Sports Training

Market value of Brazilian soccer players that played 2020 series A and B of the Brazilian championship: an analysis based on quarters of birth and playing position

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Abstract - Aim: The present study aimed to investigate the prevalence of RAE in soccer players from different positions in Series A and B in 2020 Brazilian soccer, as well as the impact of RAE on the estimated market value of these players. **Methods:** Data from 1080 male elite soccer athletes were analyzed. Athletes were grouped according to birth quarters: Q1 (January-March), Q2 (April-June), Q3 (July-September), and Q4 (October-December) and the competitive level (Series A or B). Chi-square tests (χ^2) were performed to compare the birthdates' distribution of athletes according to a competitive level and playing positions. Kruskal-Wallis test was used to compare the market values of players born in each of the quarters of the year across competitive levels and playing positions. The significance level was set at 5%. **Results:** The overall analyses showed the prevalence of RAE in Series A and B, with an overrepresentation of athletes born in the first two quarters of the year. The RAE analysis based on playing positions showed different from expected distributions for forwards, midfielders, and defenders in Series A. In Series B, only midfielders showed a difference from the expected distribution. As for the market values analyses, no differences were found based on the athletes' birth quarters, regardless of competitive level or playing position. **Conclusion:** Our results indicate that, although RAE is prevalent in Series A and B of elite Brazilian soccer, it does not seem to influence players' estimated market values.

Keywords: relative age effect, talent identification, soccer.

Introduction

The relative age effect (RAE) is known as the impact on sports participation and performance caused by being relatively younger or older[1]. RAE occurs during the talent identification process, in which occurs an overrepresentation of players born closer to the arbitrary cut-off dates in relation to their peers born further away from these dates[2]. This phenomenon can be explained by variations in the maturation process of young athletes[3], who are favored in the talent identification process due to their superior physical characteristics in relation to their younger peers[4,5]. RAE is observed in several sports, such as volleyball[6], handball[7,8], beach handball[9], futsal[10,11,] and soccer[2,12,13]. Evidence indicates that RAE is particularly pervasive in the soccer contexts[14], occurring in youth categories and remaining up to the senior categories of high-level competitions, such as in the first and second divisions of the main European soccer leagues[15,16]. Costa[17] and Figueiredo[18] also observed this phenomenon in Brazilian soccer. Thus, RAE can be persistent even in elite soccer, favoring relatively older athletes and impairing talented players to achieve their potential.

Even though evidence has suggested that RAE favors relatively older soccer athletes in the talent identification process[15,19,20], literature also indicates that relatively younger athletes that manage to reach elite level play may benefit from the challenging environment they endure throughout their athletic development pathway[21]. In younger categories, the relatively younger players must overcome the greater height, body sizes, and strength generally presented by relatively older athletes[14]. Therefore, relatively younger athletes usually develop greater technical, tactical, and psychological features, that are associated with successful sports performance[14] to thrive in this unfavorable environment. This may explain why relatively

younger soccer players are more likely to earn higher salaries[22] and win more awards when they reach the senior level in many leagues around the world[21], even though they were part of a system that puts them at a disadvantage. This notion has raised the interest of clubs and researchers to better understand the relationship between RAE and the market value of soccer players[23-26].

In a recent investigation, Gyimesi and Kehl[23] found strong evidence that RAE is associated with the market value of European elite soccer players since players born closer to the cut-off dates showed higher market values than players born away from the cut-off dates did. On the other hand, Ramos-Filho and Ferreira[25] found no relationship between RAE and market values of Brazilian soccer players that participated in the 2015 Brazilian championship Series A, even though relatively younger players had better sports performance compared to relatively older players. These results are in line with findings from Doyle and Bottomley[19] and Perez-Gonzalez[27], in which no relationship between RAE and market values was found for elite European soccer players. The contradictory results reinforce the relevance of investigating the relationship between RAE and the market value of soccer athletes. This may be particularly of interest in Brazilian elite soccer, since the Brazilian championships are one of the most important leagues in the world, exporting many athletes to European soccer[28].

It is essential for clubs to identify potential sports talents, so that they have greater chances of achieving sporting success and higher market values, also favoring economic performance. Thus, the present study aimed to investigate the prevalence of RAE in soccer players from different positions who participated in Series A and B of the 2020 Brazilian championships, as well as the possible impact of RAE on the estimated market value of these players. We hypothesize that RAE will be present in the investigated sample, corroborating previous investigations with elite Brazilian soccer players[17,18]. In addition, considering previous results found within European soccer[19,27] and especially in Brazilian soccer[25], we assume that the players' birth quarters will not affect their market values, since these values are associated with the technical-tactical performance presented by the players and external variables, such as club management and public attention[29]. These aspects are not likely to be associated with RAE in the senior categories, as transitory maturational benefits are not expected to play an important role at this point in the sports career[3].

Metodology

Participants

We collected data from 1080 male elite soccer athletes who participated in the 2020 Brazilian soccer championships, in Series A or B. These athletes were organized based on their competitive level (Series A and B, n = 633; n = 447, respectively) and playing position (forwards, n = 280; midfielders, n = 340; defenders, n = 353; and goalkeepers, n = 107).

Data collection and procedures

Players' full names, date of birth, competitive level, and playing positions were obtained from rosters available at the Brazilian Soccer Confederation (CBF) Official Website (www.cbf.com.br) and clubs' websites. Data regarding the players' market value were obtained from the "Transfermkt" database (www.transfermarkt.com.br), similarly to previous studies[25,26]. Data collection was performed during March 2021, when the season was already over for Series A and B, and players' market value is supposedly stabilized. Athletes whose information was incomplete were not considered for the study. All data used in this study were reported anonymously.

The variables analyzed included the athletes' birth quarters: Q1 (January-March), Q2 (April-June), Q3 (July-September), and Q4 (October-December), the competitive level (Series A and B), playing positions (forwards, midfielders, defenders, and goalkeepers), and the players' market values in thousands of euros, as this is the most common currency in soccer transactions.

Statistical analysis

The frequencies of athletes' quarters of birth were presented in absolute values. We analyzed the occurrence of the RAE among players by comparing the frequency of athletes born in each quarter and the frequency expected for the overall Brazilian population-based on official Brazilian reports, in order to minimize bias associated with seasonal variations in the birth rate between months of the year. Thus, we considered the number of births in each quarter of the year based on Brazilian reports from 1994 to 2001 (Brazilian Ministry of Health), which led to the following expected observations for each quarter: Q1 = 25.7%, Q2 = 26.3%, Q3 = 24.8% and Q4 = 23.2%.

Chi-square tests (χ^2) were performed to compare the birthdates' distribution of athletes according to a competitive level and playing positions. The effect size (ω) of the chi-square tests was calculated for all analyses. As a reference, 0.1 was considered a small effect, 0.3 a medium effect, and 0.5 a large effect, based on Cohen[30]. The significance level was 0.05, except when multiple comparisons between quarters were necessary, in which Bonferroni's corrections were performed. In these cases, the significance level was adjusted to 0.0083.

Regarding the market value analyses, the Kolmogorov-Smirnov test indicated that data does not present a normal distribution. Therefore, the market values of players born in each of the quarters of the year were compared across the competitive levels and for each playing position

using the Kruskal-Wallis test. The effect size (η^2) of the Kruskal-Wallis tests was calculated for all 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[30]. The level of significance was 0.05. All analyses were performed in the Statistical Package for the Social Sciences (SPSS), version 20.0 (Chicago, USA).

Results

The overall analyses of Brazilian elite soccer players indicated the prevalence of RAE in the sample of Brazilian Series A [$\chi^2 = 44.525$; $p = 0.001$; $\omega = 0.265$] and B [$\chi^2 = 14.293$; $p = 0.003$; $\omega = 0.179$] (Table 1). In Series A, the post hoc analysis indicated an overrepresentation of athletes born in the first quarter of the year compared to athletes born in the third [p = 0.0001] and fourth [p = 0.0001] quarters of the year, and athletes born in the second quarter of the year compared to athletes born in the third [p = 0.0008] and fourth [p = 0.0001] quarters of the year. In Series B, the post hoc analysis indicated an overrepresentation of athletes born in the first [p = 0.0001] and second [p = 0.0032] quarters of the year compared to athletes born in the last quarter of the year.

When competitive level and playing positions were considered, unexpected distributions were found for Series A forwards, midfielders, and defenders, but not for goalkeepers. In the case of forwards, the post hoc analysis indicated that athletes born in the first quarter of the year were more frequent than athletes born in the third [p = 0.0007] and fourth [p = 0.0017] quarters of the year. In the case of midfielders, the post hoc analysis indicated that athletes born in the first quarter of the year were more frequent than athletes born in the third [p = 0.001] and fourth [p = 0.0001] quarters of the year and that athletes born in the second quarter of the year were more frequent than athletes born in the last quarter of the year [p = 0.001]. Finally, the post hoc analysis of defenders indicated an overrepresentation of athletes born in the first [p = 0.0001] and second [p = 0.002] quarters of the year compared to athletes born in the last quarter of the year.

The analysis of the Series B players only showed unexpected distributions for midfielders, but not for forwards, defenders or goalkeepers. In the case of midfielders, post hoc analysis indicated an overrepresentation of athletes born in the first quarter of the year compared to athletes born in the last quarter of the year [p = 0.0027].

The overall players' market values were compared across quarters of birth for Series A (Figure 1) and B (Figure 2) separately, without considering playing positions. Results indicated that market values were not different according to the athletes' birth quarters both in Series A [$H(3) = 1.169$; $p = 0.76$; $\eta^2 = 0.003$] and B [$H(3) = 1.468$; $p = 0.69$; $\eta^2 = 0.003$].

Players' market values were also compared according to playing position, for Series A and B separately (Table 2). Results indicated that market values did not differ based on the players' quarter of birth for all playing positions, both in Series A [p > 0.5] and B [p > 0.2].

Discussion

To analyze the possible impact of RAE on soccer players' market values, this study aimed to investigate the prevalence of RAE in male soccer players from different positions who participated in the 2020 Brazilian Series A

Table 1 - Observed and expected absolute birth quarter distribution of Brazilian elite soccer players according to playing position and competition level.

		Playing position				
		Forward (Exp)	**Midfielder (Exp)**	**Defender (Exp)**	**Goalkeeper (Exp)**	**Total**
Series A	Q1	61[c,d] (43.18)	71 [c,d] (49.60)	68 [d] (52.94)	22 (16.96)	222[c,d] (162.68)
	Q2	49 (44.18)	60 [d] (50.76)	59 [d] (54.18)	17 (17.36)	185[c,d] (166.48)
	Q3	28 (41.66)	36 (47.86)	50 (51.09)	11 (16.37)	125 (156.98)
	Q4	30 (38.98)	26 (44.78)	29 (47.79)	16 (15.31)	101 (146.86)
	χ^2	14.431	21.728	12.124	3.295	44.525
	p	0.002	0.001	0.007	0.348	0.001
	ω	0.293	0.336	0.243	0.223	0.265
Series B	Q1	35 (28.78)	51 [d] (37.78)	44 (37.78)	13 (10.54)	143[d] (114.88)
	Q2	29 (29.46)	42 (38.66)	38 (38.66)	9 (10.78)	118[d] (117.56)
	Q3	27 (27.78)	30 (36.46)	41 (36.46)	12 (10.17)	110 (110.86)
	Q4	21 (25.98)	24 (34.1)	24 (34.1)	7 (9.51)	76 (103.7)
	χ^2	2.327	9.052	4.595	1.864	14.293
	p	0.507	0.029	0.204	0.601	0.003
	ω	0.144	0.248	0.177	0.213	0.179

Note: Q1-Q4, birth quarters; (Exp), expected distribution; χ^2, chi-square; p, level of significance; ω, effect size; c, different from Q3; d, different from Q4.

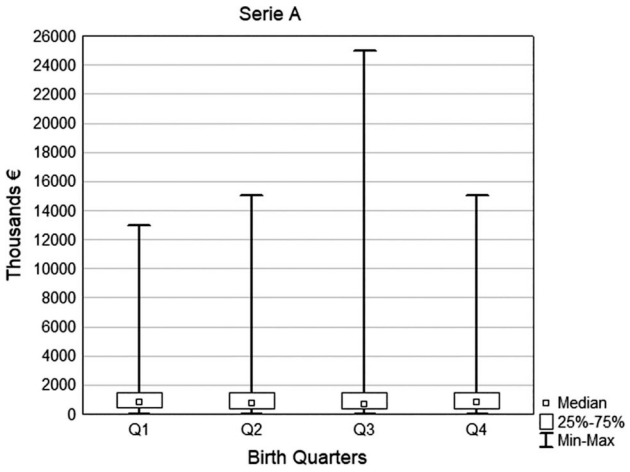

Figure 1 - Boxplots for estimated market values of Series A Brazilian soccer athletes.

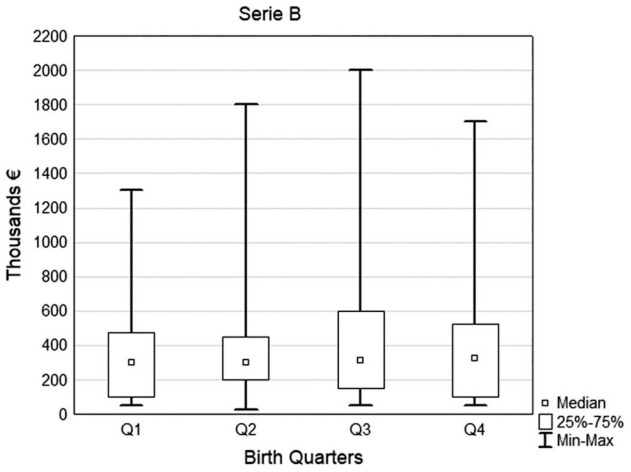

Figure 2 - Boxplots for estimated market values of Series B Brazilian soccer athletes.

and B. The overall analyses an overrepresentation of athletes born in the first two quarters of the year in both Series, confirming our first hypothesis. These results corroborate Yagüe[31], who analyzed 5201 professional players that participated in ten professional leagues: Premier League (England), Ligue 1 (France), Santander League (Spain), Bundesliga (Germany), Serie A (Italy), Premier League (Portugal), Eerste Klasse A (Belgium), SüperLig (Turkey), Bundesliga (Austria), and Eredivisie (Holland) during the 2016-2017 season. These authors found a greater representation of players born in Q1 and Q2 for all leagues, except for Eerste Klasse A. In another study, Perez-Gonzalez[27] also found a significant presence of RAE in the European Soccer Leagues, in agreement with our findings. Additionally, our results partially corroborate the study by Figueiredo[18], as the authors observed an overrepresentation of Brazilian elite players born in the first quarter of the year, while players born in the last quarter of the year were underrepresented, regardless of age category and competition level. Even though RAE tends to reduce as age categories increase[26], evidence suggests that this phenomenon is so pervasive in youth soccer[26,32] that it lasts up to the senior category.

The RAE analysis based on playing positions showed an overrepresentation of athletes born in the first months of the year for Series A forwards, midfielders, and

Table 2 - Median and interquartile range of Brazilian elite soccer players' market values in thousands of euros, according to birth quarters and playing position across Series.

		Playing position			
		Forward	**Midfielder**	**Defender**	**Goalkeeper**
Series A	Q1	900 (600-2000)	800 (350-1650)	800 (500-1125)	550 (313-875)
	Q2	850 (400-1800)	750 (375-1925)	800 (475-1350)	350 (100-700)
	Q3	725 (488-1950)	725 (438-2250)	675 (450-1500)	250 (175-650)
	Q4	800 (300-1500)	850 (500-1575)	1000 (475-1600)	275 (125-950)
	H	2.310	1.134	1.827	1.610
	p	0.510	0.768	0.609	0.657
	η^2	0.004	0.01	0.006	0.022
Series B	Q1	325 (200-400)	350 (200-525)	250 (100-538)	100 (50-100)
	Q2	350 (200-475)	300 (150-450)	325 (200-475)	250 (150-250)
	Q3	325 (200-500)	350 (175-650)	325 (150-550)	225 (100-363)
	Q4	325 (300-525)	325 (100-550)	325 (200-525)	200 (50-325)
	H	0.391	2.549	2.096	4.494
	p	0.942	0.467	0.553	0.213
	η^2	0.024	0.003	0.006	0.04

Note: Q1-Q4, birth quarters; H, Kruskal-Wallis; p, level of significance; η^2, effect size.

defenders. In Series B, the results only showed an overrepresentation of athletes born in the first months of the year for midfielders. Similar results were reported by Figueiredo[18], in an investigation that evaluated 2,660 male U20 and senior elite soccer athletes that participated in the 2019 Brazilian soccer championships Series A and B. The results showed that athletes born in the first semester were more frequent in all playing positions in both study categories, except for the goalkeepers in the senior category. In another study, Yagüe[31] analyzed ten major Male Professional Soccer Leagues of the Union of European Football Associations (UEFA) and observed that RAE was more pervasive in midfielders and defenders. These authors suggested that these playing positions may be more physically demanding than others, which may have favored relatively older athletes since they are more likely to benefit from maturational aspects due to their chronological advantage. This argument is debatable since the forward playing position is physically demanding, especially in terms of high-speed running and high-intensity accelerations[33], which would favor the occurrence of RAE[14]. On the other hand, RAE was not prevalent for goalkeepers in the European soccer leagues investigated[27,31], nor in the Brazilian context[18], which corroborates our results. The absence of RAE in this playing position may be because this is a very specialized role and children show less interest in this position compared to line positions[34,35], reducing the competition for spots in teams and identification processes, which consequently decreases the likelihood of RAE[5].

The analyses of Players' market values based on their birth quarters showed no differences in the overall sample and in playing positions, regardless of the Series. These results confirm our second hypothesis, that the players' birth quarters would not affect their market values. These findings are in line with Doyle and Bottomley[19], in which the market values of the 1000 most valuable soccer athletes in the UEFA 2014-15 professional and Youth Leagues were not different, even though RAE was present in both samples. Similarly, Perez-Gonzalez[27] demonstrated the presence of RAE in 2577 professional athletes from five European soccer leagues (Spain, Italy, England, Germany, and France), but no influence on the market value of these athletes was found. On the other hand, Romman[26] analyzed the relationship between RAE and the market value of the 2000 most valuable soccer athletes from the U18 to U23 age categories and found biased associations between RAE and market values. While higher market values were found for Q1 in the U19 athletes, this trend was reversed in U21, U22, and U23, as athletes born in Q4 showed significantly higher market values. Likewise, Furley[24] investigated the association between RAE and market values in a sample of the 100 most valuable soccer players at the time and demonstrated that players born in the first semester were more valuable than players born in the second semester. Taken together, these results highlight that the relationship between RAE and market values is not well established in soccer players. Overall, it seems that market values are not related to RAE in professional soccer, since this effect is not expected to operate at its full as it does in youth sport[15]. Since sports performance in youth categories is more affected by anthropometric and physical aspects, we speculate that relatively older athletes may be perceived as more talented[14,36], which increases their market values. However, further investigations are needed in order to verify this assumption.

The present study has some limitations, such as the analysis of athletes from other countries based on the Brazilian expected births. In our study, we had 59 foreigners in series A and 14 in series B, which represent 6.75% of the total sample. Even though birth rates may be different in other countries, it is noteworthy that RAE observed in our sample was robust, minimizing this limitation. In addition, our sample only comprised senior athletes, which prevented us from comprehending how the relationship between RAE and market values operate throughout soccer athletes' careers. Thus, we suggest further studies to investigate athletes from different age categories, aiming to understand how market values vary over time and which variables are likely to influence these values. Additionally, research that aims to investigate the different phases of senior athletes' careers may also provide insightful evidence on market values' variation along the athletic developmental pathway.

Conclusion

Our results suggest that, although RAE is prevalent in elite Brazilian soccer it does not seem to influence the market value attributed to players. This reinforces that sports administrators should seek to reduce the RAE in this sports system since the relatively younger athletes (who are more likely to reach the elite level) do not have greater market values than the other athletes. Therefore, it is possible that potential talents are being overlooked throughout the athlete developmental pathway due to the RAE, generating sports and financial losses for clubs.

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