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original article

The relative age effect in soccer: a case study of the São Paulo Football Club

Efeito da idade relativa no Futebol: o estudo de caso do São Paulo Futebol Clube

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Abstract – The aim of this study was to compare the birth-date distribution of youth athletes of a high-level Brazilian soccer club with the general population of the same age group. In a cross-sectional study, the birth date of 341 youth athletes (under 10-20) was compared with a reference population (live births that occurred in São Paulo state in the same age group; n = 5,480,868). The subjects were divided into quarters of birth: 1st = January-March; 2nd = April-June; 3rd = July-September; 4th = October-December. The chi-square test (χ^2) was used to compare the expected (reference population) and observed (athletes) distributions. It was detected a significant difference between the expected distribution and observed distribution (χ^2= 29.53; p<0.0001), with a higher percentage of athletes born in the 1st quarter (47.5%) and a lower percentage in the 4th quarter (8.8%). The present results confirm the occurrence of the relative age effect (RAE) during the player selection process in a top-level Brazilian soccer club. The occurrence of this phenomenon during the selection and development of young athletes needs to be taken into account and should be analyzed carefully in order to minimize the loss of potential youth soccer talent. Further studies are required to identify the determinants of RAE and to establish preventive strategies that ensure a more efficient selection process of young soccer players.

Key words: Athlete; Maturation; Relative age effect; Soccer; Talent identification; Youth.

Resumo – *O objetivo do presente estudo foi comparar a distribuição das datas de nascimento dos atletas das categorias de base de um clube da elite do futebol brasileiro com a população do estado de São Paulo da mesma faixa etária. Por meio de estudo transversal, as datas de nascimento de 341 atletas das categorias de base de um clube de São Paulo (sub 10-20) foram comparadas com uma população de referência (nascidos vivos do Estado de São Paulo da mesma faixa etária; n = 5.480.868). Os indivíduos foram distribuídos por trimestre de nascimento: 1° = Janeiro a Março; 2° = Abril a Junho; 3° = Julho a Setembro; 4° = Outubro a Dezembro. Para análise comparativa entre a distribuição esperada (população de referência) e a distribuição observada (atletas), foi utilizado o teste qui-quadrado (χ^2). Foi detectada diferença significante entre a distribuição esperada e a distribuição observada (χ^2= 29,53; p<0,0001), com maior concentração de atletas nascidos no 1° trimestre (47,5%) e menor no 4° trimestre (8,8%). Os resultados do presente estudo confirmam a existência do "efeito da idade relativa" (EIR) no processo de seleção de atletas em um clube de elite do futebol brasileiro. A ocorrência deste fenômeno durante o processo de seleção e formação de jovens atletas precisa ser considerada e analisada cuidadosamente, a fim de minimizar a exclusão de jovens atletas de futebol potencialmente talentosos. Estudos adicionais são necessários para identificar os fatores determinantes do EIR e promover estratégias preventivas que tornem o processo de seleção e formação de jovens futebolistas mais eficiente.*

Palavras-chave: *Atleta; Detecção de talento; Efeito da idade relativa; Futebol; Jovens; Maturação.*

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INTRODUCTION

During the main stages of human psychobiological development, i.e., childhood and adolescence, individuals are universally divided into chronological age groups based on a specific cut-off date, usually the year of birth, in order to guarantee equal opportunities of development[1]. In the sport context, the same concept is applied particularly to youth level. Individuals are generally grouped and selected based on the year of birth considering a period of 12 or 24 months[1,2]. The assumption is the same: to guarantee equitable opportunities, similar development, and fair competition[3,4].

However, subjects born in the same year may present different biological ages. For example, an individual born in January is almost one year older than an individual born in December of the same year. This difference is maximized when grouping is performed within a period of 24 months, with the difference being almost 2 years[1]. In theory, this fact may favor the selection of athletes born in the first quarter since they are generally taller and heavier than those born in the last quarter of the year[5,6]. Within this context, the current model of youth athlete grouping seems to contribute to the occurrence of high interindividual variability in terms of biological growth and development[7].

In fact, since the 1980s[8] studies investigating the birth dates of senior and youth athletes in different sports have shown a higher prevalence of individuals born in the first months of the year[2-4,9,10]. This phenomenon is known as the "relative age effect" (RAE). The occurrence of RAE has been attributed to the large biological variability between individuals of the same chronological age during childhood and adolescence[3,4,11]. Some hypotheses have been raised to explain this scenario. For example, this phenomenon seems to exert a greater influence in sports that mainly depend on factors such as body composition, aerobic endurance, and muscle strength and power[4,12]. In addition, the influence of RAE has been suggested to be greater in sports characterized by frequent physical contact[13]. In this respect, it is questionable whether this model of birth year division guarantees equitable opportunities, and similar chances to achieve success in competitions among youth athletes, especially in categories formed by pre-adolescents and adolescents.

Among the different sports disciplines, soccer has been shown to be strongly influenced by the RAE[2-4,9,10]. Data from international studies have demonstrated the impact of RAE on youth categories[1,2,9,14,15]. However, there are no specific Brazilian studies investigating the RAE in youth categories of high-level Brazilian soccer clubs. Therefore, the aim of the present study was to compare the birth-date distributions between a youth athletes group of a high-level Brazilian soccer club and the reference population.

METHODOLOGICAL PROCEDURES

In a cross-sectional study, 341 youth athletes of the São Paulo Football Club (SPFC) were divided into nine categories: under-10 (U-10), U-11, U-12,

U-13, U-14, U-15, under-16, U-17, and U-20. All athletes were properly registered as soccer players of the club and had participated actively in official competitions in 2011. On the basis of a previous study[1], the reference population consisted of live births that occurred in the State of São Paulo between 1991 and 2001, the age group corresponding to the categories analyzed. The data of the reference population were provided by the SEADE Foundation (Fundação Seade - Sistema Estadual de Análise de Dados), an agency of the Department of Planning and Regional Development of the State of São Paulo (Secretaria Estadual de Planejamento e Desenvolvimento Regional do Estado de São Paulo). Birth dates of 1994, 1995 and 1996 were not included (data not available).

The study was approved by the Ethics Committee of the School of Physical Education, University of São Paulo (Escola de Educação Física da Universidade de São Paulo) (Protocol 2012/07). In addition, the SPFC Board officially agreed to the dissemination of the results obtained in the present study.

The subjects were divided into four groups according to the quarter in which they were born[1]: 1st quarter: January, February, and March; 2nd quarter: April, May, and June; 3rd quarter: July, August, and September; 4th quarter: October, November, and December.

Statistical analysis

The results are expressed as absolute (n) and relative (%) frequency. The chi-square test (χ^2) was used to determine differences between expected (reference population) and observed (youth athletes) birth dates. All analyses were performed using the SPSS® 19.0 for Windows package (SPSS®, Chicago, USA). A p value < 0.05 was considered to indicate statistical significance.

RESULTS

Table 1 shows the quartile distribution of birth dates of youth players of SPFC according to category (U-10 to U-20).

Table 1. Quartile distribution of birth-dates of athletes from the São Paulo Football Club according to category.

Age Category	N	Birth quarter			
		1st n (%)	2nd n (%)	3rd n (%)	4th n (%)
Under-10	13	7 (53.8%)	2 (15.4%)	4 (30.8%)	-
Under-11	47	17 (36.2%)	20 (42.5%)	8 (17.0%)	2 (4.3%)
Under-12	48	23 (47.9%)	7 (14.6%)	11 (22.9%)	7 (14.6%)
Under-13	48	29 (60.4%)	10 (20.9%)	6 (12.5%)	3 (6.2%)
Under-14	63	32 (50.8%)	17 (27.0%)	10 (15.9%)	4 (6.3%)
Under-15	43	26 (60.5%)	8 (18.6%)	6 (13.9%)	3 (7.0%)
Under-16	31	13 (41.9%)	9 (29.1%)	5 (16.1%)	4 (12.9)
Under-17	21	7 (33.3%)	9 (42.9%)	3 (14.3%)	2 (9.5%)
Under-20	27	8 (29.7%)	5 (18.5%)	9 (33.3%)	5 (18.5%)

1st quarter: January to March; 2nd quarter: April to June; 3rd quarter: July to September; 4th quarter: October to December.

Table 2 shows the absolute (n) and relative (%) frequency of live births that occurred in the State of São Paulo between 1991 and 2001, divided into quarters, and the birth-date distribution of youth SPFC players. A significant difference was detected between the percentage of birth-date distribution of SPFC young players and the percentage of birth-date distribution of general population (χ^2= 29.53; p<0,0001).

Table 2. Quartile distribution of live births that occurred in the State of São Paulo between 1991 and 2001 and quartile birth-date distribution of youth athletes from the São Paulo Football Club (SPFC).

	N	Birth quarter			
		1st n (%)	2nd n (%)	3rd n (%)	4th n (%)
São Paulo State	5,480,868	1,412,346 (25.8%)	1,427,254 (26.0%)	1,351,200 (24.7)	1,290,068 (23.6%)
SPFC	341	162 (47.5%)	87 (25.5%)	62 (18.2%)	30 (8.8%)
			29.53*		

1st quarter: January to March; 2nd quarter: April to June; 3rd quarter: July to September; 4th quarter: October to December. Chi-square test; *: significant difference ($p < 0.0001$). Source of the São Paulo State data: Fundação SEADE.

DISCUSSION

The aim of the present study was to compare the birth-date distribution of youth athletes of a high-level Brazilian soccer club with the distribution of general population of the same age group. Approximately half the athletes selected from the categories analyzed were born in the 1st quarter and less than 10% were born in the 4th quarter. These findings indicate the occurrence of RAE, since a similar distribution among quarters (~25% each) was observed for the reference population.

Mujika et al.[1] analyzed the RAE in 13,519 Basque football players of different age groups and competition levels. The study included senior professionals (n = 114) and elite youth players (U-11 to U-18; n = 189) of Athletic Club Bilbao, regional youth federated players (U-11 to U-14; n = 4,382), and school youth players (U-10 and U-11; n = 8,834). The birth-date distributions of the athletes were compared to that of the general Basque male population born between 1975 and 2004 (n = 341,976), which presented a uniform distribution among quarters (~25% each). The authors observed a significant difference for all groups of players. Similar to the present results, there was a higher percentage of athletes born in the 1st quarter and a lower percentage of those born in the 4th quarter. Interestingly, this phenomenon was more pronounced in groups of higher competition level, i.e., senior professionals and youth players of Athletic Club Bilbao, when compared to regional and school youth players. Analyzing specifically the data obtained for the U-11 to U-18 categories of Athletic Club Bilbao, the results are closely similar to those observed in the present study: 1st quarter: 46.6%; 2nd quarter: 28.6%; 3rd quarter: 14.8%, and 4th quarter:

10.0%. The findings reported by Mujika et al.[1] suggest a high incidence of RAE in youth soccer players. These findings are supported by the data of the present study.

In another comprehensive study, Helsen et al.[14] investigated the occurrence of RAE in 10 European youth soccer teams (U-15 to U-18; n = 763), teams participating in Union des Associations Européennes de Football (UEFA) tournaments (U-16, U-18, and U-21; n = 591), teams of 16 professional clubs participating in U-14 international tournaments, and 32 teams participating in a U-12 international European tournament (n = 677). The authors detected RAE in almost all groups and categories analyzed. Exceptions were the U-18 and U-21 national teams that participated in the UEFA tournaments. Among the U-15 to U-18 categories analyzed, the percentage of athletes born in the 1st quarter ranged from 36.00 to 50.49%, whereas this percentage ranged from 3.89 to 17.02% for athletes born in the 4th quarter. For the national teams participating in the UEFA tournaments, the RAE was observed for the U-16 category (48.96 and 7.64% in the 1st and 4th quarter, respectively). The phenomenon was also seen in U-12 and U-14 players of the professionals clubs, with 32.64 and 15.95% of the athletes being born in the 1st and 4th quarter, respectively. The results suggest that RAE are more pronounced in the U-12 to U-17 age groups and becomes less relevant in the older age groups (U-18 and U-21). This suggestion seems to agree with the results of the present study in which a more uniform birth-date distribution was observed for the U-20 category of SPFC (see Table 1).

Although the cited studies[1,14] only investigated athletes born in Europe, the occurrence of RAE seems to be a global phenomenon. This observation is confirmed by the study of Williams[9]. The author investigated the birth dates of players of U-17 national teams participating in six tournaments (1997 to 2007) of the Fédération Internationale de Football Association (FIFA) World Cup, thus including athletes from all continents (53 nations; n = 1,985). In general, about 40% of the athletes were born in the 1st quarter of the year and only 16% in the 4th quarter. In addition, the median birth month of the players was May (ranging from April to May in all tournaments). This trend was similar for all geographical regions (Asia, Oceania, Europe, Central America, North America, and South America), except for Africa which presented an inverse effect (median birth dates in August). A possible explanation raised by the author was that African players born in the last quarter were taller, a fact not observed for the other regions. Another possible explanation for this particular distribution seen in Africa could be the difficulty in obtaining the true birth date of the athletes. In this respect, Ndong et al.[18] found that only 33% of births in Cameroon could be confirmed by the birth certificate.

Williams[9] also demonstrated similar RAE for the most (1st to 4th place) and least successful teams (last four places) of all six FIFA World Cups (median between April and May). That study is particularly important since it indicates the occurrence of RAE in elite U-17 players around the

world, a category in which differences in biological maturity and time of soccer experience between athletes born in the 1st and 4th quarter are expected to be minimal.

The incidence of RAE has also been reported for Brazilian youth soccer national teams [16] and the Brazilian adult national team. Altimari et al.[16] analyzed the birth dates of U-14 to U-20 players (n = 167) and of players of the adult national team (n = 23) in 2010. Dividing the groups into 4-month periods (1st, 2nd and 3rd), the percentage of athletes born in the 1st period ranged from 43 to 81%. This percentage tended to decrease with increasing category (U-14 = 81%; U-15 = 65%; U-16 = 61%; U-17 = 57%; U-18 = 45%; U-19 = 44%; U-20 = 43%). Only the adult national team presented no incidence of RAE. These results confirm the presence of RAE in elite youth soccer, especially at younger ages.

Although evidence indicates the existence of RAE in international soccer, the causes of this phenomenon are still a matter of discussion and studies suggest that there are various determinants of this phenomenon[4,13,15,17]. Differences in biological maturation, a greater height and higher weight have been indicated as factors responsible for RAE phenomenon[4-6,14,19]. In fact, when children and adolescents are grouped according to birth year, it is plausible to assume that cognitive, physical and behavioral differences exist between older individuals born near the cut-off date (i.e., January) and younger individuals born near the end of the selection year (i.e., December)[1,2,4-6]. Other factors such as psychological (perception of competence) and physiological factors (speed, strength, power), as well as years of training, may also contribute to the occurrence of RAE in youth soccer[4,11,13,15].

CONCLUSION

The results of the present study confirm the marked presence of RAE among youth athletes of a high-level Brazilian soccer club, especially in the U-10 to U-17 categories. Another important finding was the attenuation of RAE with increasing chronological age, suggesting that misjudgments have been made in the selection process and training of young soccer players in the early age categories. Comprehensive national studies are required to identify the factors related to the occurrence of RAE in Brazilian soccer clubs. The understanding of the determinants of RAE in soccer may contribute to improve the selection process of young athletes, minimizing possible errors in the identification and selection of talents.

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