Sports Training

Relative age effect and age of peak performance: an analysis of women's football players in the Olympic games (1996-2016)

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Associate Editor: Dustin Jay Oranchuk, Auckland University of Technology, Sports Performance Research Institute New Zealand, Sprinz, New Zealand.

Abstract - Aim: The purpose of this study was to investigate the relative age effect and the age of peak performance of women's football players who participated in the Olympic Games from 1996 to 2016. **Methods:** Birth dates, playing positions, and nationality of all players registered in women's football competition in the Olympic Games (1996 to 2016) were collected. All data used in this study were obtained from the official website of the Federation Internationale de Football Association (www.fifa.com). The sample size of the study comprised 1,203 players. **Results:** We found an average age of 25.1 ± 4.0 years old and a significant increase of 1.4 years in the average age from 1996 (25.0 ± 3.9 years old) to 2016 (26.4 ± 3.7 years old) ($p < 0.001$). The comparison of the players' age between playing positions reveals that the goalkeepers are the oldest players (26.2 ± 4.4 years) and the forwards are the youngest players (24.4 ± 3.8 years) ($p < 0.001$). The RAE for women's football players showed neither effect over the years nor in different playing positions. **Conclusion:** We found an aging trend in women's football in the past two decades and different ages of peak performance among the playing positions. The current findings provide valuable information to coaches and professionals to program long-term training and to promote athletes' progression towards their performance targets.

Keywords: elite sport, development, athlete selection, maturation, women's sport.

Introduction

In elite sport, the path to excellence is a complex process being affected by direct (e.g. genes, training, and psychological characteristics) and indirect (e.g. social-cultural aspects, familial support, and instructional resources) factors[1]. Age has a dual role in this process acting as a direct factor and influencing indirect aspects of sports systems. On the one hand, chronological age, maturation, and growth are individual characteristics that influence the athlete's development. On the other hand, the age groups and the talent selection and judgment processes are human constructions that play an important role in maintaining and developing practitioners in the sport. This understanding led to two research topics related to the aging process in sport, the age of peak performance (APP) and the relative age effect (RAE). The former investigates the relationship between age and maximum sports performance, while studies on RAE investigate the influence of age, growth, and maturation on the selection, training, and development of the athletes. Both areas provide valuable information to coaches and scientists regarding the individual development of the athlete as well as the social-cultural influence on his/her formation.

The age of peak performance has been mainly investigated in athletics showing different characteristics between male and female athletes[2-5]. For instance, Lara et al.[5] showed that the best women's performance was obtained at 29 years and in men and at 27 years. Nikolaidis et al.[4] has also shown that women were older than the men in the 10-km, half-marathon, and marathon events. These results are important to analyze athletes' longitudinal performance and to program long-term training aiming to obtain maximal performance at specifics ages. However, the analysis of peak performance in team sports is more recent and mainly focused on male athletes. In football, Kalén et al.[6] have recently shown that the average age of men's players increased from 24.9 to 26.5 years over the last decades and suggested that factors like the increased investments of football clubs, increased support and facilities, and the greater monitoring led to an extended sports career. We found only one study on women's football showing the average peak age between 21-29 years of age based on the athletes at the London 2012 Olympic Games[7]. Although this cross-sectional study provided a picture of APP in women's football, the aging patterns in the past decades are still unknown. Furthermore, there is evidence that the physiological demands of football vary in different positional roles[8] indicating that the age of peak performance may also be different according to the tactical positions.

In international football, age becomes also an important indirect factor in athlete's development as players are organized in categories based on their chronological age aiming to promote fair and competitive competitions[9]. Most classification by chronological age uses a set cutoff date comprising one or two calendar years per cohort[10-12]. Although the classification is proposed to balance competition level, this division leads to an age difference of up to 11 or 23 months between the youngest and oldest athlete in the same category and the selection bias of athletes born in the early months of the years, known as relative age effect[13-15]. Based on the advanced growth and maturation and, consequently, on the physical, psychological, and cognitive advantage of the players, athletes, born in the early months of the years, have greater access to coaching and training, and more opportunities to develop in sport[16]. By contrast, relatively younger athletes may not receive adequate support, possibilities of practice, and play at lower competitive levels[17], which may reflect in higher ratios of drop out[18].

After decades of studies on RAEs in men's football and the knowledge of its negative consequences for the athlete's development, no change in RAEs was found over the past 10 years[10]. The great demand for the sport and the search for immediate results sustain the player selection bias in football. By contrast, cultural constraints have historically distanced women from sports and led to lower rates of sports participation. The gender constructions and differences in the opportunities of practice led to a different process of promoting and detecting talents. It is known that the influence of RAE on women's sports is smaller (in certain cases nonexistent) compared to male counterparts[19-21]. On the one hand, it can represent an alarming scenario reflecting the gender barriers that still prevent women from practicing sports. On the other hand, the lack of RAE can represent a structured system for sports development that provides fair development for many women's practitioners.

Studies on women's football showed no RAE in French[22] and Swiss players[17], while a broader analysis showed the lack of RAE in women's football players participating at Rio 2016 Olympic Games[23]. Still, significant RAEs were found in defenders and goalkeepers in Swiss national team[17], Spanish regional teams[24], and in different national teams from Europe and North and Central America in under-17 Women's FIFA World Cup[25]. The results indicate that coaches may tend to select relatively older athletes for goalkeepers and defenders looking for more mature and taller players[25]. These studies provided rich information on the (non) existence of the RAE in women's football in specific populations and periods. However, it is still unknown if RAE has been affected by the increase in the number of women's football practitioners in the past decades[26] as well as the differences in the RAE between practitioners of different positions and nationalities over time.

The present study intends to investigate these gaps in the literature on age, performance, and position in women's football. Therefore, this study aimed to investigate the APP and the RAE of elite women's football players and to analyze these phenomena over time and in athletes from different nationalities and playing positions.

Methods

Three methods are usually used to identify the APP in elite sports in the scientific literature: using the age at which top athletes achieve their best performance; calculating the age of top athletes competing at events such as the Olympics and World Championship, or analyzing the age-related career performance of top athletes[27]. This investigation is based on the age of the top athletes competing in the Summer Olympic Games from 1996 to 2016.

Data collection

Birth dates, playing positions, and nationality of all players registered in the women's football competition Olympic Games (1996 to 2016) were collected. The lower limit (1996) was defined based on the first edition of women's football at the Olympics and the upper limit (2016) represents the most recent edition at the time of this study. All data used in this study were obtained from the official website of the Federation Internationale de Football Association (www.fifa.com). The sample size of the study comprised 1,203 players.

Procedures and data analysis

Based on the birth dates, we calculated the age of the players in the different editions of the Olympic games. Descriptive statistics (mean, standard deviation, minimum, maximum) were used to summarize the collected data. The Lilliefors test was used to test data normality. The relationship between team average age and sports performance was analyzed using Spearman's correlation coefficient and the Mann-Whitney U Test (comparison between medalist and non-medalist teams). The Kruskal Wallis test was used to analyze the age of the players from different positions and seasons. Dunn's posthoc test was used when significant differences were found.

The birth month of each player was classified into four quarters. The cut-off date in FIFA championships is January 1st. The first quarter (Q1) represents January, February, and March; the second quarter (Q2) represents April, May, and June; the third quarter (Q3) represents

July, August, and September; and the last quarter (Q4) represents October, November, and December. Absolute and relative frequencies were used to summarize the collected data. A Pearson's Chi-Square test and odds ratios (OR) were used to assess the differences between the observed and expected birth months' distributions. The expected frequencies are based on the equally distributed birth rate over the year. This choice was made given the difficulty of accessing the birth statistics of each studied population[16]. To assess the magnitude of the effect size for the chi-square analyses, Cramer's V was used[17,25]. For the interpretation of the results, V between 0.06 and 0.17 was considered a small effect, from 0.18 to 0.29 was considered a medium effect, and above 0.30 was considered a large effect[28]. A standardized residual was also calculated, as suggested by Sharpe[29], and interpreted as significant when exceeding $z>|2.0|$. To compare the average age of the players among the six seasons, the Kruskal Wallis test with Dunn's post-hoc was used. The level of significance was set at $p < 0.05$. All analyses were performed using MATLAB (TheMathWorks).

Result

Figure 1 shows the age distribution of all the players from 1996 to 2016. We found an average age of 25.1 ± 4.0 years old, with 16 and 41 the minimum and maximum age, respectively.

Figure 2 shows the average age of the players in the six seasons. We found an increase of 1.4 years in the average age from 1996 (25 ± 3.9 years old) to 2016 (26.4 ± 3.7 years old). The average age in 2016 was significantly higher than the 1996, 2000, 2004 and 2008 seasons ($H(5)$ =32.29; $p < 0.001$).

Table 1 shows the average age of the players in different tactical positions over the six seasons of the tournament. Only the forwards showed an increase in average age from 2004 and 2008 to 2016 ($H(5)$ = 12.70; $p < 0.001$), while players from other positions showed no difference between the seasons.

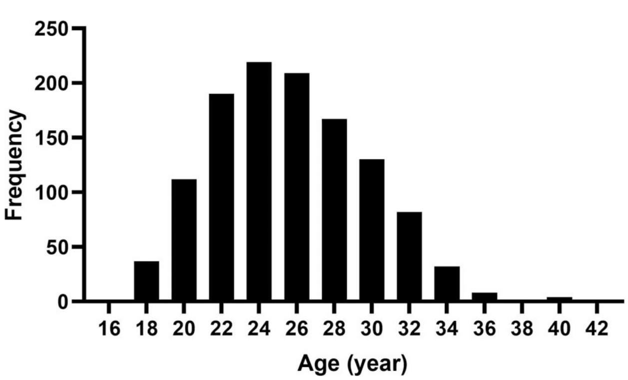

Figure 1 - Age distribution of women's football players in Olympic Games from 1996 to 2016.

The comparison of players' age between the playing positions reveals that goalkeepers are older than midfielders and forwards, and fullbackers are older than forwarders (Figure 3) ($H(3)$ = 19.76; $p < 0.001$).

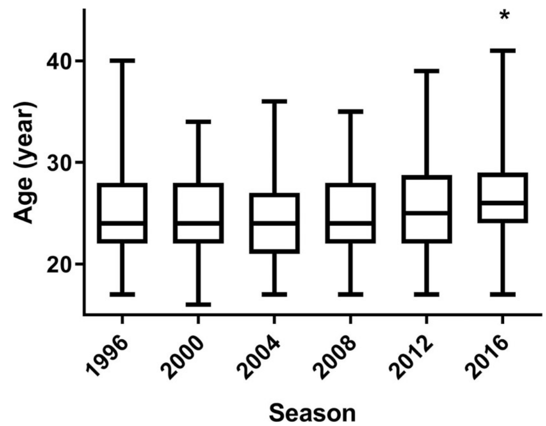

Figure 2 - The average age of women's football players in the Olympic Games from 1996 to 2016. Legend: * statistically different from 1996, 2000, 2004, and 2008 in Kruskal Wallis test ($p < 0.001$).

Table 1 - Age of the players in different tactical positions in the Olympic Games from 1996 to 2016.

	1996	2000	2004	2008	2012	2016	p-value
Goalkeeper	26.9 (4.4)	24.8 (4.1)	25.1 (3.8)	25.8 (4.4)	27.9 (5.4)	27.1 (4.0)	0.090
Fullbacker	25.0 (3.4)	25.0 (3.9)	25.1 (4.5)	25.2 (4.2)	25.6 (4.2)	25.6 (3.4)	0.142
Midfielder	24.6 (4.0)	24.7 (4.2)	24.1 (3.8)	24.8 (3.8)	24.9 (4.4)	26.2 (3.9)	0.066
Forward	24.6 (4.1)	24.0 (3.6)	23.5 (4.0)	23.7 (3.5)	24.7 (3.6)	25.9 (3.9)	0.026

Legend: data expressed as mean (STD).

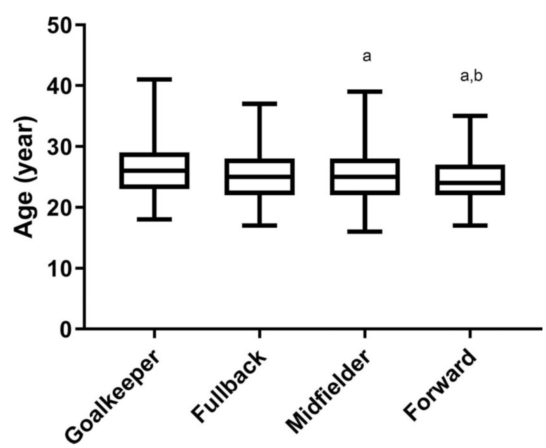

Figure 3 - Age of peak performance in women's football according to playing positions. Legend: a - statistically different from the goalkeeper, b - statistically different from fullback in Kruskal Wallis test ($p < 0.001$).

Table 2 shows the birth month distribution in each season. We found a small effect size and a non-significant standardized residual in all seasons indicating the absence of RAE in elite women's players at the Olympic Games.

Table 3 shows the distribution of the birth months by playing position. No RAE was found in goalkeepers, fullbacks, and midfielders. Although a significant RAE was found in forwards, the magnitude of effect reveals a small effect size and a non-significant standardized residual.

Discussion

This study aimed to investigate the relative age effect and the age of peak performance of women's football players who participated in the Olympic Games from 1996 to 2016. We found the current average age of 26 years old (SD = 4.0) with an aging trend over the years. The goalkeepers showed the highest average age (26.2 ± 4.4 years), while the forwards are the youngest players (24.4 ± 3.8 years). The analysis of the birth months showed neither RAE in women's football players over the years nor in different playing positions. Such information is useful in the decisions of athlete selection for major competition and in allocating funding and resources based on an athlete's chances of success[30,31].

The analysis of the average age and the standard deviations of women's football players showed that most of the athletes' age is between 21 and 29 years old. Although we found an increase in the average age in the last edition (2016), athletes remain below 30 years old. It is known that the game consists of stimuli of high-intensity aerobic and speed endurance fitness[32,33], requiring a high fitness of the resistance strength, agility, and speed capacities of the athletes[34,35]. The intermittent feature of the sport, coupled with high physical demand, limits the age of peak performance. The results of this study corroborate that sports that require a high fitness of strength and power capacities limit the APP until the 30 years old[36].

The average age of women's football players showed an increase of 1.4 years in the last two decades. The same pattern of increasing average age over the years was recently found in men's football[6]. According to the authors[6], the development of science, multidisciplinary work, and greater support for the athletes, made possible their greater permanence in the sport. Although women

Table 2 - Distribution of the birth months of women's football players in Summer Olympic Games.

Season		Q1	Q2	Q3	Q4	Chi-Square	p-value	OR Q1/Q4	V	Effect
1996	f (%)	41 (27%)	49 (33%)	28 (19%)	32 (21%)	7.066	0.066	1.28	0.125	Small
	Std. Res	0.4	1.6	−1.2	−0.8					
2000	f (%)	45 (26%)	58 (34%)	31 (18%)	39 (23%)	9.047	0.029	1.15	0.131	Small
	Std. Res	0.2	1.8	−1.4	0.4					
2004	f (%)	53 (25%)	58 (27%)	50 (23%)	54 (25%)	0.660	0.882	0.98	0.030	Small
	Std. Res	0.0	0.4	−0.4	0.0					
2008	f (%)	49 (23%)	61 (28%)	60 (28%)	47 (22%)	2.944	0.400	1.04	0.067	Small
	Std. Res	−0.4	0.6	0.6	−0.6					
2012	f (%)	62 (28%)	52 (24%)	65 (30%)	41 (19%)	6.436	0.096	1.51	0.098	Small
	Std. Res	0.6	−0.2	1.0	−1.2					
2016	f (%)	58 (26%)	58 (26%)	62 (28%)	41 (19%)	4.907	0.178	1.41	0.085	Small
	Std. Res	0.2	0.2	0.6	−1.2					

Table 3 - Distribution of the birth months by playing position in all Olympic Games (1996-2016).

Season		Q1	Q2	Q3	Q4	Chi-Square	p-value	OR Q1/Q4	V	Effect
Goalkeeper	f (%)	53 (27%)	53 (27%)	53 (27%)	34 (18%)	5.611	0.130	1.55	0.098	Small
	Std. Res	0.4	0.4	0.4	−1.4					
Fullback	f (%)	123 (25%)	143 (29%)	102 (21%)	120 (25%)	6.934	0.074	1.02	0.068	Small
	Std. Res	0.0	0.8	−0.8	0.0					
Midfilder	f (%)	139 (27%)	136 (27%)	106 (21%)	126 (25%)	5.260	0.150	1.10	0.058	Small
	Std. Res	0.4	0.4	−0.8	0.0					
Forward	f (%)	96 (27%)	105 (30%)	72 (21%)	78 (22%)	8.172	0.042	1.23	0.087	Small
	Std. Res	0.0	1.0	−0.8	−0.6					

receive less investment than men, the increased support received over time may have contributed to extending their careers. It is possible that, even with the social barriers that still exist for the participation of women in sport, the sports development system is providing better opportunities and support for the players allowing them to extend their careers.

The sample analyzed in this study also contributes to explaining the increase in average age. International championships, such as the Olympic Games, are characterized by full stadiums with a high demand for sports performance. Athletes' performance might be negatively affected by the stressful environment if they are not familiarized with it[37]. Therefore, being older and having previous experiences in the competition are important for the development of coping strategies and effectiveness[38]. Furthermore, lower rates of player turnover may be beneficial for team performance in women's football championship at elite level[37]. Maintaining teammates together for a longer period might improve human and social capital[37]. Consequently, increasing the team's average age might be beneficial for performance. These results reinforce the need to prolong women's football players' careers, thought greater support for the athletes, allowing their physical, technical, and tactical development throughout a long-term training program.

The analysis by playing position in women's football revealed that goalkeepers and defenders are older than forwarders corroborating previous findings in men's football[6]. The lower physical demand for goalkeepers and defenders is possible one of the reasons they tend to peak at a later age and maintain a high performance higher up in age[6]. For instance, it is known that defenders perform less high-intensity running during a game than midfielders and attackers[39]. On the contrary, the higher amount of high-intensity activity performed by forwarders[32,33] is probably one of the causes of the earlier APP.

The results of this study corroborate previous findings of no existence of RAEs in women's football national teams[17,22,23,25,40]. As a possible and optimistic explanation, women's football has been recently practiced in high performance (e.g. the first FIFA Women's World Cup was established in 1991) and, possibly, it is being structured in order to avoid the RAE phenomenon. The sports development system provides the players a fair structure for long-term development without favoring those born at the beginning of the year and who have psychophysiological advantages. We suggest that these hypotheses should be investigated by future studies. But, the lack of RAE might also indicate that, although female football players have increased 38% since 2000[26], a greater number of athletes does not seem enough to increase the competition in selection and, consequently, the occurrence of RAE. Women still face disadvantages accessing and developing in sports and, consequently, there is less competition and less selection for the entrance and development in the sport compared to men[22].

Lastly, to compare the observed and expected frequency of birth we assumed a uniform distribution over the months. It should be recognized that the assumption of uniform wider populations for all gender, region, and age subgroups is a limitation of our study[41].

Conclusion

In this study, we investigated the age and birth date of players in one of the main events in elite women's football, the Summer Olympic Games. We found the current average age of 26.4 years old in elite football players and an aging trend in the past two decades. Coaches should consider the differences between players from different playing positions to program long-term training. We found the highest average age in goalkeepers (26 years old) and the youngest players as the forwards (24.4 years old). This knowledge provides valuable information to coaches and professionals involved in training to program, plan and promote athlete's progression towards their performance targets. The analysis of the birth months showed neither RAE in women's football players over the years nor in different playing positions. There is the need for future studies that assess whether the absence of RAE remains as the recruiting bias does not benefit player development or on-field success.

References

1. Baker J, Horton S. A review of primary and secondary influences on sport expertise. High Abil Stud. 2004;15(2):211-28. doi:10.1080/1359813042000314781
2. Nikolaidis PT, Ramón Alvero-Cruz J, Villiger E, Rosemann T, Knechtle B. The Age-Related Performance Decline in Marathon Running: The Paradigm of the Berlin Marathon. 2019;16(11):2002. doi:10.3390/ijerph16112022
3. Zavorsky GS, Tomko KA, Smoliga JM. Declines in marathon performance: Sex differences in elite and recreational athletes. PLoS One. 2017;12(2):e0172121. doi:10.1371/journal.pone.0172121
4. Nikolaidis PT, Onywera VO, Knechtle B. Running performance, nationality, sex, and age in the 10-km, half-marathon marathon, and the 100-km ultramarathon IAAF 1999-2015. J Strength Cond Res. 2017;31(8):2189-207. doi:10.1519/jsc.0000000000001687
5. Lara B, Salinero JJ, Del Coso J. The relationship between age and running time in elite marathoners is U-shaped. Age. 2014;36(2):1003-8. doi:10.1007/s11357-013-9614-z
6. Kalén A, Rey E, de Rellán-Guerra AS, Lago-Peñas C. Are soccer players older now than before? Aging trends and market value in the last three decades of the UEFA champions league. Front Psychol. 2019;10. doi:10.3389/fpsyg.2019.00076
7. Barreira J. Age of Peak Performance of Elite Women's Soccer Players. Int J Sports Sci. 2016;6(3):121-4.

8. Martínez-Lagunas V, Niessen M, Hartmann U. Women's football: Player characteristics and demands of the game. J Sport Heal Sci. 2014;3(4):258-72. doi:10.1016/j.jshs.2014.10.001
9. Hurley E, Comstock BA, Haile L, Beyer KS. Relative Age Effect in Collegiate Soccer: Influence of Nationality, Playing Position, and Class. J Strength Cond Res. 2019;33(12):3295-301. doi:10.1519/JSC.0000000000003356
10. Helsen WF, Baker J, Michiels S, Schorer J, van Winckel J, Williams AM. The relative age effect in European professional soccer: Did ten years of research make any difference? J Sports Sci. 2012;30(15):1665-71. doi:10.1080/02640414.2012.721929
11. Helsen WF, Van Winckel J, Williams AM. The relative age effect in youth soccer across Europe. J Sports Sci. 2005;23(6):629-36. doi:10.1080/02640410400021310
12. Delorme N, Boiché J, Raspaud M. Relative age effect in elite sports: Methodological bias or real discrimination? Eur J Sport Sci. 2010;10(2):91-6. doi:10.1080/17461390903271584
13. Williams JH. Relative age effect in youth soccer: Analysis of the FIFA U17 World Cup competition. Scand J Med Sci Sport. 2010;20(3):502-8. doi:10.1111/j.1600-0838.2009.00961.x
14. Lovell R, Towlson C, Parkin G, Portas M, Vaeyens R, Cobley S. Soccer player characteristics in English lower-league development programmes: The relationships between relative age, maturation, anthropometry, and physical fitness. PLoS One. 2015;10(9). doi:10.1371/journal.pone.0137238
15. Nora Wiium, Yngrar Ommundsen, Hege R. Enksen, Stein Atle Lie. Does Relative Age Effect Exist among Norwegian Professional Soccer Players? International J Appl Sport Sci. 2010;22(2):66-76. doi:10.24985/ijass.2010.22.2.66
16. Cobley S, Baker J, Wattie N, McKenna J. Annual age-grouping and athlete development: A meta-analytical review of relative age effects in sport. Sport Med. 2009;39(3):235-56. doi:10.2165/00007256-200939030-00005
17. Romann M, Fuchslocher J. Relative Age Effects in Swiss Women's Soccer. 2011.
18. Delorme N, Boiché J, Raspaud M. Relative age effect in female sport: A diachronic examination of soccer players. Scand J Med Sci Sport. 2010;20(3):509-15. doi:10.1111/j.1600-0838.2009.00979.x
19. Albuquerque MR, Franchini E, Lage GM, Da Costa VT, Costa IT, Malloy-Diniz LF. The relative age effect in combat sports: An analysis of Olympic judo athletes, 1964-2012. Percept Mot Skills. 2015;121(1):300-8. doi:10.2466/10.PMS.121c15x2
20. Müller L, Hildebrandt C, Schnitzer M, Raschner C. The role of a relative age effect in the 12th winter European youth olympic festival in 2015. Percept Mot Skills. 2016;122(2):701-18. doi:10.1177/0031512516640390
21. Smith KL, Weir PL, Till K, Romann M, Cobley S. Relative age effects across and within female sport contexts: a systematic review and meta-analysis. Sports Med, 48(6). 2018; 1451-78.
22. Delorme N, Boiché J, Raspaud M. The relative age effect in elite sport: The french case. Res Q Exerc Sport. 2009;80(2):336-44. doi:10.1080/02701367.2009.10599568
23. Barreira J, Bueno B, Chiminazzo JGC. Relative age effect in women's soccer: an analysis of player nationality and playing position at the Rio 2016 Olympic Games. Sport Sci. 2018;11(1):37-41.
24. Sedano S, Vaeyens R, Redondo JC. The Relative Age Effect in Spanish Female Soccer Players. Influence of the Competitive Level and a Playing Position. J Hum Kinet. 2015;46(1):129-37. doi:10.1515/hukin-2015-0041
25. Romann M, Fuchslocher J. Influences of player nationality, playing position, and height on relative age effects at women's under-17 FIFA World Cup. J Sports Sci. 2013;31(1):32-40. doi:10.1080/02640414.2012.718442
26. FIFA. FIFA Women's Football Survey. 2014.
27. Allen S V., Hopkins WG. Age of Peak Competitive Performance of Elite Athletes: A Systematic Review. Sport Med. 2015;45(10):1431-41. doi:10.1007/s40279-015-0354-3
28. Cohen J. Statistical Power Analysis for the Behavioral Sciences. L. Erlbaum Associates; 1988.
29. Sharpe D. Your chi-square test is statistically significant: Now what? Pract Assessment, Res Eval. 2015;20(8):1-10.
30. Allen S V., Vandenbogaerde TJ, Hopkins WG. Career performance trajectories of Olympic swimmers: Benchmarks for talent development. Eur J Sport Sci. 2014;14(7):643-51. doi:10.1080/17461391.2014.893020
31. Hollings SC, Hopkins WG, Hume PA. Age at Peak Performance of Successful Track & Field Athletes. Int J Sports Sci Coach. 2014;9(4):651-61. doi:10.1260/1747-9541.9.4.651
32. Andersson HÅ, Randers MB, Heiner-Møller A, Krustrup P, Mohr M. Elite female soccer players perform more high-intensity running when playing in international games compared with domestic league games. J Strength Cond Res. 2010;24(4):912-19. doi:10.1519/JSC.0b013e3181d09f21
33. Krustrup P, Mohr M, Ellingsgaard H, Bangsbo J. Physical demands during an elite female soccer game: Importance of training status. Med Sci Sports Exerc. 2005;37(7):1242-8. doi:10.1249/01.mss.0000170062.73981.94
34. Mujika I, Santisteban J, Impellizzeri FM, Castagna C. Fitness determinants of success in men's and women's football. J Sports Sci. 2009;27(2):107-14. doi:10.1080/02640410802428071
35. Manson SA, Brughelli M, Harris NK. Physiological characteristics of international female soccer players. J Strength Cond Res. 2014;28(2):308-18. doi:10.1519/JSC.0b013e31829b56b1
36. Radek V. Identification of peak performance age in track and field athletics. In: International Journal of Performance Analysis in Sport. Vol 14. Centre for Performance Analysis; 2014:238-51. doi:10.1080/24748668.2014.11868718
37. Barreira J, De Sousa GC, Galatti LR. Player turnover and team performance in FIFA Women's World Cup. Motriz Rev Educ Fis. 2019;25(3):1-6. doi:10.1590/s1980-6574201900030002
38. Nicholls AR, Polman RCJ. Coping in sport: A systematic review. J Sports Sci. 2007;25(1):11-31. doi:10.1080/02640410600630654
39. Mohr M, Krustrup P, Bangsbo J. Match performance of high-standard soccer players with special reference to the

development of fatigue. J Sports Sci. 2003;21(7):519-28. doi:10.1080/0264041031000071182
40. Vincent J, Glamser FD. Gender differences in the relative age effect among US Olympic Development Program youth soccer players. J Sports Sci. 2006;24(4):405-13. doi:10.1080/02640410500244655
41. Edgar S, O'Donoghue P. Season of birth distribution of elite tennis players. J Sports Sci. 2005;23(10):1013-20. doi:10.1080/02640410400021468

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Manuscript received on April 7, 2021
Manuscript accepted on August 1, 2021