Fenerbahçe Üniversitesi
Spor Bilimleri Dergisi
Cilt 5, Sayı 1, 21-35, 2025
Fenerbahce University
Journal of Sport Science
Volume 5, Issue 1, 21-35, 2025

FBU-JSS e-ISSN: 2791-7096

Özgün Araştırma / Research Article

THE IMPACT OF RELATIVE AGE EFFECT ON PLAYER DISTRIBUTION AND MARKET VALUE IN TOP UEFA COUNTRIES

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ABSTRACT

The Relative Age Effect (RAE) is a well-documented phenomenon that influences the development and young athletes' career trajectories, particularly in football. This study examines the impact of RAE on the distribution and market value of U19 players in the top 10 UEFA-ranked countries since January 2024 Data were collected from Transfermarkt, analyzing players' birth quarters using the Chi-Square Goodness-of-Fit test, while market value differences were examined through ANOVA. The results indicate a significant overrepresentation of players born in the first two quarters of the year, with a corresponding underrepresentation in the final quarter. The findings reveal a significant overrepresentation of players born in the first two quarters of the year, particularly in Germany, France, and Turkey, while England exhibited a more balanced distribution. Furthermore, players born in the first quarter commanded the highest market values, highlighting the long-term economic implications of RAE. These findings underscore the need for ongoing efforts to address RAE in youth football development, ensuring that talent identification and development practices are equitable and inclusive. By fostering a more balanced environment, the football industry can better recognize and nurture potential across all birth quarters, ultimately promoting fairness and diversity in the sport.

Key Words: Relative Age Effect, Youth Football, Market Value, Talent Identification

UEFA SIRALAMASINDA ÜST SIRADA YER ALAN ÜLKELERDE BAĞIL YAŞ ETKİSİNİN OYUNCU DAĞILIMI VE PİYASA DEĞERİ ÜZERİNDEKİ ETKİSİ

ÖZET

Bağıl Yaş Etkisi (Relative Age Effect - RAE), özellikle futbolda, genç sporcuların gelişim süreçlerini ve kariyer yönelimlerini etkileyen iyi belgelenmiş bir fenomendir. Bu çalışma, Ocak 2024 itibarıyla UEFA sıralamasında ilk 10 sırada yer alan ülkelerde U19 futbolcuların dağılımı ve piyasa değerleri üzerindeki RAE etkisini incelemektedir. Veriler Transfermarkt platformundan elde edilmiş; oyuncuların doğum çeyreklerine göre dağılımları Ki-Kare Goodness-of-Fit testi ile, piyasa değeri farkları ise ANOVA analiziyle değerlendirilmiştir. Sonuçlar, yılın ilk iki çeyreğinde doğan oyuncuların anlamlı düzeyde fazla temsil edildiğini ve son çeyrekte doğan oyuncuların ise önemli ölçüde az temsil edildiğini ortaya koymuştur. Özellikle Almanya, Fransa ve Türkiye'de bu dengesizlik belirgin bir şekilde gözlemlenirken, İngiltere daha dengeli bir dağılım sergilemiştir. Ayrıca, yılın ilk çeyreğinde doğan oyuncuların en yüksek piyasa değerine sahip olduğu belirlenmiş ve bu durum, RAE'nin uzun vadeli ekonomik etkilerine işaret etmiştir. Elde edilen bulgular, genç futbolcu gelişiminde RAE'nin etkilerini azaltmaya yönelik çabaların gerekliliğini vurgulamakta ve yetenek seçimi ile gelişim süreçlerinin daha adil ve kapsayıcı bir şekilde yürütülmesi gerektiğini ortaya koymaktadır. Daha dengeli bir gelişim ortamının sağlanması, tüm doğum çeyreklerinden gelen potansiyel yeteneklerin tanınması ve desteklenmesini mümkün kılacak, böylece futbolda adalet ve çeşitliliğin teşvik edilmesine katkı sağlayacaktır.

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Anahtar Kelime: Bağıl Yaş Etkisi, Genç Futbolu, Piyasa Değeri, Yetenek Seçimi

1. INTRODUCTION

The development and valuation of young football players have long been focal points of interest for clubs, agents, and researchers alike. The identification and nurturing of talent at young age are crucial, not only for the individual careers of players but also for the financial and competitive success of football clubs. As the global football market continues to grow, understanding the factors that influence the emergence and market value of young talent becomes increasingly important.

One significant, yet often underexplored, factor that may influence a player's development and subsequent market value is the timing of their birth within the selection year, a phenomenon known as the Relative Age Effect (RAE). Research has consistently shown that players born earlier in the selection year often enjoy physical and developmental advantages over their peers born later in the year, leading to higher representation in elite youth sports (Gil et al., 2014; Helsen et al., 2012). These advantages, which include superior physical maturity and cognitive skills, often translate into increased opportunities for selection, development, and, ultimately, higher market values (Tonnessen et al., 2013). For instance, Cabezón et al. (2024) demonstrated that RAE is evident in European women's professional soccer, particularly among midfielders, suggesting that early-born players may be favored in talent selection processes, potentially skewing the focus towards short-term performance over long-term talent development.

The RAE has been observed in various sports, including football, where it has significant implications for talent identification and development strategies. For example, Carling et al. (2009) discussed how anthropometric and fitness characteristics in young football players are often influenced by RAE, with relatively older players demonstrating superior physical profiles. Similarly, Mujika et al. (2009) found that RAE can significantly impact a player's progression into professional football, often giving those born earlier in the selection year a competitive edge. Heilmann et al. (2024) further found that while RAE is significantly prominent among younger players in German youth soccer, its impact diminishes with age and professional experience, suggesting a gradual reduction in selection biases as players advance in their careers.

In addition to physical attributes, RAE has also been linked to psychological and sociological factors that contribute to player success. Delorme et al. (2010) emphasized that the influence of RAE extends beyond physical advantages, highlighting that relatively older players often develop higher levels of confidence and self-efficacy, which are critical for success in competitive sports. This psychological edge is reinforced by findings from Hirose (2009), who examined the relationship between birth-month distribution and psychological traits, noting that relatively older players frequently exhibit greater psychological resilience and social maturity, both of which are pivotal in high-stakes sports environments.

Moreover, the broader implications of RAE have been studied in various contexts within football. Huertas et al. (2019) explored how RAE influences not only physical but also tactical development in young footballers, suggesting that relatively older players may have an advantage in understanding and executing complex tactical concepts. Additionally, Wattie et al. (2008) emphasized the need for a unified understanding of RAE across different levels of competition, noting that the effects of RAE are not uniform and can vary depending on the competitive environment. Supporting this, Gutierrez et al. (2010) found that while RAE was prevalent in both elite and amateur Spanish soccer clubs, significant changes in birth-date distribution were primarily observed within elite groups, indicating a nuanced evolution of RAE over time. Furthermore, Musch and Hay (1999) provided robust evidence of RAE's presence across diverse cultures and climates, establishing the cut-off date in youth soccer as the primary driver behind the skewed birth date distributions observed in professional soccer worldwide.

Despite the well-documented effects of RAE in youth sports, its impact on the market valuation of football players in elite European leagues has not been comprehensively studied. The UEFA rankings, which serve as a benchmark for the most competitive football leagues in Europe, provide a fertile ground for such an investigation. Analyzing the distribution of U19 players across birth quarters in these top leagues offers insights into whether the RAE plays a significant role in the composition of young football talent. Moreover, by examining the market values of these players, we can explore whether the advantages associated with earlier birth dates extend to economic valuation within the highly competitive environment of European football. Doncaster et al. (2024) highlighted that while RAE is prevalent among U18 and U21 squads, it is less apparent at the senior level, suggesting that as players mature and progress in their careers, the impact of RAE may diminish, although its presence in youth categories indicates ongoing selection biases.

Interestingly, the effectiveness of targeted training programs, such as the F-MARC 11+ developed by FIFA's Medical Assessment and Research Centre, has shown significant reductions in injury risk and severity among soccer players, which could further influence player development and market value (Grooms et al., 2017). This study, which demonstrated a 72% reduction in lower extremity injury risk among collegiate male soccer athletes, highlights the critical role of tailored training programs in enhancing player longevity and performance, factors that are undoubtedly linked to market value. Additionally, the role of physical preparedness, particularly in terms of eccentric hamstring strength, has been underscored by Opar et al. (2015), who found that low levels of eccentric hamstring strength significantly increased the risk of future hamstring strain injuries, a factor that could adversely affect a player’s career trajectory and market valuation. Furthermore, Fernández-Galván et al. (2024) suggested that the quarter of birth significantly influences physical condition variables in adolescents, which may carry over into sports contexts where early-born individuals are more likely to excel, underscoring the importance of physical conditioning in mitigating RAE-related disadvantages.

This study aims to investigate the distribution of U19 players across the four birth quarters in the top 10 UEFA-ranked countries and to assess whether there are significant differences in their market values based on their birth quarter. By employing statistical analyses, including the Chi-Square Goodness-of-Fit test and Analysis of Variance (ANOVA), this research seeks to provide a comprehensive understanding of how birth timing influences both the representation and valuation of young football talent in Europe's premier leagues. Unlike previous studies that primarily focused on RAE's influence on player distribution, this study simultaneously addresses its economic consequences by integrating market valuation analysis, thereby offering a more holistic and actionable perspective on youth football inequalities.

2. METHODS

2.1. Data Collection

The data for this study were obtained from the Transfermarkt website in March 2024. This website is widely recognized in the sports research community and has been utilized in numerous studies to assess player performance, market value, and career trajectories (e.g., Locks et al., 2017; Niederer et al., 2018; Peeters, 2018). The dataset includes detailed information on U19 players (19 years old and under) from the top leagues of the top 10 ranked UEFA countries as of January 2024. The data collected encompassed each player's birth quarter, nationality, and market value in euros. The selection of the top 10 UEFA countries was based on their rankings, ensuring that the analysis reflects the most competitive leagues in Europe.

2.2. Study Design and Statistical Analysis

This study employed a series of statistical methods to explore the distribution of U19 players across birth quarters and to assess whether there are significant differences in their market values by birth quarter. The following statistical analyses were conducted:

2.2.1. Distribution analysis using chi-square goodness-of-fit test

The distribution of U19 players across the four birth quarters was analyzed using the Chi-Square Goodness-of-Fit test. This non-parametric test was chosen to determine whether the observed frequencies of players' birth quarters deviated from an expected uniform distribution. Initially, the Chi-Square test was applied to the aggregate data for all players from the top 10 UEFA countries to assess whether there was a significant difference in the distribution of players' birth quarters on a broader scale. Subsequently, the Chi-Square test was performed for each of the top 10 UEFA countries individually. This allowed for the identification of any country-specific deviations from a uniform distribution, providing insights into whether certain countries exhibited a preference or bias towards players born in specific quarters. The second stage of the analysis focused on evaluating differences in market values across birth quarters, using ANOVA.

2.2.2. Market value comparison using analysis of variance (ANOVA)

To investigate potential differences in market values across the birth quarters, an ANOVA was employed. ANOVA is a parametric test used to compare the means of three or more independent groups—in this case, the four birth quarters. This method was chosen because it is well-suited for determining whether there are statistically significant differences between the average market values of players born in different quarters.

The market values of players were first grouped according to their birth quarters. The ANOVA test was then applied to compare the mean market values across these groups. This test assumes that the market values are normally distributed and that the variances are equal across groups. To ensure the validity of the ANOVA results, the assumptions were checked, and appropriate transformations or non-parametric alternatives would be considered if necessary.

2.2.3. Statistical significance and software

For all statistical tests conducted, a significance level (alpha) of 0.05 was used. This threshold is standard in social sciences and sports analytics, indicating that results with a p-value less than 0.05 would be considered statistically significant. All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences), a widely used software for data analysis in social sciences, which ensured rigorous and accurate statistical testing.

2.3. Ethical Considerations

Ethical approval for this study was obtained from the University Scientific Research Ethics Committee (Meeting No: 2024/11). The data used in this study were publicly available and did not involve any intervention or interaction with human subjects. The information was anonymized, with no personal identifiers being used.

3. RESULTS

The analysis began with the examination of the distribution of U19 players across birth quarters in the top 10 UEFA countries. The Chi-Square Goodness-of-Fit test was applied to assess whether the distribution of players' birth quarters was uniform across all four quarters.

The overall distribution analysis revealed significant deviations from a uniform distribution, indicating that players were not evenly distributed across the birth quarters (Figure 1).

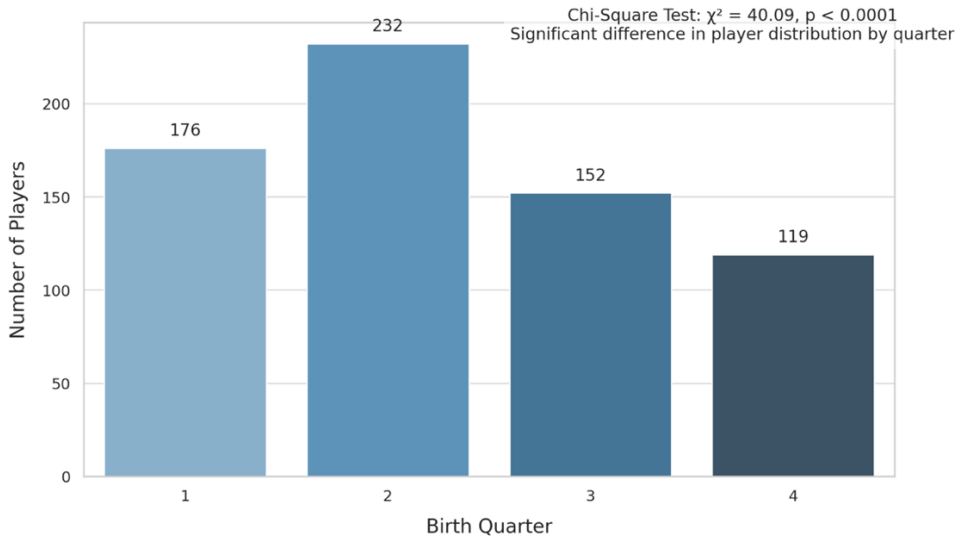

Figure 1. Distribution of U19 Players by Birth Quarter in Top 10 UEFA Countries

Further, when the Chi-Square test was conducted at the country level, the results varied across the different UEFA countries. Some countries displayed significant deviations from a uniform distribution, while others did not, as detailed in **Table 1** and Figure 2.

Table 1. Chi-Square Test Results for Birth Quarter Distribution of U19 Players Across Top 10 UEFA Countries

Country	Q1	Q2	Q3	Q4	Total	χ^2 Value	p-Value	Sig.
England	13	12	12	12	49	0.061	0.996	No
Spain	8	18	10	5	41	9.049	0.029	Yes
Italy	16	19	7	12	54	6.000	0.112	No
Germany	16	30	12	10	68	14.353	0.002	Yes
France	23	28	12	15	78	8.256	0.041	Yes
Netherlands	29	31	29	20	109	2.670	0.445	No
Portugal	6	13	17	12	48	5.167	0.160	No
Belgium	24	32	26	19	101	3.436	0.329	No
Turkey	36	39	21	7	103	25.427	0.000	Yes
Scotland	5	10	6	7	28	2.000	0.572	No

Note: Q1, Q2, Q3, Q4: Number of U19 players born in each quarter, Total: Total number of players, χ^2 Value: Chi-Square test statistic, p-Value: Probability value from the Chi-Square test, Sig.: Significance of the test result (Yes if $p < 0.05$, otherwise No).

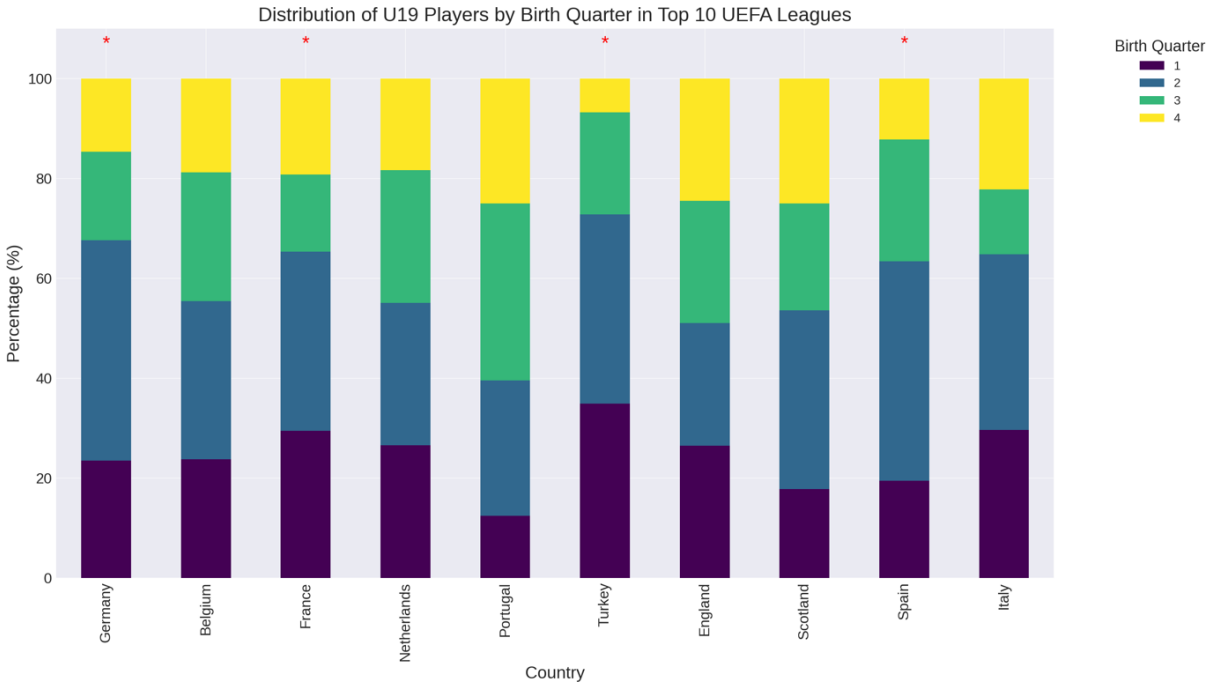

Figure 2. Distribution of U19 Players by Birth Quarter in Top 10 UEFA Leagues. The figure illustrates the percentage distribution of U19 football players across different birth quarters in the top 10 UEFA leagues. The data is represented for each country, with birth quarters grouped as Q1 (January-March), Q2 (April-June), Q3 (July-September), and Q4 (October-December). *The red asterisks ()* above the bars for Germany, France, Spain, and Turkey indicate statistically significant differences in birth quarter distribution, with $p < 0.05$.*

Subsequently, the market values of players were compared across the four birth quarters. The Analysis of Variance (ANOVA) test was performed to determine whether there were statistically significant differences in the average market values between the birth quarters. The results indicated significant differences in the mean market values, suggesting that the birth quarter had an impact on the players' market valuations (Figure 3).

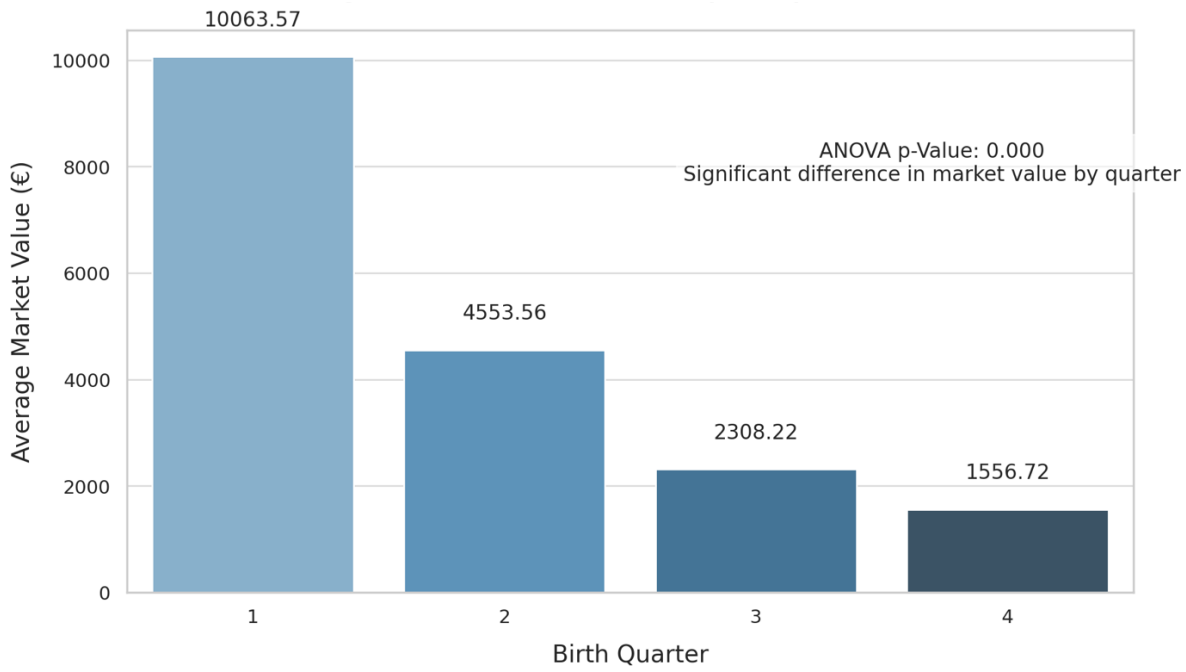

Figure 3. Average Market Value of U19 Players by Birth Quarter Across Top 10 UEFA Countries

Figure 3 illustrates the average market value of U19 players in the top 10 UEFA countries, categorized by their birth quarter. It visually highlights that players born in the first quarter (Q1) consistently have higher market values compared to those born in subsequent quarters, particularly Q4, suggesting a clear economic gradient aligned with birth timing. In addition to the aggregated analysis, market value distributions by birth quarter varied across countries. For instance, in Germany and Turkey, where RAE was statistically significant in player distribution, players born in Q1 had markedly higher market values compared to those born in Q4. Conversely, in England—where distribution across quarters was more balanced—market value differences were less pronounced, reinforcing the interplay between equitable selection practices and economic outcomes.

4. DISCUSSION

The findings of this study provide compelling evidence of the ongoing influence of the Relative Age Effect (RAE) in the top 10 UEFA-ranked countries. The distribution analysis revealed a significant underrepresentation of players born in the final quarter of the year, a trend that has been consistently documented in the literature and continues to persist in modern football (Gil et al., 2014; Helsen et al., 2012). This underrepresentation suggests that players born later in the selection year face systemic disadvantages that limit their opportunities for development and selection at elite levels.

Our analysis showed that the distribution of U19 players across birth quarters is not uniform, with a notable concentration of players born in the first two quarters of the year. This distribution imbalance is particularly pronounced in countries like Turkey, Germany, and France, where the Chi-Square test

indicated significant deviations from a uniform distribution. These findings align with previous research that has highlighted the competitive advantage held by relatively older players, who are often more physically mature and thus more likely to be selected for elite training programs (Carling et al., 2009; Tonnessen et al., 2013). Furthermore, Cabezón et al. (2024) found that RAE is evident in European women's professional soccer, particularly among midfielders, indicating that similar selection biases may be present in both men's and women's football, potentially leading to an unfocused selection of talent that prioritizes short-term performance over long-term development.

Interestingly, our results also indicate that in some countries, such as England, the distribution of players across birth quarters is more balanced. This study offers a novel contribution to the literature by examining not only the distributional impact of the Relative Age Effect (RAE) but also its economic implications through an integrated analytical framework. By analyzing both the birth quarter distribution and market values of U19 players across the top 10 UEFA-ranked countries using Transfermarkt data, it empirically demonstrates that RAE manifests at varying degrees across national contexts and significantly influences player market valuation. This multidimensional approach provides a comprehensive and policy-relevant perspective on both fairness in youth talent selection and the dynamics of the football economy. This suggests that recent efforts to mitigate the effects of RAE, possibly through more equitable selection and development practices, may be yielding positive results in certain regions (Wattie et al., 2008). England's relatively balanced distribution could reflect an increased awareness among coaches and scouts about the biases introduced by RAE and a deliberate effort to ensure that talent identification processes are more inclusive of players born later in the year. To further address these disparities, practical measures such as organizing U19 competitions in separate groups based on birth quarters (e.g., Q1–Q2 and Q3–Q4) have been proposed in recent literature. Such structural adjustments could help level the playing field by aligning competition more closely with players' developmental stages, thereby reducing the systemic advantages conferred by early birth dates.

However, the persistence of RAE in other countries raises important questions about the efficacy of existing youth development systems. In countries where the imbalance remains stark, the systemic advantages conferred to relatively older players may result in the premature exclusion of talented individuals who, despite their late birth dates, could have achieved success if given equal opportunities. The continued prevalence of RAE in these countries suggests that further interventions are necessary to create a more level playing field for all young players. As Heilmann et al. (2024) noted, while RAE is significantly prominent among younger players in German youth soccer, its impact diminishes with age and professional experience, suggesting that selection biases might be more pronounced in early stages of player development and may decrease as players mature.

The analysis of market values further underscores the impact of RAE on players' professional trajectories. Our findings revealed significant differences in the average market values of players based

on their birth quarter, with players born in the first quarter commanding the highest market values. This economic discrepancy emphasizes the long-term consequences of early-age advantages and suggests that RAE contributes to structural inequality in football's talent economy. This result is consistent with the notion that players who are relatively older at the time of selection not only have more opportunities for development but also achieve greater recognition and valuation in the marketplace (Jiménez & Pain, 2008; Mujika et al., 2009). The economic implications of this disparity are significant, as market value plays a crucial role in a player's career prospects, influencing their transfer opportunities, contract negotiations, and overall visibility in the football industry.

The fact that players born in the final quarter of the year continue to have the lowest market values highlights the enduring nature of RAE in the professional valuation of athletes. This finding suggests that even as players advance to the highest levels of competition, the disadvantages associated with being born later in the year persist, affecting their perceived value and potentially limiting their career opportunities. Hirose (2009) and Wattie et al. (2008) both pointed out that psychological and emotional development might also be slower in these relatively younger players, which could compound the challenges they face in achieving parity with their older peers.

Adding to this, Waldén et al. (2005) highlighted the increased risk of injury among younger players, particularly those who might be physically less developed due to their later birth dates. This heightened injury risk could further contribute to the lower market values and career instability observed among players born in the final quarter. Injuries not only disrupt development but also diminish a player's visibility and perceived value, thereby perpetuating the disadvantages associated with RAE.

Moreover, Vaeyens et al. (2005) found that RAE could also influence match performance and tactical decisions, with relatively older players often being preferred in key positions, thereby receiving more opportunities to demonstrate their abilities on the field. This preferential treatment exacerbates the disparities in career progression and market value between players born in different quarters, as those born later in the year are less likely to be selected for critical roles in matches, limiting their exposure and potential for advancement. Additionally, Schorer et al. (2009) emphasized the complex interplay of factors such as competition level, playing position, and handedness, which further modulate the influence of RAE on the development and maintenance of athletic expertise, suggesting that the impact of RAE extends beyond mere physical maturity and encompasses a broad range of contextual and individual factors. Doncaster et al. (2024) supported this by showing that while RAE is prevalent among U18 and U21 squads, it is less apparent at the senior level, suggesting that as players mature and progress in their careers, the impact of RAE may diminish, although its presence in youth categories indicates ongoing selection biases. From a policy perspective, these findings have important implications for youth development programs and talent identification strategies across Europe. To address the persistent effects of RAE, it may be necessary to implement more nuanced selection criteria that account for the relative age of players, perhaps by grouping players according to physical and

developmental maturity rather than strictly by chronological age. Additionally, the success of countries like England in achieving a more balanced distribution of players across birth quarters could serve as a model for other nations seeking to mitigate the effects of RAE.

Muscle development and physical conditioning, as explored by Bemben and Lamont (2005), could also play a role in balancing these disparities. By focusing on tailored training regimens that enhance the physical capacities of relatively younger players, youth academies could help bridge the gap between older and younger players, making it possible for those born later in the year to compete on more equal footing. Pareja-Blanco et al. (2017) demonstrated that a resistance-training program characterized by low fatigue could improve neuromuscular performance, suggesting that similar approaches could be particularly beneficial for younger players who may be at a developmental disadvantage due to RAE. Furthermore, Styles et al. (2016) highlighted that even simple in-season strength training programs could result in significant improvements in both maximal strength and short sprint performance, underscoring the importance of incorporating strength training into the development programs of younger players to help offset the physical disadvantages they may face due to RAE. Similarly, Timmins et al. (2016) found that higher levels of eccentric knee flexor strength and longer biceps femoris fascicles significantly reduced the risk of hamstring injuries in elite soccer players, emphasizing the importance of targeted physical training in mitigating injury risks and enhancing long-term player development. Additionally, Vincent and Glamser (2006) pointed out that while RAE is prevalent among male youth soccer players, the effect is less pronounced in female players, suggesting that gender differences in biological and maturational factors might influence the extent of RAE's impact in sports.

In conclusion, while some progress has been made in certain regions, the Relative Age Effect continues to exert a significant influence on both the distribution and market value of young football players in Europe's top leagues. Addressing this issue requires a concerted effort from all stakeholders involved in youth football development, including clubs, coaches, and governing bodies. By fostering a more equitable environment for player development, the football community can ensure that talent is recognized and nurtured based on ability rather than the arbitrary factor of birth timing.

5. CONCLUSION

This study provides robust evidence that the Relative Age Effect (RAE) continues to significantly influence both the distribution and market value of U19 football players across the top 10 UEFA-ranked countries. The findings underscore a persistent imbalance in the birth dates of young players, with a clear overrepresentation of those born in the first two quarters of the year and a corresponding underrepresentation of those born in the final quarter. This imbalance not only affects the composition of youth football talent but also extends to their economic valuation, with players born earlier in the year commanding higher market values.

The cross-country analysis revealed that while some nations, such as England, have made strides towards mitigating the effects of RAE through more balanced player distributions, other countries, including Turkey, Germany, and France, still exhibit significant deviations. These disparities highlight the need for continued efforts to address the systemic biases that favor relatively older players, which could result in the exclusion of equally talented individuals born later in the year.

Moreover, the analysis of market values demonstrated that the economic implications of RAE are far-reaching. Players born in the earlier quarters of the year are not only more likely to be selected and developed at elite levels, but they also enjoy higher market valuations, which can impact their career trajectories and opportunities for advancement. This suggests that the advantages conferred by being relatively older at the time of selection persist throughout a player's career, reinforcing the need for interventions that promote fairness and equity in youth football development. The findings of this study call for a re-evaluation of current talent identification and development practices within football academies and clubs. To ensure that all young athletes have an equal opportunity to succeed, regardless of their birth date, it is crucial to implement strategies that account for RAE in both selection processes and training programs. This could include grouping players by developmental maturity rather than chronological age or providing additional support to those born later in the year to help bridge the physical and psychological gaps.

In conclusion, while some progress has been made in addressing the Relative Age Effect in certain regions, it remains a pervasive issue that continues to shape the landscape of youth football in Europe. By fostering a more equitable environment for player development, the football community can ensure that talent is recognized and nurtured based on actual ability and potential, rather than age-related advantages stemming from the athlete’s month of birth—an uncontrollable and arbitrary aspect of current selection systems. By concurrently evaluating player distribution and market valuation, this study advances the current understanding of RAE by exposing its dual impact on both equity in player selection and economic opportunity, thus reinforcing the necessity for systemic reforms in youth football development. Future research should continue to explore the long-term impacts of RAE and evaluate the effectiveness of interventions designed to mitigate its effects, thereby contributing to a more inclusive and just sporting world.

Acknowledgments

We extend our gratitude to all athletes who contributed to this research. Their invaluable contributions have significantly enriched the study and are deeply appreciated.

Declaration of Interest Statement

There is no conflict of interest between the authors regarding the publication of this article.

REFERENCES

Bemben, M. G., & Lamont, H. S. (2005). Creatine supplementation and exercise performance: Recent findings. Sports Medicine, 35(2), 107-125. https://doi.org/10.2165/00007256-200535020-00002

Brustio, P. R., McAuley, A. B. T., Ungureanu, A. N. & Kelly, A. L. (2024). Career trajectories, transition rates, and birthdate effects in youth national football players across Europe. Frontiers in Sports and Active Living, 6, 1420220. https://doi.org/10.3389/fspor.2024.1420220

Cabezón, J. M. Y., García, B. F., Castán, J. C. R. & Velasco, A. T. (2024). The effect of relative age in the top seven professional women's football leagues in Europe. Retos-Nuevas Tendencias en Educación Física Deporte y Recreación, 54, 519-528.

Carling, C., le Gall, F., Reilly, T. & Williams, A. M. (2009). Do anthropometric and fitness characteristics vary according to birth date distribution in elite youth academy soccer players? Scandinavian Journal of Medicine & Science in Sports, 19(1), 3-9. https://doi.org/10.1111/j.1600-0838.2008.00867.x

Delorme, N., Boiché, J. & Raspaud, M. (2010). Relative age effect in elite sports: Methodological bias or real discrimination? European Journal of Sport Science, 10(2), 91-96. https://doi.org/10.1080/17461390903271584

Doncaster, G., Kelly, A. L., McAuley, A. B. T. & Cain, A. L. (2024). Relative age effects and the Premier League's youth development: A longitudinal study. Journal of Science in Sport and Exercise, 1-10. https://doi.org/10.1007/s42978-024-00285-w

Fernández-Galván, L. M., Belando-Pedreño, N. & Yáñez-Sedeño, P. (2024). Influence of relative age on physical condition and academic performance in adolescents. Behavioral Sciences, 14(3). https://doi.org/10.3390/bs14030181

Gil, S. M., Badiola, A., Bidaurrazaga-Letona, I., Zubero, J., Alkorta, P. & Aritzeta, J. (2014). Relationship between the relative age effect and anthropometry, maturity and performance in young soccer players. Journal of Sports Sciences, 32(5), 479-486. https://doi.org/10.1080/02640414.2013.832355

Grooms, D. R., Palmer, T., Onate, J. A., Myer, G. D. & Grindstaff, T. L. (2017). Soccer-specific warm-up and lower extremity injury rates in collegiate male soccer players. Journal of Athletic Training, 52(8), 728-736. https://doi.org/10.4085/1062-6050-52.3.15

Gutierrez Diaz del Campo, D., Pastor Vicedo, J. C., Gonzalez Villora, S. & Contreras Jordan, O. R. (2010). The relative age effect in youth soccer players from Spain. Journal of Sports Science and Medicine, 9(2), 190-198.

Heilmann, F., Kuhlig, A. & Stoll, O. (2024). Relative age effects in German youth A and B male soccer leagues and third-division professionals. Frontiers in Sports and Active Living, 6. https://doi.org/10.3389/fspor.2024.1432605

Helsen, W. F., Baker, J., Michiels, S., Schorer, J., Van Winckel, J. & Williams, A. M. (2012). The relative age effect in European professional soccer: Did ten years of research make any difference? Journal of Sports Sciences, 30(15), 1665-1671. https://doi.org/10.1080/02640414.2012.721929

Hirose, N. (2009). Relationships among birth-month distribution, skeletal age and anthropometric characteristics in adolescent elite soccer players. Journal of Sports Sciences, 27(11), 1159-1166. https://doi.org/10.1080/02640410903131770

Huertas, F., Ballester, R., Gines, H. J., Hamidi, A. K., Moratal, C., & Lupiáñez, J. (2019). Relative Age Effect in the Sport Environment. Role of Physical Fitness and Cognitive Function in Youth Soccer Players. International journal of environmental research and public health, 16(16), 2837. https://doi.org/10.3390/ijerph16162837

Jiménez, I. P. & Pain, M. T. G. (2008). Relative age effect in Spanish association football: Its extent and implications for wasted potential. Journal of Sports Sciences, 26(10), 995-1003. https://doi.org/10.1080/02640410801910285

Locks, R., Utsunomiya, H., Briggs, K. K., McNamara, S., Chahla, J., Sikka, R. S. & Philippon, M. J. (2017). Return to play after hip arthroscopic surgery for femoroacetabular impingement in professional soccer players. The American Journal of Sports Medicine, 45(7), 1601-1608. https://doi.org/10.1177/0363546517694855

Musch, J. & Hay, R. (1999). The relative age effect in soccer: Cross-cultural evidence for a systematic discrimination against children born late in the competition year. Sociology of Sport Journal, 16(1), 54-64. https://doi.org/10.1123/ssj.16.1.54

Mujika, I., Vaeyens, R., Matthys, S. P. J., Santisteban, J., Goiriena, J. & Philippaerts, R. M. (2009). The relative age effect in a professional football club setting. Journal of Sports Sciences, 27(11), 1153-1158. https://doi.org/10.1080/02640410903220328

Niederer, D., Engeroff, T., Wilke, J., Vogt, L. & Banzer, W. (2018). Return to play, performance, and career duration after anterior cruciate ligament rupture: A case-control study in the five biggest football nations in Europe. Scandinavian Journal of Medicine & Science in Sports, 28(10), 2220-2233. https://doi.org/10.1111/sms.13239

Opar, D. A., Williams, M. D., Timmins, R. G., Hickey, J. & Duhig, S. J. (2015). Eccentric hamstring strength and hamstring injury risk in Australian footballers. Medicine & Science in Sports & Exercise, 47(5), 857-865. https://doi.org/10.1249/MSS.0000000000000505

Pareja-Blanco, F., Sánchez-Medina, L., Suárez-Arrones, L. J. & González-Badillo, J. J. (2017). Effects of velocity loss during resistance training on performance in professional soccer players. International Journal of Sports Physiology and Performance, 12(3), 293-299. https://doi.org/10.1123/ijspp.2015-0791

Peeters, T. (2018). Testing the wisdom of crowds in the field: Transfermarkt valuations and international soccer results. International Journal of Forecasting, 34(1), 17-29. https://doi.org/10.1016/j.ijforecast.2017.10.005

Schorer, J., Cobley, S., Büsch, D., Bräutigam, H. & Baker, J. (2009). Influence of competition level, gender, player nationality, career stage and playing position on relative age effects. Scandinavian Journal of Medicine & Science in Sports, 19(5), 720-730. https://doi.org/10.1111/j.1600-0838.2008.00838.x

Styles, W. J., Matthews, M. J. & Comfort, P. (2016). Effects of strength training on squat and sprint performance in soccer players. Journal of Strength and Conditioning Research, 30(6), 1534-1539. https://doi.org/10.1519/JSC.0000000000001281

Timmins, R. G., Bourne, M. N., Shield, A. J., Williams, M. D., Opar, D. A. & Hickey, J. (2016). Short biceps femoris fascicles and eccentric knee flexor weakness increase the risk of hamstring injury in elite football (soccer): A prospective cohort study. British Journal of Sports Medicine, 50(24), 1524-1535. https://doi.org/10.1136/bjsports-2015-095362

Tonnessen, E., Hem, E., Leirstein, S., Haugen, T. A. & Seiler, S. (2013). Maximal aerobic power characteristics of male professional soccer players, 1989–2012. International Journal of Sports Physiology and Performance, 8(3), 323-329. https://doi.org/10.1123/ijspp.8.3.323

Vaeyens, R., Philippaerts, R. M. & Malina, R. M. (2005). The relative age effect in soccer: A match-related perspective. Journal of Sports Sciences, 23(7), 747-756. https://doi.org/10.1080/02640410400022052

Vincent, J. & Glamser, F. D. (2006). Gender differences in the relative age effect among US Olympic Development Program youth soccer players. Journal of Sports Sciences, 24(4), 405-413. https://doi.org/10.1080/02640410500244655

Waldén, M., Hägglund, M. & Ekstrand, J. (2005). High risk of new knee injury in elite footballers with previous anterior cruciate ligament injury during a 14-year follow-up. British Journal of Sports Medicine, 40(2), 158-162. https://doi.org/10.1136/b