Relative Age Effect in the Girls' Volleyball U18 World Championship

by
Fábio A. D. Campos[1], Ídico L. Pellegrinotti[2], Leandra C. B. Campos[1,2],
Tiago M. R. Dias[3], Miguel-Ángel Gómez[4]

The relative age effect (RAE), within the sporting scope, refers to the possible advantages of participation and performance of athletes born in the first months of the year of selection in relation to others within the same age category. The aim of the present study was to investigate the RAE in girls' volleyball players participating in the U-18 World Championship, analysing the differences between the medal teams and other teams in the tournament, and considering this phenomenon in relation to the continents. Data collection was obtained from the website of the International Volleyball Federation with a sample made of 1654 youth players in the last six world championships (2007, 2009, 2011, 2013, 2015 and 2017). A greater representation of athletes born in the first months of the year of all the world championships was observed. In the comparison among the continents, it was observed that in Africa, there was a more equal distribution of quartiles compared to America, Asia and Europe. It should be noted that there was a higher percentage of medalist athletes born at the beginning of the year in comparison to the countries that placed in the last three positions of the championship. Therefore, in U-18 female volleyball, there is an advantage to have the closest birth age at the beginning of the competitive biennium.

Key words: youth, volleyball, birth date, player selection, age effect.

Introduction

The priority for the selection of athletes born at the beginning of the year is a phenomenon observed in several competitive and amateur sports and is called the relative age effect (RAE). In general, the main reason for age-related groupings is to minimize developmental differences and to ensure more equitable competition in the minor categories. Even in this system designed to promote equity, inequalities exist. The RAE is based on systems that primarily use January 1st as the cut-off date. There are studies that have been based on other cut-off dates, mainly related to local culture (Lídor et al., 2010; Reed et al., 2017).

Compared to a child born in December, a child born in January of the same year can have a benefit of up to 364 days in their cognitive and physical development, although these two young people are in the same age category (Kalinski et al., 2017). Thus, within a biennial system that uses January 1st as the cut-off date, a child born in January of the first year of a category will show a discrepancy of up to 23 months with a child born in December of the second year. The main difference between athletes of early and late maturity is related to physical maturation (such as body height, bone development, or body mass) and the performance factors that accompany the

---

[1] – *Federal Institute of Education, Science and Technology Goiano, Ceres, Brazil.*
[2] - *Methodist University of Piracicaba, Piracicaba, Brazil.*
[3] - *Sesi Volleyball Club, São Paulo, Brazil.*
[4] - *Polytechnic University of Madrid, Madrid, Spain.*

influence of muscle mass (Cobley et al., 2009; Musch and Grondin, 2001).

Two arguments have been suggested to explain the RAE (Baker and Logan, 2007). First, older athletes are probably more experienced than younger athletes in various physical abilities, such as balance, coordination, speed and strength, and therefore better in sports skills. Second, older athletes in a cohort are more likely to be selected for better teams, and therefore, the guidance and training provided are superior to that of younger athletes. This more advanced training, as well as an enhanced support environment, will likely enable older athletes to improve their physical and athletic abilities to a greater extent than younger athletes. The RAE implies that individuals who are relatively older than their peers in a given cohort are more likely to have better achievements (Musch and Grondin, 2007; Wattie et al., 2008). In collective sports, in which physical and cognitive skills are crucial to performance in grassroots competitions, tournament organizations rely exclusively on winning rather than developing long-term sports training (Musch and Grondin, 2007).

In fact, understanding the qualities that support sports performance and facilitate their development is the cornerstone of sports sciences (Baker and Schorer, 2010). Understanding the relative importance of factors that separate elite athletes from less-skilled athletes is a necessary precursor to evidence-based talent development programmes (Farrow, 2010).

The presence of a RAE is consolidated in the youth categories of collective sports, such as basketball (Arrieta et al., 2016; Oliveira et al., 2017; Subijana and Lorenzo, 2018), handball (Gómez-Lopes et al., 2017) or soccer (Folgado et al., 2006; Rubajczyk and Rokita, 2018; Subijana and Lorenzo, 2018). Williams (2010) sought to determine whether a RAE existed in the competition of the FIFA U-17 World Cup from 1997 to 2007. The results of this investigation showed that, at the highest level of youth soccer, there was a strong trend towards inclusion of players born earlier in the selection year in question.

In volleyball, Campos et al. (2016) investigated the RAE in the world men's volleyball competitions in four different categories (Boys' U19 World Championship,

Men's U21 World Championship, Men's U23 World Championship and Men's World Cup) and concluded that in all categories, there was a prevalence of athletes born at the beginning of the competitive year, especially in the younger competitions. In volleyball, competitions involving young athletes are held every two years, indicating that athletes may have considerable differences in their maturational stages of development (Musch and Grondin, 2001).

Although the RAE was extensively researched in men's sports, little work was done identifying the prevalence of the RAE in female sports. To date, only 2% of the available research focused on the RAE has analysed the female context (Cobley et al., 2009). In this sense, special attention should be paid since the results of the masculine and feminine genders can be contradictory in all categories. The contradictory results obtained in the scarce studies involving female participants showed that current knowledge about the mechanisms that explain the presence or absence of the RAE remains to be improved (Delorme et al., 2010a). Although this number has probably increased in recent years, it is still unclear why female sports received little attention in the literature (Dixon et al., 2013).

To our knowledge, no study has yet focused on girls' volleyball in youth tournaments, more precisely in U-18 championships. Thus, the goals of this study were 1) to determine the average age and quarterly cut-off of all athletes who participated in the U18 World Championship (2007 to 2017); 2) to determine differences in the average age between the teams that were medallists and the teams that were placed in the last three positions of the championship; and 3) to determine the relative age differences comparing the four continents that participated in the championships (Africa, America, Asia and Europe). Our first hypothesis was that the effect of relative age existed in volleyball, particularly related to the high level of the championship analysed. The second hypothesis was that the best teams qualified in the championship (medallists) had a more consistent effect when compared to the other teams, and the third hypothesis was related to whether this effect occurred in all the countries that participated in these championships, independent of the continent.

Methods

Sample

The sample consisted of 1654 girls' athletes from 28 countries that participated in the last six editions of the World Volleyball Championship (2007, 2009, 2011, 2013, 2015 and 2017). The competition was selected for this study because it is considered a competition with a high performance level in the youth category.

Procedures

Statistical data for this study were extracted directly from the official website of the Fédération Internationale de Volleyball, publicly available at http://www.fivb.com. The website of the competition provides statistical data about each player's name, day and month of birth, height, and their countries. The cut-off date in the FIVB system is January 1st. Thus, the birth months of the young players were classified in two ways: in eight quarters, Q1 (January to March), Q2 (April to June), Q3 (July to September), and Q4 (October to December) to the first year of the competition, and Q5 (January to March), Q6 (April to June), Q7 (July to September), and Q8 (October to December) to the second year; the second way was whether the players were younger than the competitive biennium: Y.

Players younger than the target year of the competition were also analysed according to their birth months. The results were compared in three different ways. First, the objective was to identify the RAE phenomenon in the whole group analysed. The next objective was to compare the results of the medal teams in comparison to the teams that stayed in the other rankings (medallists vs intermediate teams vs the last three teams of each championship) and, finally, to analyse the possible differences that existed in comparison to the different continents.

This method of data analysis has been used in previous studies (Campos et al., 2016; Dixon et al., 2013). The study sample was composed of young players from different countries so that the expected values were calculated on the assumption of a uniform distribution of birth throughout each quarter of the year, as was established in the available research (Campos et al., 2017; Reed et al., 2018).

Statistical Analysis

The RAE is identified when a significant difference is found between the expected theoretical number of players born per month or quarter (i.e., three consecutive months) and the observed number of players. A chi-square goodness-of-fit test was conducted to determine if the quarterly distribution differed significantly from the expected theoretical distribution. Due to this aspect, the newly published studies perform all analyses based on the theoretical assumption that birth dates are equally distributed. One-way analysis of variance was performed to compare height among performance groups (medallists, intermediaries and last ranking) and between continents (Africa, America, Asia and Europe). The Bonferroni post hoc test was applied to test pairwise comparisons among continents. The data were analysed using the statistical software IBM SPSS Statistics for Windows (Version 21.0, Armonk, NY: IBM Corp.). The level of significance was set at $p < .05$.

Results

A total of 28 countries participated in the six tournaments in the present study. In 2007, 2009 and 2011, 16 countries participated, while 20 countries participated in the world Championship in 2013, 2015 and 2017. Table 1 shows the birthdate distribution by quartile for the total sample according to the World Championship. The observed distribution was significantly different ($p < .01$). These U-18 tournaments are related to players aged between 16 and 17 years old, although players under the age of 16 were observed in the championships. In general, 61.3% of the athletes were born in the first year of the biennium, 29.1% were born in the second year and 9.6% were athletes of the categories below the biennium of the competition. It is worth noting that there was a higher frequency of players born in the first half of the year and a lower frequency of players born in the second half of the year.

Table 2 shows the distribution in quarters of the dates of birth according to classification. Specifically, Table 2 shows that in the medal teams, approximately 40% of the young athletes were born in the first semester of the competitive biennium, while in the teams that were in the intermediary positions, 37% were born in the first semester. In the teams that were placed in the last three positions of the tournament, only 25% of the athletes were born in the first semester. In the teams that were last placed, 22% of the athletes

were younger than the competitive biennium. The results showed that there were significant differences ($p < .01$).

Table 3 presents the distribution in quarters of the dates of birth according to the continent. In the first analysis, we can observe the specific characteristics of the countries in the African continent. There were significant differences among all continents ($p < .01$). In these locations, the quartile distribution was more homogenous throughout the eight quartiles, and approximately 30% of the athletes who participated in the championships were younger than the competitive biennium. This fact was not observed considering the other continents. For example, in Europe, only 3% of young athletes were younger than the competitive biennium.

Figure 1 presents players' height in each performance group at FIVB Girl's U18 Championship. There were significant differences among all groups ($p < .01$). It was observed that the medal teams had higher stature than the other teams.

Figure 2 shows the height of the young athletes according to the continents. The results showed that there were significant differences in the comparison of all continents ($p < .01$), except when comparing Africa and Asia ($p > .05$).
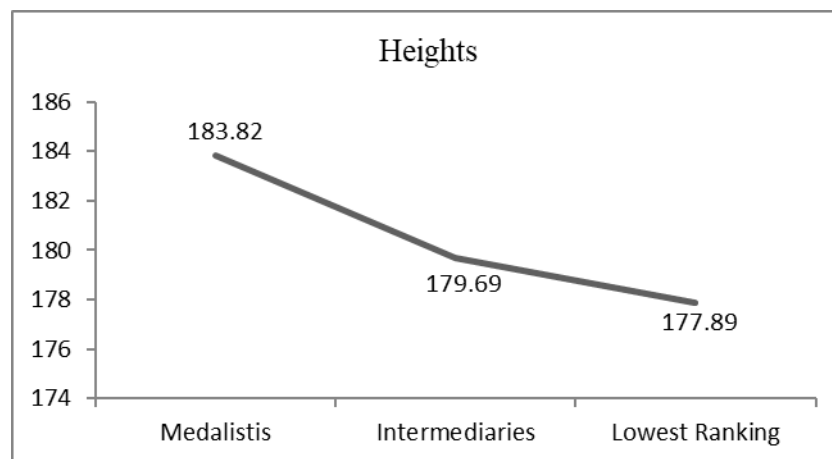

Figure 1

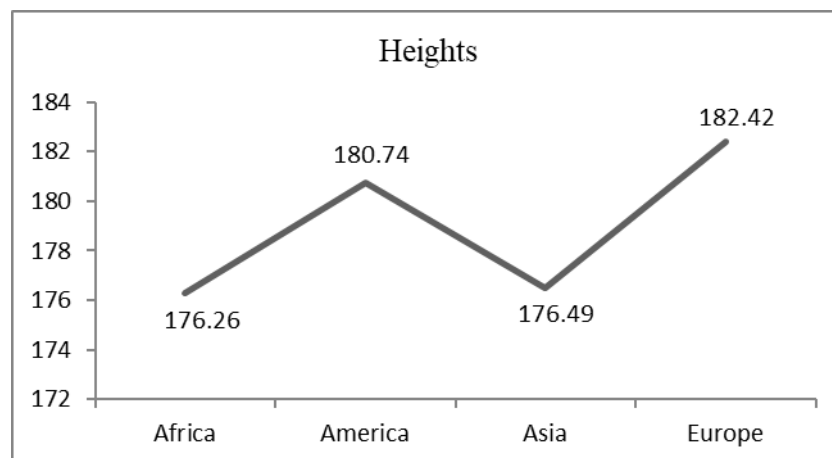*Players' height in each performance group at the FIVB Girl's U18 Championship*

Figure 2

Players' height in each continent group at the FIVB Girl's U18 Championship

Table 1

RAEs in the Girls` U18 World Championship according to the World Championship.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Y	χ^2	OR Q1/Q8	OR Q1/Y
Mexico 2007	38	34	31	23	15	12	13	11	14			
n = 191	20%	18%	16%	12%	8%	6%	7%	6%	7%	42.010	3.45	2.71
Thailand 2009	30	32	33	26	19	16	17	7	12			
n = 192	16%	17%	17%	14%	10%	8%	9%	4%	6%	32.438	4.29	2.50
Turkey 2011	51	50	50	27	30	15	11	21	42			
n = 297	17%	17%	17%	9%	10%	5%	4%	7%	14%	60.000	2.43	1.21
Thailand 2013	66	66	48	40	36	35	23	10	29			
n = 353	19%	19%	14%	11%	10%	10%	7%	3%	8%	70.408	6.60	2.28
Peru 2015	64	60	48	49	36	29	27	22	46			
n = 381	17%	16%	13%	13%	9%	8%	7%	6%	12%	41.055	2.91	1.39
Argentina 2017	44	46	34	24	31	14	22	9	16			
n = 240	18%	19%	14%	10%	13%	6%	9%	4%	7%	50.625	4.89	2.75

Table 2

RAEs in the Girls` U18 World Championship according to the classification.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Y	χ^2	OR Q1/Q8	OR Q1/Y
Medalists	52	58	51	26	24	22	23	10	9			
n = 275	19%	21%	19%	10%	9%	8%	8%	4%	3%	88.764	5.20	5.78
Intermediaries	205	198	174	133	112	81	67	50	91			
n = 1111	19%	18%	16%	12%	10%	7%	6%	5%	8%	214.041	4.10	2.25
Lowest ranking	36	32	19	30	31	18	23	21	58			
n = 268	13%	12%	7%	11%	12%	7%	9%	8%	22%	40.955	1.71	0.62

Table 3

RAEs in the Girls` U18 World Championship according to the continent.

Continent (number of countries)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Y	χ^2	OR Q1/Q8	OR Q1/Y
Africa (3)	17	18	10	18	13	9	12	4	44			
n = 145	12%	12%	7%	12%	9%	6%	8%	3%	30%	64.979	4.25	0.39
America (9)	91	95	78	74	60	41	31	35	73			
n = 578	16%	16%	13%	13%	10%	7%	5%	6%	13%	70.716	2.60	1.25
Asia (5)	54	78	62	33	30	24	22	13	21			
n = 337	16%	23%	18%	10%	9%	7%	7%	4%	6%	103.733	4.15	2.57
Europe (11)	131	97	94	64	64	47	48	29	20			
n = 594	22%	16%	16%	11%	11%	8%	8%	5%	3%	153.758	3.73	1.25

Discussion

The current study was designed to 1) determine the average age and quarterly cut-off of all athletes who participated in the U18 World Championship (2007 to 2017); 2) determine differences in the average age between the teams that were medallists and the teams that placed in the last three positions of the championship; and 3) determine the relative age differences among the players from the four continents that participated in the championships (Africa, America, Asia, and Europe).

The first hypothesis predicted the effect of relative age on women's volleyball World Championships in the U-18 category. The data presented supported this hypothesis and showed that the percentage of young athletes born in the first half of the competitive biennium was higher in the first months of the year compared to other months of the year in the competitive biennium. In agreement with previous research on women's sports, there were more young athletes born in the first months of the year (Cobley et al., 2008; Delorme et al., 2010a; Wilson, 1999). Previously, researchers have suggested that the prevalence of the RAE in sports is driven by different mechanisms and hypotheses.

Among the most widely used hypotheses to explain these observed differences is the maturational theory, which is based on maturation differences attributable to age variations in a single age group (Delorme et al., 2010b; Helsen et al., 2005; Musch and Grondin, 2001). This theory suggests that when players are selected for a team, there is a tendency for the selection of those born in the first months of the year. These players have a more advanced maturational age for their selection year, which gives them a number of anthropometric and physical abilities over other younger players born in the last months of the same year. In relation to the international competitions of volleyball in the basic categories that determine a competitive period, these differences are expressly identified (Table 1).

The hypothesis of maturational theory suggests that physical development is an important factor in sports in which advanced maturation promotes performance. Volleyball is one of those sports in which certain anthropometric characteristics combined with physical performances (e.g., strength, power, agility) are important requirements (Petroski et al., 2013; Tsoukos et al., 2019). When analysing height, we observed that the medallist athletes were taller compared to other teams (Figure 2). This fact corroborates the advantages of athletes born at the beginning of the year (Musch and Grondin, 2001).

Among the environmental factors are the quality of the training programme, training and family support. It is assumed that each factor, as well as the interactions among factors, influences the chances of an athlete achieving a high level of excellence in a sport. Howe et al. (1998) contextualized that in sports, a young person's likelihood of achieving high levels of sports performance may be dependent on innate talent or prolonged exposure to environmental stimuli that promote learning and development. The development of sports talent is a non-linear process and predicts that a series of developmental trajectories in different time periods may lead to the achievement of sports knowledge (Phillips et al., 2010).

The second hypothesis was that the teams with the best performances in the championships (that is, the teams that finished in the first three places) had a more consistent effect from the RAE when compared to the other teams. The data of the present study supported this hypothesis, showing that the teams with greater competitive performance were those with a higher RAE athletes born at the beginning of the competitive year or the competitive biennium. This fact reflects that the selection process of talented players is mainly based on the RAE criterion and, consequently, players born in the first months of the year are more often selected to be part of training teams and participate in national youth competitions (Delorme et al., 2010b).

The results differentiating continents pointed out the RAE effect, supporting the third hypothesis of the present study. It should be noted that the athletes born in Africa, regarding the distribution of birth dates, were more equitable than in the other continents observed. In U-17 men's soccer, the RAE was observed in different countries when analysing the Soccer World Cup of the category, except for in Nigeria and the Ivory Coast, where an inverse effect of relative age was observed (Sallaoui et al., 2014).

One of the arguments may be related to the smaller number of children and adolescents practising this sport modality, making the coach selection process more flexible than that conducted by coaches from other continents. This fact has already been observed in other studies that analysed countries with lower numbers of inhabitants (Lédor et al., 2010).

From another perspective, coaches are able to select children who are not necessarily advanced in their development since only a small number of children are competing for the available number of places in the sporting activity. It has already been suggested that a lack of competition can serve as a moderator for the RAE. It may be beneficial for relatively younger athletes to have the opportunity and need to develop the specific technical or tactical skills necessary to compete successfully against their older adversaries with greater maturational development (Schorer et al., 2009).

Some practical suggestions can be listed to decrease the RAE. One possible solution is to design multiple base teams in multiple patterns, allowing children to have the opportunity for fair competition. Another possible solution is to shorten the cut-off date of the age of the championships. In the case of volleyball, hold annual and/or semi-annual championships. In this way, the RAE could be reduced. In a recent study, the RAE dynamic model showed that a lower cut-off variation (every six months), coupled with additional support for children unable to participate throughout the process, led to a 96% RAE reduction (Pierson et al., 2014). Finally, raising awareness about the RAE is a possible approach to the problem because those who are responsible for organizing a sport must understand the issue of the RAE and how it can affect the development of young people in competitive sports.

Conclusion

In conclusion, the present study demonstrated the presence of RAE in females when analysing U-18 volleyball competitions. In addition, the RAE was more related to the performance of the teams since the best placed teams had more expressive results in the RAE when compared to the other teams investigated. Another highlight is the data from Africa, where a considerable number of lower-level athletes competed in the U-18 category. This suggests the need to improve the information and training processes of young volleyball players so that the results can help coaches and technical staff in the training process of this modality from a long-term perspective.

References

Arrieta H, Torres-Unda J, Gil SM, Irazusta J. Relative age effect and performance in the U16, U18 and U20 European Basketball Championships. *J Sports Sci*, 2016; 34(16): 1530-1534

Baker J, Logan AJ. Developmental contexts and sporting success: birth date and birthplace effects in national hockey league draftees 2000–2005. *Br J Sports Med*, 2007; 41(8): 515-517

Baker J, Schorer J. Identification and development of talent in sport: Introduction to the special issue. *Talent Development & Excellence*, 2010; 2(2): 119-121

Campos FA, Campos LC, Pellegrinotti IL, Gómez MA. The relative age effect in soccer: an analysis of the U20 Libertadores Cup. *Int J Exer Sci*, 2017; 10(8): 1157-1164

Campos FAD, Stanganelli LCR, Rabelo FN, Campos LCB, Pellegrinotti ÍL. The relative age effect in male volleyball championships. *Int J Sports Sci*, 2016; 6(3): 116-120

Cobley S, Abraham C, Baker J. Relative age effects on PE attainment and school sport representation. *Physical Education and Sport Pedagogy*, 2008; 13: 267–276

Cobley S, Baker J, Wattie N, McKenna J. Annual age-grouping and athlete development: A meta-analytical review of relative age effects in sport. *Sports Med*, 2009; 39: 235–256

Delorme N, Boiché J, Raspaud M. Relative age effect in female sport: a diachronic examination of soccer players. *Scand J Med Sci Sports Sports*. 2010a; 20(3): 509-515

Delorme N, Boiché J, Raspaud M. Relative age effect in elite sports: Methodological bias or real discrimination?. *Eur J Sports Sci*, 2010b; 10(2): 91-96

Dixon JC, Liburdi V, Horton S, Weir PL. An examination of the impact of relative age effects and academic timing on intercollegiate athletics participation in women's softball. *J Intercoll Sport*, 2013; 6(2): 147-163

Farrow D. A multi-factorial examination of the development of skill expertise in high performance netball. *Talent Development & Excellence*, 2010; 2: 123-135

Folgado HA, Caixinha PF, Sampaio J, Maçãs V. Relative age effects among youth soccer players according to playing positions. *Rev Port Cien Desp*, 2006; 6(3): 349-355

Gómez-López M, Angosto Sánchez S, Granero-Gallegos A, Chirosa Ríos LJ. Relative age effect in handball players of Murcia: Influence of sex and category of game. *J Hum Sports Exer*, 2017; 12(3): 565-573

Helsen WF, Van Winckel J, Williams AM. The relative age effect in youth soccer across Europe. *J Sports Sci*, 2005; 23(6): 629-636

Howe MJ, Davidson JW, Sloboda JA. Natural born talents undiscovered. *Behavioral and Brain Sciences*, 1998; 21(3): 432-437

Kalinski SD, Jelaska I, Knežević N. Age effects among elite male gymnasts. *Acta Kine*, 2017; 11(2): 84-89

Lidor R, Côté J, Arnon M, Zeev A, Cohen-Maoz S. Relative age and birthplace effects in division 1 players – Do they exist in a small country. *Talent Development & Excellence*, 2010; 2(2): 181-192

Musch J, Grondin S. Unequal competition as an impediment to personal development: A review of the relative age effect in sport. *Dev Rev*, 2001; 21:147-167

Oliveira HZD, Junior R, Borges D, Vianna JM, Werneck FZ. Relative age effect in Brazilian Basketball Championship: Under 15 players. *Rev Bras Cineantropom Desempenho Hum*, 2017; 19(5): 526-534

Petroski EL, Fraro JD, Fidelix YL, Silva DAS, Pires-Neto CS, Dourado AC, Viera FS. Anthropometric, morphological and somatotype characteristics of athletes of the Brazilian Men's volleyball team: An 11-year descriptive study. *Rev Bras Cineantropom Desempenho Hum*, 2013; 15(2): 184-192

Phillips E, Davids K, Renshaw I, Portus M. Expert performance in sport and the dynamics of talent development. *Sports Med*, 2010; 40(4): 271-283

Pierson K, Addona V, Yates, P. A behavioral dynamic model of the relative age effect. *J Sports Sci*, 2014; 32(8): 776-784

Redd MJ, Fukuda DH, Beyer KS, Oliviera LP. No Observable Relative Age Effects in Professional Surfers: a Constraints-Based Evaluation. *Int J Sports Sci*, 2018; 11(6): 355-363

Reed KE, Parry DA, Sandercock GRH. Maturational and social factors contributing to relative age effects in school sports: Data from the London Youth Games. *Scand J Med Sci Sports*, 2017; 27(12): 2070-2079

Rubajczyk K, Rokita A. The Relative Age Effect in Poland's Elite Youth Soccer Players. *J Hum Kinet*, 2018; 64(1): 265-273

Sallaoui R, Chamari K, Chtara M, Manai Y, Ghrairi M, Belhaouz M, Baroon A. The relative age effect in the 2013 FIFA U-17 Soccer World Cup competition. *Am J Sports Sci*, 2014; 2(2): 35-40

Schorer J, Cobley S, Büsch D, Bräutigam H, Baker J. Influences of competition level, gender, player nationality, career stage and playing position on relative age effects. *Scand J Med Sci Sports*, 2009; 19(5): 720-730

Subijana CL, Lorenzo J. Relative age effect and long-term success in the Spanish soccer and basketball national teams. *J Hum Kinet*, 2018; 65: 197-204

Tsoukos A, Drikos S, Brown LE, Sotiropoulos K, Veligekas P, Bogdanis GC. Anthropometric and Motor Performance Variables are Decisive Factors for the Selection of Junior National Female Volleyball Players. *J Hum Kinet*, 2019, [ahead of print]. DOI: 10.2478/hukin-2019-0012

Wattie N, Cobley S, Baker J. Towards a unified understanding of relative age effects. *J Sports Sci*, 2008; 26: 1403–1409

Williams JH. Relative age effect in youth soccer: analysis of the FIFA U17 World Cup competition. *Scand J Med Sci Sports*, 2010; 20(3): 502-508

Wilson G. The birthdate effect in school sports teams. *Eur J Phys Educ*, 1999; 4(2): 139-145

Corresponding author:

Fábio A D Campos,
Federal Institute of Education, Science and Technology Goiano, Ceres, Brazil, 76300-000
Phone: +005519982069866; Fax: +005519982069866
Email: fabiocampos06@gmail.com