different snacks and to evaluate bone resorption, the C-terminal telopeptide of type I collagen (CTX), glucagon-like peptides (GLP) 1 and 2, and the gastric inhibitory polypeptide (GIP) was analysed from four urine samples, collected at different time points: pre-snack (t0); after 90 minutes from the snack (t1); at the end of training (t2); after 60 minutes from the end of training (t3). To evaluate these markers, we used a flow technology coupled with an ORBITRAPTM mass spectrometer.

Results: The snacks provided had a positive effect on the performance of the gymnasts. In particular, 55% felt a change in their performance and reported an increase in energy and attention during training. All the gymnasts involved in the study showed the same lean mass of 39.7% and bone mass 9.4%; the responders also reported an improvement in energy during the training after the intake snack provided (36%).

Conclusions: In conclusions, concerning the assessment of biomarkers of bone resorption, there are some evidence that show a change following the snacks intake. In particular the results suggests that the consumption of a carbs meal before training reduces post exercise resorption in athletes, as evidenced by reduced CTX levels sixty minutes after the end of physical activity.

A suitable pre-workout snack based carbs is essential to improve performance, reduce fatigue and bone resorption in young gymnasts. This is a pilot study that needs a deep investigation to confirm the preliminary results obtained.

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PP5 LEGAL, ECONOMIC AND SOCIAL ASPECTS OF SPORTS

PP5-17

Age and sex difference in access to sports: a 1-year retrospective study in Modena

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Purpose: Regular physical activity is a cornerstone in the prevention and treatment of cardiovascular disease thanks to its anti-inflammatory effects. Thus, favouring the access to sports is of importance for promoting the wellbeing. The aim of the present study was to investigate how the practise of different sports is distributed among different age and between men and women, by taking a picture of the of medical certificate request in 2017 for sports in the population of the province of Modena, Italy.

Methods: We analysed the difference in distribution of requested medical certificate from 18,874 males and 7,625 females stratified for age (under 18 years, from 18 to 40 years and over 40 years) and for different sporting disciplines (athletics, football, bike, swimming, basketball, volleyball, tennis, other team sports, other individual sports and disabled sports).

Results: The distribution of requested certificates differs significantly (Chi-square test $p < 0.0001$) at different age and between males and females of same age.

Conclusions: In order to decrease the imbalance between men and women access to sports, it is mandatory to promote a healthy life style and reduce, as consequence, cardiovascular risks, mostly in women after 40 years.

PP6 POSTURE AND FUNCTIONAL RECOVERY

PP6-1

Effects of tongue position on posture stability

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Purpose: Body posture has been shown to be affected by various factors, including vision, trigeminal afferents, head-neck position and proprioception. Jaw and neck regions share anatomical, biomechanical and neurological links; in addition, dental occlusion status contributes to the maintenance of postural balance. Here we investigated the effects of the tongue-mediated activation of trigeminal nerve endings, located at the palatine spot, on postural parameters of healthy active adults.

Methods: Seven active men (age 26.6 ± 3.6 yrs; height 176.9 ± 4.7 cm; weight 79.4 ± 9.0 kg; BMI 25.4 ± 2.9) and seven active women (age 26.0 ± 3.4 yrs; height 165.4 ± 9.7 cm; weight 58.3 ± 7.5 kg; BMI 21.3 ± 1.8) were recruited. Specific postural parameters were recorded using the DIERS Pedoscan platform: the sways of the Center of Pressure at the left and right foot (CP_L and CP_R) and the sways of the Center of Mass (CoM); both for CP and CoM the sways were monitored on the antero-posterior (AP) and on the medial-lateral (ML) planes. Static and dynamic balance were evaluated with/without tongue positioned at the palatine spot.

Results: During the static balance test, when tongue was located at the palatine spot, men significantly reduced CoM sways at the ML plane ($p < 0.05$); a similar behavior was observed when male and female data were grouped ($p < 0.05$). Considering the dynamic balance, we observed a significant reduction of AP sways in the CoM of grouped men and women ($p < 0.05$). Interestingly, within all considered groups (men, women, all), the AP sways of CP_L and CP_R were always significantly higher compared to ML ones, both during the static and the dynamic balance tests ($p < 0.05$); nevertheless, when the tongue position was evaluated, no statistical significance was observed.

Conclusions: This pilot study confirms how the correct tongue position within the mouth is instrumental to get a better posture. In particular, the activation of the trigeminal nerve endings allows to reduce the ML sways of CoM in the static balance, whereas it reduces the AP sways of CoM in the dynamic evaluation.

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PP6-2**Functional and postural evaluation of orthopaedic pillows in the prevention and treatment of musculoskeletal disorders of idiopathic neck pain**

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Purpose: The purpose of our study was to evaluate the postural function and effects on the muscles and cervical proprioception of three different types of orthopaedic and medical pillows, which have been modelled and manufactured to prevent and treat cervical skeletal muscle disorders. To this end, they have been compared with a commercial standard pillow not classified as medical or orthopaedic.

Methods: We used a Standard Pillow (Sigma) and three medical pillows from Fabre srl Company: Orthopedic Pillow (Alfa), Orthopedic Memofoam Pillow (Beta) and Ergo Praxis Orthopedic Pillow (Gamma). 30 cervicogenic subjects were recruited and have undergone the following evaluations: Test Neck Disability Index (NDI); Mobility of the Head (ROM) assessed with inertial accelerometers; Postural Spinometric examination; Baropodometric - Stabilometric evaluations; Gnathologic evaluation with cutaneous electromyography. The participants used the Standard Pillow every night at home for 15 days. Subsequently, after seven nights in which they slept according to their habits or with their usual pillows, they were invited to rest for 15 days using one of the examined orthopaedic pillows, randomly assigned. The procedure was then repeated for all the examined pillows. In all conditions, evaluations were repeated prior to the 1st night and after the 7th and the 15th night. Repeated-measure ANOVAs were used to compare the effects of the different pillows.

Results: The data did not reveal any significant effect related to the time of use of the pillows under examination. Conversely, significantly different effects were observed for the different orthopaedic pillows as compared to the standard pillow regarding postural parameters such as anterior-posterior flexion, lumbar parameter, and lateral flexion. Concerning the Neck Disability Index, the Beta pillow showed a trend to a significant difference vs. the Sigma pillow, whereas head range of motion parameters, linked to musculotensive and fibromyalgia symptoms, showed statistically significant differences between the standard Sigma pillow and the Gamma pillow.

Conclusions: These findings, showing postural effects as confirmed by the performed examinations, induce to consider the three specific FABE orthopaedic pillows as orthosis instruments. The orthopaedic pillows analysed in our study have also demonstrated an important value in preventing and mitigating disorders linked to the cervical tract and, therefore, are suitable for physical rehabilitation and physiotherapy purposes in the prevention and treatment of skeletal muscular disorders of idiopathic cervical rachialgia.

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PP6-3**Evaluation of proprioception in women with postmenopausal osteoporosis**

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Purpose: Osteoporosis is a disease characterized by low bone mass, micro architectural deterioration of bone tissue. Therefore, the impaired postural alignment and the reduced mobility and flexibility of the spine limit the use of the normal motor strategies for the static and dynamic control of balance. The aim of this study is to evaluate the proprioception in 29 patients with postmenopausal osteoporosis using Delos Postural Proprioceptive System (DPPS; Delos, Turin, Italy).

Methods: 29 women with osteoporosis (mean lumbar T-score -2.8, age 65 ± 6 years) were recruited at Rizzoli Orthopaedic Institute. We evaluated proprioception using static Riva test performed in single leg stance and fear of fall by FES-I short form. The parameter assessed during this test has been the Stability Index (SI; percentage score where 100% is a theoretical task performed with maximum stability).

Results: During single stance test with open eyes, the SI was 86.81 ± 8.88 in right lower limb, and 84.92 ± 12.88 in left lower limb. During single stance test with closed eyes the SI was 51.73 ± 15.44 in right limb and 52.63 ± 12.32 in the left one. 14 women are part of 75° percentile, 6 between 50°-75° percentile, 5 between 25°-50° and 4 under 25° percentile. All subjects have a mean Fes-I score of 8.62 (min 7 - max 13).

Conclusions: Analyzing these preliminary results, in terms of SI there aren't significant differences between women with osteoporosis and the healthy female population. Anyway, more than half of subjects have values predictive of a mean/high risk of fall that's not correlated with FES-I. Moreover, there is a wide gap between open and closed eyes task. This could possibly affect the emergency management capability, in terms of risk of fall, given the important preventive role that proprioception bears.

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PP6-4**New insights from gait and posture analysis in patients with schizophrenia**

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Purpose: Deficits in postural stability in schizophrenia subjects have been well documented^{1–4}. However, it is still lacking the knowledge about dynamic motor faults in schizophrenia and no data are still available on their onset. Therefore, the purpose of this study was (i) to evaluate the outcomes of a quantitative analysis of gait and posture parameters in patients with schizophrenia, and (ii) to investigate if they are peculiar in early schizophrenia.

Methods: Static and dynamic parameters were tested both in schizophrenic (SG, n = 30) and control (CG, n = 25) groups. Static parameters were analysed by stabilometry (PoData®) in open eyes (OE) and closed eyes (CE) conditions. Dynamic parameters were assessed by gait analysis (G-Sensor®). Schizophrenic group was subdivided into 3 sub-groups, according with age of illness (≤ 5 years, Early Term Disease, ETD; 6–14 years, Middle Term Disease, MTD; ≥ 15 years, Long Term Disease, LTD).

Results: Schizophrenic patients showed specific static and dynamic patterns. The sway was higher in SG vs CG, in both OE and CE conditions. Sway alterations in SG were independent from visual input and age of illness, starting from the very early stage of disease. For dynamic parameters, SG showed significant lower cadence and percentage of stride length, and similar gait speed, as compared to CG. The lower cadence and percentage of stride length were independent from age of illness, whereas gait speed showed a specific pattern, being significantly higher in ETD and lower in MTD and LTD, as compared to CG.

Conclusions: Our data suggest that postural static and dynamic alterations start at the very early stage of the disease, with a specific pattern. Therefore, quantitative analysis of postural and gait indices could be a strategy to point out early motor abnormalities related to the onset of schizophrenia.

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PP6-5**Study of postural control in subjects with Down syndrome**

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Purpose: Postural instability and faulty control of balance in Down syndrome have a negative impact on gait. Poor balance increases the risk of falls and limits the quality of life in these subjects. The aim of this study was to investigate postural control in people with Down syndrome.

Methods: Participants recruited for the study were assigned to either of two groups: a Down syndrome group (DSG) and an age-matched control group (CG) with typical development, comprising 22 and 25 subjects, respectively. In order to evaluate postural control it was performed a stabilometric test in which each participant was instructed to maintain an upright standing position on a platform (FreeMed® model, Sensor Medica®; Guidonia Montecelio, Roma, Italia) for 30 seconds with their arms at their sides and feet in external rotation forming a 30-degree angle with heels 4 cm apart, first with eyes open (EO) and then closed (EC).

Results: Measures of sway upon postural analysis resulted in higher values of Maximum Speed (Max-S), Minimum Speed (Min-S) and Average Speed (AS) ($p = 0.003$, 0.036 and 0.029 , respectively) in the DSG with eyes open, compared to the CG. With eyes closed, however, the DSG showed parameters that were significantly higher than controls only for Max-S ($p = 0.003$) and AS ($p = 0.005$). The Ellipse Sway Area (ESA), which is an overall measure of balance, gave higher values in the DSG compared to controls, both with eyes open ($p = 0.009$) and closed ($p = 0.000$). We found, moreover, that the DSG showed significant worsening of Sway Path Length (SPL; $p = 0.013$), Max-S ($p = 0.001$) and AS ($p = 0.046$) during postural analysis with EC compared to EO.

Conclusions: On the basis of the poorer postural control demonstrated in the DSG compared to the CG, we infer that a Down syndrome-related impairment could underlie delayed information processing and decision making, poorer integration of multimodal sensory inputs, longer motor reaction times, inadequate grip force and loss of anticipatory postural control.

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PP6-6**Case Report: Proprioceptive training program in a patient with total knee arthroplasty**

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Purpose: Total knee arthroplasty (TKA) is the gold standard treatment for severe arthrosis, with great results in about the 80% of patients. Nevertheless, the remaining 20% complains about residual pain and functional limitations. Some studies showed no balance improvement in orthostatic position after TKA, if no specific proprioceptive training is performed.

The aim of this study was to evaluate the effects of proprioceptive training in one patient with TKA using Delos Postural Proprioceptive System (DPPS; Delos, Turin, Italy).

Methods: The subject was a 71-years-old female with TKA. The proprioception was evaluated before surgery, after surgery and after training, with a static monopodal test by mean of the DPPS. Moreover, WOMAC and SPPB score were acquired. The training program consisted in different protocols, aimed to recover joint mobility and improve balance. The patient trained twice a week, for 5 weeks. Parameter considered was the Stability Index (SI) which is a score (0-100%) based on autonomy and postural instability.

Results: The SI results before surgery, after surgery and after training in operated limb were respectively: 67.2%, 84.7% and 87% with open eyes; 30.1%, 27.1%, 37.9% with closed eyes. The SI in contralateral limb increased in each follow up, scores were also slightly higher than the operated limb. The WOMAC score improved along the evaluations: 38.54% before the surgery, 8.33% after surgery and 3.1% after training. SPPB results were: 6 before surgery, 9 after surgery and 12 after training.

Conclusions: TKA confirmed positive effects in terms of pain reduction and physical function. Nevertheless, the SI performed in operated limb with closed eyes, which is a predictive factor for proprioceptive ability, decreased after surgery. The proprioceptive training was instead able to improve all patterns, giving a much global benefit.

In future, a specific proprioceptive training could be used after standard rehabilitation.

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PP6-7**Postural rebalancing with integrated treatment: Postural Back School C.A.MO.® and K1 Posture Keeper Brace**

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Purpose: The aim of the research is to highlight the contribution of a posture keeper brace (K1 Posture Keeping, Dual Sanity) on postural rebalancing in subjects with paramorphisms, to evaluate whether its use can reduce the timing of a postural balance protocol, Postural Back School CA MO® method.

Methods: Inclusion criteria: Subjects of both sexes between 25 and 45 years, with asthenic dress and attitudinal curved back. Exclusion criteria: Spinal disorders: vertebral fractures, cuneization, Scheuermann's disease, scoliosis, shoulder injuries; impingement syndromes. The control group (10 subjects) underwent standard treatment (10 postural sessions in a month). The study group underwent 5 postural sessions in 15 days and 15 days of use of the postural mesh.

At the beginning and at the end of the treatment, morphofunctional parameters (physiological curves, muscle and joint tests) and the results of postural baropodometry performed with DIASU instruments were evaluated.

Results: Curved spine test. At the beginning of the treatment the Study Group presented a positive percentage to the back stiffness of 36.70% of the total tests performed compared to the 16.70% of the Control Group. At the end of the treatment the results in terms of prevalence are almost identical and the stiffness of the back has been reduced to reach a percentage of positive tests of 6.70% in both groups. Muscle strength evaluation. At the beginning of the treatment the average strength value expressed by the various muscle groups, considering a scale of 1 to 5, was 3.7 in the Study Group and 3.5 in the Control Group. At the end of the treatment the final average values were 4.48 for the Study Group and 4.47 for the Control Group. Scapulo-thoracic joint mobility evaluation. At the beginning of the treatment the Study Group presents a greater number of positivity to the rigidity than the Control Group: the Study group has 11.10% of positive tests, while the Control Group 7.14% of positive tests. At the end of treatment, joint mobility was re-established in both groups and negative tests were 100%.

Conclusions: The CAMO® Method is effective in reducing the curved spine, in the overall postural balance and in increasing the erectory musculature both when used for 30 days, and when used for 15 days, combined with the use of the eKeep® jersey. This aid can reduce the time required to achieve the desired results by 50%.

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PP6 MOTOR CONTROL AND LEARNING

PP6-8

Applicability of brain oxygenation measurement in the assessment of post-concussion outcomes in combat sport

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Purpose: Investigate the association in semi and professional boxers (mTBI), who experienced previous multiple sports concussions, between brain oxygenation, balance, maximal aerobic capacity and power, in comparison to non concussed (NC) subjects.

Methods: We tested 6 mTBI age 20-43 years (1 female and 5 males) and 7 NC age 24-38 (3 females, 4 males) subjects. Cerebral changes in ΔO_2Hb , ΔHHb and total hemoglobin were measured using a protocol of three steps (Rest before max VO_2 test, Hypercapnia, and recovery after max VO_2 test, 5 minutes each) with a Nimo Nirs system (Nirox, Brescia) and O_2 measurement with a Cosmed Quark CPET (Cosmed, Roma). CVR (cerebral vascular reactivity) in mTBI and NC subjects and respiratory parameters were calculated. Aerobic fitness outcome was quantified by mean of VO_{2max} with a Bruce test on a bike. A Romberg Test was performed on a force platform (Kistler 9281, Switzerland) and software Sway (BTS Eng., Milan). Analysis of transversal (ML) and Longitudinal (AP) range of oscillation was performed. A Fitt's test, was performed on a pc and scoring was obtained. Statistical analysis was performed with SPSS-v.23 (IBM Inc. Chicago) using the Mann-Whitney U test.

Results: Any difference mTBI/NC was found in Fitt's test. Any differences were found between males and females in any of the parameters measured, except anthropometry with a weight of 0.29 for sex (GLM test, SPSS). VO_{2max} for mTBI was 49.58 ± 5.19 and for NC was 47.47 ± 4.91 ml/kg/min⁻¹ without any significant difference. mTBI (17.65 ± 4.79 mm) show a significant differences with NC (25.35 ± 4.11 mm) in medio-lateral sway with eyes open (sig. 0.008). At GLM test, major predictor was the medio-lateral sway with eyes open with a weight of 0.71. Also a significant was found difference of FetO₂ average in hypercapnia (sig. 0.008).

Conclusions: Concussion seems to be evidenced by medio-lateral sway values (eyes open) and FetO₂ in hypercapnia.

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PP6-9

Action anticipation for different sounds' semantics

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Purpose: Fast reaction to approaching stimuli is vital for survival: sounds entering the Peripersonal Space (PPS) provoke higher motor cortex activation and anticipated muscular activity based on the

distance¹ and the sound's semantics². Here we compare the effect that sounds entering the PPS inducing different emotions (Positive P, Negative Ne, Neutral, Nu) have on sound localization and action preprogramming by comparing Normal Hearing (NH) with Cochlear Implanted (CI) individuals. The departure from normality of the CI individuals will help to better understand the involvement of the perceptual and the motor components in sound recognition.

Methods: 26 NH and 10 CI subjects and 3 sound stimuli with different emotional components virtually ending at 5 distances from subjects (30-70 cm). Pre-motor reaction time (PRTs) was detected via EMG from postural muscles while subjects performed fast upper arms flexion in reaction to the sound end. Sound localization and subjective emotional ratings (valence and arousal) were measured as well.

Results: Contrary to CI, NHs modulated PRTs based on the sound distance. Listening to Nu triggered a prompt reaction and higher underestimation in distance localization for all subjects. Emotional ratings showed lower valence for closest sounds in both groups, but only NH evaluated both valence and arousal based on the sound distance.

Conclusions: Decoding meaningful sounds delayed the motor response but only NH group modulated these responses based on the sound distance. On the contrary, CIs were not able to preprogram their actions appropriately nor to evaluate appropriately the sounds arousal and valence. These results indicate that properly reacting and localizing sounds in the near space involve both perceptual and motor components.

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PP6-10

Listening to music while running alters foot collision forces with gender differences

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Purpose: Listening to music during exercise yields a number of positive and measurable physiological effects. However, to date the possible influence of music listening on the amount of impact forces during running has not been investigated yet. This study tested the effects of different volumes of music on running mechanics at different velocities.

Methods: A total of 50 fit healthy volunteers (22 women, 28 men; age 23 ± 2 yrs; weight 69.7 ± 11.6 kg) performed 2-minute running stints over 3 different randomly assigned experimental conditions (running while listening via earphones to 80-or 85-dB music, or no music) at 3 different velocities (8, 10, 12 km/h). Participants ran on a treadmill with embedded pressure force piezo-resistive sensors and a 3D-gait analysis stereophotogrammetric system. Measures of average and peak ground pressure force with kinematic and kinetic parameters describing the running mechanics were recorded during the experimental conditions.

Results: Running while listening to 85-dB music resulted in significantly greater impact loading at 8 ($p = 0.0005$) and 10 km/h ($p = 0.04$) but not at 12 km/h ($p = 0.35$) and not with the 80-dB volume. Gender-based analysis revealed significant Condition*Gender interactions only for the comparison “85-dB music” vs “no music”. After correcting by body weight, Bonferroni-adjusted comparisons revealed significant music-induced increases in impact loading only for the male group at 8 km/h (men: $+4.1 \text{ kg/cm}^2$, $p < 0.0005$; women: $+0.8 \text{ kg/cm}^2$, $p = 0.47$) and 10 km/h (men: $+3.3 \text{ kg/cm}^2$, $p = 0.004$; women: $+0.8 \text{ kg/cm}^2$, $p = 0.51$) but not at 12 km/h. Gender-based comparisons also revealed significant changes in COG vertical displacement only in men (\uparrow) in ankle ROM and knee ROM only in women (\downarrow), while stride length was found increased in women.

Conclusions: Data indicate that, in recreationally active male subjects, listening to loud music while running results in increased impact pressure forces. This was not the case for women, who showed no changes in impact in response to music. Gender differences in pelvis, hip and knee joints may explain the observed gender differences. We also offer that, compared to men, women were likely running at a greater percentage of their maximum effort during each speed condition, thus being more engaged even at the lowest velocity and paying lesser attention to music. The present findings introduce high-volume music listening during running as a new potential risk factor for injury.

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PP6-11

Time-course of running treadmill adaptation

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Purpose: Studies on running biomechanics and energetics are usually conducted using a treadmill. However, to ensure that treadmill locomotion is representative of overground locomotion, subjects need to be adapted in the use of the device¹. Adaptation includes the processes of familiarization (i.e. short-term, within-session) and habituation (i.e. long-term, between-session)^{2,3}. We aimed to identify the number and duration of sessions needed to obtain stable measurements for spatiotemporal and metabolic parameters in runners naïve to treadmill running.

Methods: Fourteen male recreational runners performed three treadmill running sessions (15 minutes each, three times/week), at a constant submaximal speed corresponding to their half-marathon seasonal best. Spatiotemporal and metabolic parameters were registered at minutes 5, 10, 15 of each trial and changes across time points

(familiarization) and sessions (habituation) were analysed by two-way repeated measures ANOVA and Bonferroni post-hoc test.

Results: Within-session changes were found in Cadence, which decreased over time, while Stride Length and Contact Time increased, reaching stable measures at different time points. Among metabolic measurements, Ventilatory parameters increased, reaching stability after 5-10 minutes, while Heart Rate (HR) increased progressively over time. Between-trials comparison showed an increase in Stride Length and a decrease in Cadence at minute 1, between trial 1 and 3. None of the Metabolic parameters changed over trials.

Conclusions: Results suggest that at least three 15-minutes trial are required for full adaptation in novice treadmill runners. Parameters collected in the last 5 minutes of the third trial can be regarded as stable measurements. The only parameter that did not reach stable measurements was HR, that continued to increase over time throughout the trials. This phenomenon is compatible with the appearance of the so called “slow component of HR”, i.e. a slow increase of HR occurring at about 120-180 s into exercise, possibly also in absence of a slow component of $\dot{V}O_2^4$. Moreover, the speed of adjustment of oxidative metabolism at exercise onset is unaffected by habituation to treadmill.

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PP6-12

Relations between motor learning and memory

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Purpose: Research on learning a motor task, although generally conducted on healthy subjects, can offer useful indications on the best strategies to be adopted in the rehabilitation of subjects with CNS injuries. In fact, rehabilitation can be considered as a learning process in pathological conditions^{1,2}. There is a lot of experimental evidence that a lower relative frequency (FR) with which the knowledge of the result (CR) about the outcome of the response is provided, and the request for the formulation of a subjective estimate before the CR (SS), both positively affect the fixation of a motor task. Recently, however, it has been suggested the possible occurrence of an interaction between these two variables. Indeed, when the subject has to formulate a subjective estimate of the error, he/she could benefit from a greater, and not lesser, FR³.

Methods: To verify the above hypothesis, 60 healthy subjects (mean age 24.1 ± 3.2 years) performed a simple task of producing a concentric work target with elbow muscles flexed during isokinetic contraction at a rate of 30 degrees/second. Subjects were allocated to four groups which a) were required, or were not required, to estimate the error made in the trial just ended, and b) to which the CR was provided after each trial (100% FR) or after one trial out of five (20%

FR). To further highlight the difference between groups when formulating or not an SS, in the latter case it was asked, immediately after the conclusion of the trial, to perform a simple mental calculation. All subjects performed 15 sets of 10 repetitions of the task during a single practice session. One retention test (1 set of 10 repetitions without CR or SS) was performed the following day. The comparison of the groups in the retention test was carried out with the analysis of the variance, before and after adaptation to the initial conditions.

Results: The results showed that, after adjusting for the initial conditions, the group of subjects who received CR with 100% FR and who had to formulate the SS during the practice period, performed the retention test in a significantly better way than the other groups.

Conclusions: The internal model of the dynamics of a limb is a field in which the forces generated by the muscular apparatus are related to the state of motion (position and speed) of the limb. We shed light on the structures generated by the output stages of the motor system, although much remains to be understood on how the different parts of the brain learn and assemble different and more elaborate fragments of behavior.

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PP6-13

Insights on the intra-cerebellar dentate structural connectome: relationship with motor and non-motor behaviors

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Purpose: Understand the relationship between quantitative structural connectivity of the dentate nucleus to different aspects of behavior: motor, cognitive and emotion. To the best of our knowledge, neither quantitative connectivity measure nor the possible relationship with different behavioral tasks have been estimated yet for connections linking cerebellar cortex to dentate nucleus.

Materials and Methods: 100 healthy subjects from the human connectome project have been employed in this research. We first characterized the whole dentate nucleus connectome by means of advanced tractography techniques, reconstructing its connectivity to each hemispheric lobule. Then, we assessed quantitative connectivity measures, streamlines counts (SC) and Streamline density index (SDI) and related them with results of selected motor and non-motor tasks.

Results: Cerebral and cerebellar cortices are densely interconnected via the cortico-cerebellar loops, which influence motor, cognitive and emotional behavior. Such a functional heterogeneity is underlaid by a compartmentalization within cerebellar cortex which has been divided in anterior motor (Lobules I-V, medial region of lobule VI and lobule VIII) and posterior cognitive/affective (Crus I, Crus II, VIIb)

compartments. Recently, there is a growing interest in establishing how lobular volumes vary between hemispheres and sex and how they relate to different behaviors, linking somehow structure to function¹. Dentate nucleus is the largest output nucleus of the cerebellum. Tract tracing studies demonstrated that its projections to the cerebral cortex are topographically organized, introducing the presence of a rostro-dorsal (motor) and a ventral-lateral (cognitive/affective) subdivision of dentate nucleus².

Conclusions: Investigating structural connectivity between cerebellar cortex and dentate nucleus in humans is challenging. However, advanced diffusion tractography techniques have been recently employed to demonstrate that intracerebellar connections from motor (H-IV, H-V and H-VI) and cognitive (Crus I, Crus II) lobules maintain the aforementioned topography within dentate nucleus³.

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PP6-14

Assessment of the effects of Kinesiotaping on musical motor performance in musicians suffering from focal hand dystonia. A pilot study

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Purpose: Task-specific training and learning time are crucial factors to achieve and preserve high level of performance in a particular domain. Yet, repetitive use of a specific body segment for an extensive period can induce a deterioration of voluntary motor control due to maladaptive plastic changes in the sensorimotor system by interacting with other triggering factors such as psychological stresses, neuromuscular trauma, along with genetic susceptibility. In a musical setting, intensive training regimes can be associated with loss of motor control, leading to the manifestation of focal dystonia, also known as musician's dystonia (MD). MD is a movement disorder compromising the playing ability of musician and in many cases terminates musical careers. The study explores the immediate and short-term effects of a Correction Kinesiotaping intervention on fine motor control in musicians with focal hand dystonia.

Methods: Seven male musicians with focal hand dystonia (FHD) performed musical exercises under the following conditions: without Kinesiotape (baseline); during a Correction Kinesiotaping intervention and immediately after tape removal (block 1); during a Sham Kinesiotaping intervention and immediately after tape removal (block 2). Blocks were randomly presented across participants. A tailored Correction Kinesiotaping intervention on affected fingers was provided based on the dystonic pattern that each patient manifested while playing. Motor performance was video-documented and four independent experts assessed blindly the general performance and fingers'

posture on visual analogue scales (VASs). Also, musicians' self-reports of the musical abilities were evaluated. Finally, electromyographic activity and co-activation index of wrist antagonist muscles were analyzed.

Results: No significant differences of effects between Correction Kinesiotaping and Sham Kinesiotaping were reported by the experts, either for general performance or for fingers' posture; any subtle benefits observed during Correction Kinesiotaping were lost after the tape was removed. Musicians estimated that Correction Kinesiotaping was ineffective in improving their musical abilities. Also, no significant changes with respect to the co-activation index were found among the conditions.

Conclusions: Correction Kinesiotaping intervention may not be useful to reduce dystonic patterns, nor to improve playing ability, in musicians with FHD.

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PP6-15

Effects of stroboscopic visual feedback disruption on postural control during dynamic single-limb balance tasks in female athletes after anterior cruciate ligament reconstruction. A pilot study

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Purpose: Athletes involved in a primary anterior cruciate ligament (ACL) injury are predisposed to an increased risk of experiencing a second noncontact ACL injury, despite surgical ACL reconstruction (ACLR) and rehabilitation. Females are also at a high risk, with nearly 4 times as likely as their male counterparts to experience an ACL reinjury. Researchers exploring neuroplasticity after ACLR showed different brain-area activation during repeated cycles of knee flexion and extension and inferred a possible visual-motor control alteration after ACL injury. Such hypothesis would be confirmed by previous biomechanical studies showing a greater degradation in postural control in athletes with ACL when visual information was minimized when compared to healthy control group. However, the approach used in these studies to minimize vision (closed eyes condition) permitted to assess movements that lacked generalizability and sport specificity. The development of visual-disruption technology, such as stroboscopic glasses, that obstruct vision without completely obscuring it, has enabled the assessment of visual-motor control during dynamic movements more closely mimicking the dynamic demands of athletic activity. This pilot study explores the effect of stroboscopic visual feedback disruption (SVFD) on postural control

during single-limb dynamic balance tasks in female athletes with ACLR.

Methods: Seven athletes with ACLR and 7 matched healthy control athletes performed the Drop Landing, the Dynamic Postural Stability Index (DPSI) and 90° Jump Cut, under normal and SVFD conditions. The three single-limb dynamic balance tasks were performed on the Kistler force platform. The Senaptec Strobe glasses imposed the SVFD. For drop landing task, peak of vertical ground reaction force (GRF) and loading rate were measured; for DPSI task, DPSI and balance of the Centre of Pressure (COP) were calculated; for 90° Jump Cut, vertical and lateral peaks of GRF and vertical/lateral ratio (Lat/Ver Max) were measured. Peak Vertical of GRF were expressed relative to body weight.

Results: Preliminary data show that ACLR may induce alterations on postural control in all the three tasks investigated. In addition, SVFD via stroboscopic glasses alters parameters investigated in the drop landing, DPSI and 90° Jump Cut. Finally, in the drop landing task, peak of GRF and loading rate decremented more under the SVFD condition in participants with ACLR than in controls.

Conclusions: SVFD via stroboscopic glasses can influence postural control during single-limb dynamic balance tasks. The fact that, under the SVFD condition, postural control during the drop landing was found to be reduced more in athletes with ACLR than in controls suggests possible sensorimotor adaptations occurring after ACL reconstruction. Finally, the limited and dynamic vision disruption provided by stroboscopic glasses can allow for the investigation of possible visual-motor control alteration following ACL injury, by means of reproducing in clinical setting motor tasks that more closely mimic the cognitive stress of sport.

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PP6-16

Effects of stimulation of the palatine spot on postural stability during a timed up-and-go (TUG) test before and after the Judo fall Ushiro-Ukemi

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Purpose: The aim of the research is to investigate the acute effect of the judo fall Ushiro-Ukemi on posture control of young adults during a TUG test, and the possible modulating influence of the stimulation of the palatine spot on this result. Hypotheses were: 1) the position of the tongue maintained during the test will change the expression of

force in the lower limbs while the participant stands up from the chair. 2) the position of the tongue maintained during the test will change the dynamic stability during walking, assessed using parameters relating to mid-lateral oscillations occurred during this phase.

Methods: 39 students (27 M, 12 F) were recruited for this study. A common smartphone (Samsung Galaxy S4-TS-L1-070) was connected via Bluetooth to a wearable inertial unit (pERhl) embedding triaxial accelerometer, gyroscope, and magnetometer¹. The sensing unit was strapped to the lower back (L5) by means of an elastic belt. An application (uPerhl) was used to start/stop the recording and to insert temporal markers. Participants performed 9 total tests before and after the judo fall, with 3 randomized repetitions of different tongue positions: A in rest position, B between the lower incisors, C on the palatine spot. Repeated-measures ANOVA was used to analyse data.

Results: Vertical acceleration increased in the post-fall condition with the position of the tongue in the state of rest (A) and in position (B); but was almost unchanged in position C, with the stimulation of the palatine spot the mid-lateral acceleration increased in the post-fall condition with the position of the tongue in positions (A) and (B), and was almost unchanged in position C (against the palatine spot).

Conclusions: The stimulation of the spot seems decrease the effects of the increase in strength of the lower limbs after falling during standing from the chair, and Increase postural stability by reducing oscillations during the walking phase.

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PP7 PHYSICAL ACTIVITY AS PREVENTION AND THERAPY

PP7-1

The 12 months adapted physical activity (APA) impact on functional capacities in post-stroke subjects: exercise facility *Esercizio Vita*

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Purpose: Emilia-Romagna fosters a network of gyms and fitness centers (PPM-AMA) qualified for APA program to people affected by chronic disease. In chronic stabilized syndromes as stroke, APA is the intervention after an intensive rehabilitation period. This observational study examines the impact of APA to hold residual abilities and to counteract hypokinesia that occurs in adult patients with Post-Stroke outcomes.

Methods: A sample of 122 (82 M) post-stroke subjects attending PPS-AMA were recruited for this study. All those who did not complete 12 months of continuous APA were excluded. All subjects have performed the functional assessments, 6MWT, BBS, STS, TUG, 10MWT at the beginning (T0) and after one year of activity (T1). The proposed APA model is based on stride training, mobility, static and dynamic balance, resistance training, agility and aerobic work with a frequency of at least 2 times a week and a duration of 60 minutes per session.

Results: 37 subjects (27 M; age 72±10 yrs) completed one year of training [78% ischemic stroke, 20% hemorrhagic stroke and 5%

cryptogenetic stroke]. After 12 months of APA, an improvement, although not statistically significant, of the functional capabilities of STS, 6MWT, 10MWT, BBS has been pointed out, whereas the improvement in execution time of TUG was statistically significant ($P = 0.006$).

Conclusions: As already demonstrated in the literature, after 12 months of supervised APA program it was observed the maintenance of functional capacity in post-stroke subjects. The efficacy of APA program continuous and supervised is evident in post-stroke subjects¹. The presence of certificate structures PPS-AMA is therefore relevant, both in terms of prevention programs, in sport management and in therapies in people with chronic stroke. The benefits concern a reduction in mortality, drug costs, crowding of medical studies and hospitalization, both in individual and collective level: this allows an increase in quality of life thanks to a single medication, exercise.

Reference

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PP7-2

Activity breaks: an effective strategy to attenuate post-prandial glucose spikes in healthy young subjects

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Purpose: Post-prandial hyperglycaemic excursions are related to many cardiometabolic disorders¹. Activity breaks may counteract these negative outcomes by enhancing post-meal glycaemic control². The purpose of the present study was to assess the effects of different types of activity breaks on post-prandial glycaemic control.

Methods: 14 healthy active young subjects performed four protocols in random order. Each protocol lasted three hours and was preceded by the consumption of a standardized meal high in carbohydrate-content. On one occasion, participants remained seated for the entire experimental period (CON). During the other three experimental trials, 30 min of brisk walking (120 steps per minute) were split as follows: two bouts of 15 min (W15), six bouts of 5 min (W5), twelve bouts of 2.5 min (W2.5). The first exercise bout of each protocol started 15 min after the beginning of the meal. Glycaemia was assessed throughout the experimental sessions.

Results: Significant differences ($p < 0.05$) in the glycaemic time course were found across conditions at 30, 45, 60, 75, 90, and 120 min after breakfast. Specifically, a reduction in glycaemic levels was found for the three experimental trials compared to CON, but W5 and W2.5 were more effective compared to W15 in reducing the glycaemic peak, while showing a less variable decrease in glycaemia over time. Furthermore, the incremental area under the curve of the two hours post breakfast was significantly ($p < 0.002$) lower than CON for W5 and W2.5.

Conclusions: Interrupting prolonged sitting time with short walking breaks attenuated post-meal glucose responses. Furthermore, spreading a fixed amount of exercise over the post-prandial period with more and shorter bouts may be more effective compared to fewer and longer bouts.

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PP7-3**Inhibition of prostate cancer cell proliferation and tumorigenesis by serum obtained after HIIT**

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Purpose: Prostate cancer is the second most frequent cancer diagnosis made in men and the fifth leading cause of death worldwide. Evidence showed that serum obtained from healthy adults after moderate intensity continuous training (MICT, 65% VO_{2max}) had a growth inhibitory effect on the established prostate cancer cell line (LNCaP)¹. It is well known that high intensity interval training (HIIT) is superior to MICT in improving cardiorespiratory fitness, a strong determinant of morbidity and mortality. The first aim of this study was to examine the effect of sera collected after high-intensity endurance cycling (HIEC) test sessions (a reliable form of HIIT) on LNCaP prostate cancer cells proliferation. The second aim was to compare the proliferative activity of sera obtained before and after a 9-week of HIIT.

Methods: Twenty healthy sedentary male performed two HIEC test sessions before and after 9 weeks of HIIT training. Serum samples were obtained before (rest serum, t0), immediately after (t1), 4 hours (t2) and 24 hours (t3) after HIEC sessions. LNCaP prostate tumor cells were grown in media supplemented with the collected sera; cell number was evaluated after 48 hr by cell count with a hemocytometer. Inhibition of tumorigenesis was also evaluated using the soft-agar culture technique.

Results: Post-HIEC sera showed a lower capacity to sustain cell proliferation as compared to sera collected at rest (t0); in particular t1 and t2 sera caused an average cell number decrease of $-13 \pm 4.2\%$ and of $-22 \pm 4.9\%$, respectively; interestingly, t3 sera also retained this capacity $-23 \pm 4.4\%$. Moreover, sera obtained after the acute HIEC sessions showed a lower ability to induce the formation of colonies in soft agar as compared to rest sera: a difference of $-18 \pm 2.2\%$ was observed in the case of t1 sera, of $-22 \pm 1.8\%$ with t2 sera and of $-27 \pm 2.3\%$ with t3 sera. Finally, no differences were found in proliferative activity between sera obtained pre-HIEC, before and after a 9-week of HIIT.

Conclusions: Our results indicate that sera obtained following HIEC sessions exhibit a lower growth stimulating and tumorigenic capacity as compared to sera taken at rest. Training did not further increase the anti-proliferative action, suggesting that these effects are mainly due to acute high-intensity exercise-induced factors. On the whole, our results suggest that HIEC might exert a beneficial effect in the progression of neoplasia. Further mechanistic studies in this direction are in progress.

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PP7-4**Effects of Yoga on flexibility and balance in the elderly**

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Purpose: Balance, flexibility and strength are the main functions that must be kept in training in the elderly. Yoga is a gentle form of exercise that has positive impact on physical, mental and emotional wellbeing, but, despite its increasingly popularity, few trials have employed rigorous methodology to explore its functional benefits, compared with more established forms of physical activity, such as stretching. The aim of this study was to compare the effects of yoga and conventional stretching exercises on flexibility and balance in a group of elderly people.

Methods: Thirty-two healthy older subjects (N = 32; age = 67.59 ± 2.61 years) participated in a 12-week (two times a week for 1 hour) controlled trial and were randomly divided in a yoga group (n = 16; 11 women, 5 men, age = 68.13 ± 3.07 years) and a stretching group (n = 16; 11 women, 5 men, age = 67.06 ± 2.02 years). The yoga intervention was designed as a beginner, progressive 12-week program, based on learning balance and flexibility postures. Particularly, participants learned a series of physical postures, which integrates standing, sitting and lying postures, plus breathing exercises. The stretching intervention consisted of a warm up and a cool down, and the participants completed 10–12 repetitions of 8–10 different stretching exercises. All the programs were done under the supervision of certified trainers. Balance and flexibility were assessed by Berg Balance Scale and Back Scratch, Chair Sit-and-Reach tests, respectively, at baseline (T0) and 12 weeks later (T1).

Results: Our study demonstrated that, after 12 weeks of intervention, yoga induced in older subjects significant improvements in balance ($p < 0.05$) and flexibility ($p < 0.01$) similar to those induced by stretching, and no significant differences were shown between the two groups.

Conclusions: The results of the present study suggest that in older subjects yoga is equally effective to improve balance and flexibility, compared to conventional stretching exercises. Therefore, yoga can represent a feasible and effective exercise concept to be carried out in older people to improve balance and flexibility, with a high individual compliance and adherence to the exercise program, due to its positive impact on physical, mental and emotional wellbeing.

Reference

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PP7-5**Active Mamy–Active Baby: health benefits of a 10-weeks strength training in the post partum**

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Excessive weight retention, perinatal depression, reduced cardiovascular fitness and muscle strength occur in the postpartum, increasing health risks at 10-15 years follow-up. Physical activity effectively contrasts weight gain, favours weight loss after delivery, improves perinatal depression, fitness and muscle strength. However, subjective fatigue and baby's care obstacle the maintenance of an active life style. The potential health benefits of muscle strengthening during post-partum have been scarcely explored; yet, this time-efficient form of exercise, that can be performed with the baby and with lower effort, may be particularly appealing to new mothers.

Aim: to quantify the possible benefits of a 10-weeks strength training on body composition, depression, fitness and muscle force in the postpartum.

Methods: 33 women (34±5 yrs, 5±2 months from delivery, BMI: 23.2±3.1, 2.6±3.2 Kg weight retention) were assigned to either the intervention (I = 27) or the control (C = 6) group. The I group undertook a strength training intervention, for 60 min, twice *per week* for 10 weeks, while C maintained their habitual lifestyle. Before and after 10 weeks we measured muscle force (F, with a standardised field battery), perinatal depression (Edimburg Postnatal Depression Scale EPDS), cardiovascular fitness (VO_{2max}, with modified Astrand step test), body weight (BW) and composition (by plicometry). Data were compared by 2-way RM-ANOVA.

Results: In the I group: *i*) F increased markedly and significantly (squat +76 ± 74%; core +59 ± 50%; push up +22 ± 16%, $p < 0.001$ for all comparisons) following training; *ii*) perinatal depression scores, though not in the pathological range at baseline (4.8 ± 3.4) significantly improved at 10 weeks (-38 ± 83%, $p = 0.001$); *iii*) VO_{2max} increased significantly (+25 ± 13%, $p < 0.001$); *iv*) % body fat significantly decreased (-4.1 ± 5.9%, $p = 0.002$) while lean body mass remained unchanged (0.4 ± 2.1%, $p = 0.337$). No significant changes were recorded in the above variables in the C group.

Conclusions: A 10-weeks strength training group intervention performed in the postpartum, with the presence of the baby, positively and significantly affects various aspects of health, ranging from body composition, perinatal depression, aerobic fitness and muscle force. This time-efficient form of exercise can be a valuable alternative or complement to more time-consuming and strenuous aerobic activities in the early post-partum.

PP7-6**Pilot study on the effect of supervised training vs. exercise counseling on long-term physical activity adherence in breast cancer survivors**

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Purpose: Breast cancer survivors (BCSs) adherence to recommended Physical Activity (PA) level is low (52-60% according to Park¹), thus motivating women to sustain a physically active lifestyle is important for promoting health after diagnosis. The aim of this pilot study was to compare the effects of a supervised PA intervention, with respect to a prescribed but not supervised PA program, on exercise adherence and on psychological function and QoL.

Methods: Twenty sedentary BCSs (age 56 ± 11 yrs) were enrolled in a 16 week "Lifestyle Program" (LP) consisting of exercise counseling and clinical-functional monitoring. Women were assigned to either the study Control Arm (CA; n = 10) or the Interventional Arm (IA; n = 10). IA women participated in a 3 d/week training program for 8 weeks. 2 sessions each week were supervised and consisted in 5 min warm-up, 45 min of circuit-based resistance and aerobic exercise, and 10 min cool-down and stretching. 1 session each week women exercised aerobically autonomously without supervision, following advices received in the last supervised training session. All participants underwent the following assessments before the LP (t0), and 4 (t1), 8 (t2), and 16 (t3) weeks from LP start: PA level (primary outcome), expressed in METs and calculated using the International Physical Activity Questionnaire Short Form (IPAQ-SF); cardiorespiratory fitness, expressed as distance (meters) walked during the Six-Minute Walk test (6MWD); Hand Grip Strength (HGS) test (kg); QoL, calculated using the SF-36. Separate two-way mixed ANOVAs were performed on each outcome variable, followed by Bonferroni corrected pairwise comparisons. α was set at .05.

Results: PA level increased two-fold in IA women compared to CA ($p = .0002$) at t1. In IA women at t3, the PA level continued to be higher than t0 ($p = .03$) and with respect to CA ($p = .02$). 6MWD showed a stable increase over time, with respect to t0, only in IA ($p = .003$), while in CA its score did not change (inter-group comparison: $p = .003$). In IA women HGS improved at t1 compared to t0 ($p = .01$) and with respect to CA ($p = .02$). Self-assessed QoL resulted better in IA group ($p = .01$).

Conclusions: Exercise counseling alone seems not sufficient to provide a stable long-term increase of PA level in sedentary BCSs, while a mixed approach, with an exercise specialist that supervises exercise training, may provide the achievement and maintenance of higher PA and fitness levels.

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PP7-7

Effects of six months supervised and six months unsupervised Nordic walking versus Walking exercise on weight and body composition parameters in overweight and obese adults

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Purpose: Long-term maintenance of weight loss remains a challenge in the treatment of obesity. Inclusion of different types of walking programs may help people to reach this goal. The aims of this study were: 1) to compare the effects of 6 months of supervised Nordic Walking (NW) and Walking (W) programme on weight and body composition parameters; 2) to examine the possible maintenance or loss of gains after the 6 months of unsupervised period of training.

Methods: 38 middle-aged overweight and obese adults were randomly assigned to a NW (n = 19) and W (n = 19) group. They trained 3 times/wk for 6 months under the supervision of a qualified instructor and for other 6 months they were asked to train independently. During the unsupervised phase, the subjects collected the number of training sessions and steps. At baseline, after 6 and 12 months (i.e. pre, post and follow-up period) the changes in total and compartmental body composition mass were assessed by means of Dual Energy X-ray Absorptiometry (DEXA).

Results: At post, BMI decreased similarly in both groups (NW: -6%; W: -4%, $p < 0.05$). However, only NW group showed a decrease in total body fat mass (8%, $p < 0.001$), leg fat mass (9%, $p < 0.001$) and android fat mass (14%, $p < 0.001$) compared to no significant changes in W group. No changes were observed in both groups for total and compartmental lean mass. During the 6 months of unsupervised training, the mean of steps in each training session was about 9438 ± 707 and 7380 ± 331 , respectively in the NW and in the W group; moreover, the steps count decreased over time in the W group ($p < 0.05$) with a trend in the NW group ($p < 0.06$). With respect to the baseline, W group decreased in total body fat mass (-9%, $p < 0.05$), both groups changed in leg fat (NW: -12%, $p < 0.05$; W: -11%, $p < 0.05$) and leg lean (NW: -21%, $p < 0.001$; W: -15%, $p < 0.05$) mass. All the other variables returned at baseline or did not show any significant difference after the 12 months of intervention.

Conclusions: A long-supervised period of NW and W exercise can lead to an adequate weight loss in overweight and obese adults but, the NW programme induces larger improvements in some body composition parameters. Most of these positive benefits may decline

without an appropriate supervision in the training sessions; this highlights that a qualified instructor is required for prescribing the training programme and for promoting a long-term adherence and changes in exercise behaviour.

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PP7-8

Walking energy expenditure: Is it a moderate physical activity for obese women?

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Purpose: The outdoor setting could have positive effects on the treatment of obesity, increasing the adherence to physical activity. In an urban context, it could be difficult to follow the prescription of physical activity (PA) based on individual ventilatory threshold (IVT), one of the common exercise intensities used in the prescription of PA in obese subjects. The aim of this study was to investigate differences on energy expenditure (EE) and fat oxidation (FO) at different exercise intensities.

Methods: Eighty-six adult obese women (age 44.7 ± 11.5 years; BMI = 39.4 ± 5.7 kg/m²) were involved in this study. According to their BMI, subjects were divided into three groups: OBI (30.0 > BMI < 34.9), OBII (35.0 > BMI < 39.9), and OBIII (BMI > 40). Subjects carried out one single test session in which body composition was assessed and they performed an incremental sub maximal test on treadmill to evaluate VO₂, FO, heart rate (HR) and rate of perceived exertion (RPE) at different exercise intensities.

Results: A two-way analysis of variance tested the differences in VO₂ (ml/min) between obesity class groups at different exercise intensities (speed) compared to their VO_{2IVT}. VO₂ at 3 km/h is under the IVT and at 4 and 5 km/h is around the IVT in OBI. VO₂ at 5 km/h is over the IVT in OBII and OBIII.

Conclusions: Considering that the normal speed in outdoor urban context is between 4 and 5 km/h, it could be difficult, for obese subjects of OBII and OBIII to maintain the walking speed corresponding to IVT in outdoor urban context performing an unsupervised aerobic exercise.

PP7 ADAPTED PHYSICAL ACTIVITY AND SPORT

PP7-9

Features and assessment of resilience in wheelchair tennis players and able bodied tennis players

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Purpose: Recent study displayed significantly lower mean resilience of athletes with a physical disability than those reported in other studies with the general population¹. This study aimed to analyze whether there are differences or/and similarities between wheelchair tennis players (WTP) and able-bodied tennis players (TP) and to investigate about the characteristics of resilience.

Methods: 80 participants: 39 WTP and 41 TP. Several tools have been used: a personal data collection form and 6 self-report questionnaires (1: Italian Adaptation of Connor-Davidson Resilience Scale, CD-RISC; 2: Trait Sport-Confidence Inventory, TSCI; 3: Italian Adaptation of the General Self-Efficacy Scale, GSE; 4: Emotion Regulation Questionnaire, ERQ; 5: *Multidimensional Scale of Perceived Social Support*, MSPSS; 6: Inventory of Stressful and Traumatic Life Events, STLE). The data collected were analyzed using the SPSS 16 statistics program.

Results: The analysis of CD-RISCs showed: 18% of WTP had a level of resilience beneath 30 compared to 46% of TP; 82% of WTP had a good/excellent ability to manage stress compared to 54% of TP. Through the analysis of TSCIs, no significant differences of confidence emerged between WTP and TP. GSEs showed: 78% of WTP had a self-efficacy of more than 30 compared to 64% of able-bodied players. The analysis of ERQs showed that TP controlled emotions slightly better than WTP and that WTP suppressed emotions more than TP. MSPSSs showed that TP perceived social support slightly higher than WTP. Through the analysis of STLEs, it was noted that 15% of WTP had suffered a high level of traumatic events during the life compared to 8% of TP.

Conclusions: The majority of WTP of this study have a higher level of resilience than the majority of TP. The most significant result concerns the self-efficacy which was higher in WTP. Further research is needed to study any correlations between the different aspects of resilience. The strength of this study is its innovative way of analyzing the resilience through different questionnaires.

Reference

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PP7-10

Kinematic comparison between Paralympic and able-bodied elite karateka

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Purpose: Karate is a Japanese martial art that requires high levels of functional and motor abilities. Karate is spreading also in Paralympic competitions, requiring accurate categories definition for disabled athletes. To promote a better karate classification we compared kinematic data of an elite Paralympic karateka with those of able-bodied athletes.

Methods: A male black belt Paralympic karateka (36 y; 75.5 kg 173 cm) with lower limbs impairments was evaluated. He had been performing high level karate for 20 years before his disability. After the post-operative rehabilitation, he attended 3/4 sessions of para-karate training per week. He performed a standardized sequence of movements from traditional *Shotokan* karate. Joints and body Center of Mass (CoM) kinematics were collected with a motion capture system and compared with those obtained in able-bodied elite athletes¹. Knee angular range of motion (RoM) and peak angular velocity were obtained. Coordinates of CoM were estimated², along with CoM average velocity and acceleration. To assess differences between Paralympic karateka and able-bodied athletes, the one-sample t-test was performed.

Results: The sequence performed by the karateka lasted more than in able-bodied athletes. CoM average velocity and acceleration decreased in comparison with able-bodied karateka, as well as knees RoM and peak angular velocity. During the whole sequence flexion angles of the left knee resulted lower than the values of able-bodied athletes.

Conclusions: Results show that the physical impairments negatively affected the function of lower limbs in the Paralympic athlete. Fundamental skills in karate elite performance (dynamic balance control and knee joint RoM and angular velocity) were reduced.

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PP7-11

Anthropometric prediction of percent of body fat mass in athletes with lower limb amputation: a pilot study

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Purpose: Current anthropometric predictive equations validated in the athletic able-bodied population may reveal not accurate when used to estimate percentage fat mass (%FM) in athletes with physical

impairments. Accordingly, impairment-specific predictive equations are worth developing. The aim of this pilot study was to develop predictive anthropometric equations for %FM at the whole-body and trunk level in male amputee athletes.

Methods: 9 male amputee soccer players aged 34.3 ± 11.7 years with unilateral lower limb amputation were recruited. Whole-body and trunk %FM was assessed by means of Dual-Energy X-ray Absorptiometry. Skinfold thickness was measured with a Harpenden calliper at the biceps, triceps, axillary, subscapular, supriliac, abdominal, thigh, and calf site according to standard procedures. Body circumferences were assessed by means of whole-body photonic 3D scanning at the following sites: neck, upper arm, forearm, wrist, waist, hip, thigh, calf and ankle. Several stepwise multiple regression analyses were run using skinfold thickness and body circumferences as independent variables to identify predictor(s) of DXA-measured %FM. Adjusted coefficients of determination (adj. R^2) and standard error of the estimate (SEE) were used to represent the goodness of the predictor model.

Results: A statistically significant (adj. $R^2 = 0.98$, $SEE = 0.82\%$; $P < 0.001$) model for whole-body %FM included the thigh skinfold, and hip and ankle circumference as predictors. A statistically significant (adj. $R^2 = 0.92$, $SEE = 1.91$; $P < 0.001$) model for trunk %FM included chest skinfold and abdominal circumference as the predictors.

Conclusions: This work showed the feasibility of developing anthropometric, impairment-specific predictive equations for estimating %FM at the whole-body and trunk level in male athletes with unilateral lower limb amputation. Future work in a larger population is required to generalize equations to the amputee athletic population so that sports professionals can benefit from using such an accessible and cost-effective tool for assessing and monitoring %FM.

Reference

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PP7-12

Postural control in children with congenital hypothyroidism

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Purpose: Congenital hypothyroidism is a disease of the endocrine system caused by a deficiency of thyroid hormones that causes a reduction in the body's metabolic processes and affects the maturation of several tissues, including the musculoskeletal system. The aim of the present study was to evaluate differences on postural control in children with congenital hypothyroidism compared to healthy children.

Methods: Nineteen children with hypothyroidism (EG) composed of 7 males and 12 females (age: 10.52 ± 3.03 years; height: 131.53 ± 15.22 cm; weight: 31.37 ± 10.8 kg) and nineteen healthy children (CG) consisting of 10 males and 9 females (age: 10 ± 1.5 years; height: 142 ± 11.95 cm; weight: 39 ± 10.36 kg) were recruited for this study. All participants, with bare feet forming

an angle of 30° and both heels 4 cm apart, performed a stabilometric evaluation for 51.2 seconds with eyes open and in an upright position using a force platform (freeMed[®] model; Sensor Medica[®], Guidonia Montecelio, Rome, Italy). Data are presented as means \pm standard errors. The differences between groups were analyzed using a t-test with an α value set at 0.05

Results: We found that the EG group showed a significantly higher sway path length than the CG group (846.84 ± 70.06 vs 254.32 ± 81.94 mm; $p < 0.01$).

Conclusions: Our findings suggest that children with congenital hypothyroidism have lesser postural control than healthy children. This means that children with congenital hypothyroidism have greater energy expenditure compared to healthy peers in order to control body posture. Further studies are needed to confirm our results.

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PP7-13

What kind of motor activity is proposed for people with intellectual disabilities, in complement to sporting activities? Exercise facility *Esercizio Vita* proposal

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Purpose: People with disabilities may have different disorders over time with limitations in functional and mental abilities (balance, gait, etc.). The opportunities to play physical activities in people with congenital and acquired mental disabilities are always linked to sport activities or rehabilitation programs. However subjects with intellectual disabilities are often excluded from sport proposals, so the promotion of Adapted Physical Activity (APA) becomes important to counteract sedentary and hypokinesia. This observational study was to investigate the effect of APA to hold residual abilities and to counteract hypokinesia that occurs in subject whit disabilities.

Methods: A sample of 53 (16: F) subjects attending a social occupational workshop for people with acquired disabilities were recruited for this study. All those who did not complete 12 months of continuous APA were excluded. All subjects have performed the functional assessments, 2MWT, STS, TUG, BBS at the beginning (T0) and after one year of activity (T1). The proposed APA model is based on static and dynamic balance, resistance training, agility and aerobic exercise training work with a frequency of at least 2 times a week and a duration of 60 minutes per session.

Results: 34 subjects (12:F; age 43 ± 10) completed one year of training. After 12 months of APA, an improvement of the functional capabilities of 2MWT ($> 5\%$ $P = 0.001$), STS ($> 23\%$ $P = 0.007$), TUG ($> 24\%$ $P = 0.001$) was statistically significant, BBS was not statistically significant ($> 5\%$, n.s).

Conclusions: The efficacy of continuous and supervised APA programs is evident to improve functional abilities in subjects with disabilities. The integration of APA in social occupational workshop for people with acquired disabilities can be useful to reduce physical

inactivity and improve functional capacity. Expanding the offer on the territory could be an alternative to reduce the effects induced by a sedentary lifestyle in people with disabilities.

PP7-14

Soccer for mentally disabled athletes

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Purpose: Sport activity represents an important method to improve the social and environmental interactions in a context of mental disabilities. The Italian Football Federation (FIGC) organized a tournament focused on this type of disability and divided the players in three different categories around homogeneous levels of sport and performance abilities. The aim of this study is to assess some motor skills ranges for soccer players with mental different abilities, in order to make their inclusion easier in the specific based-skills performances.

Methods: The participants of the Soccer Group (SG, n = 90) were recruited between 15-57 aged players of both sexes; they were enrolled in organized soccer competitions taking in the “Campionato di IV, V e VI categoria” in Lombardy. The participants were classified in mild, moderate and severe ID according to etiology (Down Syndrome, mental retardation, pervasive developmental disorders, uncertain etiology). The following tests were performed: CMJ; CMJas; RSA (10x10 m x 6 reps, with 20” of recovery); simple visual stimulation reaction test, with ball and acoustic; COD- Change of Direction: Control with linear ball and 45 °-90° bounce both right and left; Leger test.

Results: Descriptive statistics are presented as the mean for each category. In the CMJ the difference between the IV and the VI category is about 10 cm. In the Leger test the IV cat. achieves results far higher (718 m) compared to the V and the VI cat. (about 300 m). The VO₂max in the IV category is 30.63 ml/kg/min, in the other two categories it does not reach 24 ml/kg/min. In the test of repeated sprinting, the difference between the three categories is very clear with the average time values about 1 second longer between the IV and the V and the V and the VI. In the visual and acoustic reactions tests, the results are similar with slight difference between the IV and V category (about 300 ms), while in the VI category the reaction time is doubled. In the COD test the IV and V categories have close results, basically about one second to check and relaunch the ball in different directions, while in the VI category the reaction time is tripled.

Conclusions: The tests used in this study showed a high discriminating value among the investigated categories of motor skills highlighting the borderline values among the three categories.

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PP8 SPORTS AND EXERCISE PHYSIOLOGY

PP8-1

Salivary cortisol concentration in response to acute sleep hygiene strategy following a late-night soccer-specific training session

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Purpose: The aim of this study was to investigate the effects of an acute sleep hygiene strategy on salivary cortisol concentration in soccer players following a late-night (8.00 p.m.) soccer specific training session (i.e. small sided games) at their habitual training time.

Methods: This was a two-armed, parallel group, randomized-controlled trial in which 29 soccer players were allocated to either an experimental group (EG, n = 17) that performed a sleep hygiene strategy, or a control group (CG, n = 12) that performed their habitual sleep routine. All subjects underwent measurements of salivary cortisol at 7.00 p.m., 8.00 p.m., 11.00 p.m., 7.00 a.m.

Results: Two-way analysis of variance with Bonferroni’s multiple comparisons test showed significant variations over 7.00 p.m. (EG: 1.63±0.76 ng/ml; CG: 1.79±0.48 ng/ml) cortisol concentrations respect to post training samples both in the EG (8.00 p.m.: 3.33±1.84 ng/ml, p = 0.0005, ES ≥ 2.0±0.3, most likely; 7.00 a.m.: 5.13±0.81 ng/ml, p < 0.0001, ES ≥ 2.0±0.6, most likely) and in CG (8.00 p.m.: 3.37±1.42 ng/ml, p = 0.0036, ES = 1.4±0.7, very likely; 7.00 a.m.: 7.00±1.07 ng/ml, p < 0.0001, ES ≥ 2.0±0.8, most likely). Post-hoc intragroup comparisons showed that EG and CG differed in salivary cortisol concentration in 7.00 am condition (5.13±0.81 ng/ml vs 7.00±1.07 ng/ml, p = 0.0001, ES ≥ 2.0±0.6, most likely). An interaction of p = 0.0013 was found.

Conclusions: The present findings suggest that soccer players should be educated on the appropriate activities, behaviours, and sleep hygiene recommendations following late-night soccer practice to reduce training stress response and therefore nocturnal salivary cortisol secretion.

PP8-2

Effect of stimulation with pulsed electromagnetic fields during sport activity

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Purpose: Pulsed electromagnetic fields (PEMFs) are a medical and non-invasive therapy, used for many years for clinical treatments; trials in humans, animals and cells in vitro, indicate that PEMFs increases blood flow, rate of tissue oxygenation and velocity of gas exchanges. Until now, no study investigated the influence of PEMFs

stimulation during sports activity: our aim was to investigate the role of PEMFs stimulation on muscular tissue, during a very strong physical effort performed by bike.

Methods: Nine semi-professional male cyclists [mean age 22.3 ± 4.6 ; mean VO_2max 56.8 ± 6.1 ml/kg/min] participated in this study. Experiments were performed on a cycle ergometer (Lode-H-300-R) in three different days. At day 1 we measured for each subject, ventilatory threshold (VT) and VO_2max . At day 2 and 3 we performed the experiments with activated and inactivated PEMFs stimulation, during a constant-load exercise with a very high intensity of physical effort, corresponding to $\sim 50\%$ of the difference between ventilatory threshold and peak VO_2 . Athletes cycled 1 minute without load, then cycled at their specific workload for at least 6 minutes, time necessary to record the slow component of VO_2 kinetics. PEMFs stimulation (Ivivi Health Sciences, USA) was applied to right vastus medialis and right bicep femoris for the entire duration of recording. We recorded the pulmonary oxygen uptake (Quark, CPET Cosmed, Italy) and the hemodynamic activity of vastus lateralis (NIRS, Nirox srl Italy).

Results: During PEMFs stimulation, we found a lower oxygen uptake kinetics at steady-state ($p = 0.045$), highlighted by a lower amplitude of the primary component ($p = 0.026$). In the stimulated muscles, PEMFs caused a greater amplitude of the primary component of deoxyhemoglobin ($p = 0.046$). The values of lactic acid measured at the 3rd minute of effort were higher during PEMFs stimulation ($p = 0.001$).

Conclusions: The results of lower amplitude of primary component of O_2 uptake kinetics, with greater amplitude of primary component of deoxyhemoglobin, suggest that PEMFs stimulation caused a higher release of O_2 during muscle contraction, leading to higher aerobic efficiency. The higher values of lactic acid could arise from the PEMFs influence on the glycolytic-oxidative metabolism of fibers IIa.

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PP8-3

Electromyographic activity in viscose-loaded leg press exercise: a pilot study

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Purpose: Viscose resistance training, mainly in the form of aquatic resistance training, is widely used in the rehabilitation of different musculoskeletal conditions. The aim of this study was to investigate the activity of the vastus lateralis (VL) muscle during exercise with a

new commercial leg press machine based on a variable viscose resistance.

Methods: Six young male volunteers (aged 23.3 ± 2.06 years, height 1.81 ± 4.9 cm, body mass 74.6 ± 10.1 kg) familiar with resistive exercise were recruited for this study. Tests were performed on a Leg-press Biostrength (Technogym s.p.a.-Italy). The load was set to the subjects' body weight. The participants performed a total of 12 sets of 6 repetitions using conventional isotonic load (ISO) or different viscosity (LOW, MEDIUM, HIGH). Three different time-under-tension profiles (SLOW, MODERATE, FAST) were used in the concentric phase of each condition. A metronome was used to maintain the desired cadence. Sets were separated by a 2-minute rest period. Surface EMG activity of VL was recorded and the signal was integrated (RMS) using a Biopac system (MP100, Biopac INC, USA).

Results: Both viscose coefficient ($p < 0.01$) and TUT ($p < 0.001$) influenced the EMG activity. Results showed that RMS EMG activity increased when the concentric TUT decreased (mean EMG difference between slowest and highest velocity, 34%). Conversely, higher RMS activity was found when a higher viscosity coefficient was set (mean EMG difference between slowest and highest viscosity, 21%).

Conclusions: These findings clearly show that for achieving a greater motor unit recruitment, exercise should be performed using high viscose coefficients and low TUT values. Health practitioners should consider both viscosity and TUT in the development of rehabilitation programs. This research provides new data regarding the physiological responses to viscose loaded exercise performed with a new commercial leg press machine.

Reference

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PP8-4

Human diaphragm muscle mechanical response during electrical phrenic nerve stimulation: reliability of mechanomyography and electromyographic measurements

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Purpose: The combined analysis of electromyographic (EMG) and mechanomyographic (MMG) signals obtained during an electrical phrenic nerve stimulation (PNS) can be used to non-invasively evaluate the functionality of the diaphragm muscle. This study sought to assess the intra- and inter-session reliability of diaphragm MMG and EMG during PNS in healthy subjects.

Methods: Thirteen healthy male subjects were recruited (age 25.4 ± 4.4 yrs., body mass 72.4 ± 5.1 kg, stature 1.78 ± 0.06 m, mean \pm SD). Participants were evaluated on two different days (Day 1 and Day 2) with the same stimulation protocol. The right phrenic nerve was stimulated with a supramaximal single-twitch (110% of peak MMG), with a compensated biphasic square wave type, stimulation duration 0.2 ms, stimulation frequency 1 Hz.

Results: Intra-session ICC of MMG on Day 1 was 0.994, on Day 2 was 0.994, and inter-session ICC was 0.985. Intra-session ICC of EMG on Day 1 was 0.992, on Day 2 was 0.993 and inter-session ICC was 0.976.

Conclusions: These findings suggest that MMG and EMG of diaphragm PNS have very high reliability. MMG and EMG after PNS can be considered as a useful tool to assess diaphragm functionality in the clinical setting and in sport science.

PP8-5

Comparison of hemodynamic and strength parameters during intermittent isometric exercise with or without electromyostimulation (EMS): a case study

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Purpose: No investigations are available on the effects of electromyostimulation (EMS) superimposed to voluntary contraction on hemodynamic parameters.

Methods: A single subject performed intermittent maximal voluntary isometric contractions (MVC) of the upper limb with (EMS) or without (Control) superimposed electromyostimulation of the biceps brachii for 12 min (4 sec on 4 sec off, duty ratio 50%, rectangular impulse, 80/85 Hz, 350 μ s). During procedure, deoxygenated Hemoglobin (HHb) and total Hemoglobin (tHb) were detected by near infrared spectroscopy (NIRS). The rate of perceived exertion (RPE) was measured immediately after session.

Results: At the end of the task, a higher loss in MVC was observed in EMS vs Control (EMS: Δ absolute -14.38 Kg; Δ relative 32%; Control Δ absolute -17Kg; Δ relative 37%), whereas an higher RPE was reported in Control (17) vs EMS (12). As regards the hemodynamic data, during EMS bout, HHb and tHb appeared to stabilize quicker than in Control (HHb 92 sec vs 124 sec.; tHb 140 sec. vs 212 sec). In this condition, for both parameters, a lower absolute value was also observed (EMS: HHb 76.06 μ M vs Control 110.54 μ M; EMS tHB 77.37 μ M vs Control 136.10 μ M).

Conclusions: In EMS, the quicker stabilization of the hemodynamic parameters suggests a faster increase in blood flow and oxygen utilization during contraction, probably due to higher degree of motor unit synchronization that may justify the higher force reduction at the end of task. Importantly superimposing EMS to voluntary contraction reduced the perceived exertion notwithstanding the higher peripheral fatigue.

Reference

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PP8-6

Correlations between myoelectric and hemodynamic parameters changes in biceps brachii during sustained isometric contraction in healthy elderly

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Purpose: The purpose of present study was to evaluate the Pearson correlations between hemodynamic parameters obtained with near infrared spectroscopy (NIRS), namely total hemoglobin (tHb) and tissue oxygen index (TOI %), as indicators of blood flow and oxygen extraction, and myoelectric parameters obtained with surface multi-channel electromyography (sEMG), namely fractal dimension (FD) and conduction velocity (CV) slopes, as descriptors of central and peripheral fatigue, during sustained high level isometric contractions at 60% MVC, in elderly subjects.

Methods: Ten recreationally healthy elderly subjects (age 67.7 ± 4.6 years), 5 males and 5 females, performed one isometric contraction of the elbow flexors at 120° degree joint angle at 60% of maximal voluntary contraction (MVC) until exhaustion in two subsequent trials one week apart, one for sEMG and one for NIRS recordings from the biceps brachii.

Results: A negative strong Pearson's correlation between TOI % slope in the functional hyperemic phase (HP) of contraction and a positive correlation between the slope of TOI % recorded during the ischemic phase (IP) and the CV slope were found ($r = -0.76$, $P < 0.05$; $r = 0.91$, $P < 0.01$).

A negative strong correlation between tHb IP slope and tHb HP slope and TOI % IP slope and TOI % HP slope ($r = -0.78$, $P < 0.01$, $r = -0.78$, $P < 0.01$ respectively) were also found. No correlation was found between FD slope and hemodynamic parameters (FD slope vs HP tHb slope; $r = -0.19$, FD slope vs IP tHb slope; $r = 0.16$, FD slope vs HP TOI % slope; $r = 0.19$, FD slope vs IP TOI % slope; $r = 0.27$).

Conclusions: In aged individuals, CV slope correlated with muscle O₂ desaturation (TOI %) rather than reduced muscle blood flow (tHb) in the ischemic phase of isometric contraction to exhaustion. No correlations were found between myoelectric manifestations of central fatigue (FD slope) and data obtained by NIRS.

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PP8-7**Prolonged visual reaction time after strenuous endurance exercise: higher increment in male compared to female recreational runners**

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Purpose: Previous studies have suggested that simple visual reaction time (SVRT) was shorter in men than women at rest and prolonged by general aerobic exercise. However, there has been a poor investigation of SVRT changes in athletes after prolonged and strenuous exercises. The aim of this study was to determine the SVRT changes in endurance-trained recreational athletes of both sexes after a half-marathon.

Methods: 40 runners (20 Males: age 35.3 ± 17.1 years, BMI 23.5 ± 3.3 kg/m²; 20 Females: age 32.2 ± 14.3 years, BMI 24.8 ± 4.2 kg/m²) regularly engaged in endurance activities (M: 245 ± 158 min/week; F: 225 ± 187 min/week) were evaluated before and after a 21.1 km race. After 30 minutes of rest, subjects were asked to press an electronic button at the lighting of a lamp for 11 trials. Effort-perception data were collected by using a Borg CR100 scale. A two-way RM ANOVA assessed the effects of exercise and biological sex on SVRT.

Results: Men completed the race faster than women (M: 104.2 ± 14.4 vs W: 113.0 ± 16.9 min, $p < 0.05$), although their weekly minutes of training were similar ($p = 0.72$). The effort was defined as very/extremely hard based on Borg-CR100 data, with similar values into two groups (M: 82.4 ± 3.9 vs W: 84.7 ± 4.9 AU, $p = 0.68$). SVRT was shorter in men than women before (M: 234.05 ± 3.33 vs F: 239.47 ± 6.1 msec, $p < 0.05$) but not after the exercise (M: 249.9 ± 7.18 vs F: 252.09 ± 16.93 msec, $p = 0.7$). Exercise lengthened the SVRT (both sexes $p < 0.05$), but the increment was higher in males (+7%) than females (+5%). Response accuracy was higher in men, both before and after exercise.

Conclusions: Previous studies suggested exercise lengthened SVRT due to a lowered post-exercise cerebral oxygenation that decreases efficiency in cognitive processes, but not to a reduced nerve conduction velocity. In our results, this process seems to be more afflicted in men than women. In agreement with literature, we associated the sex-related response accuracy to a different effect of estrogens which play a key role in information processing, motor performance, and attention. Our data could also be explained, as indicated in psychology studies, by a different processing strategy between sexes, by a narrowed attentional focus and respond to the true stimuli perception in males and by a broad attentional focus or anticipatory strategy in females.

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PP8-8**Cardiorespiratory and metabolic responses to different sinusoidal workloads**

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Purpose: Sinusoidal work loading (SWL) may provide merits for assessment of the kinetics of the cardio-respiratory response to physical exercise. This study aimed at evaluating the cardiorespiratory and metabolic responses to different sinusoidal work rates.

Methods: Nine well-trained male participants (age: 28 ± 6 yrs., body mass: 74 ± 6 kg; stature: 1.79 ± 0.6 m) performed a ramp maximal oxygen uptake ($\dot{V}_{O_{2max}}$) test on a cycle ergometer. Subsequently, each subject's critical power (CP) was determined and considered as the reference value for the two sinusoidal tests that were sustained till exhaustion: i) midpoint (MP) equal to CP (50CP₅₀) and ii) MP at 50 watts below CP (50CP₋₅₀). In both protocols, the sinewave amplitude (A) and period accounted for 50 W and 240 s, respectively. \dot{V}_{O_2} , carbon dioxide output (\dot{V}_{CO_2}), expiratory ventilation (\dot{V}_E) and heart rate (HR) were measured on a breath-by-breath basis using a previously calibrated metabolic device. Blood lactate concentration ($[La^-]_b$) was measured from blood drops from the ear lobe and the rate of perceived exertion (RPE) was evaluated by a general, muscular and respiratory point of view (RPE_G, RPE_M, and RPE_R) at the end of each test. All cardiorespiratory parameters were fitted off-line by the sinewave function that minimized the errors. Thereafter, A and MP were obtained for each period. The time shift between the sinewave of each parameter and of the workloads was also obtained (time-delay, tD).

Results: As expected, A was not significantly different between protocols in all parameters, whereas MP was higher in 50CP₅₀ compared to 50CP₋₅₀. The tD of \dot{V}_{O_2} , \dot{V}_{CO_2} and HR were significantly higher in 50CP₅₀ ($p = 0.015$, $p = 0.017$ and $p = 0.024$ respectively) as well as $[La^-]_b$ ($p = 0.001$). No group difference was found for RPE.

Conclusions: Contrary to A, the increase in MP work rate influenced both MP and tD of the cardio-respiratory responses and $[La^-]_b$. While a change in MP of all the variables and of $[La^-]_b$ was expected because of the different MP work rate level, changes in tDs represents a new finding. Further studies are needed to generalize this SWL protocol to athletes with different characteristics, which are expected to yield valid results in assessing physical fitness.

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PP8-9**Lifetime exposure of swimming training: its effects on cardiac autonomic responses**

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Purpose: There is a direct relationship between physical activity and cardiorespiratory health. Physical activity improves cardiorespiratory fitness, and it has a direct dose-response relation between intensity, frequency, duration and volume. Based on World Health Organization guidelines, risk reductions routinely occur at levels of 150 minutes of moderate activity per week. The aim of the present investigation was to determine if this minimum amount of exercise per week was suitable to improve cardiac autonomic responses in healthy population.

Methods: 70 trained (48.6 ± 14.3 yrs.; 48 males, 22 females) and 60 sedentary (51.5 ± 10.4 yrs.; 23 males, 37 females) healthy adults were recruited for the study. Height, weight, sex, age, body mass index (BMI), and a questionnaire with lifetime and current exposure to swimming training were collected. Arterial blood pressure was recorded with participants placed in a supine position for 10 minutes in room with stable temperature (21 °C; 52% of humidity), with a respiratory frequency maintained at 12–15 breaths/min. The last 5 minutes of recording were used to analyse time and frequency domain parameters of heart rate variability (HRV).

Results: Questionnaire showed that trained subject practiced physical activity for about 207 minutes a week for 14 years. Between groups, no significant difference was detected on BMI (24.9 vs. 24.4 kg/m²). In the time domain analysis of HRV, significant differences were detected for standard deviation of all R-R intervals (SDNN) and root-mean-square of successive differences (RMSSD) between trained and sedentary group ($p = 0.034$ and $p = 0.001$ respectively). In the frequency domain analysis, sedentary tended to display lower high frequency (HF) and higher low frequency (LF) power than did trained subjects ($p = 0.009$).

Conclusions: Our results suggest that there is a major effect of exercise on HRV in subjects who had spent a minimum swimming training exposure of 207 minutes a week for about 14 years. Measures of HRV have been shown to be independent predictors of mortality in the older adult population, suggesting that any intervention, such as physical activity, that improves these measures might be protective against sudden cardiac death.

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PP8-10**Lifetime exposure of swimming training: its effects on baroreflex sensitivity**

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Purpose: The recommended levels of physical activity for health, in adults aged 18–64 years, based on World Health Organization (WHO) guidelines, are at least 150 minutes of moderate-intensity aerobic physical activity throughout the week. The aim of the present investigation was to evaluate if such minimum amount of exercise per week was adequate to allow changes in the arterial blood pressure and hemodynamic activity.

Method: The study population consisted of 70 trained (48.6 ± 14.3 yrs.; 48 males, 22 females) and 60 sedentary (51.5 ± 10.4 yrs.; 23 males, 37 females) healthy adults. Data on height, weight, sex, age, body mass index (BMI), and a questionnaire with lifetime and current exposure to swimming training were collected. Arterial blood pressure was recorded with participants placed in a supine position for 10 minutes in a quiet room with stable temperature (21°C; 52% of humidity), without speaking or making any movements, and with a respiratory frequency maintained at 12–15 breaths per minute. The last 5 minutes of recording were used for baroreflex sensitivity (BRS), blood pressure and hemodynamic (cardiac output, stroke volume, heart rate, total peripheral resistance) analysis.

Results: Questionnaire showed that trained subject practiced physical activity for about 207 minutes a week for 14 years. We found significant differences between trained and sedentary subjects on BRS ($p = 0.046$). At rest, trained subjects showed higher cardiac output and stroke volume, whereas, lower heart rate, blood pressure and total peripheral resistances with respect to sedentary group. BMI was non significantly different between groups (24.9 vs. 24.4 kg/m²).

Conclusions: A swimming training exposure of 207 minutes a week for about 14 years allows to elicit hypotensive effects and improvements in hemodynamic function in healthy subjects. However, adjustments for each individual based on their exercise capacity and specific health risks or limitation should be considered.

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PP8-11**Essential amino acids (EAA) mixture supplementation: effects of an acute administration protocol on myoelectric manifestations of fatigue in the biceps brachii after resistance exercise**

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Purpose: The purpose of this study was to investigate the acute effects of a single oral administration of an essential amino acids enriched mixture (EAA) on myoelectric descriptors of fatigue and maximal force production after a resistance exercise protocol (REP).
Methods: Twenty adult males were enrolled in a double-blind crossover placebo-controlled study. Subjects were randomized to receive EAA mix or a placebo (PLA). In both trials subjects completed a REP two hours after the ingestion of the EAA mix or PLA. Before ingestion and after REP subjects performed isometric contractions of the dominant upper limb. Mean values of MVC, conduction velocity initial values (CV), fractal dimension initial values (FD), their rates of change (CV slopes, FD slopes) and the Time to perform the Task (TtT) were obtained from a multichannel surface electromyography (sEMG) recording technique. Basal blood lactate (BL) and BL after REP were measured.

Results: Following REP a significant decrease of MVC was observed in PLA ($P < 0.05$), while no statistical differences were found in EAA between pre-REP and post-REP. After REP, although a significant decrease in BL was found in both groups ($P < 0.0001$) a higher BL $\Delta\%$ was observed in PLA compared to EAA ($P < 0.05$). After REP, at 60% MVC a significant increase of CV rate of change ($P < 0.05$) was observed in PLA but not in EAA. At the same force level TtT was longer in EAA compared to PLA, with a significant TtT $\Delta\%$ between groups ($P < 0.0001$).

Conclusions: Acute EAA enriched mix administration may prevent the loss of force-generating capacity during MVC following a REP. During isometric contraction at 60% MVC after REP the EAA mix may maintain CV rate of change values with a delay in the TtT failure.

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PP8 BIOMOLECULAR ASPECTS OF EXERCISE AND SPORT**PP8-12****Salivary adiponectin expression in sedentary and physically active CF patients**

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Purpose: Adiponectin is an insulin-sensitizing, anti-atherogenic, anti-inflammatory hormone circulating at different oligomerization state (HMW, MMW and LMW). The HMW represent the most biologically active oligomers. Cystic fibrosis (CF) is a respiratory genetic disease with a progressive decline of lung functions. Recently, we demonstrated that physical activity improves CF outcome and also that adiponectin serum expression is correlated to physical activity in patients affected by CF. In this study, we characterized levels of total salivary adiponectin and its HMW oligomers in adult CF patients sedentary and that performed physical exercise.

Methods: 116 CF patients and 98 age- and sex-matched controls were recruited. Patients were divided into two groups (58 *versus* 58) on the basis of supervised physical activity performed in the last three years. In the salivary samples of CF patients and controls, total adiponectin levels and its HMW oligomers were measured by ELISA-test and western blot.

Results: Salivary total adiponectin and its HMW levels are significantly more expressed in CF patients compared to healthy population. Additionally, there is not statistical difference in salivary total adiponectin and its HMW oligomers between sedentary CF patients and CF patients that performed physical activity.

Conclusions: Our results demonstrate that regular physical activity improves outcome in CF patients. Salivary adiponectin and its HMW oligomers are significantly more expressed in CF patients compared to healthy controls, confirming the previous results in serum. Nonetheless, these results confirmed the strongly involvement of adiponectin and its HMW oligomers in CF disease.

PP8-13**Mir-1303 is down regulated in muscle tissue of veteran football players**

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Aim: Lifelong football training induces the expression of key markers involved in muscle oxidative metabolism, senescence suppression and DNA repair pathways, positively influencing the autophagy and protein quality control processes in skeletal muscle, thus promoting healthy aging^{1,2}. The present study is aimed to identify miRNAs differentially expressed in Veteran Soccer Players (VSP) compared to healthy untrained subjects (CG).

Methods: We analyzed miRNAs expression profiles in muscle biopsies from 6 VSP (aged 65-75) and 6 healthy untrained age-matched men (CG) by microarray (Human Genechip HTA 2.0 Arrays, Affymetrix). Microarray analyses were supported by quantitative real time PCR (RTqPCR) validation. To identify targets of specific identified miRNAs, an *in silico* prediction analysis, was performed by combining three distinct bioinformatic softwares: Miranda (www.microrna.org), TargetScan (www.targetscan.org) and PicTar (www.pictar.org). The list of the putative target genes was matched by the MatchMiner software (www.discover.nci.nih.gov/matchminer/index.jsp). The expressions of the putative shared identified targets were validated by Western blot analysis.

Results: The microarray output revealed 10 differentially expressed miRNAs; among them, miR-1303, was down regulated in muscle tissue of VSP compared to CG. RTqPCR confirmed the microarray results. By using bioinformatics tools, we found that putative miR-1303 targets genes belong to protein degradation and the protein quality control proteasome pathways. Additionally among predicted target genes, BAG2, KLHL7 and KBTBD6, were chosen for further validation. Interestingly, BAG2 was up regulated in skeletal muscle from VSP compared to CG.

Conclusions: This study evidences a new molecular cross-talk between miR-1303 and BAG2 in skeletal muscle lifelong football players.

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PP8-14**Effects of adiponectin and IGF-1 on human LHCN-M2 myoblasts differentiation**

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Purpose: Several factors, such as hormones and growth factors, can modulate myogenic proliferation and differentiation. The IGF-1-mediated signal transduction leads to the activation of PI-3 K/Akt and Ras/MAPK signaling pathways that act on growth, development and differentiation in several tissues. Conversely, the adiponectin-mediated inhibition of PI-3 K/Akt signaling pathway, induces cell growth inhibition. Recently, attention has been focused on the interaction between IGF-1 and adiponectin, and on their effects in different pathways¹. In this scenario, we investigated the effects of both adiponectin and IGF-1 on the differentiation of human myogenic LHCN-M2 cell line^{2,3}.

Methods: The human LHCN-M2 myoblast cells were cultured in growth medium (GM-15% FBS) or in Differentiation Medium (DM) supplemented with 0,5% FBS, apotransferrin and insulin or with Adiponectin (0.1 µg/ml) (2) or with IGF-1 (15 ng/ml) or with Adiponectin (0.1 µg/ml) and IGF-1 (15 ng/ml) for 4d. The expression levels of mTOR, p-ERK and p-Akt were determined by Western blot analysis.

Results: Our data suggest that IGF-1 treatment induced the phosphorylation of mTOR, ERK and Akt in a greater extent compared to DM supplemented with 0,5% FBS, apotransferrin and insulin ($p < 0.05$). On the contrary, the co-treatment with adiponectin and IGF-1 induced a decrease in the phosphorylation of the above-mentioned kinases, that resulted similar to that observed in cells treated with adiponectin alone or DM supplemented with 0,5% FBS, apotransferrin and insulin.

Conclusions: Our preliminary results suggest an interplay between adiponectin and IGF-1 action in human skeletal myoblast cells. Further studies are needed to fully clarify the molecular pathways underlying the adiponectin and IGF-1 interaction beside the PI-3 K/Akt axis in the differentiation pathways.

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PP8-15**Effects of soccer training on TNF-alpha mediated inflammation and inhibition of myogenic differentiation in human LHCN-M2 cells**A. Alfieri^{1,2}, A. Terracciano^{1,2}, A. Mancini^{1,2}, P. Buono^{1,2}¹Department of Movement Sciences and Wellness, University Parthenope, Naples, Italy;²CEINGE-Biotecnologie avanzate, Napoli, Italy

Purpose: Tumor Necrosis Factor-alpha (TNF- α) plays a pivotal role in muscular atrophy by inhibiting myogenic differentiation¹. We recently demonstrated that serum from differently trained subjects induced myogenic differentiation in human LHCN-M2 myoblast cells². The aim of this project is to induce an inflammatory process in LHCN-M2 cells by treating cells with TNF- α for 4d and to evaluate the effects of serum from soccer-trained subjects in counteracting the inflammatory effects of TNF- α in LHCN-M2 cells.

Methods: LHCN-M2 cells were treated with 20 ng/ml of TNF- α for 4d in Differentiation Medium (DM) supplemented with 0.5% serum pool from n.4 male soccer trained subjects (SO \geq 180 min/w), practicing physical activity for at least 3 years, or from human sera pool (HC, Randox Laboratories Ltd., Crumlin, UK), used as untrained control. Cell morphology and myogenic differentiation were assessed by determining the Fusion Index³. Bcl-2 protein expression level was determined by western blot analysis; GAPDH was used as internal control.

Results: LHCN-M2 myotube formation was inhibited after 4d of TNF- α treatment; SO sera treatment partially rescued the inhibition of myogenic differentiation induced by TNF- α in LHCN-M2 cells, as evidenced by the presence of myotube formation (about 70%) when compared to cells treated with TNF- α . The expression of Bcl-2 protein, a mediator of inflammation regulating autophagy and apoptotic processes, resulted increased (about 2 times) in LHCN-M2 cells treated with TNF- α , when compared to DM-treated cells.

Conclusions: Our preliminary results suggest that soccer training counteracts the inhibition of myogenic differentiation and partially reduces the inflammation process induced by TNF- α . These results could contribute to understand the potential role of exercise in the reduction of “low-grade systemic inflammation”, associated with aging and dysmetabolic diseases in the muscle cells.

Acknowledgements: This work was supported by University of Naples Parthenope, “Bando per la ricerca individuale, annualità 2017” e “Bando di Ateneo per il sostegno alla partecipazione ai bandi di ricerca competitiva per l’anno 2016 (quota C)”.

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PP8 ANATOMY AND SPORT**PP8-16****Effects of different running intensity on rat myocardium mitochondria: an ultrastructural morphometric study**

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Purpose: Aerobic exercise requires structural and functional modifications of the heart to satisfy the highest energy demands. Different running intensities imply myocardium mitochondria changes, which depend on training type and degree¹. The present study evaluates the effects of different running intensities on left ventricular myocardium using stereological estimations of number and volume of mitochondria.

Methods: Mitochondria from the left ventricle myocardium of three rat groups have been compared: control, slow-runners (SR) and fast-runners (FR). The running speed of exercise sessions (30 min twice a day for 30 days) were respectively 15 and 25 m/min². Optical and transmission electron microscopy have been used to evaluate mitochondria morphology. The number and the volume of mitochondria have been estimated by the evaluation of Euler number³.

Results: Although, at high magnification, the mitochondria ultrastructural features seem to be comparable among the different experimental groups, mitochondrial size and density show interesting differences. In particular, the trained groups display an increased ratio between mitochondrial and cardiomyocyte volume (V_m/V_c) compared to control group, without differences between SR and FR. However, FR display an increased mitochondrial number (mn) if compared to SR.

Conclusions: Taken together, the data related to V_m/V_c and mn suggest that though the mitochondrial volume is similarly increased in both exercised groups compared to control, there is an interesting difference of the mitochondrial number between SR and FR. In fact, FR display a higher number of mitochondria compared to SR.

In summary, SR and FR improve the oxidative capacity of cardiomyocytes by an increased mitochondrial volume, but the significant difference of number between trained groups seems to display two different morphological adaptations, which could open interesting perspectives.

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SUNDAY ORAL SESSION 2

OP22 SPORTS TRAINING AND TESTING

OP22-1

KEYNOTE Cross-country skiing master athletes: excellent examples of successful aging

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Purpose: previous evidences suggest that much of the physiological decline during aging is the result of physical inactivity. In this study we aimed to investigate the effect aging process on health-related physical and socio-emotional functioning parameters in master cross-country athletes.

Methods: 36 Italian male athletes (n = 18 ranged 60-69 years and n = 18 ranged 70-79 years), participating to Marcialonga race in at least five previous editions, gave their consent to participate to data collection. Within two months from the 46th race edition (2019), all the athletes were tested for anthropometric and health-related functional parameters (knee and elbow extension maximal muscle strength and RDF, back scratch and sit & reach as flexibility tests, bipedal stabilometry and reaction time to auditory stimulus). Standardized questionnaires were proposed to evaluated health-related quality of life (SF-36 v.2) and sleep quality index (PQSI), while a custom made questionnaire was administered to quantify training habits. Unpaired *Student T-test* was used to verify the effect of age on single parameters. Athletes' performances were qualitatively compared to normative values present in the literature, by superimposing the data, accordingly to age ranges.

Results: no age effect was found for any of the anthropometric (all $P > 0.05$), health-related functional parameters (all $P > 0.05$), physical and mental health (all $P > 0.05$). Only sleep quality index worsened significantly with age ($P = 0.02$). Compared to healthy non-competitive elderly, master athletes revealed definitively higher lower-limb strength capacity, life and sleep quality indexes, showed normal values for upper-limb strength and bipedal stabilometry but high variability for flexibility parameters. Finally, they demonstrated below average body fat mass percentage and reaction time.

Conclusions: Systematically training for, and competing in cross-country skiing in later adulthood attenuates the natural detrimental effects of age on health-related physical and socio-emotional parameters, maintaining high life standards.

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OP22-2

Influence of years of practice on ball-carrying sprint ability in female rugby union players: a cross-sectional study

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Purpose: Speed is a relevant ability in rugby union. Running faster while carrying the ball is important for scoring a try, realizing precise passes and keeping possession of the ball. The aim of this study is to explore the influence of years of practice on ball-carrying sprint ability in elite female rugby union players.

Methods: Twenty-three elite women rugby players (14 forwards and 9 backs, 9 ± 4 years of practice) recruited from the same team participated in this study. Athletes performed 10 m, flying 20 m and 30 m sprint tests both with and without ball.

Results: Data from 23 female elite rugby union players (age: 24 ± 5 years, weight: 72 ± 14 kg, height: 164 ± 6 cm) were analysed. Three different linear and multiple linear regression models were used to evaluate the associations between ball-carrying sprint ability (10 m, flying 20 m and 30 m) and years of practice, and their relationships when adjusted for body weight, BMI, and sprint ability without ball (10 m, flying 20 m and 30 m). Years of practice do not influence 10 m, 20 m, and 30 m ball-carrying sprint ability in all the bivariate and multivariable models ($p = .172$; $p = .141$; $p = .145$). Multivariable linear regression models showed the following significant associations: between 10 m ball-carrying sprint ability and 10 m ($\beta = .350$; $R^2 = .943$; $p = .028$) and 20 m ($\beta = -.295$; $R^2 = .943$; $p = .001$) sprint ability without ball; between 20 m ball-carrying sprint ability and 20 m sprint ability without ball ($\beta = 1.013$; $R^2 = .969$; $p < .0001$); between 30 m ball-carrying sprint ability and 20 m sprint ability without ball ($\beta = 1.308$; $R^2 = .977$; $p < .0001$).

Conclusions: Years of practice do not influence ball-carrying sprint ability in female rugby players. However, the improvement in 10 m and 20 m sprint ability without ball is associated with an increase in the ability of sprinting while carrying the ball among elite female rugby players with at least 4 years of practice.

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OP22-3**The effects of mental fatigue and sleep deprivation on basketball free throw performance**L. Filipas¹, D. Ferioli², A. La Torre^{1,3}, J.A. Vitale³¹Department of Biomedical Sciences for Health, University of Milan, Milan, Italy;²Pallacanestro Reggiana, Reggio Emilia, Italy;³IRCCS Istituto Ortopedico Galeazzi, Milan, Italy

Purpose: Despite the growing evidence supporting the negative effects of mental fatigue and sleep deprivation on team sports performances, the physiological explanation is partly unknown. An increased cerebral concentration of adenosine could be the explanation for the reductions in performance for both conditions¹. To date, no studies have evaluated the effects of a combination of mental fatigue and sleep deprivation on sports performance. The aim of this study was to investigate the effect of mental fatigue, sleep deprivation and a combination of both on free throw performance in amateur basketball players.

Methods: A randomized controlled crossover study was carried out with 19 amateur male basketball players. Each athlete completed two experimental sessions, preceded by a familiarisation visit. Each of the two experimental visits included a free-throw test (60 shoots) followed by a 30-min mentally fatiguing basketball video (tactics of basketball) and the same free-throw test. The two sessions were completed in a one-night sleep deprivation (≤ 5 h of sleep) and normal sleep conditions. Four different conditions were compared: control (CON), mental fatigue (MF), sleep deprivation (SD), mental fatigue and sleep deprivation (MFSD). Free throw performance was measured during the test; VAS mental fatigue and motivation at baseline, before and after the videos.

Results: Free throw performance was significantly reduced in MF, SD and MFSD compared to the CON (CON: $72 \pm 12\%$, MF: $67 \pm 13\%$, SD: $67 \pm 11\%$, MFSD: $67 \pm 14\%$). Mental fatigue was significantly higher after the video in normal sleep condition, before and after the video in one-night sleep deprivation condition. Motivation was similar at the three timepoints of the two experimental sessions.

Conclusions: There was a negative effect of mental fatigue, sleep deprivation and a combination of both on free throw performance. The magnitude of reduction in performance was similar in the three conditions.

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OP22-4**Comparison of explosive strength and static balance between young female volleyball and ballet dancer athletes**C. Lucchetti¹, V. Biancalana¹, S. Scarpa³, A. Nart^{1,2}¹Department of Biomolecular Sciences, University of Urbino, Italy;²Department of Biomedical Sciences, University of Padua, Italy;³Faculty of Law, University 'Giustino Fortunato' of Benevento, Italy

Purpose: The aim of this study was to investigate possible differences in explosive strength and static balance between young female

athletes of volleyball and ballet dance. We hypothesize that the explosive strength values are high and not significantly different both in volleyball players (VP) and ballet dancers (BD), while static balance values are significantly higher in ballet dancers.

Methods: The standing broad jump test and the flamingo balance test are tests of The Eurofit Physical Fitness Test Battery assessing, respectively, explosive leg power and static balance. The two tests were administered to a total of 34 female athletes aged between 10 and 13 (M = 11.9; SD = 0.96) divided into two groups based on the sport practiced: the VP (n = 19) and the BD (n = 15). There were no significant differences in age between the two groups.

Results: The results showed that the explosive strength values are high in both groups, if we consider the range of percentiles by age. VP: M = 1.49, SD = 0.21; BD: M = 1.13, SD = 0.18. There were no significant differences between the two groups ($p = 0.89$). Static balance values were significantly higher ($p < 0.001$) in BD (M = 14.20, SD = 8.24) than in VP (M = 18.53, SD = 5.29), with a quite large effect size (Cohen's $d = 0.62$).

Conclusions: The results confirm existing studies in the literature^{2,3}. The explosive strength and power are well developed in both the two groups of athletes, while balance is more developed in BD.

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OP22-5**Is it possible to regulate participation of women with hyperandrogenism in elite sports competitions? How can be overcome the distinctions of sports categories based on sexual binarism?**S. Scarpa¹, M. Costacurta²¹Faculty of Law, University 'Giustino Fortunato' of Benevento, Italy;²Ph.D candidate in Social Sciences, Department of Philosophy, Sociology, Education and Applied Psychology, University of Padua, Italy

Participation of women with hyperandrogenism in elite sports, such as intersexual people, and the recent implementation by some major sports-governing bodies of policies governing eligibility of females with hyperandrogenism to compete in women's sports, 'forcing' individuals to undergo hormonal medical treatment, represents an issue which has raised serious questions about traditional categories of sports competition, based on gender differences.

This theme is extremely current, it draws a lot of mediatic attention and it is still very controversial.

If ten years ago the questions were: « Are there any criteria to establish a person's sexual identity? Can there be cases in which male and female polarities coexist in a single individual? », now the question that needs a possible answer is: « In which sports category(ies) should intersexual people or women with hyperandrogenism compete? »

This paper wants to open some discussions but it does not expect to reach univocal and universally accepted solutions. The interdisciplinary approach of this study will be supported by a multi-level analysis which includes biological-genetic levels and psychological-social levels. This paper addresses, moreover, two main subjects of controversy: the existing scientific basis supporting performance enhancing of high blood T levels in elite female athletes, and the ethical rationale and considerations about these policies, in order to reach scientific and ethical rationales for a possible regulation of this issue.

After a review of the literature and discussion with specialists of the field, some proposals for refining the existing policies are made: the authors will try to examine all the possible solutions, highlighting their limits, their strong points and the anthropological and ethical implications connected to them.

Finally, results of a multidimensional questionnaire which could be addressed to all stakeholders are discussed in order to find possible solutions to this specific issue.

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OP23 POSTURE AND FUNCTIONAL RECOVERY

OP23-1

KEYNOTE The effect of dual-task on static and dynamic postural balance control

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Purpose: The role of postural balance control is crucial in the elderly considering their daily-living activities, above all when dual tasks are required. The aim of this cross-sectional study was to investigate static the effect of a dual task on static and dynamic postural balance control in a population of healthy elderly.

Methods: Fifty-seven healthy elderly subjects (M = 29; F = 28; mean ± SD: 73,4 ± 5 yrs; 72,8 ± 13,8 kg; 166,5 ± 8,1 cm) were enrolled for the study after a clinical psychiatric screening. Static upright posture was tested on a dynamometric platform (RGMD, Genova, Italy) in two different conditions: with (S-DT) and without (S) an additional task, namely counting backward with a subtraction of 7 from a predetermined number. Dynamic postural balance was assessed on a Prokin 252 platform (Tecnobody, Bergamo, Italy) with (D) and without (D-DT) the additional task employed in the static test. Three trials lasting 30 seconds each were performed with opened eyes in the S, S-DT, D, and D-DT conditions. The following

parameters were considered in the static balance tests: sway path, ellipse area of 90% confidence, anterior-posterior (AP) maximal oscillation. The ProKin AP stability index was used to assess the dynamic balance. For each parameter of both static and dynamic tests, the difference in percentage between the presence or not of the dual task was calculated.

Results: Ellipse area (225.6 ± 202.9 vs 143.0 ± 99.6 mm²), sway path (17.8 ± 12.5 vs 12.8 ± 9.2 mm/s), and maximal AP oscillation (26.6 ± 10.9 vs 21.8 ± 7.3 mm) were significantly higher (p < 0.001) in the S-DT condition in comparison with the S condition. Similarly, the stability index resulted to be significantly greater (p < 0.001) in the S-DT condition (3.1 ± 2.6) than in the S condition (1.4 ± 1.3). The ProKin AP stability index worsened in percentage more than what occurred for the static parameters (p < 0.001).

Conclusions: Outcomes from this study revealed a greater negative effect of dual-task in the dynamic postural balance control with respect to the static one. Therefore, due to the importance of dynamic postural control in the daily-living activities, we suggested to integrate the static postural balance assessment of elderly with dynamic tests.

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OP23-2

Tuning of standing postural responses to instability and cost function

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Purpose: Whole-body movements are daily performed in risky environments such that humans must take into account the inherent instability of standing posture when facing different settings of cost of failure. The aim of the study was to test the hypothesis that in upright stance subjects continuously estimate both probability of failure and cost of failure such that their postural responses will be based on these estimates.

Methods: We designed a riding simulation experiment where subjects were asked to control the position of a moving snowboard within a snow lane in a risky environment. Cost functions were provided by modifying the payoff of riding off of the snow lane with the snowboard. Uncertainty was modified by changing the gain of postural responses while subjects were standing on a rocker board.

Results: We demonstrated that subjects continually evaluated the environmental cost function with feedback-based postural changes to compensate on risk behavior, even when probability of failure was negligible. Results showed also that the estimates of probability of failure accounted not only the inherent instability, but also the

direction of stability limits due to biomechanical constraints of human upright standing posture.

Conclusions: Our results suggest that subjects tuned their standing postural responses statistically weighting the estimation of cost of failure and the uncertainty level in order to minimize the risk of undesirable motor responses.

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OP23-3

Stabilometry analysis of the proprioceptive effect of foam pad in a young athletes cohort

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Purpose: The correct position and function of the locomotor apparatus depend on our feet and their support, but the influences exerted by foam pad on global and postural parameters are not clear. Recent studies of stability focus is the unstable support surface^{1,2}. Aim of this study was to investigate the relationships between the kinesthetic response on performance and the use of diversified foam pad in a group of young athletes³.

Methods: The Cyber Sabots stabilometryTM was used to evaluate the postural stability. Twenty-eight subjects (males), aged all 15 years, were recruited. Subjects were assessed through electronic stabilometry in static mode, open eyes (OE) and closed eyes (CE), on 7 conditions: barefoot (T0), applying under the foot plant five diversified foam pad (T1,T2,T3,T4,T5) in density (Shore 20 to 50) and thickness (millimeters 0.5 to 4), with only football shoes (T6).

Results: ANOVA test and post-hoc BONFERRONI test showed significant differences in foam pad T3: Y antero-OE ($p = 0.0066$); Y antero-CE ($p = 0.0074$); SKG-OE ($p = 0.0001$); LFS-OE ($p = 0.0171$); VarVit-OE ($p = 0.0031$); QRBVV ($p = 0.0003$).

Conclusions: Data suggest that the foam pad T3 of 1 millimeter thickness could be used inside the football shoe without causing dysesthesia in the athlete. Sport performance is deeply influenced by the ability of muscle recruitment and the stability of the athlete⁴.

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OP23-4

Dual-task conditions on static postural control in older adults: a systematic review and meta-analysis

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Purpose: Dual-tasks (DT) comprise the performance of a primary task while concurrently engaging a secondary task. Because several studies have employed a wide range of secondary task conditions, the aim of this review was to evaluate the effects of DT conditions during static balance in older adults.

Methods: This review is in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A total of 3,079 men and women (60 years of age and above) participated in 67 studies. Only studies that entailed static postural stability tasks with eyes open were included. The electronic databases PubMed, Web of Science, and Scopus were searched through November 26th, 2018.

Results: The DT conditions identified were grouped in one of the following groups: manual, reaction time, discrimination and decision-making, mental tracking, verbal fluency, working memory, and “other”. Even though the overall meta-analysis revealed a non-significant mean effect size of $d = 0.12$ ($p = 0.24$, SE: 0.10; CI: -0.08-0.31), probably ascribable to high levels of heterogeneity (Q ($df = 32$) = 107.9411, $p < 0.0001$), further moderator analyses revealed that mental tracking tasks ($Z = -2.13$; $p = .03$) and reaction time tasks ($Z = -2.29$; $p = 0.02$) significantly worsened static postural control.

Conclusions: The main effects of DT on static postural control are confused by high heterogeneity of the secondary tasks employed. While arithmetic tasks seem to increase postural stability, more complex tasks, such as the Stroop test, worsen postural control.

OP23-5**Skeletal muscle activation in lower limb distal district during single stance posturography in eyes open and eyes closed sensory conditions**C. Villani¹, I. Cremonesi¹, F. Manzoni², G. D'Antona^{1,2}¹Sport Medicine Centre Voghera, University of Pavia, Pavia, Italy;²Department of Public Health, Experimental and Forensic Medicine, University of Pavia, Italy

Aim: We analyzed in healthy subjects selected skeletal muscle activation in two different sensory conditions, eyes open and eyes closed, during one-foot static posturography.

Methods: 14 healthy females (mean age 27 y, range: 25–34 y) were evaluated in different sensory conditions (eyes open, EO; eyes closed, EC) during a stability test for postural control (Delos Postural System) performed in single stance on the ground, without arms counterbalance. Each leg performed a first trial with EO and a second trial with EC, in an alternate sequence for the left and the right limb. The subject stood with the weight-bearing knee bent to 170° and the non weight-bearing knee flexed to 45°. To detect muscle activation, surface electromyography (sEMG) was obtained from the following muscles: tibialis anterior, peroneus longus, gastrocnemius medialis, gastrocnemius lateralis. Average rectified value (ARV) was recorded. For simplicity, the measurements were obtained only on the dominant limb.

Results: EO: a reduction of the sagittal plane oscillations (y_{EO}) correlated with increased activation of the long peroneus ($r = -0.63$) whereas a reduction of the frontal plane oscillations (x_{EO}) correlated with increased activation of the medial gastrocnemius muscle ($r = -0.54$); EC: an increase of the oscillations on the frontal plane correlated with the activation of the long peroneus ($r = 0.55$).

Conclusions: Results show that in EO the activation of long peroneus and the medial gastrocnemius muscle is associated with better postural control, while in EC, despite the activation of long peroneus, oscillations increase indicate a worsening of postural control.

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OP24 SPORTS AND EXERCISE PHYSIOLOGY**OP24-1****KEYNOTE Sex hormones response to physical hyperoxic and hyperbaric stress in male scuba divers**V. Verratti¹, D. Bondi², T. Jandova², E. Camporesi³, A. Paoli⁴, G. Bosco⁴¹Department of Psychological, Humanistic and Territorial Sciences, University "G. d'Annunzio" of Chieti-Pescara, Italy;²Department of Neurosciences, Imaging and Clinical Sciences, University "G. d'Annunzio" of Chieti-Pescara, Italy;³University of South Florida College of Medicine, Tampa, Florida;⁴Department of Biomedical Sciences, University of Padova, Italy

Purpose: Scuba diving represents an interesting model to investigate the endocrine adaptive responses to hyperbaric oxygen and physical

conditioning from both physiological and therapeutic point of view. However, there are few studies that analyzed the role of hyperbaric oxygen, in addition to physical exercise, on the endocrine profile. The aim of this study was to compare changes in plasma male sex hormones after hyperbaric physical exercise with different hyperbaric oxygen pre-conditionings.

Methods: We recruited six healthy, well-trained recreational male divers. Concentrations of prolactin (PRL), follicle stimulating hormone (FSH), luteotrophic hormone (LH), cortisol, 17- β estradiol (E2), and total testosterone (TT) were measured in venous blood immediately after different study conditions. Study protocol involving conditions with exercise performed 30 m underwater at 4 ATA: 1) after breathing ambient air at sea level; 2) after breathing 100% oxygen at sea level (Oxy-0 m) and 3) after breathing 100% oxygen 6 m below the water surface at 1.6 ATA (Oxy-6 m).

Results: Exercise increased PRL and hyperbaric oxygen potentiated this effect. Hyperbaria stimulated the E2 reduction and hyperoxia partially inhibited this reduction. Hyperbaria, but not hyperoxia, stimulated the TT reduction. There were no changes in FSH, LH, and cortisol. The increase in PRL likely reflects a stress response after physical exercise, amplified by hyperbaric oxygen. TT reduction may be interpreted as an acute and transient fertility impairment. Age, blood pressure, and BMI were taken into account as covariates for statistical analyses, and they significantly affected the results, in particular TT.

Conclusions: The major findings consisted of the increment in the level of prolactin in response to exercise, which was potentiated by hyperoxic preconditioning, and a reduction in 17- β estradiol after light hyperbaric exercise. These findings provide insights into the role of both hormones in the male adaptive endocrine responses. Prolactin, in particular, may be seen as a mediator of the effects on testosterone metabolism of physical exercise, hyperbaria, and hyperoxia. On the other hand, significance of a reduction in 17- β estradiol, in response to hyperbaria, should be subject to further studies. These data open new insights into the role of E2 and PRL in male endocrine adaptive responses.

OP24-2**Mechanical efficiency and age-related pulmonary dysfunction: the role of physical activity**

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Purpose: Aging is characterized by a significant decline in lung function, due to a loss of elastic recoil. This increase in lung compliance with age results in reduced maximal expiratory flow rates and an increase in resting functional residual capacity. During successful aging this phenomenon is compensated by a shift toward a skeletal muscle slower phenotype, which, result in improved mechanical efficiency. However, it is not clear how the level of mobility limitation affects both age-related pulmonary dysfunction and mechanical efficiency. Consequently, this study was designed to examine the effect of mobility limitation and aging on the pulmonary function and mechanical efficiency.

Methods: 12 young ($Y = 25$ yrs), 12 old mobile ($OM = 85$ yrs), and 12 old immobile ($OI = 85$ yrs) subjects were recruited for this study. FEV₁ and FVC were assessed at rest. Gas exchanges were recorded during steady state knee extension exercise (10 W). Mechanical efficiency (η) was calculated as the relationship between oxygen consumption (VO_2) and work rate.

Results: FEV₁ fell progressively across Y (3.3 ± 0.5), OM (1.1 ± 0.4), OI (0.75 ± 0.6). FVC was progressively reduced through Y (4.18 ± 0.6), OM (2.6 ± 0.8), OI (1.3 ± 0.7). At contrary η was significantly increased in the OM (32 ± 6) but significantly reduced in OI (14 ± 5) respect to the Y (25 ± 5).

Conclusions: The results of this study seem to show that pulmonary function in old individuals is exacerbated by the mobility limitation. However, this pattern is not followed by the mechanical efficiency, which is not compromised in old active individuals, suggesting that physical activity is playing a positive role in the preservation of skeletal muscle performance.

OP24-3

Changes in energy system contributions to the Wingate anaerobic test after a high-altitude expedition

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Purpose: The Wingate Anaerobic Test (WAnT) measures the maximum anaerobic capacity of the lower limbs during a 30-s all-out test. The energy sources of the WAnT are dominated by anaerobic metabolism, being ~ 80% of the total amount. High altitude exposure induces several adaptations on skeletal muscle function and metabolism. Therefore, the aim of the study was to analyze the energy system contribution of the WAnT before and after high-altitude trekking in male hikers.

Methods: Seven healthy male hikers performed a WAnT before and after a high-altitude expedition in the Himalaya lasting 43 days, among which, 23 days above 5.000 m.

The analysed mechanical parameters of the WAnT were: peak power (PP), average power (AP), minimum power (MP) and fatigue index (FI). The metabolic equivalents of oxygen consumption were calculated as aerobic metabolism from oxygen uptake during the 30 s exercise phase (VO₂), lactic and alactic anaerobic energy sources were calculated from net lactate production (VO_{2La}) and the fast component of the kinetics of post-exercise oxygen uptake (VO_{2PCr}), respectively. The total energy cost (VO_{2TOT}) was calculated as the sum of the three energy sources and the percentages of each contribution were also calculated.

Results: PP and AP were reduced from 7.3 ± 1.1 to 6.7 ± 1.1 W kg⁻¹ (p < 0.05) and from 5.9 ± 0.7 to 5.4 ± 0.8 W kg⁻¹ (p < 0.05), respectively. VO_{2TOT} was reduced from 4.97 ± 1.37 to 3.93 ± 0.77 l (p < 0.05). Aerobic contribution was unchanged (19.9 ± 4.8% vs 18.7 ± 2.2%), the anaerobic lactic contribution decreased from 48.3 ± 11.7% to 42.2 ± 8.6% (p < 0.05), while the anaerobic alactic contribution increased from 31.8 ± 14.5% to 39.2 ± 7.2% (p < 0.05).

Conclusions: Exposure to high altitude-induced a reduction of PP and AP while the total anaerobic contribution was unchanged. In particular, the anaerobic lactic contribution was reduced while anaerobic alactic increased.

OP24-4

Physiological determinants of training specificity in elderly: new perspectives

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Purpose: We recently reported a Bottom-Up Rise Strength Transfer (BURST) in male elderly as a cross-talk between lower and upper limb, mainly linked to endurance training. To better characterize the training specificity and investigate the effect of gender as a variable, we addressed the functional adaptations after three different training protocols.

Methods: 51 healthy volunteers (70.73 ± 3.98 y, 27.95 ± 2.74 Kg/m², 33 M and 18 F) were randomly assigned to endurance (ET), resistance (RT), Neuro-Muscular Electrical Stimulation (NMES) and control groups. Tests were conducted before (Ex) and after (Post) the training plans, consisting in 12 weeks, 3 sessions/w. In addition to anthropometric and functional mobility parameters, we assessed bilateral Maximal Voluntary Contraction (MVC) of quadriceps and Handgrip Strength (HS). We ran a three-way RM-ANOVA (ex-post × protocol × gender).

Results: We found significant differences: in ex-post × protocol comparison for MVC (p = 0.028, partial η² = 0.197, post-hoc for RT: p = 0.021) and HS (p = 0.003, partial η² = 0.323, post-hoc for ET: p < 0.001); in ex-post × gender comparison for HS (p = 0.040, partial η² = 0.112, post-hoc for M: p < 0.001).

Conclusions: We extended the training specificity in elderly on a functional basis. We argue that strength protocols promote muscle function improvements and endurance protocol promotes systemic effects. We provided pilot results about gender difference in the functional trainability in elderly. We are currently building an adapted training framework taking into account 3D full skeleton posture and spine morphology data and balance assessment. We are also moving forward in the understanding of training specificity looking into: redox homeostasis adaptations, cellular and molecular mechanisms linked to “exerkines” and “exersomes” release by both muscle fibres and satellite cells, muscle ultrasounds, subjective wellbeing, nutritional and lifestyle habits. These results could be used to better provide specific training plans for elderly, and perspective to address analyses and applications towards clinical populations.

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OP24-5**Exploring the frontal theta oscillations during the practice of Quadrato Motor Training: a pilot study**

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Purpose: Previous studies showed that the Quadrato Motor Training (QMT) modulates EEG theta power and improves cognition. Frontal theta power is thought to have a fundamental role in cognitive control, and the more the cognitive load the higher the power. Since QMT requires cognitive control, we hypothesized that frontal theta will increase overtime during the QMT performance, with a higher frontal theta power towards the last blocks of the QMT session compared to the starting one.

Methods: 5 healthy adults (yrs: 57.4 ± 11.3) participated in the study. They performed a single session of QMT characterized by 3 blocks of 23 movements each (duration ≈ 85 s) with a rest of 20 s between blocks. Cortical activity was measured during the QMT practice using a 32-channel EEG portable system. We computed absolute spectral power on theta band (4–8 Hz) focusing on the pre-frontal (Fp), frontal (F), and fronto-central (FC) electrodes. Friedman's test was used for statistical analyses.

Results: Significant differences were found in Fp ($p = 0.015$) and FC ($p = 0.022$) theta band among the three QMT blocks. Post-hoc analyses showed a trend toward an increased theta power in the second and third block compared to the first one ($p = 0.04$).

Conclusions: Based on these results, it is possible to hypothesize that the increased Fp and FC theta power in the last two blocks compared to the first one may reflect not only the cognitive control required by QMT performance but also the cognitive effort increase that occurs overtime. The current findings shed light on a possible mechanism by which QMT improves cognition.

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OP25 PHYSICAL EXERCISE AS PREVENTION AND THERAPY**OP25-1****KEYNOTE Exercising with the support of the SmartApp: results on physical fitness, metabolic profile and psychological parameters**M. Bonato^{1,2}, F. Turrini³, A. Meloni¹, M. Plebani¹, E. Brambilla¹, M.F. Piacentini⁴, A. La Torre^{1,2}, G. Merati^{1,5}, L. Galli³, P. Cinque³¹*Department of Biomedical Sciences for Health, Università degli Studi di Milano, via Giuseppe Colombo 71, 20133, Milan, Italy;*²*IRCCS, Istituto Ortopedico Galeazzi, Milano, Italy;*³*IRCCS, San Raffaele Scientific Institute, Milan, Italy;*⁴*Functional Evaluation and Analysis of Sport Performance,**Department of Movement, Human and Health Sciences, Foro Italico University of Rome, Rome, Italy;*⁵*IRCCS, Fondazione Don Carlo Gnocchi, Milan, Italy*

Purpose: It has been suggested that electronic devices could improve exercise adherence. Therefore, we designed a pilot study to assess improvements of physical fitness, metabolic and psychological parameters in PLWH exercising with the support of a smartphone application, compared to participants who exercised without the application.

Methods: This was a 16-week randomized-controlled study. PLWH were allocated to either an experimental group, which trained using a smartphone application (APP), or a control group, which trained following a hard copy program (No-APP). The program consisted of moderate physical activity three times/week including an initial coach-supervised period of 4 weeks, followed by 12 weeks where participants trained independently. At baseline (BL) and after 16-weeks (W16), participants were evaluated for cardiorespiratory fitness by peak oxygen consumption ($\dot{V}O_{2peak}$), body composition (body mass, body mass index-BMI, waist, hip circumferences, %fat mass-FM, and %fat free mass-FFM, by bioimpedentiometry), metabolic parameters (total-, HDL-, LDL-cholesterol, triglycerides), and Profile of Mood States (POMS; depression, fatigue, vigour, anger and tension).

Results: Forty-eight participants were screened and 38 were eligible: 20 were allocated to the APP group and 18 to the No-APP group. Two APP and two No-APP participants were lost to follow-up. Median training adherence during the autonomous training period (week 5–16), was 60% (IQR: 50–80%) and 54% (IQR: 31–76%) in the APP (based on app records) and No-APP (self-reported) participants, respectively ($p = 0.517$). Intention-to-treat analysis showed a W16 improvement from BL of $\geq 15\%$ of $\dot{V}O_{2peak}$ in 13/18 (72%) APP, but only in 3/16 (19%) No-APP participants ($p = 0.025$). Significant W16 changes from BL were observed in APP, but not in No-APP participants, in $\dot{V}O_{2peak}$, %FM, %FFM, total-, LDL-cholesterol, and triglycerides and significant change differences between groups in $\dot{V}O_{2peak}$, %FM, %FFM, total-, LDL-cholesterol, and triglycerides. Analysis of POMS showed a significant improvement of vigour in APP and a significant worsening of depression and anger in the No-APP participants at W16 compared to BL. In addition, there were significant change differences in depression, vigour and anger between the two groups.

Conclusions: Exercising with a smartphone application may improve training adherence and therefore physical fitness, body composition, blood lipid profile and psychological outcomes in PLWH.

OP25-2

The influence of an endurance training protocol on spontaneously adopted-nutritional habits in healthy sedentary subjects

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Purpose: The effects of exercise on food choices are not fully consistent even because the nutritional habits are influenced by physiological, metabolic, social and psychological factors. The aim of the present study was to evaluate the impact of an endurance cycling incremental training protocol on spontaneously adopted -nutritional habits of healthy female-male young subjects.

Methods: Thirty-two healthy normal weight sedentary subjects performed 36 indoor cycling training sessions over a 9-week period. Training sessions were structured in 3 mesocycles with an increase in number and duration of session. During the training period, subject nutrition was daily monitored (by interviews) and data were collected and processed using *MètaDieta* software (METEDA S.r.l.); macronutrient, fiber and vitamin intakes were taken into account. In order to verify changes during trial time of diets in PL and SU arms, three way mixed design (MANOVA for repeated measures) has been performed. Time was within-subject 4 levels factor (T0, T1, T2, T3). T0 was metadieta measures relieved 2 week before starting training, T1 measures from first mesocycle, T2 from second mesocycle and finally T3 from third one.

Results: Repeated measures MANOVA test was conducted to test intervention effect on diet behaviors. The results showed there was overall no difference between intervention (SU) and control group (PL) ($F_{(22,7)} = 1.18$, $p = 0.38$), neither sex ($F_{(22,7)} = 2.13$, $p = 0.15$). The caloric intake increases between the first and second mesocycle, and then it stabilizes in the third with a variation of +18% ($p < 0.05$). Protein intake decreases (-1.3%) between the first and second mesocycle while an increase of carbohydrates intake is found, with variations of +2%. The lipid intake remains constant during the training period. An increase of soluble/insoluble fibers (+18% and +20% respectively), starch (+30%) and vitamin C (+26%) between the second and the third mesocycle is observed ($p < 0.05$). The analysis of body composition, measured with bioelectrical impedance method, has evidenced a significant increase of FFM (free fat mass) between the second and third mesocycle even if the weight remained constant according to Kaya et al.¹.

Conclusions: The nutritional habits spontaneously adopted by the participants showed an increased consumption of carbohydrates, soluble and insoluble fibers, starch, vitamin C, suggesting that training can influence nutritional habits leading to a better eating, such as more fruit and vegetables consumption even if food choices can be driven by biological needs or elicited by social and psychological factors².

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OP25-3

Active breaks to promote physical activity in primary school: preliminary results on physical and cognitive functions

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Purpose: Active breaks (AB) are emerging as a promising way of increasing the frequency of total physical activity (PA), and can promote a reduction of adiposity in the long period¹. AB are characterized by 10 minutes of PA led by the teacher inside the classroom. We are conducting a research to evaluate the feasibility and the efficacy of AB intervention in terms of quality of life, cognitive functions and level of physical activity in primary school children.

Methods: Study design. Pre-post study in a primary school (44 children from 6 to 9 years, from 1st to 4th grade) in Bologna, one experimental group (EG) performing AB for 14 weeks, and one control group (CG). The assessed variables were: functional exercise capacity (6-MWT), cognitive function working memory (WMT), physical activity level (Actigraph). Ped-QL (Quality of life) and PAQ-C (Self-reported PA) questionnaires were also evaluated.

Results: We calculated the post-pre difference of the main outcomes. The experimental class improved the weekly share of minutes spent in moderate/vigorous physical activity (MVPA: EG + 72.7 vs CG-81.8, p -value = 0.006), the number of steps counts (EG + 14026 vs CG-8017, p -value = 0.0003), and reduced the minutes spent in sedentary activity (EG-168.7 vs CG + 375.7, p -value = 0.01). The results obtained from the other assessed variables are not statistically significant.

Conclusions: There is a beneficial result in experimental group in physical activity levels especially in total time spent in MVPA. WMT test increases in all children, although without significant results. The quality of life would appear to show a stronger increase related to the age of children rather than to active breaks. This suggests the importance of developing multiple aspects of PA to prevent sedentary behaviours. These results encourage the use of active breaks combined with brain breaks in a longer period of intervention in order to assess other changes related to lifestyle and cognitive functions.

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OP25-4**The preschool-FLAT, a new tool for food literacy assessment in young children from the *Training-to-Health* Project**

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Purpose: Food literacy (FL) is referred both to food knowledge and skills, and encompasses basic literacy and fundamental movement skills; its assessment is important since youth^{1,2}. The aim of this presentation is to illustrate the validity and internal consistency of the preschool-FLAT (Food Literacy Assessment Tool), a new tool for the assessment of preschool FL developed within the Training-to-Health Project.

Methods: A total of 505 preschool children aged 3-6 from 21 kindergartens in the Municipality of Palermo followed five modules of structured oral sessions and practical activities on nutritional topics³. At the end of each module they compiled prearranged sheets included in the 5 domain-toolkit preschool-FLAT. The following measures for the scale were assessed: content validity; internal consistency; validity of the scale construct; and discriminant validity, through the comparison of an intervention subgroup of 100 children with a control group of 27 children.

Results: Acceptable content validity of a 16-item scale and overall adequate internal consistency were revealed: content validity index 0.94, content validity ratio 0.88, Chronbach's alpha 0.76. The Structural Equation Modeling revealed a 4-factor model fitting the data well (comparative fit index 0.939, root-mean square error of approximation 0.033). Discriminant validity was good, with intervention group scoring higher than control ($p < 0.001$, unpaired Student's t-test).

Conclusions: This study shows that the preschool-FLAT has adequate validity and internal consistency, and good psychometric properties. It could be considered a promising tool specifically targeted to pre-schoolers that could be effectively used to assess food literacy.

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OP25-5**Can chronotype affect the rest-activity circadian rhythm in shift workers?**

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Purpose: The working hours of shift workers, which are scheduled outside the normal daily social program, lead to a circadian desynchronization due to a temporary misalignment between working hours and physiological and behavioral functions, similar to what is observed in Jet-Lag. This condition leads to a worsening of sleep quality, a reduction in the ability to work during waking hours and alertness. The aim of the current study was to evaluate the effects of shift work on Rest-Activity circadian Rhythm (RAR) in a sample of nurses, taking into account their circadian typology.

Methods: A total of 59 participants volunteered to be part of the study: 44 of them were night shift workers (Group 1) and other 15 were diurnal workers (Group 2). All 59 participants performed a continuous 7-day actigraphic monitoring to evaluate RAR and filled in the Morningness-Eveningness Questionnaire (MEQ) to detect the chronotype.

Results: The single cosinor method revealed a statistically significant RAR in all participants. The population mean cosinor applied to Group 1 and Group 2 revealed the presence of a significant circadian rhythm in both groups. Only the Amplitude resulted significantly different between the two groups and lower in Group 1 compared to Group 2 (59.9 ± 6.2 vs 90.6 ± 14.26 a.c. in Group 1 and 2, respectively, $p < 0.001$). Subsequently, we divided each group based on subject's chronotype (M-types, N-types). The intra-group analysis of Group 1 revealed differences in Amplitude between M-types and N-types (68.5 ± 12.48 vs 55.2 ± 6.65 a.c. in M- and N-types, respectively, $p < 0.04$). On the contrary, the intra-group analysis of Group 2 didn't show differences in Amplitude of two chronotypes. The comparison between Group 1 and Group 2 for each chronotype showed an higher Amplitude for the Group 2 compared to the Group 1 (M-types: 95 ± 26.88 vs 68.5 ± 12.48 a.c. Group 2 vs Group 1, $p < 0.03$; N-types: 86.5 ± 23.5 vs 55.2 ± 6.65 a.c. Group 2 vs Group 1, $p < 0.001$).

Conclusions: The RAR of night shift workers is disrupted with lower levels of Amplitude. In addition, the chronotype could affect this RAR alteration due to the presence of an higher Amplitude in M-types.

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