Elite Junior Throwers Unlikely to Remain at the Top Level in the Senior Category

DOI:10.1123/IJSPP.2020-0699

(Article begins on next page)

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Journal:	*International Journal of Sports Physiology and Performance*
Manuscript ID	IJSPP.2020-0699.R1
Manuscript Type:	Original Investigation
Date Submitted by the Author:	n/a
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Keywords:	Career trajectories, talent identification, youth training, track and field, relative age effect, development programs

Title: **Elite junior throwers unlikely remain at the top level in the senior category**

Submission type: Original investigation.

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Preferred running head: Careers of World-class throwers

Abstract word count: 248

Text-only word count: 3335

Number of figures and tables: 3

Supplementary file: 1

Abstract

Purpose. This study investigated 1) the transition rate of elite world-class throwers, 2) the age of peak performance in either elite junior and/or elite senior athletes, and 3) if relative age effect influences the chance of being considered elite in junior and/or senior category.

Methods. The career performance trajectories of 5108 throwers (49.9% females) were extracted from the World Athletics database. We identified throwers who had reached the elite level (operationally defined as the World all-time top 50 ranked for each age category) in either junior and/or senior category and we calculated the junior-to-senior transition rate. The age of peak performance and the relative age effect (RAE) were also investigated.

Results. The transition rate at 16 and 18 yrs of age was 6% and 12% in males, and 16% and 24% in females, respectively. Furthermore, elite senior throwers reached their personal best later in life than elite junior throwers. The athletes of both genders considered elite in the junior category showed a large RAE. Interestingly, male athletes that reached the elite level in senior category also showed appreciable RAE.

Conclusions. Only a few of the athletes that reach the top 50 in the World at 16 or 18 yrs of age manage to become elite senior athletes, underlining that success at the beginning of an athletic career does not predict success in senior career. Moreover, data suggest that being relatively older may confer a benefit across the whole career of male throwers.

Keywords:

Career trajectories, talent identification, youth training, track and field, relative age effect, development programs

Introduction

Within sports measured in centimetres, grams, or seconds, the selection of talented athletes is often based on objective and measurable traits, such as the actual performances. Performance outcomes in such sports are pretty clear and simple and success comes from throwing farther, running faster and lifting more. However, while identifying successful athletes on the field of play is easier, less clarity exists on identifying talented youngsters capable of developing into successful senior athletes. In fact, individual career performances present an amount of uncertainty because they are characterised by non-linear improvements in performance with highly variable oscillations across the years.[1] Previous work has already highlighted that in some sporting disciplines early age performances show low stability over the time[2,3] and do not constitute a prerequisite for senior success.[4-7] The transition rate, usually identified as the chance for an elite youth athlete to become an elite senior athlete has been reported to vary in difference disciplines.

Overall, the various studies investigating the transition rate at national and international level in track and field has determined that the chances for elite junior athletes to become an elite athlete in adulthood are low. For example, more than 50% of New Zealand and Australian elite youth athletes were not present and did not represent their countries at the senior level.[8] In the UK, only ~ 20% of male and 25% of female athletes were top 20 ranked both in youth (Under 15, U15) and senior (U20) competitions.[5] A similar pattern was observed in the Italian national rankings where only ~ 24% and 38% of male and female athletes respectively were considered top-level athletes both during their youth (age range: 14-17 years) and senior career.[3,6] At the international level, in a prospective cohort, Hollings et al.[9] found that only the 21% of medallist and 13% of the finalist athletes in the World Junior Championships (WJC) had reached success later at senior level and more than half (54%) did not compete at all as an elite senior athlete. In middle-distance events, only 31% of the junior finalists in the WJC had been ranked among the top 10 later at senior level.[10] We recently reported robust estimates of transition rate in World-class sprinters and jumpers.[7,11] After analysing the World Athletics and WJC lists over a large multigenerational sample, we found that only 20% of the sprinters and jumpers top 50 ranked at 17 years of age managed to become a top 50 ranked athlete in the senior category.

Throwing events are peculiar if compared to other track and field events. The scaling of implements' weight during the youth career, especially for males, and the consequent modification in throwing technique may make the career progression even more unpredictable and performance less stable.[4,12] Additionally, since the duration of top senior throwers' career is longer than in other events, it is more challenging for a junior thrower to progress into a successful senior compared to other athletics events.[13] In throwing events, the anthropometric characteristics combined with strength and power are crucial for performance, making earlier maturing athletes more capable of winning junior category competitions.[14,15] Also, relatively older young athletes, i.e. those born at the beginning of the calendar year, may also have more opportunities to be considered elite in the junior category.[16] This may be particularly valid in track and field competitions where age limits in competitions determine a field of play of biannual age-grouping cohorts. With such wide age-grouping, a difference between athletes born close and far to the date of selection may increase the possibility to observe an asymmetry in birthdate distribution of successful athletes that is known as the relative age effect (RAE). Nevertheless, even if the RAE reflects the possible advantages/disadvantages in early sport success, it does not seem to translate into senior excellence. In sprinters, middle-distance runners, and jumping athletes, the RAE disappeared with the transition to the senior category.[15] Instead, previous work analysing performance and RAE in throwing events has indicated its influence also in the senior category both in female and male athletes.[17] However, the study mentioned above used a cross-sectional approach, and a causal mechanism cannot be drawn for career progression. A longitudinal approach should be more appropriate to analyse career progression and provide evidence if RAE in throwing events is linked with early youth success and is a prerequisite for success at the senior level.

The literature shows conflicting findings regarding the transition rate in throwing events. Sholz at al.[13] reported that almost all WJC finalists in the 90s were also successful in the major international events for senior-level athletes after their transitioned. One could argue that the lack of systematic antidoping campaigns possibly influenced such a high transition rate. More recently, only eight throwing finalists from five editions of WJC (in the last 20 years) achieved the same level of success in the Olympics and/or in World Championships.[12] Additionally, 46% of the finalists did not compete at a high-level anymore, and javelin and hammer events appeared to have the highest drop-out.[12] However, because these data were focused on the few athletes that participated in the WJC it is not possible to accurately explain and analyse the evolution of performances from junior to senior in throwing events. Unfortunately, the studies that tracked a larger sample of athletes were performed only on national level athletes (from Italy and the UK). Research on the performance databases of these two countries reported a successful transition rate to senior success of about 20% and 30% for male and female athletes respectively.[6, 5]

Tracking the career of a large sample of multigenerational World-class athletes,[17] not only those participating in the WJC, would provide a more robust and comprehensive analysis of performance evolution and could improve the estimation of the actual transition rate.[11] Additionally, using this approach, it is possible to study the athletes' career both prospectively and retrospectively. The prospective approach would facilitate the identification of the elite young athletes and the tracking of their performance across competitions. The retrospective approach would enable to identify elite senior athletes and trace back their career up to the beginning of their international competitions. We believe that the combination of the two different perspectives would be useful to understand the importance of early age success on senior performance.

Tracking the whole career of elite athletes will also help to elucidate if junior performance might have an impact on when athletes reach their peak performance compared to the typical age reported in the literature.[17,18] Indeed the data available in the literature do not distinguish between early-success and late-success athletes, providing only the average age of peak performance of top level competitors.[17,18] Nevertheless, it is reasonable to hypothesize that early-success athletes would reach their peak performance earlier than late-success athletes. Being aware of this would allow coaches to have a more realistic prediction of the future development of their athletes.

Therefore, the aim of this study was to expand previous knowledge on throwers' career investigating 1) the transition rate, 2) the age of peak performance in those athletes who had reached an elite level in either junior and/or senior category and 3) if relative age effect influenced the chance of being considered elite in junior and/or senior category.

Methods

This prospective/retrospective study is focused on throw events (i.e., Shot Put, Hammer Throw, Discus Throw and Javelin Throw) considering both male and female athletes. To investigate the career progression, athletes' names participating in the WJC U18 (https://www.iaaf.org/competitions/iaaf-world-u18-championships) and U20 Championship (https://www.iaaf.org/competitions/iaaf-world-u20-championships) from the seasons 1998 to 2015 were collected. Differently, for the retrospective analysis, the names of the 100 top athletes in each season from 2000 to 2019 were extracted from the databases provided by the World Athletics (https://www.worldathletics.org/home). After merging the two databases and removing all duplicate names, the seasonal best performances (SBPs) for each athlete obtained in outdoor competitions were downloaded and included in the dataset for analysis. For each athlete, the SBPs were downloaded from the first to last appearance in the World Athletics database, or on December 31, 2019, if the athlete was still competing. According to the World Athletics rules, only results with regular wind were considered. Athletes, who were found to have used banned substances and disqualified for doping offences, were excluded from the analysis.

All the data were collected from the publicly available resources of World Athletics Federation, and therefore no informed consent was obtained. The local ethics committee of the University of Torino approved the study.

Procedure

Given that the database contained a multigenerational sample of throwers (i.e., from 2000 to 2019), all the SBPs were normalised according to the World Record of the corresponding discipline and gender presented in the specific years. To calculate the transition rates, athletes were firstly ranked according to their normalised SBP in an all-time ranking according to their age, i.e. 16, 17, 18, 19, 20, and >20 yrs. According to previous studies[7,19] we arbitrarily defined the elite throwers as the top 50 in the all-time ranking. We also tried to change this threshold and to calculate the transition rate for the top 10 and top 25 athletes. Since the overall results of those calculations were similar (within a range of ±6%), for conciseness, we kept the threshold of top 50 for the analysis reported in this study. In this way, the present study is also representative of a larger sample of World-Class athletes. For the analysis, the all-time top 50 ranked throwers at each age group were identified. Using a prospective and retrospective approach, the proportion of athletes that were top 50 ranked across different ages were calculated. Prospectively, we calculated how many top 50 ranked throwers at 16 yrs old remained in the top 50 ranked in the following stage of their career (e.g., at 17, 18, 19, 20, and Senior). Retrospectively we calculated how many top 50 ranked Senior throwers were already top 50 ranked at younger ages (e.g., at 20, 19, 18, 17, 16 yrs).

To answer the second experimental question, the age of peak performance was calculated on the SBP trends of each athlete. Then the following three subgroups were identified considering the overall ranking:

1. *Only Junior:* athletes top 50 ranked in U18 (i.e. aged 16 or 17 yrs) but not in Senior category
2. *Only Senior:* athletes top 50 ranked in Senior but not in U18 category
3. *Junior and Senior:* Athletes top 50 ranked both in U18 and Senior category

Finally, to answer the third experimental question, for each athlete, the date of birth was recorded. All the above analyses were performed for each discipline and gender. An athlete was included in the analysis only if his/her SBPs were presented for a minimum of three years, also non-consecutively as previously suggested.[6,11]

Statistical analysis

The transition rates were calculated prospectively (from 16 yrs and from 18 yrs to senior category) and retrospectively (from senior to 16 yrs) using binomial proportion confidence interval (90% CI).

To compare the age of peak performance among *Only Junior* and *Junior & Senior* and *Only Senior* subgroups and disciplines two-way ANOVAs for unequal sample size were carried out.

Separate analyses were performed for gender. Tukey's honestly significant difference procedure was used to identify specific subgroup differences.

Finally, athletes in the subgroups were classified according to their month birthdate in 4 different quartiles. Specifically, athletes born from January to March, from April to June, from July and September, and from October and December were classified in the 1st (Q1), 2nd (Q2), 3rd (Q3), and 4th (Q4) quartile respectively. Chi-Square was used to verify the difference between observed and expected subgroups' quartile distributions. The magnitudes of the differences were calculated as Crammer's V effect size. Threshold values for effect size statistics were: ≤0.17, small; >0.18, moderate V ≥0.29 large.[20] Comparison between the first and last quartile (Q1 Vs Q4) and between the first and last semesters (Q1,2 Vs Q3,4) was calculated using Odds ratios (ORs) and 95% confidence intervals (95% CIs). A uniform distribution (i.e., 25% for each quartile) was used as reference.[15,21] For the RAE analysis, the different disciplines were merged to increase the sample size.

All data were analysed using custom-written software in MATLAB R2020a (Mathworks, Natick, Massachusetts). The graphs were prepared with GraphPad Prism 8 (San Diego: CA, USA). The level of significance was set at $p \leq 0.05$.

Results

A total of 60 athletes (37.5% female) was excluded from the analysis because of disqualification for doping offences. A total of 5108 career profiles was evaluated. Specifically, 1344 athletes were shot putters (female: n=643, 47.8%), 1284 discus throwers (female: n=636, 49.5%), 1158 hammer throwers (female: n=616, 53.2%), and 1322 javelin throwers (female: n=604, 45.7%).

<Figure 1 about here>

Figure 1 summarises the overall prevalence of transition rate considering the prospective analysis (Figure 1a) and the retrospective analysis (Figure 1b). However, the junior-to-senior transition rate increased with increasing the reference age. Indeed, at 16 yrs of age, the transition rate was 6% for males and 16% for females while at 18 yrs of age it was larger, being 12% for males and 24% for females.

The junior-to-senior transition rates slightly varied across disciplines. In males, the javelin throw showed the largest transition rate at all ages, while in females the various disciplines showed a different behaviour. In particular, the transition rates from 16 yrs to senior category were 0%, 8%, 2% and 11.8 % in male and 14%, 14%, 26% and 8% in female for shot put, discus throw, hammer throw and javelin throw respectively. The transition rates from 18 yrs to senior category were 4%, 10%, 2% and 31 % in male and 28%, 24%, 22% and 20% in female for shot put, discus throw, hammer throw and javelin throw respectively.

The data about the age of peak performance are presented in Table 1. In both genders and all disciplines, *Only senior* and *Junior & Senior* reached their peak performance later compared to *Only Junior* subgroup. When merging all disciplines, *Junior & Senior* reached the peak performance 1.5 and 2.0 yrs before *Only Senior* subgroup in males and females, respectively. Moreover, male Javelin throwers reached their peak performance earlier than Hammer and Discus throwers.

< Table 1 about here>

<Figure 2 about here>

The prevalence of athletes in the different quartile (i.e., RAE analysis) is presented in Figure 2. The detailed results of RAE are reported in the supplementary file 1. In both genders, *Only Junior* showed a substantial over-representation of athletes born in the Q1 [χ^2=50.50, p<0.001, Cramer's V=0.30 for male and χ^2=33.20, p<0.001, Cramer's V=0.26 for female]. The probabilities of finding an athlete born in the Q1 was 3.3 [95%CI (2.0,5.4)] and 3.1 [95%CI (1.8, 5.3)] times higher than in Q4. Although the χ^2 test showed an asymmetry in the birth distribution in the *Junior & Senior subgroup* in both genders, no difference in Q1 vs Q4 was observed. On the contrary, while in male *Only Senior* subgroup an asymmetry in birth distribution and in quartile comparison was observed, the female throwers showed a more symmetric distribution.

Discussion

This study examined the career progression of 5108 world-class multigenerational throwers. We aimed at describing the junior-to-senior transition rate as well as the presence of RAE in elite athletes. i.e. those athletes who were top 50 ranked in junior and/or senior category. The main finding of this study was that the junior-to-senior transition rate at 16 and 18 yrs of age was 6% and 12% in males, and 16% and 24% in females, respectively. The early-success athletes reached their peak performance earlier than late-success counterparts. Finally, a substantial over-representation of athletes born close to the beginning of the calendar year was evident particularly in the top 50 ranked U18 athletes.

The prospective analysis of the data evidenced a low transition rate from junior to senior stage. Only a few (6–16%) of the throwers considered elite (top 50 ranked) at 16 yrs of age managed to maintain the same level of performance later in adulthood (Figure 1a). The transition rates calculated at 18 yrs of age was larger than those calculated at 16 yrs, but it was still low (12% and 24% for males and females, respectively). Therefore, predicting future success based on the performances obtained at 18 yrs of age is still inaccurate. These findings are similar to what we previously found on World-class sprinters[19] and jumpers.[7] However, we found a lower transition rate when compared with national level athletes,[5,6] indicating that the higher the level of competitiveness the lower the transition rate to senior success. In this regard, the earlier study of Sholz et al.[13] suggested that the participation in the WJC and the consequent acquired international experience during the early stage of career could be beneficial for the success at the major senior competitions later on in life. Here we do not necessarily deny that claim, but we provide evidence that the success at junior level is not an absolute prerequisite for future success. In general, the transition rate was lower in male athletes than their female counterparts. It is possible to speculate that the early maturation of young females[22] make them more physically similar to senior athletes, and this might increase the transition rate. However, in both genders, most of the elite junior athletes did not maintain the same level of competitiveness later in their career. Different factors such as early maturation[22] and specialization[23] or injuries,[24] may explain this high attrition rate as previously suggested. Moreover, both psychological and social factors may influence success at the senior level. Indeed, psychological factors (e.g., determination, confidence, motivation, clearly defined and realistic goals)[25,26] and a larger support network, as dedication and support of parents and peers, knowledge and guidance of coaches, are essential in long-term the athlete's success.[27,28]

Interesting findings also arise by analysing the retrospective approach. This analysis provides quantitative information on how the top 50 senior athletes were ranked during their junior careers. Less than 10% of elite senior male athletes were top 50 ranked in U18, and less than 20% in U20 category (Figure 1b). This means that most elite senior men outperformed their early-success counterparts later than 19 yrs of age. The trend in women was similar, but it was less pronounced. In fact, 34% of the top 50 senior women were already top 50 ranked at 19 yrs of age. This means that while few successful throwers were at the top level since the beginning of their career, most of them gained the elite status later. Throwing requires high muscle strength, power and coordination.[4] The present findings suggest that many years of training and experience are necessary to master such qualities in the international arena.[4,29] The retrospective analysis also shows that 38% of elite senior throwers of both genders were considered elite at 20 yrs of age. At 20 yrs, i.e. at the beginning of the senior career, the physical maturation is complete [22] and the athletes use the Senior implements. Together these factors make the prediction of future success much easier at 20 yrs than before. Nevertheless, more than 50% of elite senior throwers gain the elite status only later than this age.

In all disciplines the *Only Junior* subgroup reached their best performance before the age of 22, while the *Junior & Senior* and *Only Senior* subgroups reached their best performance from 2 to 6 yrs later (Table 1). The age of peak performance for *Only senior* subgroup was similar to those reported in previous studies.[17,18] However, the most interesting result was that the elite senior athletes that were considered elite already in the junior category (*Junior and Senior*) reached their peak performance earlier than the rest of the elite senior athletes (*Only Senior*). This finding provides useful information to construct a more realistic expectation for the future development of elite junior athletes. Indeed, this finding suggests that if athletes are already at the top level at 16-17 yrs of age, they may reach the peak performance earlier - and therefore have less margin of development - compared to their peers .

In men, we observed a marked difference between disciplines. Indeed, the Javelin throw showed the larger transition rate (31% at 18 yrs) and the lower age of peak performance (27 yrs). Both these findings could be related to the lighter implement and therefore the less strength/power needed to throw as well as less technical adjustments needed. In fact, the javelin throwers do not have to deal with the change of implement from U20 to Senior category, as opposed to what occurs in the shot put and discus throw. In women, the transition rate and the age of peak performance are more homogeneous across disciplines. This is possibly due to the lack of change in implements' weight from U18 to U20 category.

The *Only Junior* subgroup presented a large RAE. In this subgroup, athletes born in the first three months of the year were three times more numerous than the athletes born in the last three months (see Figure 2). This means that being relatively older (within one constituent year) at the beginning of the career may confer a large benefit on throwing performance. This is in line with previous studies reporting a large presence of RAE in disciplines, such as throwing, with a great emphasis on speed and strength/power.[15,29,30] The prevalence of RAE is consistent also in *Junior & Senior* where asymmetry in birth distribution was observed in favour of relatively older athletes. A different trend in birth distribution was observed in *Only Senior* subgroup between males and females. While the RAE disappeared in women, a significant small effect of RAE was still observed in men. In fact, the men born in the first quartile had twice the chance of being top 50 ranked in senior category compared to those born in the last quartile. These results confirm a previous cross-sectional study in World-class track and field athletes[15] and suggest that male throwers born earlier in the year could more easily reach the top ranking in the late stages of their career (Figure 2, *Only Senior*). Similarly to other competitive sport contexts,[16] it seems that the RAE produced a selection bias in the early stage of the career that still affected the later phases. Due to the longitudinal analysis of this study, the present finding is of particular importance because it shows how RAE differently affected the various phases of throwers' career. We expand the understanding of the RAE in track and field since previous studies on this topic analysed the phenomenon using cross-sectional designs[15,30,31] or on small sample sizes of WJC athletes.[29,32]

Some limitations should be pointed out. Firstly, we tracked the performance trends analysing the World Athletics database and thus focusing only on international level performers. It is possible that some throwers started their career before appearing in this database, possibly competing in lower-level national competitions. Secondly, according to World Athletics (former IAAF) rules for U18 and U20 competitions we considered December 31st as the cut-off date for calculating the RAE. However, in some countries (e.g., UK), the cut-off date is different. Therefore, the RAE findings need to be applied only in this particular context.

Practical applications

In talent identification and developmental perspective, coaches and practitioners should focus on throwers' long-term potential rather than on short-term. In fact, our study indicates that focusing on early exceptional achievement does not guarantee later success. Since most early successful throwers were born in the first part of the calendar year, corrective procedures for bias in the birthdate distribution are warranted in youth category [33]. Furthermore, the assessment of maturation status [34] should be considered when analysing youth and junior performers in order to place performance results into context and avoid early de-selection of late maturers.

Conclusions

In conclusion, the results of this study indicate that only a small percentage of elite junior throwers have maintained the same level of performance in adulthood. In other words, the present study suggests that being an elite young thrower is not a prerequisite of becoming an elite senior performer. Consequently, success in the junior category does not represent a springboard to success in adulthood and more attention should be placed on the development and encouragement of late maturers who may be capable of success at a later stage in life.

Acknowledgements

The authors acknowledge the contribution of Silvia Nicola and Luciano Passoni for entering data in the electronic sheets of the database. The authors also acknowledge Paolo Moisè, who originally inspired us to investigate the athletes' career both prospectively and retrospectively.

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Figure caption

Figure 1. The transition rates (merged across disciplines) of the top 50 ranked throwers are reported for the prospective and retrospective approach. Panel a) shows how many throwers top-50 ranked at 16 yrs old managed to become top 50 ranked in the following stage of their career. Panel b) shows how many top 50 ranked Senior throwers were already top 50 ranked at younger ages.

Figure 2. Quartile birth date distribution of throwers in *Only Junior*, *Junior & Senior* and *Only Senior* subgroups. Data are merged between the different disciplines.

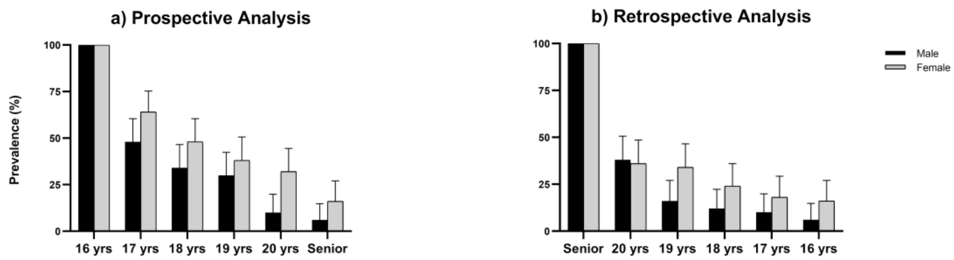

Figure 1. The transition rates (merged across disciplines) of the top 50 ranked throwers are reported for the prospective and retrospective approach. Panel a) shows how many jumpers top-50 ranked at 16 yrs old managed to become top 50 ranked in the following stage of their career. Panel b) shows how many top 50 ranked Senior jumpers were already top 50 ranked at younger ages.

257x79mm (600 x 600 DPI)

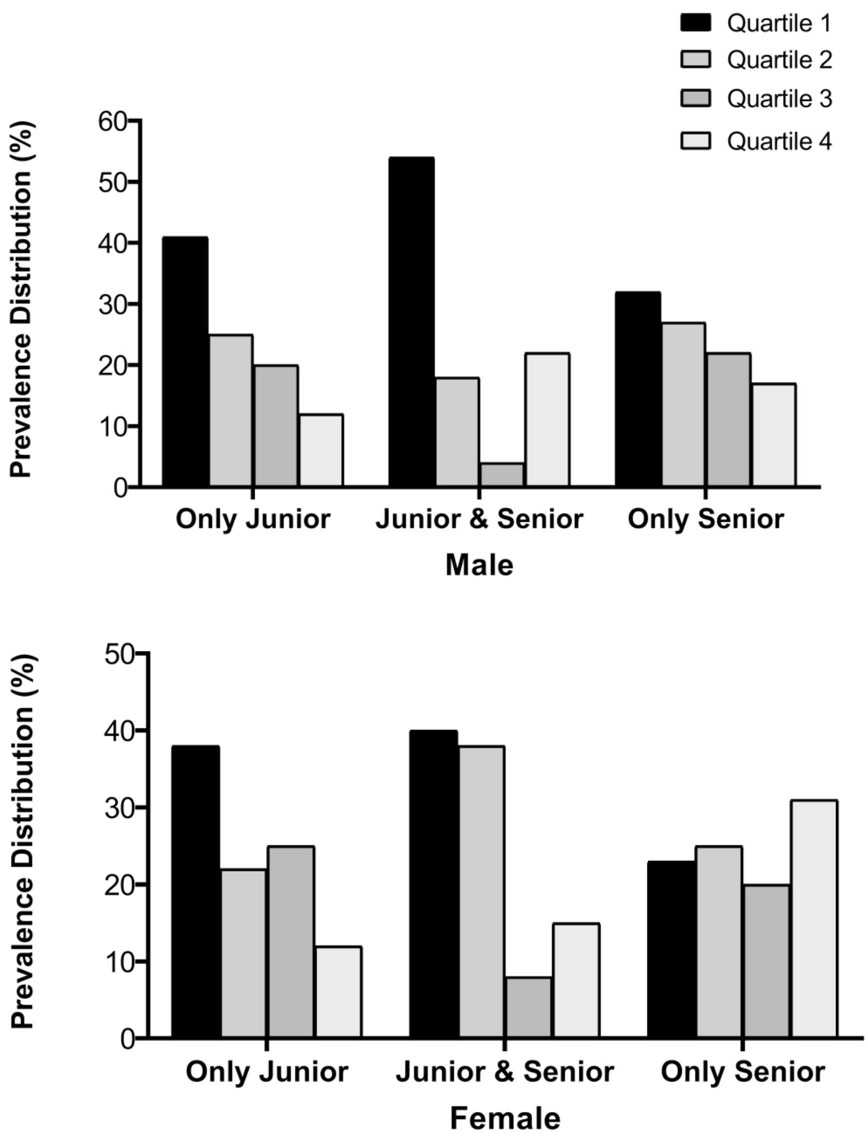

Figure 2. Quartile birth date distribution of swimmers in Only Junior, Junior & Senior and Only Senior subgroups. Data are merged between the different disciplines.

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Table 1. Descriptive data and ANOVA outcome of the Age of Peak Performance according to discipline and gender

Age of Peak Performance	Male						Female					
	Only Junior	*Junior & Senior*	*Only Senior*	ANOVA outcomes			*Only Junior*	*Junior & Senior*	*Only Senior*	ANOVA outcomes		
	M (90% CI)	M (90% CI)	M (90% CI)	Subgroup	Discipline	Subgroup x Discipline	M (90% CI)	M (90% CI)	M (90% CI)	Subgroup	Discipline	Subgroup x Discipline
Shot Put	22.4 (22.0, 22.9)	25.5 (22.3, 28.7)	26.8 (26.0, 27.6)[a]	F=222.42 P< 0.001	F=6.05 P< 0.001	F=2.72 P=0.013	20.7 (20.1, 21.3)	26.3 (24.4, 28.2)[a]	26.3 (25.4, 27.3)[a]	F=191.43 p<0.001	F=0.04 P=0.993	F=1.42 P=0.206
Discus Throw	22.0 (21.5, 22.5)	26.1 (24.8, 27.5)[a]	28.1 (27.5, 29.2)[a]				20.8 (20.2, 21.4)	24.6 (22.4, 26.8)[a]	28.2 (27.0, 29.4)[a]			
Hammer Throw	21.5 (21.2, 21.7)	27.0 (24.0, 30.0)[a]	27.8 (26.9, 28.8)[a]				21.4 (20.7, 22.1)	24.7 (23.5, 25.9)[a]	27.4 (26.6, 28.2)[a]			
Javelin Throw	21.0 (20.5, 21.5)	22.25 (20.8, 23.7)	27.0 (26.0, 28.0)[a,b]				20.5 (19.9, 21.1)	26.0 (23.6, 28.4)[a]	27.4 (26.5, 28.4)[a]			
All disciplines	21.7 (21.5, 22.0)	24.9 (23.8, 26.0)[a]	27.5 (27.0, 27.9)[a]				20.8 (20.5, 21.1)	25.3 (24.5, 26.1)[a]	27.3 (26.8, 27.8)[a]			

Note: [a], significant difference from Only Junior subgroup; [b], significant difference from Junior & Senior subgroup.

Supplementary 1. Quartile birth date distribution of swimmers in *Only Junior*, *Junior & Senior* and *Only Senior* subgroups and χ^2 and OR analysis.

	Male							Female						
	Q1(%)	Q2(%)	Q3(%)	Q4(%)	Chi Square outcomes	OR Q1/Q4	OR (Q1+Q2)/(Q3+Q4)	Q1(%)	Q2(%)	Q3(%)	Q4(%)	Chi Square outcomes	OR Q1/Q4	OR (Q1+Q2)/(Q3+Q4)
Only Junior	41.6	25.3	20.3	12.8	$\chi^2 = 50.50$ P < 0.001 V = 0.30	3.3 (2.0, 5.4)	3.0 (2.1, 4.4)	38.8	22.8	25.7	12.7	$\chi^2 = 33.20$ P < 0.001 V = 0.26	3.1 (1.8, 5.3)	1.6 (1.1, 2.3)
Junior & Senior	54.5	18.2	4.5	22.7	$\chi^2 = 11.00$ P = 0.01 V = 0.49	2.4 (0.5, 11.2)	2.7 (0.8, 8.36)	40	38	8	15	$\chi^2 = 12.60$ P = 0.007 V = 0.40	3.0 (0.7, 9.6)	3.4 (1.3, 8.8)
Only Senior	32.4	27.4	22.3	17.9	$\chi^2 = 8.42$ P = 0.038 V = 0.15	1.8 (1.0, 3.3)	1.5 (1.0, 2.2)	23.1	25	20	31.9	$\chi^2 = 4.85$ P = 0.183 V = 0.12	0.7 (0.4,1.0)	0.9 (0.6, 1.4)

Notes: Q1-Q4%, quartile percentage; χ^2, Chi-square value; P, p-value; V, Cramer's V; OR, odds ratio and 95% confidence intervals (95% CI); Q1/Q4, first vs. last quartile; (Q1+Q2)/(Q3+Q4), first and second Vs third and fourth quartile.