Running head: Relative Age Effects in Rugby League

# The Prevalence, Influential Factors and Mechanisms of Relative Age Effects in UK Rugby League

By

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Abstract

Relative Age Effects (RAEs), reflecting observed inequalities in participation and attainment as a result of annual age-grouping policies in youth sport, are common in most team sports. The aims of this study were to determine if and when RAEs become apparent in Rugby League, determine how influential variables (e.g., gender) lead and clarify whether player retention at junior representative levels can explain persistent RAEs. Player data were collected for the male and female community game ranging from Under 7s to Senior (*N*=15,060) levels, junior representative selections (i.e., Regional) and professional players (*N*=298). Chi-square analyses found significant ($p<0.05$) uneven birth date distributions beginning at the earliest stages of the game and throughout into senior professionals. In junior representative selections, 47.0% of Regional and 55.7% of National representative players were born in Quartile 1, with RAE risk increasing with performance level. Gender and nationality were also found to moderate RAE risk. When tracking representative juniors, over 50% were retained for similar competition the following season. Findings clearly demonstrate that RAEs exist throughout Rugby League with early selection, performance level and retention processes, appearing to be key contributing factors responsible for RAE persistence.



**Key words: Talent, ~~birth date~~rugby, age effects, gender, development, tracking.**

# Introduction

In youth sport, governing bodies organise participants into chronological age groups (Barnsley et al. 1992; Musch and Grondin, 2001) using specific cut off date criteria (e.g., 1st September in UK Rugby League). Whilst with honourable intentions, this procedure allows within year chronological age differences between individuals in an annual cohort to remain. This consequently leads to a sports participation and selection inequality, known as Relative Age Effects (RAEs; see Musch & Grondin, 2001; Cobley et al. in press). Previous investigations in the popular sports of ice hockey (e.g., Barnsley and Thompson, 1988; Boucher & Mutimer, 1994; Sherar et al. 2007), soccer (Helsen et al. 1998; Simmons & Paull, 2001), tennis (Edgar & O'Donoghue, 2006) and basketball (Esteva et al. 2006) have identified significant overrepresentations of players born in the first quartile (i.e., the three months after a cut off date) of the selection year. However, not all contexts have been examined with research in Rugby League limited to only one descriptive study. Abernethy & Farrow (2005) examined relative age trends in a sample of senior Australian players, establishing that 37% of professional and 40% of representative players were the relatively oldest members of their respective annual age group cohorts. Thus, Rugby League appears to be an appropriate context for further investigation.

Maturational differences have been stated as a primary cause of RAEs (Brewer et al. 1995; Musch and Grondin, 2001), with the relatively older in junior years (i.e., 11-16 years old) deemed more likely to have advanced physical and maturational characteristics compared to relatively younger peers. It is established that physical performance is related to biological maturation (e.g., Phillippaerts et al., 2006) and specifically, greater height, strength and endurance are advantageous for sport performance (e.g., soccer). Recently, advanced maturation relative to similar aged peers was found to increase the likelihood of selection opportunities in youth ice hockey (i.e., Sherar et al., 2007). However, Sherar and colleagues also identified that the likelihood of RAEs increased alongside the level of selection, with higher performance levels associated with coaches being more likely to select relatively older players. The processes and consequences of selection have been previously associated with RAE occurrence in junior sport and used to account for RAEs at the senior professional level. For example, one mechanism suggests that selected relatively older players are more likely to be prescribed higher quality training by higher skilled coaches (Helsen et al. 1998); a factor often regarded as critical toward long term sporting attainment (e.g., Baker and Horton, 2004). While access and benefits from quality training are likely, other and related mechanisms may also account for RAEs persisting into senior years. For example, player retention through repeated selection may also account for RAE propagation in sports.

Rugby League Football originated in the North of England in 1895, and is currently played at amateur (junior and senior) and professional levels worldwide. Professional teams and game popularity is most profound in Great Britain, France, Australia and New Zealand (Brewer & Davis, 1995; Meir et al., 2001). The game of Rugby League is similar to Rugby Union, in that the objective is to advance the ball into the opposition's territory and score a try (~~Gissane et al., 2002~~Gabbett, 2005a). However, the number of players, scoring system and continuity of play differ. For example, in Rugby League, teams consist of 13 players~~some basic game principles differ from Rugby Union, in that teams consist of 13 players per side~~ with 4 substitutes allowed to interchange a maximum of 12 times during the course of a professional 80 minute game (Gabbett, 2005a). A tackle is followed by a 'play the ball', involving the player rolling the ball backwards between their legs to a team member, before the commencement of another attempt to score ‘a try’. When in posession a team has six consecutive attempts (tackles) to score ‘a try’ (Gabbett, 2005a). In running toward the ‘try line’, the ball can only be passed backwards to team members, nevertheless the ball can be kicked forward at any point. The ball is normally kicked on the ‘sixth attempt’. On completion of six tackles (or the ball is kicked) the defending team now obtains ball possession and likewise begins to attack. The successive interchange of ball possession means players are required to attack and defend throughout the game (Gabbett, 2005a).

The game demands of Rugby League are intermittent, with frequent bouts of high intensity activity (sprinting, tackling) separated by short bouts of low intensity activity (walking, jogging; Gabbett, 2005b). Due to this intermittent nature, players require high physiological capacities of speed, strength, power, agility and aerobic capacity (Meir et al., 2001). The physical demands required also vary according to playing position (Clark, 2002). Players are generally grouped as ‘forwards’ (i.e., props, hooker, second row and loose forward) or ‘backs’ (i.e., fullback, wing, centre, stand off and scrum half). ‘Forwards’ are generally involved in a large number of physical collisions and tackles, whilst ‘backs’ spend more game time in free running or ball handling (Gabbett, 2005a). Playing positions can also be classified into four subgroups of ‘Outside Backs’ (i.e., fullback, wingers, centres), ‘Halves and Hookers’ (i.e., stand off, scrum half, hooker), ‘Props’ (i.e., prop) and ‘Backrowers’ (i.e., second row, loose forward). ‘Halves and Hookers’ generally spend more time handling, decision making and kicking than any of the other positions.

Like other physical contact team sports, UK Rugby League contains tiered selection processes within its junior development structure making physical and maturational characteristics valuable, but also likely to exacerbate RAE trends. Rugby

League therefore is an appropriate context in which to evaluate both RAE existence, but also to further assess influential variables and causal mechanisms. The aims of the present study can be considered in two parts. In Part 1, there were three aims. The first aim was to assess the extent to which RAEs were prevalent across the developmental and performance stages of male junior and senior Rugby League. Secondly, we wanted to understand where RAEs first appeared to identify key influential processes; and thirdly, we examined whether variables such as gender and performance level contributed to RAE risk in Rugby League. The second part of our study aimed to determine possible explanatory mechanisms accounting for RAE persistent year on year in junior representation (i.e., Under 13-15 Regional and National levels). Using existing data which tracked player selections for junior representative Rugby League, we examined whether player re-selection, during and across junior age categories, could be one viable explanation for the persistence of RAEs across Rugby League.

## Methods

*Participants*

To assess the prevalence of RAEs in Rugby League a substantial data-set had to be collected from different sources. The data set included participation and selection information from the community game, junior representative and professional levels.

Following local ethical approval, male and female local community participation data ($N$=15,060) for the 2007-08 season was provided by the Rugby Football League (RFL). This data, compiled by the RFL, included players registered with local amateur clubs ($N$=196 clubs) governed by the RFL. Compiled data included information pertaining to gender and birth date (and thus age) of junior male players across the age categories of Under 7's - Under 18's (*N* =14,390) and female players (N=670) registered at Under 12 (n=47), Under 14 (n=188), Under 16 (n=174) and senior (n=261) age categories.

Within the junior structure of Rugby League, representative (i.e., higher performance level) squads are selected. Representative squads in UK junior Rugby League consist of local district, regional and national levels across particular age categories. This data was provided directly by the RFL for Service Areas (N=1,298) and National tournaments (i.e., National Carnival; N=234) at Under 13, Under 14 and Under 15 age categories for the 2007 competitive season. Data relating to player selections at Regional and National performance camps was directly collected through a sports science support programme provided by Leeds Metropolitan University. Player information was obtained from this data set for the Under 13, Under 14 and Under 15 age categories for the 2005, 2006 and 2007 seasons.

To supplement participation and selection data across the developmental structure of UK Rugby League, senior professional player data was also obtained. Data related to current UK professional (Super League) players (*N*=298) for the 2008 season was obtained from the league official website (www.superleague.co.uk). Birth date, nationality, Great Britain international representation and playing position information were obtained for each senior professional player. Nationality was classified as either British (*n*=192), French (*n*=17) or from the Southern Hemisphere (*n*=89), while playing position was classified as either: 'Outside-Backs' (*n*=56), 'Halves and Hookers' (*n*=41), 'Props' (*n*=47) and 'Backrowers' (*n*=48).

*Developmental Stages in UK Rugby League*

To understand the possible mechanisms that lead to RAEs, it is important to understand the developmental stages and structure of Rugby League within the UK.

Rugby League is played from the community game at Under 7s to the full-time senior professional game (i.e., Super League; See Figure 1. for a summary of the developmental pathway). In line with both education and sport across the UK, participants from initial junior stages of participation are placed into annual-age group cohorts. Here, the birth dates of players are matched according to cut-off date criteria used to determine annual-age grouping (i.e., September $1^{st}$ start – August $31^{st}$). From the Under 7 stage up until the Under 16 age group this process remains consistent throughout the local community and junior representative levels of the game with the competitive season running between September and May the following year.

Between Under 12 and 16 age groups, selection to representative squads occurs. The first level of selection and representation is to the Service Area (local district team; e.g., Leeds, a city in Yorkshire). Service Area teams then compete against each other as part of 'inter-service area' competition during the latter end of the playing season (i.e., April-May each year). This competition then leads to selection for the next performance level (i.e., Regional). Regional selection means players are selected to attend a week long training camp (often occurring around July) to undertake specialised training. Based on player performances at Regional camp, a Regional squad (i.e., 20 players approx) is selected to compete in a National Carnival tournament (often around September at the start of a new season; i.e., Under 13s are now Under 14s). Only through participation at the National Carnival can a player then (generally) be considered and selected for the National junior team (i.e., National Performance = Under 14s; National Preparation = Under 15s & 16s). For each season, a new process of selection commences for all players within the junior participation structure. A summary of the selection pathway is shown in Figure 1.

*Insert Figure 1 about here*

Following participation at Under 16 level, players are then either selected to move into the professional game or remain at a lower performance level of involvement (i.e., community/amateur game). Community participation continues at Under 17 and 18 levels, before moving into the senior adult game (i.e., without annual age-groupings). At the Under 18 age category, selection cut-off dates change to the 1st of January, which caters for Under 19 players from January. For development toward the professional game, advanced players compete as part of a professional club's junior (i.e., 16-18 years old) or senior club academy (i.e., Under 21; with some accommodation for overage players allowed). Players are then selected for the senior professional side in Super League, with each team consisting of a squad of approximately 25 players.

*Measures*

*Part 1 & 2:*

To determine the existence of RAEs in UK Rugby League, player birth-dates were firstly recoded to reflect their birth quartile (Q), according to the dates used for creating annual-age groups. September 1st is used as the calendar start date for all age categories and performance levels (except for the Under 18 community males and Southern Hemisphere professional players where a 1st January cut-off date is applied). Therefore, Q1 = birth-dates between September and November; Q2 = December-February; Q3 = March-May; and Q4 = June-August. For Under 18 community level males and Southern Hemisphere professional players, quartiles were adjusted accordingly so that Q1 = January–March; Q2 = April-June; Q3 = July-September; and Q4 = October-December. With player characteristics hypothesised as possible moderators of RAE risk in Rugby League, players' attributes of gender, age category and performance level were considered. Related to the professional sample, the potential influences of nationality and playing position were also considered.

*Data Analysis*

*Part 1*

To analyse the prevalence of RAEs across the junior and senior male game, SPSS Version 15.0 for Windows was used to perform both Chi-square and Odds Ratio (risk) analyses on all player data. Chi-square analyses assessed quartile asymmetry (significance set at $p<0.05$), while logistic regression analyses determined the risk size of RAEs. Most previous investigations examining RAEs have used chi-square tests (e.g., Brewer et al. 1995; Sherar and Bruner, 2007; Simmons and Paull, 2001) to compare observed quartile frequency count and that of an expected (and often equal) distribution. To improve the accuracy of this assumption, the present analysis made direct comparisons against national (UK) birth population distributions (Office for National Statistics, 2008) for each year, corresponding to participant age categories. For example, Under 7 players in the competitive season of 2007 were compared with the distribution of national births between September 2000 and August 2001. For senior men and women, birth dates were compared with the UK distributions between the years corresponding to the oldest and youngest players respectively (e.g., oldest senior male birth-date = 10/03/1973, while the youngest senior male = 08/07/1990). A summary of the UK national birth distributions used for each age category is detailed in Table 1.

*Insert Table 1 about here*

Odds ratios (OR) and 95% Confidence Intervals (CI) were calculated by comparing quartiles (e.g., Q1 vs Q4, Q2 vs Q4, Q3 vs Q4) and half year distributions (H1 vs H2). During such comparisons, Quartile 4 and the second 6 month categories were used continuously as the referent group. These procedures of data analysis are effective in showing participation inequalities and the risk size of RAEs (Cobley et al. in press). These tests were used to identify where RAEs became established. To evaluate whether other variables (e.g., gender) moderated RAE risk, these analysis procedures were repeated on the female community players, junior representative (i.e., Service Area, Regional, etc.), British and Southern Hemisphere professional levels, with further consideration of playing position in the professional player sample.

*Part 2*

To assess whether player retention in selection was a possible mechanism accounting for persistent RAEs, the representative data for a junior cohort of male players was examined (i.e., Under 13 – Under 15s). The analysis conducted was descriptive and included calculating the percentage (and number) of players that were repeatedly selected at Regional and National representative levels. Birth date distributions of players selected for the competitive seasons 2005, 2006 and 2007 were then examined using similar procedures as applied in Part 1. The distributions of both retained players (i.e., those selected again from a previous competitive season) and new players (i.e., players not selected the previous year) were also examined, with comparisons made against the quartile distribution of players selected for representative teams the previous competitive season.

## Results

*Part 1: Prevalence of RAEs Across Male Rugby League*

Table 2 shows the quartile distributions, Chi-square ($\chi^2$), Odds Ratios (OR) and 95% Confidence Intervals (CI) analysis for all male community, junior representative and professional players when directly compared against UK national birth distributions for each respective year. Results identify that a general significant participation inequality exists, considerate of cut-off dates used for annual-age grouping in the junior and senior structures of male Rugby League.

*Insert Table 2 about here.*

Chi-square analyses found significant uneven birth date distributions in male community Under 7 to Under 18 age categories (except Under 8s; $\chi^2$ = 5.76, $p$=0.124). Significant uneven distributions also occurred in senior professional players at Super League ($\chi^2$ = 8.26, $p$=0.041) and international (i.e., Great Britian squad; $\chi^2$ = 13.21, $p$=0.004) levels. However, significant odds ratios were only found at the Under 7 level for Quartile 1 v Quartile 4 (Q1 vs Q4 OR: 2.28, 95% CI: 1.04-5.05) and half year comparisons (H1 vs H2 OR: 1.80, 95% CI: 1.02-3.17). The results identified that RAEs were prevalent across male Rugby League starting as young as Under 7 level.

*Junior Representative Selections*

Table 2 identifies significant (i.e., $p$<0.001) uneven distributions for all representative levels of junior Rugby League, except at the Under 14 National Camp selection ($\chi^2$ = 7.547, $p$=0.056), when compared against the UK national birth distributions. Odds ratios analyses identified significant risk of RAEs in the comparisons between Quartile 1 and 4; Quartile 2 and 4 and half year distributions at each selection level (i.e., Service Area to National Camp) and at each age group (i.e., Under 13 to Under 15). Figure 2 summarises the quartile distributions of junior Rugby League players by combining the Under 13-15 age groups and by categorising according to performance level.

*Insert Figure 2 about here.*

*Female Players*

No significant uneven distributions were found for female players at Under 14, 16 and senior levels with odds ratios analyses identifying no significant risk of RAEs in the female sample for any age group. However, a significant and surprising uneven distribution was found for the Under 12 age category ($\chi^2$ = 7.863, $p$=0.049) with 71.2% of players born in the second half of the selection year (March to August).

*Influence of Nationality & Playing Position at the Professional Level*

When players were categorised according to birth origin, with corresponding annual-age grouping dates applied, uneven distributions occurred (i.e., British players $\chi^2$ = 23.39, $p$<0.001; Southern Hemisphere players $\chi^2$ = 10.41, $p$=0.015). Odds ratios analysis identified similar significant RAE risks for British professional players (Q1 vs Q4 OR: 2.59, 95% CI: 1.15-5.83) and Great Britain International players (Q1 vs Q4 OR: 3.00, 95% CI: 1.36-6.61; H1 vs H2 OR: 1.99, 95% CI: 1.13-3.52).

Table 3 shows the percentage distribution according to quartile, chi-square and odds ratio results for British professional players according to their designated playing position. When considering playing position, chi-squares identified significantly deviated distributions for 'Outside-backs' ($\chi^2$ = 9.51, $p$=0.023) and 'Backrowers' ($\chi^2$ = 15.55, $p$=0.001). Odds ratios identified greater likelihoods of relatively older professional players in the positions of 'Halves & Hookers' (H1 vs H2 OR: 1.83, 95% CI: 1.04-3.23) and for 'Backrowers' (i.e., Q1 vs Q4 OR: 10.42, 95% CI: 3.30-32.89; Q2 vs Q4 OR: 5.19, 95% CI: 1.58-17.05).

*Insert Table 3 about here.*

*Part 2: Player retention in junior representative Rugby League*

Figure 3 illustrates the percentage (and number) of players retained or not selected again at Regional and National levels for the Under 13 - Under 15 age categories for the 2005-2007 competitive seasons. The figure shows that over 50% of players are successfully retained in the selection system each year for Regional and National level selections. As important, it seems 36.8% (Under 13s to Under 14s) and 39.6% (Under 14s to Under 15s) of players are not selected for subsequent competitive seasons. This suggests the possibility of player retention is generally evenly matched with the possibility of new players being selected in subsequent years.

*Insert Figure 3 about here*

Table 4 represents the birth date distribution of players selected at Regional and National representative levels. Further, it examines the quartile distributions of players retained and new selections that entered the junior representative development pathway during 2005-2007. Results illustrate consistent selections in that players both retained and newly selected reported a similar skewed birth date distribution to the players originally selected in the previous competitive season. Again this favours the selection of relatively older players within the annual cohort of players.

*Insert Table 4 about here.*

## Discussion

Whilst RAEs can be expected in a physical contact sport such as Rugby League, only limited data examining Australian professional players exists (Abernethy and Farrow, 2005). The aims of this study were to determine if and when RAEs became apparent across Rugby League; examine potential influencing variables (e.g., performance level) and examine player retention at junior representative levels to possibly explain persistent RAEs.

Findings demonstrated that RAEs were evident in male junior and senior Rugby League; consistent with findings in other team sport contexts such as ice hockey (Boucher & Mutimer, 1994; Sherar et al., 2007) and soccer (Helsen et al.

1998; Simmons & Paull, 2001). Chi square analyses showed significant frequency deviations from expected distributions across the male junior and senior game. Further, odds ratio analyses showed that the risk of RAE inequalities increased as the number of months away from the referent groups (Quartile 4 / 2$^{nd}$ half of selection year) also increased, similar to the meta-analytical findings reported by Cobley, et al., (in press). More substantial however, was the finding that RAEs increased with each and every performance level, where selection for a smaller number of places on a representative squad occurred.

In male junior competitive sports, such as ice-hockey and soccer, chronological age grouping provides an advantage to boys born earlier in the selection year (Vaeyens et al. 2005), resulting in consistent participation and attainment inequalities (Barnsley and Thompson, 1988; Helsen et al. 2000). Similar participation disparities were apparent in the present sample from the very earliest stages of the community game, notably the Under 7 age category. These findings resonate with Helsen et al.'s (2000) analysis of soccer, who identified RAEs as young as 6 and 8, with the relatively older more likely to be labelled as talented. Collectively, these findings suggest developmental advantages (e.g., greater height and body mass) provide performance advantages in the game context, potentially explaining why participation inequalities become manifest so early in competitive sport.

Based on their meta-analysis, Cobley et al. (in press) suggest that RAE risk is inflated during mid to late adolescence (i.e., 14 to 18 years) and when representative levels of competition (i.e., national representation) occur. To date, and with notable recent exceptions (e.g., Sherar et al. 2007), few studies have been able to assess these propositions. However, findings from the present study, examining the structured developmental pathway across Rugby League, do demonstrate an increased risk of

RAEs when selection steps and performance levels increase, which become an integral aspect of the game from the Under 13 category onwards. These findings emphasise how processes associated with player performance evaluation, assessment and selection are also likely to be a key causal mechanism leading to the heightended RAE inequalities.

Numerous previous studies (e.g., Brewer et al. 1995; Musch and Grondin, 2001) suggest maturational differences as the primary cause for RAEs, especially at the time period associated with puberty. During this period, one year chronological age differences can be substantial (Musch and Grondin, 2001), leading to greater variability in physical attributes such as height, body mass, speed and strength (Malina, 1994; Malina et al. 2004). As performance demands of Rugby League advantage players with exceptional high physiological capacitiies (~~Meir, 1994;~~ Meir et al. 2001), it is perhaps not suprising that increased selection opportunities exist for the relatively older athlete. However, early identification and selection could permit a more long-term attainment advantage, as this has been suggested to increase an individuals chance of selection in subsequent competitive seasons (Simmons and Paull, 2001) and possibly be retained within a development system. Likewise, Dudink (1994) adds that this may permit an increased likelihood to access advanced quality training and gain more beneficial experiences obtained from advanced competition. Whilst, our data indicated that over half of the tracked players are retained across age categories at representative levels, results also identified that RAE risk tapers at the adult professional stage, when compared to RAE risk in representative junior players; a trend also consistent across previous sports examined (Cobley et al. in press). There may be several possible reasons for this trend, relating to the removal of maturation as an influential variable, greater likilhood of injury and withdrawal in the relatively older players. Nonetheless, such reasons remain speculative until investigations examine this trend in more detail.

Gender was examined as a potential moderator of the RAE as little is known about the effect of gender on RAEs in sport. No RAEs were identified in female community level players at the Under 14, 16 and senior players. However, an uneven distribution favouring participation for the relatively younger player was identified in the Under 12 age category. A possible explanantion for this uneven distribution may be the onset of puberty occurring at approximately 12 years of age in girls. Therefore the relatively younger player would be less likely to have started menstruation with girls opting out of physical competition until regular menstruation has occurred. Overall, the general pattern of female data provides no evidence for RAEs, so gender does therefore act as a moderator variable. The discrepancy between gender remains unclear, however it has been suggested that the depth of participation and intensity of selection and competition between the male and female game may be accountable (Vincent and Glasmer, 2006; Wattie et al. 2007). This is evident in the current study when the male (N=14,390) and female (n=670) sample sizes are compared.

Player nationality was examined in professional Rugby League due to the large number of overseas players (n=106) contracted with clubs in the UK Super League. RAEs were evident in British and overseas players, considerate of the alternative dates used for annual age-groupings in respective development systems. Similar to Abernethy and Farrow (2005) who found that 37% of Australian professional Rugby League and 40% of representative level players were the relatively oldest (i.e., January to March born), 38.1% of British and 48.9% of British international professionals were the relatively oldest (i.e., Quartile 1). Specific, to

Southern Hemisphere international players, 38.2% of players born were Quartile 1 categorised. Thus, nationality acts a potential moderator for RAE.

The potential influence of playing position on RAEs has rarely been examined in previous studies (e.g., Edwards, 1994; Schorer et al. in review). For the present study, players were classified into four subgroups of positions, ‘Outside backs’, ‘Halves and Hookers’, ‘Prop’ and ‘Backrowers’. Significant uneven distributions were found for ‘Outside backs’ ($\chi^2$ =9.51, $p<0.05$) and ‘Backrowers’ ($\chi^2$ =15.55, $p<0.005$) for British professional players, with sample size limitations possibly preventing associations to be made with remaining positions. Considering these observations, it is difficult to accurately determine whether playing position acts a moderator of RAEs in senior Rugby League players. Although the backrow position require size and strength and are involved heavily in the physical aspects of ball carrying and tackling, the ‘Props’ position also posess similar qualities. Further assessments at the junior and representative levels may provide the necessary data and evidence to make a better assessment of RAE variations according to playing position and associated performance demands.

Research on longitudinal tracking of players in sport development systems is generally limited, and certainly not evident in previous RAE literature. In this study, the tracking of player selections across a three year period at the Under 13-15 category was done to determine if player retention was a possible mechanism explaining consistent RAEs across youth sport, as observations are often made based on repeated cross-sectional data. Findings show that over 50% of players were retained each year, demonstrating a probable selection advantage or preference for subsequent competitive seasons. Likewise though, a significant minority were not selected again with varied reasons possible. These findings do on the one hand demonstrate a possible bias in player retention, but also show that opportunities do exist for players to still enter the representative levels of performance. Nonetheless, it remained more likely that those entering the representitive level after the Under 13 age category were relatively older; with probable preferred physical characteristics which underpin performance requirements for Rugby League. Thus, at the junior representative level, despite some degree of change in squad composition, RAE biases remain consistent from year to year due to both retention and selection of relatively older athletes.

## Perspectives

The present study identifies that relatively older males, in all tiers of Rugby League (i.e., junior participation, junior representative and senior profesional) have a greater likelihood of participation and selection than their relatively younger peers, commencing at the earliest stages of the game. Risk of RAEs increased with each performance level (i.e., from community to National levels), where selection for a smaller number of places on a representative squad occurred. This suggests that present coaching practices, without direct awareness or probable intention, bias selection toward relatively older players, possibly as the result of physical and cognitive variability within annual age-cohorts. Gender and nationality were both found to moderate RAEs, while an influence for playing position is also probable. The retention of players in representative samples and their repeated selection during adolescence are likely reasons accounting for maintained and inflated RAE risks in junior sport.

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Table 1: UK birth-distributions according to quartile, matching participants in the sample.

| Age Group | Relevant Dates for Sample Matching | % in Quartile (Q1) | % in Quartile (Q2) | % in Quartile (Q3) | % in Quartile (Q4) |
|---|---|---|---|---|---|
| Under 7s | Sept 2000 - Aug 2001 | 25.30 | 24.33 | 24.96 | 25.41 |
| Under 8s | Sept 1999 - Aug 2000 | 25.22 | 24.48 | 24.94 | 25.35 |
| Under9s | Sept 1998 - Aug 1999 | 25.34 | 23.97 | 25.12 | 25.57 |
| Under 10s | Sept 1997 - Aug 1998 | 24.76 | 24.43 | 25.02 | 25.79 |
| Under 11s | Sept 1996 - Aug 1997 | 25.47 | 24.22 | 25.03 | 25.28 |
| Under 12s | Sept 1995 - Aug 1996 | 25.18 | 24.17 | 24.58 | 26.07 |
| Under 13s | Sept 1994 - Aug 1995 | 25.11 | 23.96 | 25.19 | 25.74 |
| Under 14s | Sept 1993 - Aug 1994 | 25.06 | 24.14 | 25.51 | 25.29 |
| Under 15s | Sept 1992 - Aug 1993 | 25.04 | 23.79 | 25.15 | 26.01 |
| Under 16s | Sept 1991 - Aug 1992 | 24.85 | 24.38 | 25.20 | 25.57 |
| Under 17s | Sept 1990 - Aug 1991 | 25.24 | 24.13 | 24.88 | 25.75 |
| Under 18s | Dec 1989 - Aug 1990 | 24.17 | 25.75 | 25.92 | 24.16 |
| Male Senior | Sept 1972 - Aug 1990 | 24.65 | 23.90 | 25.78 | 25.68 |
| Female Senior | Sept 1952 - Aug 1991 | 24.24 | 24.20 | 26.19 | 25.37 |

Table 2: Relative age effects according to age-group and performance level in UK Rugby League.

| Age Group | Skill Level | N | %Q1 | %Q2 | Q3% | Q4% | $X^2$ | *P* | OR (CI) Q1vQ4 | OR (CI) Q2vQ4 | OR (CI) Q3vQ4 | OR (CI) H1vH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Under 7s | Community | 316 | 38.92 | 25.00 | 18.99 | 17.09 | 36.36 | <0.001 | 2.28 (1.04-5.05) | 1.53 (0.67-3.50) | 1.13 (0.48-2.66) | 1.80 (1.02-3.17) |
| Under 8s | Community | 468 | 27.78 | 27.14 | 23.72 | 21.37 | 5.75 | 0.124 | 1.31 (0.59-2.88) | 1.31 (0.59-2.91) | 1.13 (0.50-2.52) | 1.23 (0.71-2.15) |
| Under 9s | Community | 771 | 33.07 | 21.92 | 21.66 | 23.35 | 22.50 | <0.001 | 1.43 (0.67-3.07) | 1.00 (0.45-2.24) | 0.94 (0.42-2.11) | 1.26 (0.72-2.19) |
| Under 10s | Community | 1311 | 27.88 | 27.57 | 23.17 | 22.63 | 16.69 | 0.001 | 1.28 (0.59-2.81) | 1.29 (0.59-2.82) | 1.06 (0.47-2.35) | 1.29 (0.74-2.24) |
| Under 11s | Community | 1305 | 27.82 | 26.82 | 22.38 | 22.99 | 12.82 | 0.005 | 1.20 (0.55-2.62) | 1.16 (0.53-2.53) | 0.98 (0.44-2.19) | 1.22 (0.70-2.13) |
| Under 12s | Community | 1251 | 28.54 | 25.10 | 22.22 | 24.14 | 10.65 | 0.014 | 1.12 (0.59-2.10) | 1.08 (0.49-2.35) | 0.98 (0.44-2.17) | 1.19 (0.68-2.07) |
| Under 13s | Community | 1469 | 28.18 | 24.57 | 24.71 | 22.53 | 11.74 | 0.008 | 1.28 (0.59-2.80) | 1.17 (0.53-2.60) | 1.12 (0.51-2.48) | 1.16 (0.67-2.02) |
| | Service Area | 425 | 43.53 | 26.59 | 18.59 | 11.29 | 100.52 | <0.001 | 4.06 (1.73-9.56) | 2.47 (1.01-6.02) | 1.63 (0.65-4.10) | 2.67 (1.48-4.80) |
| | Regional | 138 | 52.17 | 26.81 | 15.22 | 5.80 | 67.49 | <0.001 | 9.08 (3.27-25.18) | 4.84 (1.68-13.93) | 2.60 (0.86-7.84) | 3.88 (2.09-7.22) |
| | Nat. Carnival | 75 | 62.67 | 25.33 | 10.67 | 1.33 | 66.72 | <0.001 | 47.55 (7.83-288.9) | 19.95 (3.20-124.5) | 7.95 (1.21-52.35) | 7.57 (3.69-15.55) |
| | National Camp | 40 | 60.00 | 27.50 | 10.00 | 2.50 | 31.68 | <0.001 | 24.22 (6.09-96.32) | 11.52 (2.81-47.19) | 3.97 (0.89-17.61) | 7.23 (3.55-14.71) |
| Under 14s | Community | 1428 | 31.09 | 25.77 | 23.18 | 19.96 | 41.37 | <0.001 | 1.57 (0.71-3.46) | 1.35 (0.60-3.03) | 1.15 (0.51-2.60) | 1.36 (0.78-2.38) |
| | Service Area | 435 | 33.33 | 31.72 | 21.61 | 13.33 | 49.44 | <0.001 | 2.59 (1.12-6.01) | 2.60 (1.11-6.07) | 1.68 (0.70-4.02) | 1.95 (1.11-3.44) |
| | Regional | 139 | 44.60 | 29.50 | 17.99 | 7.91 | 42.52 | <0.001 | 5.86 (2.30-14.91) | 4.08 (1.56-10.67) | 2.35 (0.87-6.39) | 3.00 (1.65-5.44) |
| | Nat. Carnival | 80 | 46.25 | 30.00 | 15.00 | 8.75 | 27.62 | <0.001 | 5.49 (2.22-13.60) | 3.75 (1.47-9.56) | 1.77 (0.65-4.81) | 3.36 (1.84-6.16) |
| | National Camp | 24 | 45.83 | 29.17 | 12.50 | 12.50 | 7.54 | 0.056 | 3.81 (1.66-8.75) | 2.55 (1.07-6.06) | 1.03 (0.40-2.69) | 3.14 (1.73-5.72) |
| Under 15s | Community | 1932 | 28.47 | 26.71 | 24.28 | 20.55 | 38.71 | <0.001 | 1.44 (0.65-3.17) | 1.42 (0.64-3.16) | 1.22 (0.55-2.73) | 1.29 (0.74-2.24) |
| | Service Area | 438 | 43.38 | 24.66 | 19.41 | 12.56 | 95.13 | <0.001 | 3.55 (1.54-8.20) | 2.06 (0.86-4.95) | 1.57 (0.64-3.85) | 2.20 (1.24-3.90) |
| | Regional | 140 | 44.29 | 28.57 | 15.71 | 11.43 | 38.43 | <0.001 | 3.99 (1.70-9.36) | 2.62 (1.08-6.33) | 1.39 (0.54-3.57) | 2.77 (1.53-4.99) |
| | Nat. Carnival | 79 | 45.57 | 26.58 | 16.46 | 11.39 | 22.42 | <0.001 | 4.12 (1.76-9.65) | 2.45 (1.01-5.95) | 1.47 (0.58-3.73) | 2.67 (1.49-4.81) |
| | National Camp | 24 | 58.33 | 29.17 | 4.17 | 8.33 | 18.01 | <0.001 | 7.21 (2.89-17.94) | 3.67 (1.42-9.49) | 0.51 (0.14-1.86) | 7.22 (3.55-14.69) |

Table 2: *continued.*

| Age Group | Skill Level | N | %Q1 | %Q2 | Q3% | Q4% | $X^2$ | *P* | OR (CI) Q1vQ4 | OR (CI) Q2vQ4 | OR (CI) Q3vQ4 | OR (CI) H1vH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Under 16s | Community | 1884 | 30.89 | 25.96 | 23.41 | 19.75 | 56.96 | <0.001 | 1.61 (0.73-3.55) | 1.38 (0.62-3.09) | 1.20 (0.53-2.71) | 1.36 (0.78-2.37) |
| Under 17s | Community | 1244 | 31.59 | 24.68 | 21.62 | 22.11 | 31.14 | <0.001 | 1.46 (0.67-3.16) | 1.19 (0.54-2.65) | 1.01 (0.45-2.27) | 1.33 (0.76-2.31) |
| Under 18s | Community | 1011 | 28.39 | 26.71 | 26.21 | 18.69 | 20.19 | <0.001 | 1.52 (0.67-3.42) | 1.35 (0.60-3.02) | 1.31 (0.58-2.94) | 1.23 (0.71-2.15) |
| Senior | Super League | 297 | 28.62 | 26.60 | 25.93 | 18.86 | 8.26 | 0.041 | 1.58 (0.71-3.53) | 1.48 (0.66-3.33) | 1.34 (0.60-3.01) | 1.30 (0.75-2.28) |
| | British Professional | 192 | 38.1 | 21.16 | 25.40 | 15.34 | 23.29 | <0.001 | 2.59 (1.15-5.83) | 1.45 (0.61-3.42) | 1.62 (0.70-3.73) | 1.54 (0.88-2.69) |
| | S. Hemisphere Professional | 89 | 38.2 | 19.11 | 21.35 | 21.35 | 10.40 | 0.015 | 1.79 (0.83-3.85) | 0.90 (0.39-2.05) | 1.00 (0.44-2.26) | 1.34 (0.77-2.34) |
| | Great Britain International | 49 | 48.94 | 18.37 | 18.37 | 16.33 | 13.20 | 0.004 | 3.00 (1.36-6.61) | 1.18 (0.50-2.81) | 1.10 (0.46-2.60) | 1.99 (1.13-3.52) |

N = Total in sample; Q = Quartile; OR = Odd Ratio calculation; CI = Confidence Interval calculation; H = Half-year (i.e., 6 months)

Table 3: Relative Age Effects of British Super-League Professionals (2008 season) according to playing position category.

| Position | N | %Q1 | %Q2 | Q3% | Q4% | $X^2$ | *P* | OR (CI) Q1vQ4 | OR (CI) Q2vQ4 | OR (CI) Q3vQ4 | OR (CI) H1vH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 'Outside Backs' | 56 | 39.29 | 10.71 | 28.57 | 21.43 | 9.51 | 0.023 | 1.91 (0.89-4.11) | 0.52 (0.21-1.32) | 1.30 (0.60-2.85) | 1.06 (0.61-1.84) |
| 'Halves & Hookers' | 41 | 39.02 | 24.39 | 17.01 | 19.51 | 5.25 | 0.155 | 2.08 (0.96-4.54) | 1.31 (0.59-2.96) | 0.85 (0.37-2.00) | 1.83 (1.04-3.23) |
| 'Props' | 47 | 34.04 | 27.66 | 21.28 | 17.02 | 3.70 | 0.296 | 2.08 (0.93-4.66) | 1.70 (0.75-3.87) | 1.22 (0.33-2.83) | 1.70 (0.97-2.99) |
| 'Backrowers' | 48 | 41.67 | 20.83 | 33.33 | 4.17 | 15.55 | 0.001 | 10.42 (3.30-32.89) | 5.19 (1.58-17.05) | 7.81 (2.46-24.79) | 1.76 (1.00-3.10) |

N = Total in sample; Q = Quartile; OR = Odd Ratio calculation; CI = Confidence Interval calculation; H = Half-year (i.e., 6 months)

Table 4. Birth date distributions of retained and new Regional and National players between Under 13 and Under 15 age categories

| | | U13s | Retained U14s | New U14s | U14s | Retained U15s | New U15s | U15s |
|---|---|---|---|---|---|---|---|---|
| Regional | N | 95 | 54 | 47 | 101 | 58 | 42 | 100 |
| | % Q1 | 45.3 | 46.3 | 55.3 | 50.5 | 48.3 | 52.4 | 50.0 |
| | % Q2 | 25.3 | 25.9 | 21.3 | 23.8 | 27.6 | 28.6 | 28.0 |
| | % Q3 | 21.1 | 18.5 | 17.0 | 17.8 | 15.5 | 9.5 | 13.0 |
| | % Q4 | 8.4 | 9.3 | 6.4 | 7.9 | 8.6 | 9.5 | 9.0 |
| National | N | 41 | 16 | 8 | 24 | 14 | 10 | 24 |
| | % Q1 | 56.1 | 62.5 | 87.5 | 70.8 | 64.3 | 50.0 | 58.3 |
| | % Q2 | 31.7 | 25.0 | 12.5 | 20.8 | 21.4 | 40.0 | 29.2 |
| | % Q3 | 9.8 | 6.25 | 0 | 4.2 | 7.15 | 0.0 | 4.2 |
| | % Q4 | 2.4 | 6.25 | 0 | 4.2 | 7.15 | 10.0 | 8.3 |

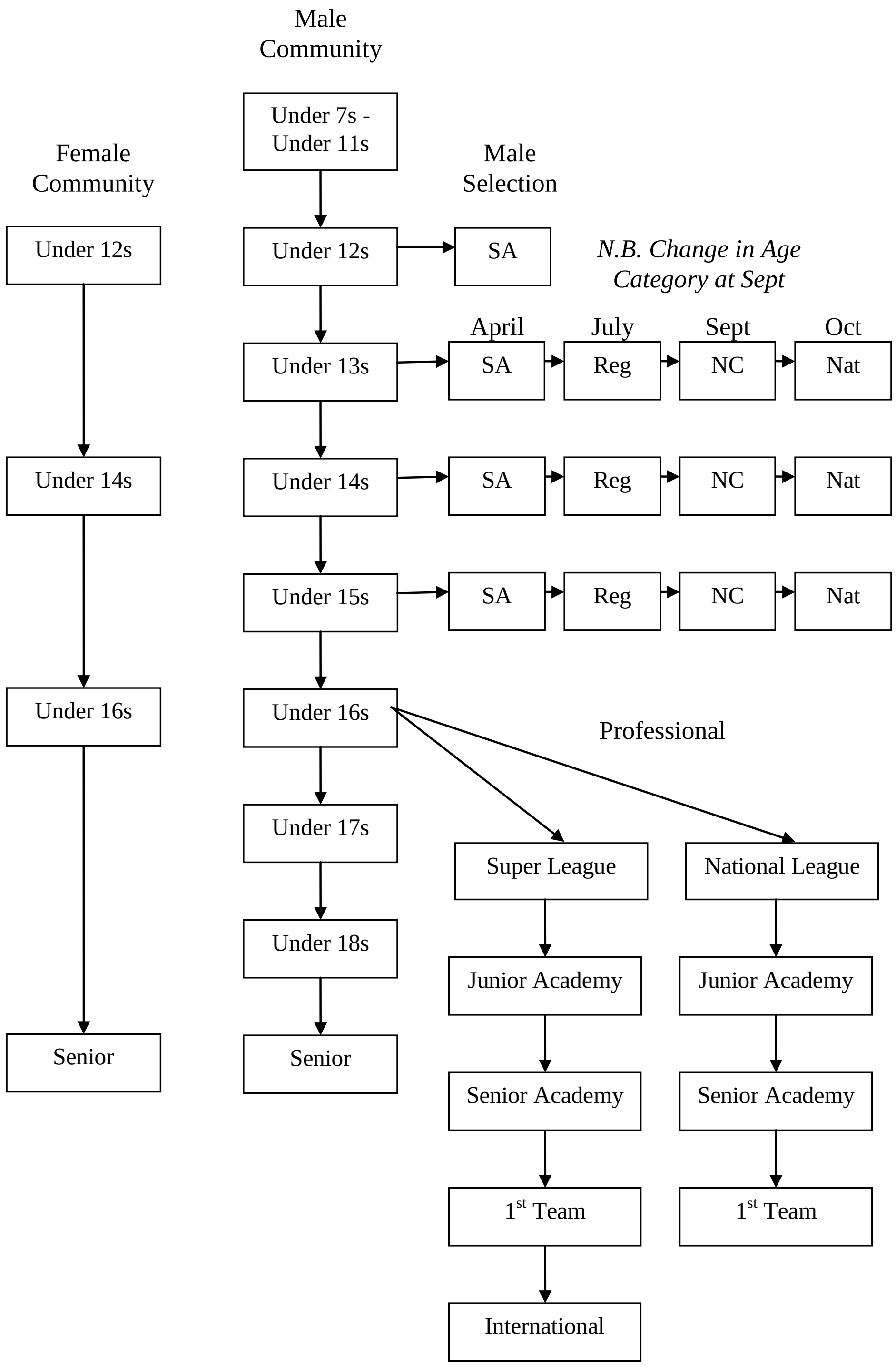
Figures Captions

*Figure 1*: An overall model describing the developmental structure in UK Rugby League.

*Figure 2*: Quartile distributions of junior rugby players in the Under 13-15 categories (combined) according to performance level.

*Figure 3*. Players retained for Regional and National levels between Under 13 and Under 15 from 2005 and 2007

Figure 1: An overall model describing the developmental structure in UK Rugby League.




SA = Service Area; Reg = Regional; NC = National Carnival; Nat = National Camp.

Figure 2: Quartile distributions of junior rugby league players in the Under 13-15 categories (combined) according to performance level.

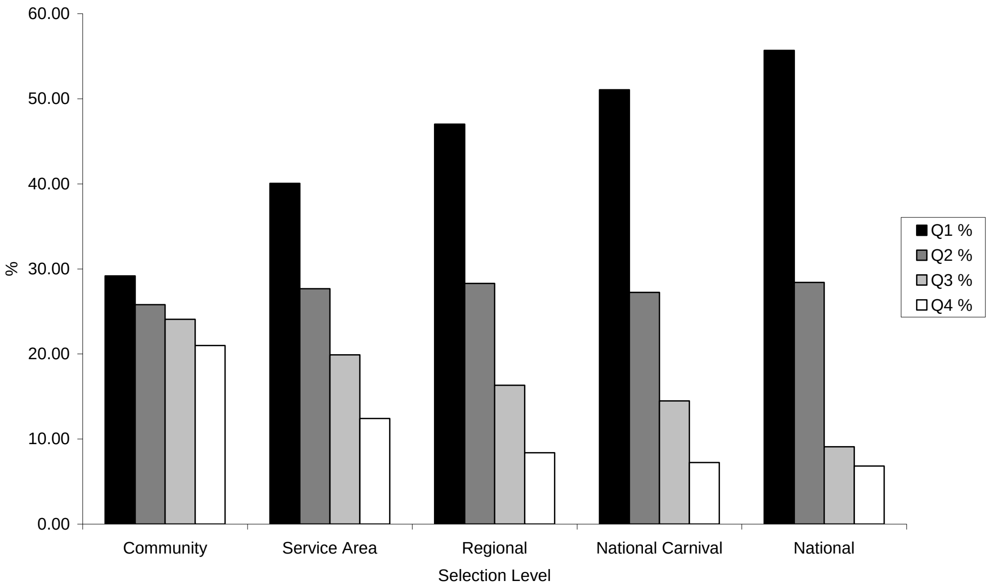


Figure 3. Players retained for Regional and National levels between Under 13 and Under 15 from 2005 and 2007