

Is the Relative Age Effect prevalent in the most important Brazilian soccer youth competition? An analysis based on age and team final placement

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Abstract - Aim: Investigate the prevalence of the Relative Age Effect (RAE) in 2023 Copa São Paulo de Futebol Júnior and its association with athletes' ages and team final placement. **Methods:** Data from 3,743 youth male soccer players were collected. The variables analyzed included the players' birth quarters, players' birth years, and final placement in the competition. Chi-square goodness of fit tests (χ^2) were performed to compare the birthdate distribution of athletes for each of the variables. Odds ratios and effect sizes (V) were also calculated for these analyses. **Results:** The overall analysis of the birth quarters indicated an overrepresentation of athletes born in the first semester of the year ($p < 0.001$; $V = 0.55$). The analysis based on the athletes' birth years followed a similar pattern for all age groups ($p < 0.001$) but indicated that the RAE was more pronounced in younger players ($V = 0.71$ compared to $V = 0.47$ in older athletes). The birth quarters analysis based on the team's final placement in the competition also revealed that athletes born in the first months of the year were more frequent than those born in the last months ($p < 0.001$), which was even more pronounced in the top-ranked teams ($V = 0.88$ compared to $V = 0.48$ in low-ranked teams). **Conclusion:** We concluded that RAE was prevalent in the pool of players who participated in 2023 edition, regardless of their age and final placement in the competition, reinforcing that RAE is highly prevalent in the Brazilian elite youth soccer context.

Keywords: talent, young athletes, birth-date, men, birth-quartile.

Introduction

The period comprising adolescence is characterized by massive changes¹, and puberty is characterized as the major biological transition in life² marked by physical changes^{3,4}, such as an increase in height, strength, and speed, and neurological changes¹ such as remodeling of the pre-frontal cortex. These shifts occur according to individual biological maturation characteristics. Consequently, young people who were born in the same year but in different months may exhibit different physical and cognitive characteristics, which may be due to the maturational process occurring at different moments, such as greater or lesser height, and strength, among others⁴, affecting sports performance.

At school, students are grouped by birth year, to create an environment with people at similar stages of development⁵. However, this grouping puts children with similar chronological ages in the same environment, despite the differences in biological ages up to one year. In team sports, players are also grouped according to their birth year, but in age categories, which comprise two to three years, also aiming to minimize the maturational differences between them⁶. Consequently, the difference in biological age, which in school can reach one year, reaches up to three years in team sports. The impact that these differences have on players' sports participation due to being relatively younger or older is known as the Relative Age Effect⁷.

The Relative Age Effect (RAE) occurs because, during the talent selection process, which often takes

place in childhood/adolescence, players born in the first months of the year are perceived by coaches as more talented than players born at the end of the year⁸. This perception contributes to players appearing to have more stature, more strength, and more skills than younger players⁹. However, these players are probably just more biologically mature¹⁰. This preference is driven by the pressure to achieve immediate results, especially in highly competitive sports systems like Brazilian soccer. Early-born players are perceived as more capable of delivering short-term success⁸, reinforcing the Relative Age Effect and creating a cycle of exclusion for late-born athletes. Such practices undermine long-term talent development and overlook the potential of players who may excel with appropriate time and support¹². Consequently, this athlete grouping policy may benefit players born closer to the cut-off date¹¹ and impair relatively younger players' quality practice opportunities¹² and make them more likely to drop out of the sport¹³, wasting potential talents.

RAE is expected to occur strongly at the onset of puberty, which is a time when large interindividual differences can occur^{4, 14}. Furthermore, RAE is observed strongly in contexts in highly competitive¹⁵ in which there is a lot of competition for spots on teams. However, studies have observed RAE both in youth categories^{16, 17} and in professional sports^{18, 19}, which indicates that this phenomenon can occur in the early stages of training and remain until the higher levels of performance, even though in a smaller magnitude^{19, 20}.

Furthermore, other research has focused on investigating the association between RAE and competitive performance. Athletes who are successful in team sports are often born in the first months of the year²¹. For instance, Augste and Lames²² observed a higher prevalence of relatively older players in the top-ranked teams in U17 soccer. This indicates that, in addition to influencing talent selection, having relatively older players on a team may be associated with their performances. On the other hand, although RAE has been found in professional soccer leagues, it was similarly present in better and worse-ranked teams²¹. Considering this possible association between RAE and competitive performance, as well as divergent results on this topic, it is necessary to continue studying RAE and its possible implications in sports to further understand its manifestation in various competitive contexts.

The *Copa São Paulo de Futebol Júnior* is the most representative youth soccer competition in Brazil, it has been held for more than 40 years and thousands of athletes participate every year. In recent years, 144 teams from all regions of Brazil have participated in each edition. Additionally, this competition is notorious for having been the scene of the discovery of sev-

eral legendary Brazilian soccer athletes, such as Cafu, Raí, Rivaldo, Ronaldinho Gaúcho, and Kaká, top players nowadays like Neymar and Gabriel Jesus, and possibly future stars like Estêvão Willian and John Kennedy - all of which were born in the first semester of the year. This competition includes players between the ages of 15 and 21 years, so it comprises various age categories in soccer. This factor, together with the highly competitive context of this competition, makes it fertile ground for RAE to occur. However, to the best of our knowledge, no studies investigated the RAE in the *Copa São Paulo de Futebol Júnior*. Moreover, since it covers a wide age range, RAE may operate in different magnitudes within the same competition since this phenomenon tends to be more pervasive in adolescence^{4, 14} and tends to reduce in older age groups²⁰. As this competition is fundamental for the selection and formation of talents in Brazilian soccer, investigating the impact of the RAE may bring new information to this context, and help coaches and managers evaluate the current policies of talent selection and development. Specifically, these insights may aid in reducing the structural imbalances in youth football towards a more equitable environment that prioritizes long-term athlete development over short-term performance outcomes.

Thus, this study aimed to investigate the prevalence of RAE in *Copa São Paulo de Futebol Júnior* and its association with athletes' ages and team final positions. Considering previous studies in soccer with similar age groups¹⁹, The hypothesis of our study is that RAE will be found in this sample, as well as that this effect will be greater in younger age groups²⁰ and the top-ranked teams²².

Methods

Study design

The study used a cross-sectional design and investigated the RAE among Brazilian soccer athletes using quantitative and descriptive analytic approaches.

Participants

For this study, we analyzed data collected from the 2023 *Copa São Paulo de Futebol Júnior*. Participants in the data collection were 3,743 male soccer players who were registered to participate in the aforementioned competition.

Data collection and procedures

Players' full names, ages, dates of birth, and final placement in the competition were obtained as publicly available information from the Paulista Soccer

Federation. Data collection was performed on February 1st, 2023. Two independent researchers manually retrieved the final placements in the competition and complete data for all athletes (full name, nickname, category, register number, age, date of birth, and contractual information), which allowed the inclusion of every athlete registered for the competition in our sample, since no missing data was found. After the data collection, researchers entered the information of interest (final placements, date of birth, and age) into a Microsoft Excel spreadsheet and converted the birth dates of each athlete into a birth quarter. The data were then separated according to the study variables and transcribed into statistical software for analysis.

The variables analyzed included the players' birth quarters (Q1 - from January to March, Q2 - from April to June, Q3 - from July to September, and Q4 - from October to December), players' birth years (2002/2003, 2004/2005, and 2006/2007) and final placement in the competition (1st to 16th, 17th to 64th, and 65th to 128th).

Statistical analysis

Players' quarters of birth frequencies were presented in relative and absolute values. The occurrence of the RAE among players was assessed for each variable by comparing the frequency of athletes born in each quarter and the frequency expected for each of the quarters. The expected frequencies were determined based on the number of males born in each quarter of the year on Brazilian reports from 2002-2007 (Brazilian Ministry of Health), which led to the following expected observations: Q1: 25.5%, Q2: 26.43%, Q3: 24.88%, and Q4: = 23.19%.

Chi-square goodness of fit tests (χ^2) were performed to compare the birthdate distribution of athletes for each of the variables. The effect size (Cramer's V) of the chi-square tests was calculated for all analyses based on Cohen²³, considering that contingency tables larger than 2 × 2 were used. Following this author's reference and considering the degrees of freedom (3) of the analysis, 0.06 was considered a small effect, 0.17 a medium effect, and 0.29 a large effect. The significance level was set to 0.05, except when multiple comparisons between quarters were used as post hoc analyses for the chi-square tests, in which Bonferroni's corrections were performed. In these cases, the significance level was adjusted to 0.0083, by dividing the significance level by the number of comparisons²⁴. Complementarily, odds ratio (ORs) and 95% confidence intervals were calculated for quarter and half year's distribution according to the athletes' age and team ranking. All analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 20.0 (Chicago, USA).

Results

The analysis of the whole pool of athletes enrolled in the 2023 *Copa São Paulo de Futebol Júnior* revealed that the birth distribution across quarters differed from expected ($\chi^2 = 378.046$; $p < 0.001$; $V = 0.55$; OR Q1:Q4 = 3.59; OR 1st:2nd = 3.86). [Figure 1](#) indicates the post hoc analysis results regarding differences between birth quarters ($p < 0.001$).

The analyses of birth quarters based on the athlete's birth year followed a similar pattern to the previous analysis, revealing that the distribution of births across quarters was different from expected in athletes born in 2002/2003 ($p < 0.001$; $V = 0.47$), 2004/2005 ($p < 0.001$; $V = 0.62$), and 2006/2007 ($p < 0.001$; $V = 0.71$). As seen in [Table 1](#), athletes born in the last months of the year (Q3 and Q4) were less frequent than athletes born in the first months of the year (Q1), regardless of their age groups ($p < 0.006$).

Birth quarters analyses based on the teams' final placement on the competition also revealed a distribution of births across quarters different from expected for teams that finished 65th to 128th ($p < 0.001$; $V = 0.48$), 17th to 64th ($p < 0.001$; $V = 0.54$), and 1st to 16th ($p < 0.001$; $V = 0.88$). As seen in [Table 2](#), athletes born in the last months of the year (Q3 and Q4) were less frequent than athletes born in the first months of the year (Q1 and Q2), for athletes placed 65th to 128th ($p < 0.001$) and 17th to 64th ($p < 0.003$). Regarding athletes placed 1st to 16th, post hoc analyses indicated that athletes born in Q4 were less frequent than all of the other quarters ($p < 0.006$) and that athletes born in Q1 were more frequent than those born in Q2 ($p < 0.001$) and Q3 ($p < 0.001$).

Discussion

This study aimed to investigate the prevalence of RAE in 2023 *Copa São Paulo de Futebol Júnior* and its

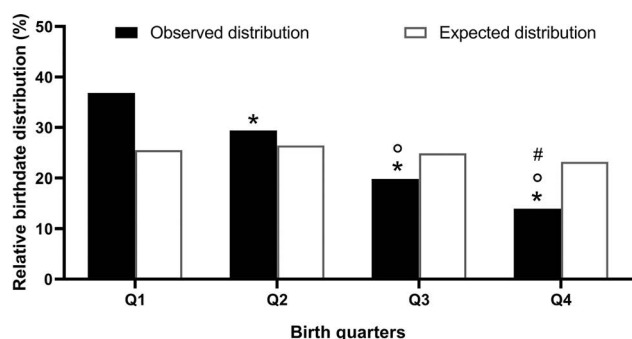


Figure 1 - Relative observed and expected distribution of quarters of birth for athletes enrolled in the 2023 *Copa São Paulo de Futebol Júnior*. Note: * = different from Q1; ° = different from Q2; # = different from Q3.

association with athletes' ages and team final positions. We hypothesized that RAE would be identified in this sample, as well as that this effect would be greater in younger age groups and the top-ranked teams. Our results indicated that RAE was pervasive in this pool of athletes, which confirmed our hypotheses.

The analysis of the pool of athletes enrolled in the 2023 *Copa São Paulo de Futebol Júnior* revealed clear RAE evidence since athletes born in the first semester of the year were overrepresented compared to those born in the second semester. This result is in line with previous studies that indicated that the RAE is pervasive across many age categories of Brazilian male elite soccer^{19, 25-27}. RAE is so prevalent in youth categories of this sports system that it contradicts the tendency for the effect to disappear in the adult category, as observed in specific team sports systems such as male handball²⁸ and male volleyball²⁹. Indeed, evidence indicates that RAE tends to decrease but not disappear in elite senior soccer^{19, 20}.

Even though the *Copa São Paulo de Futebol Júnior* is organized in a single category, we analyzed the prevalence of RAE based on the athletes' birth years, to investigate how this phenomenon operates across younger and older athletes in this competition. Results indicated that RAE was present in all age groups analyzed, however, this effect was greater in the younger group, and reduced as group ages increased. By way of illustration, athletes born in the first quartile were 2.92 times more likely to be selected than athletes born in the fourth quartile in athletes born in 2002/2003. In turn, this chance increased to 4.23 times in the group of athletes born in 2004/2005 and reached 5.63 times for athletes born in 2006/2007. These findings are in line with the notion that RAE is more pervasive in lower categories of competitive sport^{4, 8}, and at the beginning of the senior career in many teams' sports, including soccer³⁰.

It is important to note that the *Copa São Paulo de Futebol Júnior* allows the registration of athletes aged 15 to 21 years old, encompassing several categories of youth football. Thus, while athletes from lower categories participate in this competition, athletes who already are professional players are also represented in the pool of athletes registered. The wide age range allowed in this competition (from 15 to 21 years old) contributes to the understanding of the results above, in which the RAE manifests robustly among younger athletes. This age range could favor athletes born at the beginning of the year, as these athletes may present an advanced development, more similar to that of relatively older athletes³¹. In this sense, the maturational differences that are so important for sports performance in the youth categories⁸ could be reduced by the selection of relatively older athletes. This mechan-

ism corroborates the notion that athletes born in the first quartiles do receive more attention and development opportunities in a sports system affected by RAE³². In our study, athletes born in the first months of the year were the majority among all the enrolled athletes, particularly among athletes born in 2006/2007. This implies development advantages for these athletes, since the very chance to compose the team in a competition with older athletes is a great learning opportunity, even if it does not translate into minutes played on the field.

We also investigated the relationship between RAE and collective performance, based on the final team placement. Even though an overrepresentation of relatively older athletes and large effect sizes were reported for all three groups, RAE was more robust in top-placed teams. Among teams placed 1st to 16th, athletes born in the first quarter were 9.12 times more likely to be selected than athletes born in the fourth quarter of the year. In intermediate and lower-placed teams, these ratios were 3.58 and 2.93 respectively. These findings are in line with the notion that high-performance teams are mainly composed of athletes born in the first months of the year³³. It is important to note that in our study RAE was prevalent regardless of the final team placement. This indicates that Brazilian elite youth soccer presents itself as a highly competitive environment in which short-term performance is prioritized. These elements favor RAE, as indicated previously^{26, 27}. Even though our results suggest that RAE is positively associated with short-term performance (final team placement), it is important to acknowledge evidence indicating that this association is not the case with long-term performance in team sports³⁴. Actually, in some cases, this association even reverses, with relatively younger athletes outperforming relatively older ones^{35, 36}. Further evidence indicates that relatively younger athletes are more likely to earn higher salaries in professional male soccer³⁷ and to play more minutes in professional competitions³⁸, suggesting that athletes who overcome the RAE selection bias may possess unique qualities that enhance their potential for prolonged and successful careers. Therefore, Brazilian soccer coaches must consider the long-term development of athletes, to avoid wasting potential talents in the early phases of this sporting context¹⁹. By promoting inclusive practices and offering equal opportunities for athletes born later in the selection year, Brazilian youth football can better align with holistic development principles, reducing the risk of prematurely excluding late maturers with significant potential.

Sport Federations can also play a pivotal role in mitigating the effects of RAE and its consequences by proposing changes in youth competitions, which have

been increasingly competitive at progressively younger categories in this sports system. Strategies such as implementing regulations that require a minimum percentage of athletes born in the second semester³⁹ and the reduction of age bands within each category⁸ in younger competitions can contribute to ensuring a fairer environment for the development of younger soccer athletes. As an additional strategy to mitigate the effects of RAE, bio-banding has been explored as a means to create fairer competition environments by grouping athletes based on their maturational status rather than chronological age. For instance, a bio-banded tournament involving 66 soccer players from Premier League clubs aged 11 to 14 grouped participants based on predicted adult stature⁴⁰, ensuring that teams comprised athletes at similar maturational stages. Post-tournament feedback revealed that players reported positive experiences in terms of physical, psychological, and social development⁴⁰. Expanding the application of bio-banding across different contexts could produce a deeper understanding of its benefits.

The limitations of the present study include the fact that only a short period of a single competition was analyzed (a single season of the *Copa São Paulo de Futebol Júnior*), which impairs a long-term analysis. This information could provide insights into the impact of the RAE on the career development of youth soccer athletes in Brazil. Another limitation is the lack of data concerning the athletes' maturational stage, experience time, and competitive experience. Therefore, future research on youth Brazilian soccer is warranted to include the analysis of multiple seasons and competitions, athletes' maturational stage and experience history, along with a longitudinal follow-up of athletes, to assess if the RAE continues to affect the career development of young players, specifically concerning the chances of reaching the professional tier.

Conclusion and practical applications

In conclusion, our results demonstrate that RAE is prevalent in the pool of players who participated in the 2023 *Copa São Paulo de Futebol Júnior*, regardless of their age and final placement in the competition. These results reinforce the notion that RAE is widely prevalent in the Brazilian elite soccer context. This may be associated with biased selection processes that favor relatively older athletes over their peers, especially in youth soccer. To minimize the loss of potential sports talents in this system, some interventions are warranted. The education of coaches and club administrators remains the most important strategy, as this action has the potential to reduce the search for short-term results in youth categories^{41, 42}, considering both the coaches' perspective and clubs' internal policies.

Specifically in Brazil, it is important to note that the pressure for immediate results imposed by the fans and the press is culturally accepted, which puts the positions of coaches and directors at risk, encouraging victories at any cost, even in youth categories. Therefore, also educating the press and fans about the RAE and the complexity of the talent development process could be a promising intervention for the Brazilian context.

AI use statement

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Data availability statement

The research data is available upon request.

Conflict of interest statement

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report.

Author contributions (CRediT)

Lucas Savassi Figueiredo: conceptualization, investigation, methodology, supervision, formal analysis, project administration, validation, writing - original draft, writing - review and editing. **Davi Amador Fioreti Costa:** conceptualization, investigation, data curation, writing - original draft. **Henrique de Oliveira Castro:** conceptualization, investigation, methodology, writing - original draft, writing - review and editing. **Gustavo De Conti Teixeira Costa:** conceptualization, investigation, methodology, writing - original draft, visualization, writing - review and editing. **Lidiane Aparecida Fernandes:** conceptualization, investigation, methodology, writing - original draft, writing - review and editing. **Lucas de Castro Ribeiro:** conceptualization, investigation, methodology, validation, writing - original draft, writing - review and editing, visualization.

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Internet resources

Paulista Soccer Federation: www.futebolpaulista.com.br.

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