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BETTER YOUTH ACADEMY… BETTER TALENT IDENTIFICATION? AN ANALYSIS OF THE RELATIVE AGE EFFECT IN YOUTH MALE SOCCER OF TOP-10 UEFA CLUBS

¿Mejor academia… mejor identificación de talento? análisis del efecto de edad relativa en categorías inferiores masculinas de clubes UEFA TOP-10

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Abstract

Being a major club should imply a more effective talent selection process. The present study investigates the Relative Age Effect (RAE) in youth soccer, with a focus on the top-10 UEFA clubs. Utilizing a Poisson regression model, the association between players' week of birth (WB) and their frequency in different age groups, field positions, and clubs, was examined. Results show a significant RAE presence in almost all the top 10 UEFA clubs, except for Paris Saint Germain. The phenomenon was consistent across age groups and field positions, with the highest index of discrimination (ID) noted for goalkeepers. Importantly, the study found that clubs like Real Madrid, Bayern Munich, and FC Barcelona exhibited strong model fits, suggesting a pattern in talent selection biased towards players born earlier in the selection year. These findings underscore the need for policy interventions to create a more equitable selection environment in youth soccer.

Key words: RAE; Academies; Talent Development; Talent Identification.

Resumen

Ser un club importante debería implicar una mayor eficiencia en los procesos de selección de talentos. El presente estudio investiga el efecto de la edad relativa (RAE) en las categorías inferiores de diversos clubes de fútbol, centrándose en los 10 mejores clubes del ranking UEFA. Utilizando un modelo de regresión de Poisson, se examinó la asociación entre la semana de nacimiento (WB) de los jugadores y su frecuencia en diferentes grupos de edad, posiciones en el campo y clubes. Los resultados muestran una presencia significativa de RAE en casi todos los 10 mejores clubes de la UEFA, excepto en el Paris Saint Germain. El fenómeno fue consistente en todos los grupos de edad y posiciones en el campo, y el índice de discriminación (ID) más alto se observó en los porteros. Es importante destacar que el estudio encontró que clubes como el Real Madrid, el Bayern de Múnich y el FC Barcelona exhibieron fuertes ajustes del modelo, lo que sugiere un patrón en la selección de talentos sesgado hacia los jugadores nacidos antes en el año de selección. Estos hallazgos subrayan la necesidad de intervenciones políticas para crear un entorno de selección más equitativo en el fútbol de cantera.

Palabras Clave: RAE; Academias; Detección de Talento; Desarrollo de Talento.

Introduction

The pathway to a successful sports career is a topic of general concern among scholars and professionals in the sports industry. Typically, young athletes are grouped according to their birth age, a practice aligned with most educational systems (Musch & Grondin, 2001). However, this method often overlooks varying levels of physical or mental maturity, as well as latent potential. As a result, sports systems across countries may unintentionally prevent emerging talents

from achieving their full capabilities, limiting their progression to elite levels. This phenomenon, where individuals born in the latter months of an age cohort are underrepresented, is commonly known as the Relative Age Effect (RAE).

The RAE has gained attention in numerous fields of knowledge. However, it is the educational environment that has initiated and generated the greatest controversy. Important studies within this context corroborate that students born in the latter months of the calendar year exhibit lower academic performance (Alton & Massey, 1998; Crawford et al., 2014; Russell & Startup, 1986). Concurrently, various investigations indicate a heightened risk of psychiatric issues among these students, attributing this to their lesser-developed coping abilities (Goodman, 2003; Matsubayashi & Ueda, 2015). Although the educational context has served as the precursor for the RAE, numerous other fields have also generated a wealth of scientific research on the subject.

In soccer, a considerable body of evidence substantiates the existence of the Relative Age Effect (RAE) across multiple competitive tiers. For instance, a longitudinal study conducted in Spain from 2000 to 2011 by Salinero et al. (2013) corroborates the manifestation of the RAE both at grassroots and elite levels, with particular prevalence in defensive and midfield positions in the upper echelons of Spanish competition. This prevalence was further verified by a targeted study during the 2009/2010 season (Lesma et al., 2011). Complementary lines of inquiry (Salinero Martín et al., 2013) have scrutinized the evolution of the RAE from youth divisions to professional levels, concluding that the effect diminishes as athletes ascend through the ranks, albeit persisting even at elite levels. Subsequent investigations (Pérez-González et al., 2018) corroborate these findings, indicating that approximately 60% of players in the premier Spanish soccer league were born in the first half of the year. In youth divisions, this proportion has escalated from 75% to 80%. Notably, in the 2017/2018 season, 19 out of 20 participating teams had a majority of players born in the first half of the year.

Various studies suggest that RAE is not confined to a specific national soccer but is prevalent in major European leagues. Research from the 2009/2010 season (Salinero Martín et al., 2013) detected RAE presence in the Italian, Spanish, and French leagues, corroborated by a study of professional UEFA players (González-Víllora et al., 2015). Recent studies have expanded the scope to include the Japanese professional league (Yamamoto et al., 2022) and the German Bundesliga (Götze & Hoppe, 2021). Additionally, the most recent generations of players in global, European, and American championships are also significantly impacted by the RAE (Pérez-González et al., 2021). This phenomenon not only takes place in clubs competition but in national and international competitions as well (Pérez-González et al., 2021; Ribeiro-Junior et al., 2023). In fact, as the scientific literature as shown us, there is not just a preference for choosing Q1-Q2 born players at national teams squats but also even occurs at regional level (Gómez-López et al., 2017). Choosing the best potential players for the national/regional team squat follows an immediate performance-focus, in contraposition, with studies on amateur football where RAE wasn´t detected (Herrero-Molleda et al., 2023). This phenomenon can be explained from the main motivations of the clubs, which are not focused on the pursuing of sportive results but in the social and health benefits of the sport practice (Herrero-Molleda et al., 2023).

Despite the evidence, two critical issues persist. First, no structural reforms have been enacted within sporting competitions to mitigate the RAE so far. Second, while multiple studies have comparatively analyzed RAE in diverse leagues, the focus has generally been on individual leagues. To address this gap, the present study aims to investigate the distribution of birth dates and RAE across positions and teams among male soccer players in the top 10 UEFA-ranked teams for the 2020/2021 season: Real Madrid, Bayern Munich, FC Barcelona, Atletico de Madrid, Juventus, Manchester City, Paris Saint Germain, Sevilla FC, Manchester United, and Liverpool FC.

Methods

Participants

A total of 1,209 male soccer players were included in the sample of this study. All were part of the youth academies of the top 10 soccer teams according to the 2020/2021 UEFA official rankings: Real Madrid, Bayern Munich, FC Barcelona, Atletico de Madrid, Juventus, Manchester City, Paris Saint Germain, Sevilla FC, Manchester United, and Liverpool FC.

The participants were categorized into the following age groups: Under 8-9, Under 10-13, Under 14-16, Under 17-19, Under 20-23.

Furthermore, they were grouped by their playing positions: goalkeepers, defenders, midfielders, and forwards.

Regarding birth dates, Table 1 illustrates the distribution variability across different age groups.

Table 1. Birth date distributions according to their quartile (Q) or semester (Se) of birth by ages.

Age		Total	Q1	Q2	Q3	Q4	Se 1	Se 2
All Players	n	1,209	599	322	165	123	921	288
	%	100	49.6	26.6	13.6	10.2	76.2	23.8
U20-23	n	267	108	73	50	36	181	86
	%	100	40.4	27.3	18.8	13.5	67.7	32.3
U17-19	n	479	228	121	74	56	349	130
	%	100	47.6	25.3	15.4	11.7	72.9	27.1
U14-16	n	198	107	57	18	16	164	34
	%	100	54.0	28.8	9.1	8.1	82.8	17.2
U10-13	n	232	137	60	22	13	197	35
	%	100	59.1	25.9	9.5	5.5	85.0	15.0
U8-9	n	33	19	11	1	2	30	3
	%	100	57.6	33.3	3.0	6.1	90.9	9.1

In terms of field positions, Table 2 highlights the birth distribution by quartiles and semesters of goalkeepers, defenders, midfielders, and forwards.

Table 2. Birth date distributions according to their quartile (Q) or semester (Se) of birth by field.

Field position		Total	Q1	Q2	Q3	Q4	Se 1	Se 2
All Players	n	1,209	599	322	165	123	921	288
	%	100	49.6	26.6	13.6	10.2	76.2	23.8
Goalkeeper	n	142	71	43	14	14	114	28
	%	100	50.0	30.3	9.9	9.8	80.3	19.7
Defender	n	397	193	108	64	32	301	96
	%	100	48.6	27.2	16.1	8.1	75.8	24.2
Midfield	n	394	197	105	51	41	302	92
	%	100	50.0	26.6	12.9	10.5	76.6	23.4
Forward	n	276	138	66	36	36	204	72
	%	100	50.0	24.0	13.0	13.0	76.0	26.0

Lastly, Table 3 provides a detailed insight into the birth date distributions among different soccer clubs. Here, clubs such as FC Barcelona exhibited pronounced inclinations towards specific quartiles, while others, such as Paris Saint-Germain, displayed a more balanced distribution.

Table 3. Birth date distributions according to their quartile (Q) or semester (Se) of birth by club.

Team		Total	Q1	Q2	Q3	Q4	Se 1	Se 2
All Players	n	1,209	599	322	165	123	921	288
	%	100	49.6	26.6	13.6	10.2	76.2	23.8
Real Madrid	n	244	121	61	38	24	182	62
	%	100	49.6	25.0	15.6	9.8	74.6	25.4
Bayern Munich	n	87	48	21	9	9	69	18
	%	100	55.3	24.1	10.3	10.3	79.4	20.6
FC. Barcelona	n	230	135	70	22	13	195	35
	%	100	56.3	29.2	9.2	5.3	85.5	14.5
Atletico Madrid	n	265	134	79	29	23	213	52
	%	100	50.6	29.8	10.9	8.7	80.4	19.6
Juventus	n	62	22	18	13	9	40	22
	%	100	35.5	29.0	21.0	14.5	64.5	35.5
Manchester City	n	48	17	17	5	9	34	14
	%	100	35.4	35.4	10.4	18.8	70.8	29.2
Paris Saint-Germain	n	50	13	11	13	13	24	26
	%	100	26.0	22.0	26.0	26.0	48.0	52.0
Sevilla FC	n	109	60	21	14	14	81	28
	%	100	55.0	19.4	12.8	12.8	74.4	25.6
Manchester United	n	53	20	14	13	6	34	19
	%	100	37.8	26.4	24.5	11.3	64.2	35.8
Liverpool FC	n	51	21	14	8	8	35	16
	%	100	41.2	27.4	15.7	15.7	68.6	31.4

Procedure

The data used in this study was sourced from publicly accessible datasets, specifically from the official websites of the involved clubs and the specialized online database Transfermark (Transfermarkt, 2021), as previously cited in prior research (Perez-Gonzalez et al., 2020). Transfermarkt was employed to compensate for the inconsistent transparency levels among clubs in releasing youth academy data. The use of Transfermarkt as a data source was applied given the varying levels of transparency among the clubs based on their geographic location. Specifically, Spanish clubs such as Real Madrid, FC Barcelona, Atletico de Madrid, and Sevilla FC, offered comprehensive data sets for their youth academies starting from the Under-8 category via their official websites. In contrast, non-Spanish clubs did not make such granular data publicly available across any age categories on their corporate platforms. As a result, Transfermarkt was employed to harmonize and complete the dataset for the purposes of this analysis.

The dataset, consolidated in March 2021, includes information from the 2020/2021 season such as team, field position, and date of birth.

Data Analysis

A Poisson regression model was utilized to identify the RAE, a method supported by existing literature (Doyle & Bottomley, 2018, 2019). The Poisson regression formula $y=e^{(b0+b1x)}$ was employed to elucidate the frequency of an event y in relation to an explanatory variable x.

The week of birth (WB) served as the basis for the Poisson regression, with the first week of January designated as WB1. A Time of Birth index (tB) was computed to quantify the temporal distance from WB1 a player was born, calculated as $tB=(WB–0.5)/52$ (Doyle & Bottomley, 2018).

In the Poisson regression analysis, the frequency of births per week functioned as the dependent variable y, while tB served as the independent variable x. The Index of Discrimination (ID) was calculated according to Doyle and Bottomley (2019), using the formula e^{-b1}. This served to measure the relative odds of selection between players born on day 1 versus day 365 of the competition year. The McFadden likelihood ratio R2 (McFadden, 1974) was computed as outlined by according to the method outlined by Cohen et al. (1996). Descriptive and inferential statistical analyses were conducted using R software (version 4.0.2), with a significance level set at $p<0.05$. Data are also presented in terms of mean, standard deviation, frequency, and percentages.

Results

The predominant trend for all players leans towards a higher birth rate in the earlier quarters and semesters. To better understand this trend in terms of specific weeks, Figure 1 presents the frequency of the week of birth (WB) for all players.

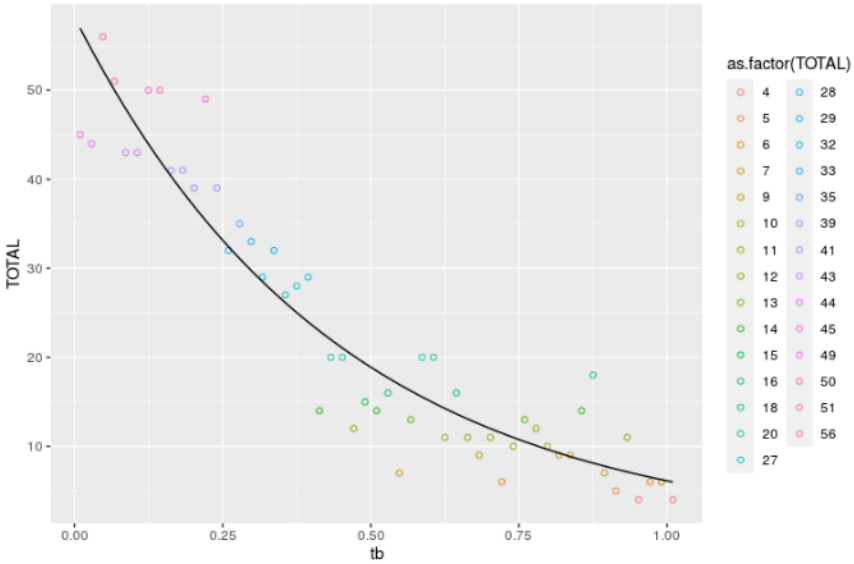

Figure 1. Frequency of week of birth (W_B) for all players.

By utilizing the Poisson regression model, we derived specific observations according to age groups, field positions, and club-specific data.

In the evaluation across different age groups, as illustrated in Table 4, there was a consistent and significant association between the week of birth (WB) and the frequency across all categories. This was further corroborated by the McFadden R2 values, which varied between 0.42 and 0.88, signifying an optimal model fit for the data across different age groups.

Table 4. Poisson regression analysis of RAE by frequency for all youth players by age groups (W_B: week of birth; t_B: time of birth; ID: index of discrimination).

Age group	Metrics	Statistical data
Overall (n=1,209)	W_B	17 ± 14
	t_B	0.32 ± 0.26
	b_0	4.06
	b_1	-2.23
	ID	9.50
	R^2 (McFadden)	0.88
	P value	**<0.001**
U20-23 (n=267)	W_B	21 ± 14
	t_B	0.39 ± 0.26
	b_0	0.20
	b_1	-0.29
	ID	4.12
	R^2 (McFadden)	0.47
	P value	**<0.001**
U17-19 (n=479)	W_B	18 ± 14
	t_B	0.34 ± 0.26
	b_0	3.06
	b_1	-2.02
	ID	7.56
	R^2 (McFadden)	0.70
	P value	**<0.001**
U14-16 (n=198)	W_B	16 ± 12
	t_B	0.30 ± 0.22
	b_0	2.42
	b_1	-2.77
	ID	15.93
	R^2 (McFadden)	0.61
	P value	**<0.001**
U10-13 (n=232)	W_B	14 ± 12
	t_B	0.26 ± 0.22
	b_0	2.72
	b_1	-3.30
	ID	27.07
	R^2 (McFadden)	0.64
	P value	**<0.001**
U8-9 (n=33)	W_B	13 ± 11
	t_B	0.24 ± 0.20
	b_0	0.86
	b_1	-3.63
	ID	37.75
	R^2 (McFadden)	0.42
	P value	**<0.001**

Turning the attention to field positions, Table 5 reveals distinct patterns. Across all positions, from goalkeepers to forwards, a significant relationship between WB and frequency was evident, with all p-values falling below the 0.001 threshold. The index of discrimination (ID) was notably highest for goalkeepers, registering at 10.94. In contrast, defenders and midfielders showcased slightly lower ID values, 10.03 and 9.48 respectively. The forwards, however, displayed the lowest ID value at 8.22.

Table 5. Poisson regression analysis of RAE by frequency for all youth players by different field positions (W_B: week of birth; t_B: time of birth; ID: index of discrimination).

Field position	Metrics	Statistical data
Overall (n=1,209)	W_B	17 ± 14
	t_B	0.32 ± 0.26
	b_0	4.06
	b_1	-2.23
	ID	9.50
	R^2 (McFadden)	0.88
	P value	**<0.001**
Goalkeeper (n=142)	W_B	17 ± 13
	t_B	0.32 ± 0.24
	b_0	1.97
	b_1	-2.39
	ID	10.94
	R^2 (McFadden)	0.48
	P value	**<0.001**
Defender (n=397)	W_B	17 ± 13
	t_B	0.32 ± 0.24
	b_0	2.97
	b_1	-2.31
	ID	10.03
	R^2 (McFadden)	0.78
	P value	**<0.001**
Midfield (n=394)	W_B	18 ± 14
	t_B	0.34 ± 0.26
	b_0	2.94
	b_1	-2.25
	ID	9.48
	R^2 (McFadden)	0.73
	P value	**<0.001**
Forward (n=276)	W_B	18 ± 14
	t_B	0.34 ± 0.26
	b_0	2.54
	b_1	-2.11
	ID	8.22
	R^2 (McFadden)	0.56
	P value	**<0.001**

Lastly, the club-specific data, as represented in Table 6, demonstrated, in each club, a significant relationship between WB and frequency, but the intensity and patterns varied. Clubs like Real Madrid, Bayern Munich, Atlético de Madrid and FC Barcelona exhibited strong model fits with McFadden R2 values of 0.64, 0.42, and 0.76 respectively. However, Paris Saint-Germain showed a weaker association with an R2 value of 0.0016, which was the lowest among the clubs studied.

Table 6. Poisson regression analysis of RAE by frequency for all youth players by clubs.

Club	Metrics	Statistical data
Overall (n=1,209)	W_B	17 ± 14
	t_B	0.32 ± 0.26
	b_0	4.06
	b_1	-2.23
	ID	9.50
	R^2 (McFadden)	0.88
	P value	<0.001
Real Madrid (n=244)	W_B	17 ± 13
	t_B	0.32 ± 0.24
	b_0	2.49
	b_1	-2.32
	ID	10.2
	R^2 (McFadden)	0.64
	P value	<0.001
Bayern Munich (n=87)	W_B	16 ± 13
	t_B	0.30 ± 0.24
	b_0	1.54
	b_1	-2.60
	ID	13.43
	R^2 (McFadden)	0.42
	P value	<0.001
FC Barcelona (n=240)	W_B	14 ± 11
	t_B	0.26 ± 0.20
	b_0	2.73
	b_1	-3.18
	ID	23.94
	R^2 (McFadden)	0.76
	P value	<0.001
Atletico de Madrid (n=265)	W_B	17 ± 13
	t_B	0.32 ± 0.24
	b_0	2.64
	b_1	-2.54
	ID	12.67
	R^2 (McFadden)	0.66
	P value	<0.001
Juventus (n=62)	W_B	21 ± 14
	t_B	0.39 ± 0.26
	b_0	0.74
	b_1	-1.28
	ID	3.59
	R^2 (McFadden)	0.19
	P value	0.004
Manchester City (n=48)	W_B	22 ± 15
	t_B	0.41 ± 0.28
	b_0	0.42
	b_1	-1.14
	ID	1.15
	R^2 (McFadden)	0.07
	P value	0.025
Paris Saint-Germain (n=50)	W_B	26 ± 16
	t_B	0.49 ± 0.30
	b_0	0.01
	b_1	-0.14
	ID	1.15
	R^2 (McFadden)	0.0016
	P value	0.767
Sevilla FC (n=109)	W_B	17 ± 15
	t_B	0.32 ± 0.28
	b_0	1.76
	b_1	-2.57
	ID	13.12
	R^2 (McFadden)	0.37
	P value	<0.001
Manchester United (n=53)	W_B	22 ± 15
	t_B	0.41 ± 0.28
	b_0	0.56
	b_1	-1.23
	ID	3.42
	R^2 (McFadden)	0.10
	P value	0.011
Liverpool FC (n=51)	W_B	21 ± 16
	t_B	0.39 ± 0.30
	b_0	0.59
	b_1	-1.39
	ID	3.42
	R^2 (McFadden)	0.11
	P value	0.006

Note: W_B: week of birth; t_B: time of birth; ID: index of discrimination.

Discussion

Over the past years, much research has proven the presence of the Relative Age Effect across the different soccer leagues (Pérez-González et al., 2018; Yagüe et al., 2018) originating at the youth competitions and escalating all the way to the top senior level (Yagüe et al., 2018). This phenomenon affects all kinds of tournaments, national team championships (Pérez-González et al., 2021; Ribeiro et al., 2024), as well as youth club competitions across various regions, as evidenced by previous literature studying China (Li et al., 2020), Australia (Tribolet et al., 2019), Latin America (Gonzalez-Bertomeu, 2018) or North America (Glamser & Vincent, 2004). In the case of the present research, focusing on Europe, the RAE effect has been shown in several youth leagues as it is the case of Germany (Augste & Lames, 2011), Belgium (Helsen et al., 2000) or France (Delorme et al., 2010). The results of the present investigation confirm the presence of RAE on almost all the top 10 UEFA Clubs (except for Paris Saint-Germain), covering the most important European leagues and supporting the theory that explains the great importance of securing a squad spot for players to continue developing their talent at the highest level (Maciel et al., 2021). Despite being the clubs with the greatest financial resources to attract sporting talent in their maturity, they unconsciously enact the RAE from the grassroots.

Not only do large national leagues exhibit the presence of RAE, but it is also observed on a smaller scale. For example, a study involving over 2,500 players from lower-division regional leagues and even amateur leagues in the Basque Country (Spain) showed that the relative age effect was significantly present in team squads (González-Aramendi, 2007). Interestingly, Luxembourg soccer lacks RAE at the youth level due to a small player base but does show it in national team squads (Simon et al., 2022). These findings reveal that when sports policies allow unrestricted selection, team recruiters (i.e., coaches and managers) tend to choose Q1 and Q2 players, no matter the latent potential of the rest of the players. And this is evident in the top UEFA clubs, which could be pioneers in a more efficient selection, postponing immediate performance for a more promising future, since a greater room for maneuver is assumed, given their financial solvency (acquisition of players in later times). To address this, the implementation of new sports regulations is required to create a fairer soccer environment for players, regardless of their birth month.

Around the RAE, several variables have captured the interest of prior scientific literature, such as the correlation between RAE and player position (Salinero Martín et al., 2013). This research states that RAE is present in all playing positions, aligning with other studies that report similar findings (Almeida & Volossovitch, 2022; Pérez-González et al., 2018), except for goalkeepers where RAE is absent (Pérez-González et al., 2018). Further, higher incidences of RAE have been found among midfielders in the FIFA Womens World Cup (Ribeiro et al., 2024) and in most of the top five European leagues (except the Premier League) and among forwards in the British Premier League, while higher rates of RAE among defenders and midfielders have been observed in Italian Serie A and Spanish La Liga (Salinero Martín et al., 2013).

Other variables that have been studied in relation to RAE can be categorized within the economic framework, such as transfer market value or player salaries. Initially, there was no scientific consensus on the influence of RAE on market value. Previous research concluded that transfer market value was not affected by RAE but rather by other sporting factors like tactical competence, technical skills, and physical performance indicators, or media factors such as player popularity. However, a large longitudinal study by Gyimesi and Kehl (2023) suggests that RAE does indeed affect the transfer market value of players in the top five European Leagues, based on a decade of data. Within the economic ecosystem, the relationship between RAE beneficiaries and their salaries was recently studied in the Italian Serie A. The study concluded that players born in Q3 and Q4 have significantly lower salaries than players born earlier, despite registering similar performance levels.

As previous research has demonstrated, our results reveal an overrepresentation of players born in the first two trimesters of the year. This finding aligns with multiple studies in both youth and professional soccer leagues (Fumarco & Rossi, 2018; Glamser & Vincent, 2004; Gonzalez-Bertomeu, 2018; Li et al., 2020; Pérez-González et al., 2018; Tribolet et al., 2019; Yagüe et al., 2018). To reach the full potential in player talent development, it is necessary to secure a spot

on the highest-level team possible. Consequently, players born in the third and fourth trimesters, who are not part of these elite teams, are not developing at the same rate as their early-born peers.

Regarding this scenario, various aspects of how this developmental imbalance affects players born in Q3 and Q4 have been studied. For example, their motivation levels are lower if they cannot participate in national team dynamics (López de Subijana & Lorenzo, 2018), leading to a higher dropout rate in sports if the demotivation persists (Delorme et al., 2011). Additionally, being unable to compete at the highest level negatively impacts players' personalities and character. This serves as an impediment to developing non-tangible soft skills (Thompson et al., 2004), lowers self-esteem (Thompson et al., 2004), and hinders the ability to develop leadership skills (Dhuey & Lipscomb, 2010). As a result, these players are deprived of the benefits associated with leadership, both for individual and team performance (Coker et al., 2022).

Lastly, considering all the factors mentioned in this manuscript, it is crucial to draw some practical implications from the current research. There is a clear need to not only identify the competitions where the RAE is evident but also to seek and implement potential solutions for a more equitable talent development ecosystem in sports. Certain structural governance decisions could have a direct impact if applied correctly. One key area is the organizational policies of various league divisions and age categories. In Europe, many countries, such as Spain and Germany, segment, and group youth sports competitions into biannual categories, showing high rates of RAE (Schorer et al., 2013). In contrast, countries like the USA often create different sports divisions based on annual criteria (Korgaokar et al., 2018). These variations should motivate governing bodies to test new organizational methods. For example, they might consider the proposal by Lagestad et al. (2018), which suggested a mandatory minimum of 40% of players born in the third and fourth trimesters per team, or semestral age-limit divisions as an alternative to annual or biannual systems (Barnsley & Thompson, 1988). If this proposal were made in the UEFA Youth League, where the big European clubs that participate in the UEFA Champions League compete annually with their U-19 teams, it is very likely that the rest of the sports pyramid would adhere and improve the balance (and therefore, the final sporting talent).

Other potential solutions described in the scientific literature aim to empower the non-competitive aspect of youth sports, relegating strict results to a secondary level of importance and foregoing leaderboards until the age of sixteen (Gerdin et al., 2018). There is also an emphasis on re-educating managers, teachers, coaches, and all those involved in the talent selection process about the importance of long-term player talent development over short-term performance and immediate results, especially at a young age (Hill & Sotiriadou, 2016).

In any case, all stakeholders should work collaboratively to coordinate a plan that mitigates and eventually eradicates the relative age effect in sports competitions, aiming for a more balanced and fair representation in the future.

Conclusions

Being a club with greater economic resources should imply a superior ability to analyze the market and select talent. In other words, it could be assumed that the better the club, the better the selection process. However, major European soccer clubs continue to exhibit the same bias concerning the Relative Age Effect (RAE). Our key findings confirm the pervasive presence of RAE in nine out of the top 10 UEFA clubs, indicating that this effect is not confined to lower-level leagues or specific countries. Interestingly, the RAE was found to be consistent across different playing positions, from goalkeepers to forwards, highlighting its ubiquitous influence.

The present study significantly contributes to the expanding literature on the RAE in soccer by offering a comprehensive analysis across multiple layers of competition and demographics. While comprehensive, the research has limitations we must acknowledge. The focus primarily on European leagues may not make the results universally applicable. Furthermore, the study does not account for other factors that might contribute to RAE, such as coaching quality, socioeconomic conditions, or injury rates, which may offer additional layers of explanation.

Future studies could consider a more global perspective by incorporating data from the best soccer teams outside Europe. Additionally, exploring the impact of RAE on women's soccer could provide valuable insights. Qualitative

research methods such as interviews with coaches, players, and policymakers could also offer a deeper understanding of why RAE persists and how it can be mitigated.

This study underscores the need for actionable steps to level the playing field. Governance bodies should consider implementing policies that balance team compositions based on birth quarters, especially in top elite clubs, for which the hiring of players can come from lower teams or from external hiring. Moreover, the sports community at large should focus on long-term talent development over immediate results, possibly by de-emphasizing competitive outcomes in youth sports. Educational interventions for coaches, managers, and even parents could further help in reducing the RAE phenomenon. By understanding the multiple facets of RAE, stakeholders can work to implementing changes that make soccer more inclusive and fairer, thereby enhancing the quality of the sport for future generations.

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