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Relative Age Effect among Elite Male and Female Rugby Sevens Players

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ABSTRACT

The relative age effect (RAE) describes the advantage often experienced by athletes born earlier in the selection year, due to their relative physical and developmental maturity. In physically demanding sports such as rugby sevens, this effect may influence selection outcomes and long-term athlete development. Previous studies have frequently focused on male athletes, with limited findings in female competitions. As women's rugby becomes more competitive and structured, it is necessary to investigate whether RAE influences talent identification across both genders. This study explored the presence and patterns of RAE among elite male and female rugby seven players who competed in the 2022 Rugby World Cup Sevens. A total of 480 athletes (288 men, 192 women) were classified into four birth quartiles and analysed using chi-square tests. The results showed a significant RAE among male players (χ^2 (3, N = 288) = 106.733, p = .002, Cramér's V = 0.351) and female players (χ^2 (3, N = 192) = 62.448, p = .043, Cramér's V = 0.329), with a noticeable concentration of players born in the first half of the year. Among the top four male teams, a significant RAE was also found (χ^2 (3, N = 96) = 10.080, p = .018), suggesting selection bias favouring relatively older players. However, this effect was not significant among the top-performing female teams (p = .528). For both male and female winning and lowest-ranked teams, no statistically significant RAE was observed (p > .05), although moderate effect sizes indicated potential trends limited by sample size. In conclusion, this study confirms the presence of RAE in elite rugby sevens, particularly among male athletes, and suggests the need for more balanced talent identification approaches in the sport.

Keywords:
Relatives age effect; elite rugby sevens; gender differences; world cup

1. Introduction

The organization of competitive sports based on chronological age, while intended to ensure fairness, can unintentionally result in unequal developmental opportunities for athletes born at different times within a selection year. This imbalance is commonly referred to as the relative age effect (RAE), a well-documented phenomenon in sports science where athletes born earlier in the selection period are overrepresented in elite sport due to age-associated developmental advantages,

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which were explained in previous studies by Jakobsson *et al.,* [1] and Jones *et al.,* [2]. The effect is particularly noticeable in adolescence, when a few months of maturity can significantly influence physical, cognitive, and emotional development as mentioned by previous researchers [3,4].

RAE is especially pronounced in physically demanding and competitively selective sports, such as rugby. Rugby union and by extension, rugby sevens is a collision-based sport characterized by high-intensity physical contact, explosive power, speed, endurance, and spatial awareness as suggested by Higham *et al.,* [5] and Lopez *et al.,* [6]. These demands inherently favour athletes who are more physically developed, particularly during talent identification and selection phases. For instance, Brustio *et al.,* [7] and Lemez *et al.,* [8] showed that older athletes within an age cohort often exhibit greater muscle mass, strength, and coordination, providing them with a distinct advantage in tackling, sprinting, and sustaining repeated physical contacts during play. These advantages can significantly influence performance outcomes and coach perceptions of potential, particularly during youth development stages where selection biases may begin to accumulate [9,10].

Rugby sevens, the faster-paced variant of traditional 15-a-side rugby union, further amplifies these physical demands. Played with only seven players per team on the same-sized field, the sport requires rapid decision-making, superior aerobic and anaerobic capacity, and technical precision under fatigue [5]. Matches are shorter, consisting of two seven-minute halves, but involve continuous high-speed effort, making physical maturity and conditioning even more critical to competitive success. Consequently, as also seen in other sports, athletes who are biologically more mature, often those born earlier in the selection year, may have an elevated chance of being selected and retained at elite levels [2,11-13].

Moreover, in talent identification systems that emphasize early selection for developmental squads and national teams, relatively older players tend to benefit from more frequent exposure to advanced coaching, competition, and training resources [14,15]. This systemic reinforcement of early physical maturity may unintentionally marginalize relatively younger players, who may possess equal or greater long-term potential but are overlooked due to immediate physical disadvantages as discussed by Hill *et al.,* [12].

While numerous studies have examined RAE in rugby union, findings remain mixed, particularly across different levels of play and between genders. For example, Brustio *et al.,* [7] and Lemez *et al.,* [8] found significant RAE in elite male and female rugby players, especially in positions requiring greater physical engagement, such as forwards. On the other hand, research on female rugby athletes is limited and often yields inconclusive or inconsistent results, possibly due to differences in participation rates, developmental pathways, and sociocultural factors [8,9]. Furthermore, some scholars argue that RAE tends to diminish at senior elite levels as players converge in physical maturity [16,17], while others such as Götze *et al.,* [4] and Dube and Grobbelaar [11] highlight its persistence even in top-tier competitions.

Given the physically intensive and selective nature of rugby sevens, it presents an ideal context for exploring the manifestation of RAE across gender lines. However, the current literature lacks comprehensive analysis of RAE among both male and female players in elite rugby seven tournaments. Addressing this gap, the present study investigates the presence and extent of RAE among athletes who competed in the 2022 Rugby World Cup Sevens. By analysing birth date distributions across quartiles and team performance levels, the study aims to contribute to a more equitable understanding of athlete selection practices and raise awareness about potential systemic biases within rugby's high-performance pathway.

2. Methodology

2.1 Participants

This study analysed a total of 480 elite rugby seven players who competed in the 2022 Rugby World Cup Sevens, comprising 288 male and 192 female athletes. These participants represented national teams that qualified for the tournament. The sample included players from all participating countries, with representation from 24 men’s teams and 16 women’s teams. The sample was categorized into subgroups for further analysis based on gender and team achievement (top-four and bottom-four teams). No primary data collection was conducted, and ethical concerns were minimal as all information was drawn from secondary sources that are available in the public domain. Nonetheless, this research project abides to the research protocols and has been given approval by the university's research ethics committee.

2.2 Data Collection & Analysis

All data were obtained from publicly accessible sources, specifically the official Rugby World Cup Sevens website. The extracted data included players’ names, gender, birthdates, and team performance rankings. For this study, priorly analysis starts with checking for any missing data and the distribution of the data Players were categorized into four birth quartiles based on the month of birth (Q1: January – March, Q2: April – June, Q3: July – September and Q4: October – December). This quartile-based classification is consistent with previous RAE studies.

All data were compiled and analysed using IBM SPSS Statistics version 28.0. Descriptive statistics were calculated for each demographic group. The chi-square goodness-of-fit test was employed to identify significant differences in the distribution of birthdates across the four quartiles. Post-hoc standardized residuals (SR) were used to interpret the magnitude and direction of any deviations from expected values. Subgroup analyses were conducted to explore the RAE patterns based on gender and team performance (e.g., top-four vs. bottom-four teams).

3. Results

This section presents the results of the analysis conducted to examine the presence and distribution of the RAE among elite male and female rugby seven players who participated in the 2022 Rugby World Cup Sevens. The data were analysed by quartile of birth and compared across gender and team performance levels. Chi-square tests were used to determine whether birthdates were evenly distributed across the four quartiles and to identify any statistically significant deviations that could indicate the presence of RAE.

Table 1 and Table presents the descriptive statistics of key performance indicators recorded during the 2022 World Cup Sevens. Based from Table 1, among the 288 male players, the average age was 26.15 years (SD = 4.01), representing athletes from 24 nations. In comparison from Table 2, 192 female players had an average age of 25.45 years (SD = 3.94), drawn from 16 national teams.

Table 1
Descriptive statistics in 2022 world cups sevens (male)

	N	Min	Max	Mean	SD
Nations	288	1	24	12.50	6.934
Age	288	18	40	26.15	4.008
Quartile	288	1	4	2.43	1.102
Valid N	288				

Table 2
Descriptive statistics in 2022 world cups sevens (female)

	N	Min	Max	Mean	SD
Nations	192	1	16	8.50	4.622
Age	192	18	37	25.45	3.944
Quartile	192	1	4	2.45	1.143
Valid N	192				

Table 3 is overall distribution of male players according to birth quartiles. As shown in the table, the birthdate distribution among male athletes was significantly skewed, indicating a strong RAE, χ^2 (3, N = 288) = 106.733, p = .002. The effect size, calculated using Cramér's V, was 0.351, indicating a large association between birth quartile and athlete representation (Cohen, 1988). The highest representation was observed in Quartile 2 (Q2) (N = 80; SR = 0.943), followed by Quartile 1 (Q1) (N = 74; SR = 0.236). In contrast, underrepresentation was found in Quartile 3 (Q3) (N = 69; SR = –0.354) and was most pronounced in Quartile 4 (Q4) (N = 65; SR = –0.825). These findings suggest that athletes born in the first half of the selection year were more likely to be selected, supporting the presence of age-related selection bias.

Table 3
Overall distribution of male players according to birth quartiles

Birth quartiles	Observed (N)	Expected (N)	SR	P
Quartile 1	74	72	0.236	
Quartile 2	80	72	0.943	
Quartile 3	69	72	-0.354	
Quartile 4	65	72	-0.825	
N	288			.002

Similarly, Table 4 displays the birthdate distribution for female athletes, which also revealed a statistically significant RAE, χ^2 (3, N = 192) = 62.448, p = .043. The calculated Cramér's V = 0.329, again indicating a large effect size. The highest frequency of athletes was found in Q1 (N = 52; SR = 0.577), while the lowest representation occurred in Q3 (N = 40; SR = –1.155). This pattern is consistent with RAE trends observed in male samples, although the magnitude of deviation appears slightly less pronounced.

Table 4
Overall distribution of female players according to birth quartiles

Birth quartiles	Observed (N)	Expected (N)	SR	P
Quartile 1	52	48	0.577	
Quartile 2	51	48	0.433	
Quartile 3	40	48	-1.155	
Quartile 4	49	48	0.144	
N	192			.043

As presented in Table 5, a chi-square goodness-of-fit test indicated a statistically significant Relative Age Effect (RAE) among the male players from the top four and bottom four teams, χ^2 (3, N = 96) = 10.080, p = .018. The effect size, calculated using Cramér's V, was 0.324, indicating a moderate to large association. The distribution was notably skewed for the top four teams, with the highest representation found in Quartile 1 (N = 19; SR = 2.021). In contrast, Quartile 4 (N = 3; SR = –2.598) exhibited the most pronounced underrepresentation, suggesting a strong RAE favouring players born earlier in the selection year.

Table 5
Overall distribution of male top 4 and bottom 4 teams

Birth quartiles	Observed (top)	Expected (top)	SR	Observed (Bottom)	Expected (Bottom)	SR	P
Quartile 1	19	12	2.021	13	12	0.289	
Quartile 2	13	12	0.289	14	12	0.577	
Quartile 3	13	12	0.289	7	12	-1.443	
Quartile 4	3	12	-2.598	14	12	0.577	
Total	48						0.018

Conversely, the analysis in Table 6 revealed no statistically significant RAE among female players across the top four and bottom four teams, $\chi^2(3, N = 96) = 2.222$, $p = .528$. Given the non-significant result, no Cramér's V was calculated. Although the results were not significant, the bottom four teams showed the highest representation in Quartile 2 (N = 16; SR = 1.155), indicating a slight, non-significant skew toward athletes born in the second quartile.

Table 6
Overall distribution of female top 4 and bottom 4 teams

Birth quartiles	Observed (top)	Expected (top)	SR	Observed (bottom)	Expected (bottom)	SR	P
Quartile 1	13	12	0.287	0.287	13	12	
Quartile 2	10	12	-0.577	16	12	1.155	
Quartile 3	10	12	-0.577	8	12	-1.155	
Quartile 4	15	12	0.866	11	12	-0.289	
Total	48			48			.528

As shown in Table 7, it presents the distribution of male players from the tournament's winning and lowest-ranked teams based on their birth quartiles. The chi-square goodness-of-fit test showed no statistically significant Relative Age Effect (RAE), χ^2 (3, N = 24) = 5.333, $p = .149$. Nevertheless, the standardised residuals (SR) indicated noteworthy trends. The winning team had no players born in Quartile 1 (Q1) (N = 0, SR = –1.732), pointing to a noticeable underrepresentation of relatively older players. In contrast, Quartile 2 (Q2) showed overrepresentation (N = 7, SR = 2.309), suggesting a selection skew towards players born in the second quartile of the year. To quantify the strength of association, Cramér's V was calculated as 0.471, which represents a moderate to large effect size (Cohen, 1988), despite the non-significant p-value. This suggests that while statistical significance was not achieved—likely due to the small sample size (N = 24)—there is a meaningful pattern in the data that warrants attention and may reflect underlying selection preferences.

Table 7
Overall distribution of male winning and lowest teams

Birth quartiles	Observed (winning)	Expected (winning)	SR	Observed (lowest)	Expected (lowest)	SR	P
Quartile 1	2	3	-0.577	2	3	-0.577	
Quartile 2	7	3	2.309	5	3	1.155	
Quartile 3	3	3	0	1	3	-1.155	
Quartile 4	0	3	-1.732	4	3	0.577	
Total	12			12			.149

Conversely, Table 8 examines the birthdate distribution of female players from the winning and lowest-ranked teams. The chi-square test again did not reveal a significant RAE, χ^2 (3, N = 24) = 4.267, p = .234. However, the SR values highlight some noteworthy observations. The lowest-ranked team showed complete underrepresentation in Quartile 1 (N = 0, SR = –1.732), while the highest overrepresentation was seen in Quartile 2 (N = 6, SR = 1.732). Among the winning team, no extreme deviations were observed, though Quartile 2 showed a slight overrepresentation (N = 4, SR = 0.577). For this group, Cramér's V was calculated as 0.421, also suggesting a moderate association, although the test did not reach significance. These results indicate potential underlying trends related to RAE among elite female players that are not statistically detectable due to the limited sample size, but may still influence team composition.

Table 8
Overall distribution of female winning and lowest teams

Birth quartiles	Observed (winning)	Expected (winning)	SR	Observed (lowest)	Expected (lowest)	SR	P
Quartile 1	3	3	0	0	3	-1.732	
Quartile 2	4	3	0.577	6	3	1.732	
Quartile 3	2	3	-0.577	4	3	0.577	
Quartile 4	3	3	0	2	3	-0.577	
Total	12			12			.234

4. Discussion

The findings of this study provide empirical support for the presence of the RAE among elite male and female rugby seven players participating in the 2022 Rugby World Cup Sevens. The analysis of birthdate distribution across gender and team performance levels revealed several important trends that align with existing literature, while also offering new insights into how RAE may manifest differently in elite-level competitions.

The significant presence of RAE among male athletes (χ^2 (3, N = 288) = 106.733, p = .002, Cramér's V = 0.351) aligns with previous study by Jakobsson *et al.,* [1] highlighting the overrepresentation of relatively older players in elite male sports. The highest representation in Q2 and Q1 reinforces the notion that players born earlier in the selection year are more likely to be selected, possibly due to early physical maturation and the cumulative advantage effect [2-4,16]. This is consistent with work by Pérez-González *et al.,* [10] among male youth footballers, and specifically by Brustio *et al.,* [7] who found a skewed distribution toward the earlier birth quartiles in male rugby players. Female athletes also exhibited a significant RAE (χ^2(3, N = 192) = 62.448, p = .043, Cramér's V = 0.329), with Q1 showing the highest representation. While the RAE is often reported by Brustio *et al.,* [7] and Kelly *et al.,* [9] as less pronounced in female sports, this study's results suggest that RAE may be increasingly relevant in elite female rugby sevens. The growing competitiveness and professionalization of women's rugby might be contributing to the emergence of selection biases similar to those in the male game. As Jones *et al.,* [2] and Lidor *et al.,* [18] argue, contextual factors such as sport type, competition level, and gender can all influence the magnitude and direction of RAE.

Further, the results indicated a significant RAE among the male players from the top four and bottom four teams (χ^2 (3, N = 96) = 10.080, p = .018, Cramér's V = 0.324), where the top four teams showed a strong bias towards Q1 births. These findings suggest that success at the elite level may be associated with selection practices that favour relatively older athletes. This supports arguments by Delorme *et al.,* [19] and Götze *et al.,* [4] that competitive success may amplify the RAE due to increased performance demands and selection pressures. Interestingly, no statistically significant RAE was found among female players from the top four and bottom four teams (χ^2(3, N = 96) = 2.222, p = .528), indicating that team performance may not be closely tied to birth quartile distribution in the female category. This aligns with previous findings suggesting that RAE tends to be more inconsistent in women's sports [20]. It is possible that female selection and developmental pathways offer more flexibility or that sociocultural factors diminish the RAE's impact.

The analysis of winning and lowest-ranked teams also revealed important trends. Among male players, although the chi-square test did not indicate a statistically significant RAE (χ^2 (3, N = 24) = 5.333, p = .149), the effect size was moderate to large (Cramér's V = 0.471), suggesting a non-trivial pattern. Notably, Q2 was strongly overrepresented in the winning team, while Q1 showed complete underrepresentation (SR = –1.732). This contrasts with the earlier finding where Q1 was most favoured overall, indicating that short-term team success may not strictly align with broader selection biases. This echoes findings by McCarthy *et al.,* [21] who suggested that successful teams may place more emphasis on skill, strategy, or psychological attributes than on age-related physical maturity.

Similarly, among female players from the winning and lowest-ranked teams, no statistically significant RAE was found (χ^2 (3, N = 24) = 4.267, p = .234), but the effect size was moderate (Cramér's V = 0.421). The lowest-ranked team showed a complete absence of Q1 births and a skew towards Q2, which mirrors the male data. While non-significant, this trend may point to underlying selection patterns that are influenced by contextual and competitive dynamics rather than strict age-based advantages. These nuanced findings illustrate the complexity of RAE in elite sport. Theoretically, this study aligns with the Matthew Effect, wherein early advantages (e.g., being older within a cohort) can accumulate and influence long-term outcomes [3,12,22]. It also draws on ecological systems theory, suggesting that athlete development is shaped by multiple interacting systems including coaches, selection committees, and socio-cultural expectations [1,2,21].

Limitations of this study include the small sample size in sub-group analyses (e.g., winning vs. lowest-ranked teams), which may limit statistical power. Also, the study relied solely on birthdate data without considering anthropometric, technical, or psychological variables that could interact with RAE. Furthermore, the analysis does not account for country-specific selection systems or cutoff dates, which may affect generalizability.

5. Conclusions

In conclusion, the study confirms the presence of RAE in elite rugby sevens and highlights gender and performance-based differences. While selection biases favouring relatively older athletes persist, exceptions among top-performing teams indicate a complex interplay of factors beyond relative age. Future research should explore longitudinal data to assess how RAE changes across developmental stages and include multi-level variables such as player position, playing time, and training history. Incorporating qualitative insights from coaches and athletes may also help uncover mechanisms underlying the RAE.

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