

NO RELATIVE AGE EFFECT AMONG BRAZILIAN ELITE FEMALE FUTSAL ATHLETES: AN ANALYSIS BASED ON TACTICAL INDIVIDUAL PERFORMANCE AND TEAM'S FINAL POSITION IN THE NATIONAL CHAMPIONSHIP

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Abstract:

Our aim in this study was to analyze: (i) the presence of the relative age effect (RAE) on the Brazilian elite female futsal athletes according to their team's final position in the National Championship, and (ii) the relationship between the presence of the RAE and the athletes' tactical individual performance. Participants were 77 female Brazilian elite futsal athletes that competed in the 2021 National Championship. Data included their dates of birth aggregation by quartiles (Q1-Q4), their team's final position in the National Championship, and their tactical individual performance indicators (time played, goals scored, assists, steals, shots on goal, unbalanced passes, and challenges won in 1vs1). Analyses of the overall sample indicated that RAE was not prevalent in this context since the observed birthdate distribution was not different from the expected one ($p=.796$). When the final placement in the championship was considered, the birthdate distributions were also not different from the expected for both the top-ranked ($p=.572$) and low-ranked ($p=.679$) team athletes. Regarding athletes' tactical individual performance, no differences were found between the athletes with early and late birthdates for any of the variables analysed ($p>.05$). Our results suggest that RAE has no impact on this specific sport context, which should be interpreted as a positive factor since female futsal athletes seem to have the same chance of achieving the elite level in Brazil, regardless of their birthdates.

Key words: birth date, player development, sports performance, futsal, female

Introduction

Grouping athletes based on a cut-off date is very common in organized sports. Although this strategy aims at a fairer competitive environment, it ends up benefiting athletes who were born closer to the cut-off date (Leite, Arede, Shang, Calleja-

González, & Lorenzo, 2021; Lidor, Maayan, & Arnon, 2021). This systematic overrepresentation of relatively older athletes in sports is known as the relative age effect (RAE) and has been reported especially among males in many competitive sports (Cobley, Baker, Wattie, & McKenna, 2009), both

among youth (Castro, et al., 2023; Figueiredo, Seabra, Brito, Galvão, & Brito, 2021; Maciel, et al., 2022) and senior athletes (Castro, et al., 2022c; Figueiredo, et al., 2022; Lago-Fuentes, Rey, Padrón-Cabo, Prieto-Troncoso, & Garcia-Núñez, 2020).

Previous investigations have associated RAE with the fact that coaches are more likely to perceive athletes born closer to arbitrary cut-off dates as more competent than those born in the last quartiles of the year (Lidor, et al., 2021), making relatively older athletes more frequent in many youth sports. The primary explanation for this selection preference is the increased likelihood of earlier maturation for older youth athletes, giving them physical advantages in team sports, such as greater height, speed, and strength (Hill, Scott, Malina, McGee, & Cumming, 2020), relative to their slightly younger peers. Nevertheless, the RAE phenomenon is influenced by the interaction of environmental, individual, and task constraints (Wattie, Schorer, & Baker, 2015). Indeed, RAE is generally smaller (Brustio, Boccia, De Pasquale, Lupo, & Ungureanu, 2022; Smith, Weir, Till, Romann, & Copley, 2018) or even non-existent in many female sports contexts (Barreira, Bueno, & Chiminazzo, 2021; Goldschmied, 2011; Lidor, Arnon, Maayan, Gershon, & Côté, 2014; Smith, et al., 2018). In this line, it seems that RAE is dependent on how deep the competition for spots in the selection process is (Peña-González, Javaloyes, Sarabia, & Moya-Ramón, 2021).

RAE is prevalent in the futsal context, as demonstrated by Figueiredo et al. (2021) in a study that investigated young futsal athletes from both sexes. These authors observed an overrepresentation of athletes born in the first quartile of the year (Q1 vs Q4) in the Under-9 female and the Under-7 and Under-9 male categories. Similar results were reported among Brazilian elite male athletes (Castro, et al., 2022b; Morales Júnior, Alves, Galatti, & Marques, 2017) from the Under-17, Under-20, and senior categories. Additionally, this effect seemed to differ based on the athletes' playing positions (Castro, et al., 2022a). On the other hand, when the sample was composed of elite adult female futsal athletes from the Brazilian National Futsal League (Morales Júnior, et al., 2017) and Brazilian Cup (Ferreira, et al., 2020), RAE was not observed. Overall, these findings reinforce the need to investigate the relationship between sex and RAE in futsal, since the occurrence of this effect may be associated with the specific characteristics of the talent development and selection processes (Peña-González, et al., 2021).

The relationship between RAE and performance has also been of interest to researchers. For example, in the study carried out by Ribeiro et al. (2023) with U17, U20, and senior female soccer

players, the authors investigated whether RAE was associated with the final ranking obtained by the athletes in the World Cup. Results indicated no relationship between RAE and collective success defined by ranking in the competition. Castro et al. (2022a) also aimed to investigate the relationship between RAE and performance. In their study, carried out with Brazilian elite male futsal players, the authors found no relationship between goals scored and RAE. Considering the central role of tactical performance in team sports' success (Santos, Mendez-Domínguez, Nunes, Gómez, & Travassos, 2019), it is imperative to investigate the relationship between individual tactical performance and RAE in women's futsal. Despite its relevance to performance in team sports, knowledge on tactical indicators is still scarce in futsal, which reinforces the importance of developing new research on the subject.

Since RAE may influence a young athlete's opportunity to obtain better training and performance conditions to reach elite levels in sports (Leite, et al., 2021; Lidor, et al., 2021), further studies with specific populations in different sports are still needed. Although RAE arouses interest among many researchers and publications have increased in recent years, investigations in specific sports contexts being underrepresented in this research are warranted, particularly including futsal (Bilgiç & Işın, 2022; Castro et al., 2022b, 2022c; Leonardi, et al., 2022). In fact, Méndez-Domínguez, Nakamura, and Travassos (2022) highlighted the importance of developing research on futsal, not only concerning physical, technical, or tactical variables, but also on research topics with practical applications, such as talent development, performance analysis, and psychological topics. This is particularly necessary for female futsal, where research is even scarcer (Alves, Da Graça, Feitosa, & Soares, 2021).

To the best of our knowledge, no previous study has analyzed the relationship between the RAE and futsal players' tactical individual performance or between the RAE and the team's final position in elite female futsal. Thus, this study aimed to: (1) analyze the presence of RAE in Brazilian elite female futsal athletes; and (2) analyze the relationship between the RAE and athletes' performance (final position in the National Championship and tactical individual performance). Considering the overall low prevalence of RAE in women's sports (Smith, et al., 2018), and previous reports of the absence of RAE in women's futsal in Brazil (Ferreira, et al., 2020; Leonardi et al., 2022; Perondi, Dalla Valle, & Bernardino, 2018), we expected that RAE would not be observed among female futsal athletes nor associated with the selected performance indicators.

Method

Participants

This sample was composed of 77 female Brazilian elite futsal athletes (age = 25.98 ± 5.59 years) from six out of the 13 teams that competed in the Brazilian Cup 2021, one of the most traditional competitions organized by the Brazilian Futsal Confederation (CBFS). The competition brings together representatives of the states (mostly the champions) of the country. The other seven teams participating in the championship did not provide the requested data and therefore were not included in the sample of this study. The inclusion criteria adopted were to participate in the competition and to have the data provided voluntarily by the teams. Those responsible/participants for the teams agreed to participate in the research and provided data on the athletes' date of birth. These are open-access data, and no ethical issues were involved in their analysis and interpretation. The videos of the analyzed games are available on the internet. All data used in this study were reported anonymously.

Data collection

Data referring to the players' date of birth and playing positions were made available by their respective teams. All information was kept confidential and was used specifically for this study. Videos of the games were obtained from YouTube® (CBFS channel: CbfsTv), as a publicly available content. The tactical individual performance indicators collected were the following: time played, goals scored, assists, steals, shots on goal, unbalanced passes, and challenges won in 1vs1. All the data were collected in the period between January and April 2022. Table 1 provides the definitions for each of these indicators.

Instruments and procedures

Data were tabulated in a spreadsheet, and the athletes were organized according to: (1) the quarter of the year in which the athlete was born (Carraco, Galatti, Massa, Loturco, & Abad, 2020; Castro, et

al., 2022a): Q1 (the first quarter: January-March), Q2 (the second quarter: April-June), Q3 (the third quarter July-September), and Q4 (the fourth quarter: October-December); and (2) the team's final position in the competition (1st, 2nd and 3rd—top-ranked teams, vs 9th, 11th, and 12th—low ranked teams). Tactical individual performance was also analyzed according to birth quarters.

Athletes' tactical individual performance was analyzed in 20 games (4,662 minutes and 45 seconds in total), equivalent to all the games of the teams that composed our sample in the Brazilian Cup 2021. For the analysis, two futsal performance analysts, with an average experience of six years as physical education teachers and two years as performance analysts in national teams, used the Videobserver™ software, validated by Fortes, Gomez, Hongyou, and Sampedro (2015). Inter- and intra-observer confidence coefficients ranged between 1 and 0.76. Using this software, the time played, goals scored, assists, steals, shots on goal, unbalanced passes, and challenges won in 1vs1 were analyzed. The selection of these specific performance indicators was based on Santos et al. (2019) since these variables allowed the discrimination of performance in a sample of elite male futsal athletes.

For the reliability testing, 20% of the total games (four games) were re-analyzed within 20 to 25 days after the first analyses (Tabachnick, Fidell, & Ullman, 2007). The intra-observer kappa-values ranged between 0.91 and 0.97. The inter-observer kappa-values ranged between 0.90 and 0.97.

Statistical analysis

Athletes' birthdate frequencies were presented in relative values. Chi-square goodness-of-fit tests (χ^2) were performed to compare the observed and the expected birthdates distribution of all the athletes and according to team placement (top-ranked teams vs low-ranked teams). Athletes were divided into four quarters (Q1, Q2, Q3, and Q4), and 25% was assumed as the expected frequency for each quarter, as proposed by Cotê, Macdonald, Baker, and Abernethy (2006). For all analyses, the

Table 1. Definitions of tactical individual performance indicators

Variable	Definition
Time played	Minutes and seconds in which the athlete was on the court, with the ball in play.
Unbalanced passes	Pass performed by the attacking player generating a defensive imbalance in the opponent team, along with a significant advance in the attack.
Assists	Pass to a player who scores in the opponent's goal (the shooter must score without performing more than two dribbles before scoring).
Goals scored	Goal scored in the opponent's goal.
Shots on goal	Shots on goal that were saved by the goalkeeper.
Challenges won in 1vs1	Confrontation in which the defender wins the 1vs1 dispute.
Steals	The action in which the defender steals the ball from the attacking athlete and thus the defenders recover ball possession.

effect size (ω) of the chi-square tests was calculated. According to the nomenclature of Cohen (1988), 0.1 is considered a small effect, 0.3 is a medium effect, and 0.5 is a large effect. Odds Ratio (ORs) for Q1 versus Q4 and the 1st versus 2nd semesters were also calculated.

Each of the athlete's tactical individual performance variables was compared based on the birth quarter distribution. The criterion for inclusion in this analysis was to have participated in at least one match, regardless of the amount of time played. Thus, twelve athletes were excluded from this analysis for not playing any match in the competition. To a fair score that accounted for the amount of time played, the initial values for each of the tactical performance variables were divided by the time played (in minutes), resulting in an adjusted score for each variable, similar to Santos et al. (2019). Kolmogorov-Smirnov test indicated that tactical individual performance data did not present a normal distribution, thus performances were compared across the birth quarters using the Kruskal-Wallis test. The

effect size (η^2) of the Kruskal-Wallis tests was calculated for all the analyses. As a reference, 0.01 was considered a small effect, 0.06 a moderate effect, and 0.14 a large effect, based on Cohen (1988). All the analyses were performed using the Statistical Package for Social Sciences (SPSS), version 21.0 (Chicago, USA). The significance level for all the analyses was 0.05.

Results

The tactical individual performance indicators analyzed were time played (>40,000 min played), goals scored (n = 105), assists (n = 62), steals (n = 472), shots on goal (308), unbalanced passes (89), and challenges won in 1vs1 (n = 119), resulting in 1,155 actions performed.

The overall analyses of the Brazilian elite female futsal athletes indicated RAE was not prevalent in this pool of athletes ($\chi^2 = 1.022$; $p = .796$; $\omega = 0.11$; OR – Q1:Q4 = 1.439; OR – 1st:2nd = 1.144). When the final placement in the championship was

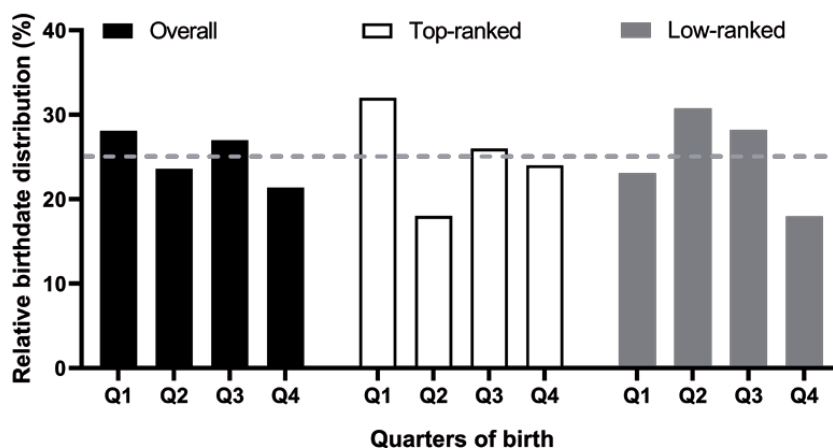


Figure 1. Relative observed and expected birthdate frequencies for overall, top-ranked, and low-ranked athletes.

Table 2. Adjusted tactical individual performance according to birth quarters

Variables	Q1 (P1-P3)	Q2 (P1-P3)	Q3 (P1-P3)	Q4 (P1-P3)	H	p
Time played	10.12 (2.43-18.29)	12.977 (2.22-20.05)	12.828 (4.78-21.6)	14.504 (5.3-17.35)	1.318	.725
Passes	0 (0-0.02)	0 (0-0.1)	0 (0-0.03)	0.008 (0-0.02)	0.628	.89
Assists	0 (0-0)	0 (0-0.02)	0 (0-0.01)	0 (0-0.01)	1.616	.656
Goals	0 (0-0.05)	0 (0-0.02)	0 (0-0.03)	0 (0-0.02)	0.544	.909
Shots	0.043 (0-0.08)	0.057 (0.01-0.1)	0.054 (0.02-0.12)	0.073 (0-0.11)	2.087	.555
1vs1	0.015 (0-0.02)	0 (0-0.03)	0.015 (0-0.06)	0.017 (0-0.04)	1.142	.701
Steals	0.083 (0-0.15)	0.052 (0-0.12)	0.088 (0.01-0.15)	0.103 (0.07-0.15)	2.605	.457

Note. Q1-Q4 = median values for each birth quarter; (P1-P3) = 25% and 75% percentile values; H = Kruskal Wallis; p = level of significance.

considered, once again no RAE was found, neither for the top-ranked ($\chi^2 = 2$; $p = .572$; $\omega = 0.2$; OR – Q1:Q4 = 1.490; OR – 1st:2nd = 1) nor the low ranked ($\chi^2 = 1.513$; $p = .679$; $\omega = 0.17$; OR – Q1:Q4 = 1.371; OR – 1st:2nd = 1.361) athletes (Figure 1).

Adjusted tactical individual performance (initial variable values divided by minutes played for each athlete) was analyzed based on the athletes' birth quarters. No differences were found ($p > .05$) for any of the variables (Table 2). Effect sizes were considered small for all the comparisons ($\eta^2 < 0.001$).

Discussion and conclusions

In this paper, we investigated the presence of RAE on Brazilian elite female futsal athletes according to the team's final position in the Brazilian Cup as well as the influence of RAE on athletes' tactical individual performance. We did not find the presence of RAE according to the final classification of the teams nor considering the tactical individual performance of the players. These results are in line with our hypotheses.

In our study, RAE was not observed in teams that were better placed in the competition analyzed, which is in line with the results found by Arrieta, Torres-Unda, Gil, and Irazusta (2015) in female basketball players and Ribeiro et al (2023) in female soccer players. On the other hand, Saavedra and Saavedra (2020) found a greater presence of older female handball athletes among the teams ranked from the first to the eighth places in the Under-18 World Championship, which is different from our results. Specifically, in futsal, Perondi et al. (2018) did not observe RAE in 410 athletes from an adult female competition in Brazil. Leonardi et al. (2022) also found no effects of RAE in 292 female futsal players aged 15 to 20, considering the teams' final classification. Our results reinforce these findings in female futsal, but now in the context of one of the most important Brazilian competitions. We believe these results are related to the influence of variables such as sex (Babić, et al., 2022) and competition level (Coble, et al., 2009) of a sport modality. These are some of the aspects that may influence the intensity of competition in a given sport context, affecting the likelihood of a biased talent selection process that favours RAE (Peña-González, et al., 2021). Accordingly, futsal is more practiced by men in Brazil (data made available by CBFS on April 27, 2023: 356,831 male and 36,915 female athletes registered), and the sport is not as popular for females, which may reduce the competition for spots in teams and cause a reduction in the RAE likelihood. Indeed, Leonardi et al. (2022) investigated 140 male futsal teams aged between 9 and 20 years, while in the same study, only 19 female futsal teams were found, between 15 and 20 years, highlighting that the female practice of the sport modality is reduced. Another relevant aspect is the

fact that in Brazil, women's futsal competitions start at later age, after 13 years old (Perondi, et al., 2018), which can lead to a later specialization in girls when compared to boys. Consequently, a lower impact of RAE is expected in female athletes, since RAE strongly operates near the beginning of puberty, where maturational differences are expected to be greater (Helsen, Starkes, & Van Winckel, 1998; Smith, et al., 2018).

Our results also indicated that RAE was not observed in relation to tactical individual performance, which indicates that RAE might not influence elite futsal female athletes' performance in terms of time played, goals scored, assists, steals, shots on goal, unbalanced passes, or challenges won in 1v1. These results are not in line with the propositions that RAE influences performance in team sports where physical and anthropometrics attributes are important to performance such as basketball, soccer, and handball (Lupo, et al., 2019; de la Rubia, Lorenzo-Calvo, & Lorenzo, 2020). A possible factor that may have influenced our results is that coaches might stipulate the players' playing time as a function of technical criteria rather than aspects derived from RAE (Karcher, Ahmaidi, & Buchheit, 2014). In this rationale, Perondi et al. (2018) suggest that the technical aspect in women's futsal is more important than in men's, which would make it more appropriate to select technically superior players rather than physically superior ones (Helsen, Van Winckel, & Williams, 2005). Thus, the potential reduction in the importance of physical aspects for competition performance and the increased importance of tactical, technical, strategic, and even psychological qualities (de la Rubia, et al., 2020; Rampinini, Coutts, Castagna, Sassi, & Impellizzeri, 2007), can mitigate the impact of RAE.

Even though RAE is well established in many sports, especially in the male context, little is known about it in female futsal athletes (Mendes, et al., 2022). Studies have shown a prevalence of RAE in male futsal, highlighting that it influences talent identification and athlete development processes (Morales Júnior, et al., 2017; Perondi, et al., 2018). Nevertheless, this effect seems limited in the female context. One could argue that some characteristics of futsal may reduce the likelihood of RAE, such as the reduced playing area, which implies more emphasis on tactical-technical components to resolve game situations. Thus, less physically mature players would have more chances to develop technical and tactical skills, compensating for eventual physical disadvantages. Yet, these are speculative arguments, since research on the theme is still scarce and the pervasiveness of RAE seems context specific. This reinforces the importance of studies involving RAE and the tactical-technical qualities of futsal players. Indeed, Figueiredo et al. (2021)

highlighted that RAE could be better monitored to minimize the loss of valuable elite players during the youth phase of their careers for both sexes.

Regarding the tactical individual performance indicators, the average of the actions was higher than in studies with male futsal players (Yiannaki, Barron, Collins, & Carlinh, 2020). This probably stems from differences in physical and perceptual motor characteristics between men and women (O'Brien-Smith, Bennett, Fransen, & Smith, 2019), which in turn affects the properties of the futsal games played by male and female athletes (Agras, Ferragut, & Abraldes, 2016). A game that relies more on tactical-technical actions would be expected for females, compared to a more physical game played by males. However, it is important to note that studies aimed at performance analysis in female futsal are scarce in the literature, which makes it difficult to compare with our results.

Despite providing important evidence to the female elite futsal context, this study has some limitations. An important limitation is the context restriction, which imposes caution when generalizing the results. Another limitation concerns the number of evaluated athletes, since not all participants of the competition were analyzed due to difficulties imposed by some clubs. In addition, another limitation is that we evaluated only one national-level competition, not allowing the analysis of the RAE behaviour at different competitive levels. Thus, to overcome the limitations of the present study, we suggest that future investigations analyze

more participants at different competitive levels. Additionally, analyzing the developmental pathway of each athlete may provide insightful information for futsal coaches and administrators.

The current research confirmed the absence of RAE among female futsal players according to the final classification of the teams and the tactical individual performance of the players. This conclusion was in line with a previous systematic review that suggested the absence of RAE in female futsal players. The present research suggests that RAE has no impact on this specific sport context, which should be faced as a positive factor since female futsal athletes seem to have the same chance of achieving the elite level in Brazil, regardless of their birthdates.

Based on our findings, Brazilian female futsal coaches should select athletes according to their technical and tactical performance rather than physical aspects, since the confound between biological maturation and sports talent is likely to favour relatively older athletes throughout sports development pathways (Peña-González, Fernández-Fernández, Moya-Ramón, & Cervelló, 2018; Peña-González, Javaloyes, Cervelló, & Moya-Ramón, 2022). Finally, in terms of practical applications, our results indicate that futsal coaches in charge of female teams in Brazil should invest a great deal of effort in developing all of their athletes' tactical capabilities, given the central role it plays in team sports and considering that RAE has no impact on performance for this population.

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