# Relative age effect on male futsal national leagues of Brazil and Spain: impact of foreign players

## Efecto de la edad relativa en las ligas nacionales masculinas de fútbol sala de Brasil y España: impacto de los jugadores extranjeros


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## Abstract

Introduction: The Relative Age Effect (RAE) encompasses variations associated with the age of athletes within the same category and is present in various sports, including futsal.
Objective: This study aimed to compare the RAE in male professional players from the Brazilian National Futsal League (Liga Nacional de Futsal [LNF]) and the Spanish National Futsal League (Liga Nacional de Fútbol Sala [LNFS]), considering differences between native and foreign players.
Methodology: The sample consisted of 401 players registered in LNF and 307 in LNFS during the 2020/2021 season. Players were grouped according to their birth quartiles (Q1-Q4) and semesters (S1 and S2). The goodness-of-fit chi-square test ($\chi 2$) was used in the statistical analysis of RAE, comparing differences between observed and expected distributions. Cramer's V was calculated as an effect size measurement. Odds ratios were also calculated for the likelihood of being born in Q1 vs. Q4 and for the first vs. second semester of the year. Results: The main results indicated that RAE was observed only in Brazilian players from the LNF, where players born in Q1 were more frequent than those born in Q3 and Q4.
Discussion: Considering the natives and foreigners in the LNFS no deviation from the expected birthdate distribution was observed.
Conclusions: Therefore, the conclusion is that RAE is a phenomenon in Brazil's LNF. However, no evidence exists in the LNFS of Spain, whether considering natives or foreigners.



## Keywords

Birthdate Distribution; Brazilian National Futsal League; Professional Futsal; Relative Age Effect; Spanish National Futsal League.



## Resumen

Introducción: El Efecto de la Edad Relativa (RAE, por sus siglas en inglés) abarca las variaciones asociadas con la edad de los atletas dentro de la misma categoría y está presente en varios deportes, incluido el fútbol sala.
Objetivo: Este estudio tuvo como objetivo comparar el RAE en jugadores profesionales masculinos de la Liga Nacional de Fútbol Sala de Brasil (Liga Nacional de Futsal [LNF]) y la Liga Nacional de Fútbol Sala de España (Liga Nacional de Fútbol Sala [LNFS]), considerando las diferencias entre jugadores nativos y extranjeros.
Metodología: La muestra consistió en 401 jugadores registrados en la LNF y 307 en la LNFS durante la temporada 2020/2021. Los jugadores fueron agrupados de acuerdo con sus cuartiles de nacimiento (Q1-Q4) y semestres (S1 y S2). En el análisis estadístico del RAE se utilizó la prueba de chi-cuadrado ($\chi 2$). Se calculó la V de Cramer como medida del tamaño del efecto.
Resultados: Los principales resultados indicaron que el RAE se observó solo en los jugadores brasileños de la LNF, donde los jugadores nacidos en el Q1 fueron más frecuentes que los nacidos en el Q3 y Q4.
Discusión: Considerando a los nativos y extranjeros en la LNFS, no se observó desviación en la distribución de fechas de nacimiento esperada.
Conclusiones: Por lo tanto, la conclusión es que el RAE es un fenómeno presente en la LNF de Brasil. Sin embargo, no existe evidencia de su presencia en la LNFS de España, ya sea considerando a nativos o extranjeros.



## Palabras clave

Distribución de fechas de nacimiento; Efecto de la Edad Relativa; Fútbol sala profesional; Liga Brasileña de Fútbol Sala; Liga Española de Fútbol Sala.

## Introduction

In futsal, as in other team sports, competitions with young people are organized into chronological age categories, generally on a biannual basis. For instance, youth futsal leagues often include categories such as U-12 (for players aged 11 and 12), U-14 (13 and 14), and U-16 (15 and 16), following this biannual structure. In theory, this division is made so that players in the same category play on equal terms with each other, considering the characteristics of physical and psychological growth and development (Schorer et al., 2009). However, in the same category, a player can present almost a year (if we consider the annual categories) or two years (if we consider the biannual categories) difference concerning his peers, depending on the player's birth month (Castro et al., 2023).

The variation in chronological age among individuals within the same age category is referred to as relative age (Díaz del Campo, 2013), while the advantage that favors players born at the beginning of the year, i.e., the first quartile or semester, can lead to the Relative Age Effect (RAE) (Musch & Grondin, 2001). According to Andronikos et al. (2016), the RAE represents the set of differences related to the age of athletes in the same category. In this sense, players born in the early months of the year are favored over players born in the final months since, in general, relatively older athletes are more likely to present advanced physical characteristics and enter puberty earlier than their younger peers (Musch & Grondin, 2001). The RAE can influence the athlete selection process and how they develop their sporting skills and athletic capabilities (Lidor et al., 2021), in addition to increasing the possibility of young athletes losing opportunities and, consequently, interest, increasing the chances of abandoning the modality (Lemez et al., 2014). For example, Mendes et al. (2021) examined in their study, among other factors, the impact of the relative age on the professional advancement of Brazilian soccer players competing in Europe. The authors found that athletes born in the second and third quarters of the year have higher likelihood (84% and 67%, respectively), playing in the Champions League rather than Europa League compared to those born in the fourth quarter, suggesting that relative age has a significant impact on the progression of professional Brazilian soccer players acting in Europe.

According to Wattie et al. (2015), to analyze the RAE in the sporting context, it is necessary to consider the interaction between personal, environmental and task factors, which will interact differently. Personal factors refer to the individual characteristics of an athlete that can influence their competitive advantage or disadvantage, and include body composition, biological sex differences, height, and maturational status. Environmental factors involve external influences that shape an athlete's development and opportunities, such as the sport's popularity in a given region, access to training facilities and coaching quality, sports policies and selection processes. Task-related factors pertain to the specific demands and structure of the sport itself, which include requirements such as agility, strength, decision-making speed, technical precision, and positional demands (Wattie et al., 2015). Confirming these findings, Silva et al. (2022) conducted a systematic literature review on RAE in youth athletes in invasion team sports and concluded that factors such as a high level of competition, the popularity of the sport, coaches' assessments, and biological traits (especially during puberty) play a crucial role in the relative age effect, impacting the retention and sporting trajectories of young athletes.

RAE has been evidenced in individual and team sports, such as basketball (Bilgiç et al., 2025), triathlon (Werneck et al., 2014), swimming (Ferreira et al., 2017), handball (de la Rubia et al., 2021), athletics (Figueiredo et al., 2021), soccer (Cabezón et al., 2024), Volleyball (Castro et al., 2022b), ice hockey (Grondin et al., 2025), among others. Furthermore, RAE is reported as a phenomenon that remains up to senior elite sports, especially in contexts where this effect is pervasive in young players (Lidor et al., 2021), as presented in futsal (Castro et al., 2022c).

Futsal is characterized by intermittent actions with high aerobic and anaerobic demand, with changes of direction, change of rhythm, and high-intensity actions requiring rapid recovery (Dos-Santos et al., 2020; Silva et al., 2021). Federated futsal players (U10 to U16) have more developed physical fitness parameters and body composition than non-federated players (Braz & Ré, 2013), which can guarantee relatively older athletes performance advantages in sports (Figueiredo et al., 2021). However, studies on RAE in futsal are controversial. The RAE was verified in the Brazilian National Futsal League (Liga Nacional de Futsal [LNF]) in the 2013 season (Morales Junior et al., 2017) and from 2016 to 2020 (Castro et al., 2022a). Analyzing the RAE in Brazilian players from the five main male futsal teams according to category and tactical positions, Castro et al. (2022c) found the RAE, especially in the U17, U20 and senior

categories, for the goalkeeper positions, winger and defender, while Figueiredo et al. (2021) analyzed the RAE in young and adult Portuguese players and verified the RAE only in U7 and U9. However, the RAE was not confirmed among players at the men's Futsal World Cup in 2021 (Castro et al., 2022d), corroborating the study by Carraco et al. (2020), who analyzed players from three editions of the men's Futsal World Cup (2008, 2012 and 2016). Lago-Fuentes et al. (2020), in a study with Spanish players with the first division teams from the Spanish National Futsal League (Liga Nacional de Fútbol Sala [LNFS]), did not find the RAE between the 2006-2007 and 2014-2015 seasons. Finally, RAE was not observed in male and female futsal players from Portuguese national teams (Figueiredo et al., 2021).

Brazil, with six titles, and Spain, with two titles, have the highest number of titles in the Futsal World Cups organized by FIFA (FIFA, 2021) and have the strongest futsal leagues in the world: Brazilian National Futsal League (LNF) and Spanish National Futsal League (LNFS). These leagues attract top national talent and serve as key platforms for player development and international competition. However, Spain's LNFS features many foreign players, including Brazilian players, which may create a bias in characterizing the League's RAE. On the other hand, in Brazil's LNF, the presence of foreign players is not observed, which may better characterize players native to that country. In soccer, the presence of college soccer players from the United States of America (USA) influenced the RAE results when comparing players born in the USA and their foreign peers (Hurley et al., 2019). Considering the contradictory results regarding RAE in futsal, the cultural and training differences in their respective countries that foreign players can bring about and that RAE can cause a bias in player selection, harming younger players and resulting in abandonment of the sport, it is essential to understand the influence of foreign players on the RAE in the two most significant futsal leagues in the world. Furthermore, to the best of our knowledge, this is the first study on RAE in futsal that directly compares the national leagues of Spain and Brazil while also considering the distinctions between native and foreign players. Thus, this study aimed to compare the RAE in male professional players from the LNF and LNFS, considering the differences between native and foreign players. Based on the existing literature, the study hypothesis is that the RAE is present in LNF and Brazilian LNFS players and that foreign players can create a bias and influence the RAE results in the competitions analyzed.

## Method

### *Participants*

This is a descriptive and retrospective study. The data were collected in 2022, on the last season that was completed until then. Among all players from the two leagues (719 players), seven and four, respectively, from LNF and LNFS, the dates of birth were not mentioned on the websites. Thus, the sample was analyzed using 708 male futsal players registered in the LNF and LNFS, 401 players from 23 LNF teams, and 307 from 18 LNFS teams who competed in the 2021 and 2020/2021 seasons, respectively. This study is based only on publicly available documentary data and does not involve human intervention or direct participation. For this reason, it did not require formal ethical approval. The data were obtained from open-access databases, ensuring compliance with national and international ethical standards for secondary data analysis (Harriss et al., 2019). Furthermore, there was no individual identification of the players, ensuring anonymity (Franchini et al., 2020). Similar methodologies have been widely accepted in previous RAE investigations (Castro et al., 2022c; Oliveira et al., 2023).

### *Procedure*

Information about the players' dates of birth was collected from the official websites of the two leagues studied: 2021 LNF teams (https://lnfoficial.com.br/equipes/?season=10) and 2020/2021 LNFS teams (https://www.lnfs.es/competicion/primera/2021/equipos). The year of birth was defined as starting on January 1. Data collection was carried out manually by two independent researchers, and after data collection, reliability was verified by comparing the collected data, with no discrepancies being found between the information. The data were tabulated in a spreadsheet, and the variables were analyzed according to the distribution of birth dates by quartiles and semester, in accordance with other studies

in futsal Castro et al., 2022a; Castro et al., 2022c; Castro et al., 2022d). Thus, each quartile represents a quarter: Q1 (January, February and March), Q2 (April, May and June), Q3 (July, August and September) and Q4 (October, November and December) and each semester: S1 (Q1 + Q2) and S2 (Q3 + Q4).

### *Data analysis*

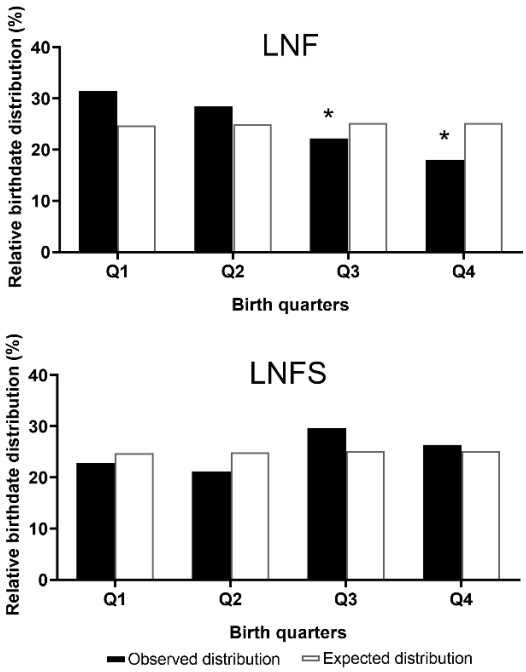
The goodness of fit chi-square test ($\chi 2$) was employed in the statistical analysis of the RAE, comparing the differences between the observed and expected birth quartiles in each of the Leagues (LNF and LNFS), and based on players' nationality (Spanish-LNFS, Brazilian LNFS, and other nationalities-LNFS). The assumptions of the chi-square test, including the independence of observations and the requirement that expected frequencies in each category be greater than five, were met for all analyses. This analysis indicates whether there is a greater tendency to select athletes born in a specific quartile, based on a pre-established distribution, and has been used in previous studies on RAE (Castro et al., 2023; Figueiredo et al., 2021). Data were analyzed considering the absolute values of the observed distribution of birthdates for each quartile of the year, compared to a predetermined expected distribution, following the guidelines by Edgar and O'Donoghue (2005), and considering a .05 significance level. A power analysis was conducted a priori using G*Power 3.1 to determine the minimum sample size required to detect a medium effect size ($\omega = .3$) with a significance level of $\alpha = .05$ and a power of .80. The analysis indicated that a sample size of 191 participants would be necessary. Whenever this sample size was not met in an analysis, the post hoc achieved power was reported.

Whenever birthdates' distributions were different from expected, post hoc comparisons were performed between the quartiles to determine which of the frequencies of the players would present divergences. In these cases, the significance level was adjusted to .0083, using the Bonferroni correction for multiple comparisons suggested by Sharpe (2015). Cramer's V was calculated as an effect size measurement, considering that we dealt with contingency tables greater than 2x2. The following references were used for Cramer's V interpretation: values ranging from .06 to .17 indicated small effect sizes, values ranging from .18 to .29 indicated medium effect sizes, and values above .30 indicated large effect sizes (Cramer, 1999). Odds ratios were also calculated for the likelihood of being born in Q1 vs. Q4 and for the first vs. second semester of the year. Statistical analysis was done using the IBM SPSS Statistics software for Windows, version 22.0 (IBM Corp, Armonk, NY, USA).

## Results

The LNF birthdate distribution analyses indicated a deviation from the expected birthdate distribution ($\chi 2 = 19.046$; $df = 3$; $p < .001$; $V = .377$). The post hoc comparison between birth quartiles indicated that players born in Q1 were more frequent than players born in Q3 ($p = .002$) and Q4 ($p < .001$). On the other hand, the LNFS birthdate distribution analyses indicated no deviation from the expected birthdate distribution ($\chi 2 = 4.763$; $df = 3$; $p = .19$; $V = .216$), as seen in Figure 1.

Figure 1. Observed and expected LNF and LNFS players' relative birthdate




Regarding the presence of foreigners in the leagues analyzed, no foreigners were found in Brazil's LNF, while in the LNFS, of the 307 players, 223 are native Spanish, and 84 are foreigners (27.4%). Among foreigners in LNFS, 58 players were Brazilian (18.9% of the total and 69% of foreigners). The first LNFS analysis based on the players' nationality considered only Spanish players and found no deviation from the expected birthdate distribution ($\chi2$ = 1.945; df = 3; p = .584; V = .162). The same was verified when only Brazilian players from LNFS were analyzed ($\chi2$ = 4.778; df = 3; p = .189; V = .497) and foreigners of other nationalities from the LNFS ($\chi2$ = 2.839; df = 3; p = .417; V = .572). However, it should be noted that in the last two analyses, large effect size values were found (V = .497 and V = .572, respectively), indicating that the chi-square analysis was possibly hampered by the small sample sizes (Bergh, 2015). The limited ability to detect smaller effects was later confirmed by post hoc power analyses, which showed a power of 0.422 and 0.26 to detect a medium effect size ($\omega$ = .50) at $\alpha$ = .05 for the Brazilian players from LNFS and foreigners of other nationalities from the LNFS analyses, respectively. The distribution of players by birth quartile is available in Table 1.

Table 1. Observed and expected LNF and LNFS players' absolute birthdate distributions based on quartiles

| Players | Q1 | Q2 | Q3 | Q4 | $\chi^2$ | P | V | OR - Q1:Q4 | OR - S1:S2 |
|---|---|---|---|---|---|---|---|---|---|
| LNF (Overall) | 126 (99.1) | 114 (99.9) | 89* (101) | 72* (101) | 19.046 | **.001** | .377 | 2.093 | 2.222 |
| LNFS (Overall) | 70 (75.9) | 65 (76.5) | 91 (77.3) | 81 (77.3) | 4.763 | .19 | .216 | 0.824 | 0.616 |
| LNFS (Spanish) | 57 (55.1) | 48 (55.5) | 63 (56.2) | 55 (56.2) | 1.945 | .584 | .162 | 1.048 | 0.791 |
| LNFS (Brazilian) | 9 (14.3) | 12 (14.4) | 20 (14.6) | 17 (14.6) | 4.778 | .189 | .497 | 0.442 | 0.322 |
| LNFS (Other nationalities) | 6 (6.4) | 4 (6.4) | 6 (6.5) | 10 (6.5) | 2.839 | .417 | .572 | 0.480 | 0.390 |

*Note. Q1-Q4: birth quartiles; $\chi^2$: chi-square; p: level of significance; V: effect size; OR - Q1:Q4: odds ratio from Q1 to Q4; OR - S1:S2: odds ratio from 1st semester to 2nd semester. * Different from Q1. Numerical values between parentheses represent expected values.*

## Discussion

This study compared the RAE in male players from the LNF and LNFS professional leagues, considering the differences between native and foreign players. The main results showed that, in general, RAE was observed only in the LNF, as players born in Q1 were more frequent than those born in Q3 and Q4. No deviation from the expected birth date distribution was observed when considering the presence of foreigners in the LNFS (since no foreign players were found in the LNF).

The results regarding the distribution of birth dates among players in the LNF align with those obtained by other authors. Penna and Moraes (2010) found significant differences in the distribution of birth quartiles, with the first and second quartiles predominating and the third and fourth quartiles underrepresented among players who competed in the LNF in 2009. Morales Junior et al. (2017) investigated RAE in the 2013 edition of the male LNF and observed a prevalence of players born in the first semester. Castro et al. (2022c) also reported that relative age effects are widespread among Brazilian male elite futsal players participating in the LNF. Regarding the LNFS, Lago-Fuentes et al. (2020) examined the birth dates of 1873 players who participated in the 2006-2007 and 2014-2015 seasons, and they identified a reversal relative age effect, i.e., players born in Q3 and Q4 were more frequent. To the best of our knowledge, the study by Lago-Fuentes et al. (2020) was the only publication that specifically evaluated the LNFS players. However, in another study by Castro et al. (2022d), the RAE was not found when evaluating European futsal players, including the Spanish National Team players. In this sense, Carraco et al. (2020) did not report the RAE in Union of European Football Associations (EUFA) players. These results corroborate the results of the present study. Another possible explanation for the results in the LNF is the presence of the RAE in the youth categories of competitive Brazilian teams, specifically from U17 to the senior team (Castro et al., 2022c). This is likely not the case with Spanish teams and, consequently, in the LNFS. However, studies are needed to confirm this data in the Spanish youth teams.

According to Wattie et al. (2015), sport's popularity influences the emergence of the RAE. The more popular the sport in a particular region, the more likely the selection process will be more restrictive, favoring the occurrence of the effect. Thus, one of the possible explanations for RAE being present in the LNF and not in the LNFS lies in the sport's popularity in each country. After ten editions of the Futsal World Cup, which has been held since 1989, with the most recent tournament taking place in 2024 in Uzbekistan, Brazil stands as the most successful nation in the competition's history. The country has secured six titles, including the most recent championship, solidifying its dominance in sport. Spain, with two world titles, is also a prominent force in international futsal. These achievements likely contribute to the distinct futsal cultures and development systems in both countries. Currently, Brazil ranks first in the 2025 FIFA Futsal World Ranking, while Spain holds the second position (data retrieved from the official FIFA website on February 1, 2025). Additionally, Futsal Planet, further highlighting Brazil's leadership in the sport, recognized the head coach of the Brazilian men's national team as the 2024 Best Men's National Team Coach in the World. Despite the presence of two strong futsal traditions and differences in their approaches to player development, these data, and the absence of foreigners in the LNF of Brazil, show that futsal is apparently a more popular and competitive sport in Brazil than in Spain, favoring the emergence of the RAE in LNF.

Regarding the nationality of players, some studies have attempted to identify whether this is a factor that impacts RAE and found similar results. Castro et al. (2022d) investigated the existence of RAE in male futsal players who participated in the FIFA Futsal World Cup (2021) and found no evidence of RAE associated with the player's region (continent). Carraco et al. (2020) examined the RAE in the sample of male players who participated in the FIFA Futsal World Cups (2008, 2012, and 2016) and found no relationship between the effect and the geographic location of the players, according to the continents of the confederations. On the other hand, López & Ferri-Carruana (2024) aimed to determine to what extent nationality can influence the relative age effect in foreign and Spanish players competing in the top leagues of Spanish handball. The results showed that the distribution of birth dates was balanced among male and female players born in Spain. However, the authors identified significant differences when analyzing the sample of foreign athletes, revealing a high percentage of players born in the second quarter.

The literature must be more consistent with the birthplace effect, especially about density and population size (van Nieuwstadt et al., 2020). Côté et al. (2006), who conducted a study with athletes from various North American sports teams, revealed a bias towards the birthplace of athletes, with professional athletes from cities with fewer than 500,000 inhabitants being over-represented. To Kyttä (2002), small and less urbanized places have been described and could be related to more significant opportunities to play and experience different sports in rural areas. On the other hand, athletes have more significant opportunities in large cities, mainly related to the club structure, better working conditions, greater population density, and more experienced coaches (Côté et al., 2006). The present

study did not indicate a difference between the birthplace players. Although the present study does not aim to verify the birthplace of the players, this could be an exciting factor to be analyzed in future studies.

This study presents limitations. First, it considers only the players' country of birth without accounting for regional variations within countries, such as city size, population density, or local development opportunities, which could influence RAE. Additionally, the sample is restricted to two championships and one season, which may limit the generalization of the findings to other competitions, regions, or periods of time. This restriction also influences chi-square and effect size analyses, as these methods are sensitive to sample size, potentially affecting the robustness and interpretation of the results. Another constraint is the exclusive focus on male players, preventing an understanding of potential gender differences in RAE. Finally, this is the first study investigating the RAE comparing native and foreign players enrolled in a futsal competition. This study was only possible because high-level teams are composed of players born and trained in different countries, limiting the possibility of comparing our results with results from previous studies.

This study focused exclusively on elite futsal teams, where players are likely to be the most talented and may have overcome relative age disadvantages. This could result in an underestimation of the true impact of RAE at earlier stages of development. To address this limitation, future studies could investigate RAE across different competitive levels and age categories. Additionally, exploring the interaction between RAE and other demographic factors such as birthplace effects, training environments, and socioeconomic background could provide deeper insights into its underlying mechanisms. Expanding the sample to include female athletes and other team sports would also contribute to a more comprehensive understanding of how RAE manifests across diverse contexts. Finally, the literature lacks longitudinal studies, which could help clarify the long-term impact of RAE throughout the various stages of athlete development.

Regarding practical implications, these findings can inform teachers, coaches, sports managers, and other stakeholders in rethinking athlete development systems in futsal, particularly in Brazil. By recognizing the influence of RAE, strategies can be implemented to ensure that players born at the beginning or end of the year have equal opportunities to develop and reach high-level sports. This approach could foster a more inclusive and equitable environment for talent identification and long-term athlete development.

## Conclusions

Our findings showed that the birth date distribution deviates from the expected pattern among LNF players, indicating that RAE is a phenomenon in Brazil. Since there were no foreign players in the Brazil LNF, it was impossible to analyze and conclude this. In contrast, the absence of significant differences in the birth date distribution of LNFS players suggests no evidence of RAE in Spanish male elite futsal, whether considering native, Brazilian players or others foreign players. These results underscore the influence of environmental and contextual factors on the manifestation of RAE. Sociocultural contexts, sports policies, economic conditions, and other elements may contribute to these observed differences, although further research is needed to confirm their specific roles. This study highlights the complexity of RAE and emphasizes the need to consider broader systemic factors when examining its prevalence across different regions and sports systems. Leagues of a lower or regional level and female futsal players must be studied in two countries to verify if the results are like the higher level of male futsal.

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