The relative age effect in male and female English age-grade rugby union: Exploring the gender-specific mechanisms that underpin participation

Adam L. Kelly[1], Daniel T. Jackson[1], Donald Barrell[2], Kate Burke[2], and Kevin Till[3]

[1]Faculty of Health, Education and Life Sciences, Birmingham City University, Birmingham, West Midlands, United Kingdom; [2]Rugby Football Union, Rugby House, Twickenham Stadium, 200 Whitton Road, Twickenham, London, United Kingdom; [3]Carnegie School of Sport, Leeds Beckett University, Leeds, Yorkshire, United Kingdom

Correspondence: Dr Adam L. Kelly, Department of Sport and Exercise, Birmingham City University, City South Campus, Westbourne Road, Edgbaston, B15 3TN, United Kingdom. E-mail: Adam.Kelly@bcu.ac.uk

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The relative age effect (RAE) is a phenomenon that represents how young athletes who are born early in the selection year are often overrepresented within youth sport settings. The contact nature of rugby union may further magnify the physiological advantages of those athletes who are chronologically older. Thus, the purpose of this study was to examine the RAE within English age-grade rugby union. Male (n=228,206) and female (n=23,563) English age-grade rugby union participants were allocated into their 12-month annual age-category (under-7 to under-18). Data was analysed using a chi-square goodness-of-fit test to compare the observed and expected distributions. Significant differences were revealed in all male ($p<0.001$) and nine out of twelve female ($p<0.05$) annual-age categories. From a male perspective, a higher relative difference became present at under-14 onwards, suggesting that there may be further implications due to the onset of puberty and the introduction of 15-a-side competition. Further female analysis revealed that there was a within-2-year effect in their 24-month age groups (under-13 and under-15). Interestingly, there was an inverse within-3-year effect (i.e., an overrepresentation of younger players) within the female 36-month age group (under-18). The key findings indicate a RAE has become ingrained in English age-grade rugby union, as well as outlining important gender-specific considerations.

Keywords: Talent identification; Talent development; Athlete development; Constituent year effect; Youth rugby; Rugby football union

Introduction

Rugby union is a popular team sport that is played globally by both males and females throughout youth levels to senior status (Sheard & Dunning, 2005). England has the highest participation compared to any other nation, with an estimated 2.1 million players competing nationwide (World Rugby, 2016). As part of this participation at youth level, England has produced a formal and progressive structure of development known as age-grade rugby union. Here, players participate in annual-age categories from under-7 to under-18, with game formats and regulations adapted to provide an age-appropriate learning environment towards the traditional 15-a-side game at adulthood (Till et al., 2020). England rugby union's national governing body, the Rugby Football Union (RFU), is responsible for regulating age-grade rugby. The RFU state that the purpose of the age-grade rugby union framework is to prepare players for adult rugby by being player-centred, development driven, and competition supported (England Rugby, 2019). However, the complex nature of the player development process, coupled with dynamic organisational structures, may not always align with these intended outcomes (e.g., Roberts & Fairclough, 2012).

Based on an interaction between social policy (e.g., cut-off dates applied by sport governing bodies to organise and group children into (bi)annual age cohorts), as well as the timing of one's birth within a cohort, an individual can be chronologically older or younger relative to their peers (Musch & Grondin, 2001). The relative age effect (RAE) refers to the participation inequalities in the immediate and long-term across youth sport (Barnsley, Thompson, & Barnsley, 1985). In team sports for instance, those born early in the selection year have been shown to be significantly overrepresented in Australian Rules football (Haycraft, Kovalchik, Pyne, Larkin, & Robertson, 2018), basketball (Delorme & Raspaud, 2009), field hockey (Wilson, 1999), handball (Schorer, Wattie, & Baker, 2013), ice hockey (Turnnidge, Hancock, & Côté, 2014), netball (Joll & O'Donoghue, 2007), rugby league (Till, Cobley, Wattie, O'Hara, Cooke, & Chapman, 2010), soccer (Romann, Rüeger, Hintermann, Kern, & Faude, 2020), and volleyball (Okazaki, Keller, Fontana, & Gallagher, 2011). As such, the contact nature of these team sports may further magnify the physiological advantages of those athletes who are chronologically older (Baker, Schorer, Cobley, Bräutigam, & Büsch, 2009; Cobley, Baker, Wattie, & McKenna, 2009;).

Since participation and selection in age-grade rugby union is often encompassed by physical qualities (Kelly et al., 2021; Till et al., 2020), coaches may misconstrue early age, enhanced growth and maturation, and greater physical capacities at youth levels as traits for greater long-term attainment (e.g., Furley & Memmert, 2016; Hancock, Ste-Marie, & Young, 2013; Kelly et al., 2020). In rugby union literature, male RAEs have been explored more frequently than their female equivalents (e.g., McCarthy & Collins, 2014; Roberts & Fairclough, 2012). For example, from a Welsh perspective, Lewis, Morgan, and Cooper (2016) found a consistent RAE across all youth and district cohorts from under-7 to under-19 (*n* = 34,788; birth quarter [BQ]1=29% [i.e., born in September, October, November] vs. BQ4=22% [i.e., born in June, July, August]), alongside an increasingly prominent effect at under-16 representative levels where regional and national selection occurs (BQ1=44% vs. BQ4=12%). However, male participation levels are yet to be explored in an English context.

In comparison, it appears only Lemez, MacMahon, and Weir (2016) have examined the RAE in a female rugby union context when they explored the BQ distributions in the New Zealand (ages 4–21 years; *n* = 13,899) and Canada (ages 4–21 years; *n* = 1,497) developmental leagues alongside senior World Cup tournaments. Interestingly, they found mixed-results with limited presence of the RAE within their New Zealand (BQ1=25% vs. BQ4=24%), Canadian (BQ1=27% vs. BQ4=21%), and World Cup (BQ1=23% vs. BQ4=27%) samples. In contrast to the male RAE literature, this preliminary study appears to demonstrate there may be smaller effects in female rugby union. It's important to highlight that the type of sport can influence the frequency of the RAE in a female youth context. For instance, the RAE has been identified in female team sports such as ice hockey (Weir, Smith, Paterson, & Horton, 2010) and volleyball (Okazaki et al., 2011), but remains inconclusive in basketball (Delorme, Boiché, & Raspaud, 2009b) and soccer (Baker et al., 2009). In fact, the lack of female athlete development literature was recently acknowledged by Curran, MacNamara, and Passmore (2019). At the time of their review, Curran and colleagues (2019) illustrated only eight articles have explored the RAE solely in female athletes, compared to 58 that have researched males and 36 that have studied both genders. Moreover, it appears the inclusion of female age-grade players alongside their male counterparts are yet to be examined together in the context of rugby union, thus this current study offers a new and welcome addition to the RAE literature.

Despite the increasing proportion of RAE studies that exist, the literature has rarely explored beyond the impact of the most frequently used 12-month age group structures adopted within youth sport systems (Steingröver, Wattie, Baker, Helsen, and Schorer, 2017). For instance, 2-year age groups are often adopted in Canadian youth ice hockey (Wattie et al., 2010), whilst 5-year age groups have been previously implemented in US Masters swimming and athletics (Medic, Starkes, & Young, 2007). Schorer and colleagues (2013) illustrated a useful guide for additional age group effects resulting from diverse selection ranges in sport. First, *within-2-year effects* (24-month) represents a typical example of the RAE within an extended selection range. Second, Wattie, Cobley, and Baker (2008) coined the term *constituent year effects,* which is applied to the outcome of a greater proportion of athletes selected in the first annual age category observed within a multi-year age group. For example, Steingröver and colleagues (2017) revealed a *within-3-year effect* and a constituent year effect across a fixed 3-year selection range in youth basketball. As such, not only did a RAE remain consistent across a 36-month range, but also favoured the older annual-age category within the respective age group. However, the implications of within-year effects and constituent year effects in rugby union remains unknown. As such, the two 24-month age groups (under-13 – aged 11–13 years; under-15 – aged 13–15 years), alongside the single 36-month group (under-18 – aged 15–18 years), within the female age-grade framework that is considered in this current study offers a useful opportunity to explore these potential RAE mechanisms.

Sustainable participation and player development within age-grade rugby union is a focus for both the RFU and World Rugby (Till et al., 2020). However, research examining

RAEs in age-grade rugby union is limited, especially concerning participation and dropout, coinciding male and female players, and within-year effects and constituent year groupings. Therefore, the purpose of this study was to examine the RAE in male and female English age-grade rugby union at the participation level, to explore the gender-specific mechanisms that underpin participation.

Methods

Sample

The sample consisted of 251,769 participants (male *n* = 228,206; female *n* = 23,563). All participants were age-grade rugby union players competing in England RFU registered clubs ranging from under-7 to under-18. The participants competed in mixed-gender competition until the under-11 age group, whereby single gender participation began at under-12 through to under-18 (see England Rugby, 2019). The England RFU collected the data during the 2018–19 season. The study was ethically approved at both organisational (England RFU) and institutional (Birmingham City University) levels.

Measures

BQ distributions were applied to assess the RAE within male and female age-grade rugby union players. In accordance with English cut-off dates, this methodology divided the year into four 3-month quartiles, starting with September 1st as *month 1* and ending with August 31st as *month 12* (e.g., Till et al., 2010). Each player was subsequently assigned a BQ corresponding to his or her birthdate to create an observed BQ distribution. Separated by gender and annual-age category (under-7 to under-18) for analysis, these observed BQ distributions were compared against the expected BQ distributions calculated from average national live births (Office for National Statistics, 2015). Moreover, in comparison to the consistent yearly age groups applied throughout male age-grade rugby union, females participate in 2-year (under-13 and under-15) and 3-year (under-18) age groups post-mixed gender competition at under-11. This is mainly due to the popularity of female rugby union and the subsequent participation numbers in comparison to males. Thus, further analysis was conducted to explore the within-2-year (6-month age group quarters [AGQ]) and within-3-year (9-month AGQs) effects within these respective female age groups (compared to assumed equal expected AGQ distributions; Schorer, Baker, Lotz, & Büsch, 2010). Figure 1 demonstrates the mechanisms of the RAE that have been explored within this current study.

****Figure 1 near here****

Data analysis

Data was analysed using a chi-square (χ^2) goodness-of-fit test to compare the observed distributions with expected distributions. Since this test does not reveal the magnitude of difference between the BQ distributions for significant χ^2 outputs, Cramer's V was also used. The Cramer's V was interpreted as per conventional thresholds for correlation, whereby a value of 0.06 or more indicated a small effect size, 0.17 or more indicated a medium effect size, and 0.29 or more indicated a large effect size (Cohen, 1988). The odds ratios (OR) and 95% confidence intervals (CI; 1 marked no association) were calculated in order to compare the odds for a BQ1 vs. BQ4 (as well as AGQ1 vs. AGQ4) player being represented.

Results

Skewed birth date distributions were observed in all male annual-age categories from under-7 to under-18 (see Figure 2) when compared to expected distributions, with small effect sizes in under-8, under-14, under-15, under-16, under-17 and under-18. ORs were also observed in all BQ1 vs. BQ4 comparisons across the male annual-age categories from under-7 to under-18

(OR ranged from 1.08 to 1.42). The OR was highest (1.42) within the under-17s (see Table 1).

****Table 1 near here****

****Figure 2 near here****

Skewed birth date distributions were observed in nine out of twelve female annual-age categories from under-7 to under-18 (see Figure 3) when compared to expected distributions, with small effect sizes observed in under-8, under-9, under-10, under-13 and under-15. No differences were observed in under-7, under-11, and under-16 annual-age categories; albeit a similarly skewed distribution was still prevalent. ORs were also observed for half of the BQ1 vs. BQ4 comparisons (including under-8, under-9, under-10, under-13, under-15, and under-17) across all female annual-age categories from under-7 to under-18 (ORs ranged from 1.20 to 1.47) (see Table 2).

****Table 2 near here****

****Figure 3 near here****

Further analysis revealed differences were observed in the female within-2-year (under-13 and under-15) and within-3-year (under-18) age groups (see Table 3) with small effect sizes observed in under-13 and under-18. ORs were observed favouring AGQ1 vs. AGQ4 across both female within-2-year age groups. Conversely, the OR observed for the female within-3-year age group favoured AGQ4 vs. AGQ1.

****Table 3 near here****

Discussion

The primary aim of this investigation was to explore the RFU age-grade BQ distribution of both male and female annual-age categories, to better understand the gender-specific mechanisms that underpin participation. Key findings indicate the RAE is evident across both genders throughout all annual age-categories (under-7 to under-18). Whilst analysing the participants collectively, there appears to be over 13,000 more age-grade players born in BQ1 (28%) compared to BQ4 (22.8%). Interestingly, the difference of male BQ1s and BQ4s is comparable from under-7 to under-13, whereas thereafter, a higher relative difference is present. In contrast, a bimodal distribution is observed in the female cohort, whereby a relative difference between BQ1 and BQ4 peaks at both under-9 and under-15. Further analysis within the female cohort also revealed a within-2-year effect at both the under-13 (AGQ1 29.2 % vs. AGQ4 21.7%) and under-15 (AGQ1 27.4% vs. AGQ4 23.9%) age groups. However, despite the within-2-year effect, a constituent year effect was not observed. Interestingly, there was an inverted within-3-year effect and constituent year effect in the under-18 age group, whereby AGQ4s (30.1%) and under-16s were significantly overrepresented compared to AGQ1s (17.9%) and under-18s, respectively.

From a male context, these current findings are consistent with Welsh youth rugby union (Lewis et al., 2015), regional representation (Roberts & Fairclough, 2012), and academy level (McCarthy & Collins, 2014). When viewed from a social and public health outlook, relative age-related sports dropout equates to lost opportunities for much broader outcomes, including psychosocial (Baker, Schorer, & Wattie, 2018; Côté, Strachan, & Fraser-Thomas, 2008) and physiological (Baxter-Jones, 1995; MacNamara, Collins, & Giblin, 2015) health development. Thus, these findings act as impetus for greater education for key stakeholders (e.g., coaches, parents, and players), as well as considering how youth competition is structured and regulated at participation levels. Whilst an uneven birthdate distribution was present across all annual-age categories, a transient trend was apparent from under-14s in male participation levels. At the under-14s, BQ1 trends increased whilst Q4 trends decreased for the first time resulting in a difference of 1,445 players (compared to 446 at the under-13s). These participation trends are similar to youth rugby league (Cobley & Till, 2017) and dropout in other youth sport contexts (e.g., soccer; Helsen, Starkes, & Winckel, 1998). Although it is difficult to fully explain these findings, it is likely a combination of individual, social, and sport system factors that impact upon these differences. This could include: (a) the timing of maturation (aged ~14 years) resulting in advanced physical development in relatively older individuals (Kelly & Williams, 2020); (b) the introduction of 15-a-side, as well as starting formal competition and league structures, at under-14; and, (c) the initiation of talent identification procedures via the RFU's Developing Player Programme (DPP) at under-15 (Till et al., 2020). Such factors may be considered for maximising participation levels and reducing relative age biases in male age-grade rugby and thus warrants further research. As an example, studying the trajectories of the under-13, under-14, and under-15 annual-age categories may prove fruitful in determining what causes dropout.

Researchers have previously evidenced a weaker RAE for girls and women compared to boys and men (e.g., Vincent & Glamser, 2006), as well as an inconsistent RAE across team sports (see Smith, Weir, Till, Romann, & Cobley, 2018). This current study suggests female annual-age categories do in fact reveal greater inconsistent RAEs throughout age-grade participation. When compared to Lemez and colleagues' (2016) female rugby union study, there appears to be a stronger RAE comparable to their Canadian youth sample, as opposed to the reduced effect that was evident in their New Zealand youth sample. As a result, this may suggest national culture is an important consideration whilst exploring the RAE in female rugby union (e.g., Romann et al., 2018). Moreover, the weaker RAEs found in the New Zealand cohort may be due to the age and anthropometric bands that are emerging throughout their rugby union organisational structures (Nutton et al., 2012); however, further research is required to examine the impact of age and anthropometric bands on the RAE to substantiate this suggestion.

Age and maturation status can also influence the occurrence of the RAE in female youth sport, whereby the magnitude is reduced with age towards adulthood (Smith et al., 2018). For example, Schorer, Cobley, Büsch, Bräutigam, and Baker (2009) reported that the RAE was strongest during early development and then decreased over time in their female handball cohort. However, this current study reveals there is a somewhat similar effect at pre-adolescent (e.g., under-8 BQ1 29.4% vs. BQ4 21.3%), adolescent (e.g., under-13 BQ1 28.5% vs. BQ4 22.2%), and post-adolescent (e.g., under-17 BQ1 27.7% vs. BQ4 23%) annual-age categories. Thus, converse to the male cohort, these current findings suggest age and maturation status may not influence the scale of the skewed BQ distributions within female age-grade rugby union. Moreover, it is important to recognise how girls begin puberty earlier than boys (~aged 10-11 years), which may be why the RAE is less prevalent amongst females since young players attain maturity at a younger age when compared to males (Malina et al., 2015). In addition to the confounding factors of sport type alongside age and maturation status, during their meta-analytic review, Smith and colleagues (2018) highlighted a pronounced RAE in female sport at higher playing levels. A consistent RAE in this current study may lend itself to the suggestion of a competition-focussed approach from clubs and coaches, whereby chronologically older players are probabilistically considered *better* or more *talented*. Thus, since the purpose of age-grade rugby union is to provide a recreational game for all ability levels, attention should logically turn to facilitating equal participation for players across all BQs.

The extended selection ranges in the female age groups permitted further analysis to test the within-2-year and within-3-year effects. Similar to the previous literature on within-2-

year effects (e.g., Steingröver et al., 2017), this current study also revealed a significant difference in the 6-monthly AGQ distributions within the under-13 and under-15 24-month age groups. As a result, these within-2-year AGQ distributions appear to replicate a similar trend to those identified in the regular within-1-year age groups; thus further increasing the RAE for those born later in the second year of the 24-month selection range. Therefore, it is important for policy makers and practitioners to recognise that those who are competing in an age group involving two consecutive years of birth can cause up to a 24-month gap between players (Dixon, Horton, & Weir, 2011). However, converse to the other female-only age groups, this current study revealed a significant inverse effect in the 9-monthly AGQ distributions within the under-18 36-month age group. Due to the association between decreasing participation and age, it is important to consider the potential causes. Perhaps the under-17 and under-18 players may begin moving into senior rugby union at this stage, thus subsequently withdrawing from age-grade participation. Alternatively, players may be dropping-out of rugby union altogether as they move towards adulthood, which has been previously illustrated in other female sports (e.g., Wattie et al., 2012). Nevertheless, the direct causes of this inverse within-3-year effect remain inconclusive and warrant further research.

When observing the 12-month annual-age categories within the under-13 and under-15 age groups, in contrast to previous research (e.g., Medic et al., 2007), a constituent year effect was not established. Using the under-15s as an example, despite being selected for the same 24-month age group, the under-14 annual-age category replicated a balanced proportion of players (49.1%) compared to the under-15 annual-age category (50.9%). Thus, this provides new evidence that a constituent year effect may not be consistent throughout youth sport. However, it is important to recognise that the recreational nature of this current study may not be comparable to the previous research in high-performance youth sport (e.g., Medic et al., 2007; Steingröver et al., 2017). As such, playing level may be considered as a contributing factor to a constituent effect in youth sport. In fact, there was an inverse constituent effect within the under-18 age group, whereby an unbalanced proportion of players were represented throughout. For instance, the under-16 (41.3%) annual-age category was overrepresented compared to the under-17 (35.7%) and under-18 (23%) annual-age categories. Therefore, it is suggested further research is conducted to explore the impact of playing level on constituent effects within youth sport.

Female players make up one quarter of the worldwide population that participate in rugby union (World Rugby, 2016). The English sample in this current study provides evidence of a greater gender gap in participation compared to the global statistics (9% vs. 91%). Consequently, this demonstrates a particularly low female participation rate in age-grade rugby union on a national scale. As a result, the need to expand selection ranges in female age-grade rugby union from 12-month (following the end of mixed-gender at under-11) to 24- (under-13 and under-15) and 36-month (under-18) age group categories may be explained through the lower demand of participation. Whilst it is beyond the scope of this study to provide a critical rationale, it would be unjust to overlook this gender difference. Thus, why do more males participate in age-grade rugby union compared to females in England? Key barriers that minimise or limit participation are perhaps due to the traditional masculine identity of rugby union, social stigma attached to playing a 'non-feminine' sport, or the social stereotypes that surround women rugby union players (e.g., Murray & Howat, 2009; Russell, 2004). In addition, it has been well documented that women face poorer career prospects, comprise fewer role models, and are often exposed to inequality throughout sport compared to males (Sporting Intelligence, 2017). Collectively, these situational factors may fortuitously lead to a decreasing level of motivation to participate in rugby union for the next generation of age-grade players. However, it is important to consider the continuously growing number of female participants, whereby a 142% global increase was recorded from

2012 to 2016 (World Rugby, 2016). Therefore, whilst it appears efforts are being made to facilitate more appropriate female participation in rugby union, it is suggested socio-cultural aspects of gender participation require further inquiry.

It is suggested future research explores potential strategies to moderate the RAE in age-grade rugby union. Individual sports have offered possible solutions for RAEs, such as corrective adjustments (Abbott et al., 2020) and birthday-banding (Kelly, Jackson, Taylor, Jeffreys, & Turnnidge, 2020). However, the dynamics of these solutions may be difficult to replicate in team sport environments. In the context of team sports, chronological age group methods (e.g., age-ordered shirt numbering; selection quotas; avoiding early deselection; flexible chronological approach) and alternative group banding policies (e.g., age and anthropometric bands; bio-banding; playing-up and playing-down) could offer useful evidence-based guidelines for organisations and coaches to adopt practical solutions (see Webdale, Baker, Schorer, & Wattie, 2019).

Limitations

Whilst the current study explored the BQ of all the players who had registered for an RFU age-grade club during the 2018/19 season, there were no mechanisms that allowed the methodology to differentiate between active and inactive players. Thus, the data collection could not remove any participants who have since stopped playing. Furthermore, the current study considered all players as one homogeneous group as position-specific data was not available. Since previous RAE research in senior rugby union has revealed inconsistent findings between playing positions (e.g., forwards vs. backs; Kearney, 2017), further research within a youth context is warranted when position-specific participation begins (e.g., players are encouraged to play in various positions until approximately under-14 when 15-a-side begins). In addition, it is also important to highlight that no additional data was available to draw additional comparisons from, such as performance analysis statistics, maturity status, or diverse playing levels. Thus, moving forward, the inclusion of supplementary data in future research may facilitate a broader understanding of the possible performance-related mechanisms that propel RAEs (e.g., Rubia Adl et al., 2020). In addition, the participation trend of significantly lower levels of involvement in females compared to males, coupled by the decreasing participation of female players towards adulthood, it was unfortunately beyond the scope of this current study to analyse the sources of these outcomes. As such, future research should examine the causality of participation and progression of female rugby union age-grade players, through qualitatively exploring their perceived experiences and opportunities.

Conclusion

Since the purpose of age grouping is designed to mediate fairness across coaching and competition in youth sport (Baxter-Jones, 1995), the findings of a predominant RAE within age-grade rugby union suggests it may not match these intended outcomes. From a male perspective, a higher relative difference becomes present at under-14 onwards that suggests there may be important considerations, such as the onset of puberty during adolescence, the introduction to 15-a-side and formal competition, and the initiation of talent identification procedures. In addition, the findings from the female data suggest a within-2-year effect may further magnify the RAE by creating up to a 24-month gap between players; although constituent year and annual-age category appeared to have little impact on the volume of these distributions, while effect sizes remained relatively small throughout. An inverse within-3-year and constituent year effect in the oldest age group also suggests a decline in participation with age. As such, the mechanisms of female participation in particular require further attention. Thus, whilst considering the pitfalls of fixed chronological age groups (e.g., the RAE), further research is required to explore the most appropriate learning environment for every player to realise their potential throughout age-grade rugby union.

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Disclosure of interest

The authors report no conflict of interest.

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