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*The influence of age-policy changes on the relative age effect across the Australian Rules football talent pathway*

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## The influence of age-policy changes on the relative age effect across the Australian Rules football talent pathway

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### ABSTRACT

**Objectives:** To identify the influence of age-policy changes on the relative age effect (RAE) across the Australian Football League (AFL) talent pathway.

**Design:** Retrospective cross-sectional analysis of junior AFL players attending the National Draft (National), State, and State Under 16s (U16) combines between 1999-2016.

**Methods:** Birth-date data was obtained for players attending the AFL State U16 (n = 663, age: 15.9 ± 0.4 years), State (n = 803, age: 19.1 ± 1.7 years), National (n = 1111, age: 18.3 ± 0.8

years) combines. Corresponding aged-matched Australian general population birth rate data was also collected.

**Results:** A chi-squared analysis comparing birth month distributions found all Combine groups differed significantly from the general population (Under 16s:  $\chi^2 = 62.61$ , State:  $\chi^2 = 38.83$ , National:  $\chi^2 = 129.13$ ,  $p < 0.001$ ). Specifically, Under 16s had greater birth frequencies for months January to March ( $\geq 2\%$ ,  $p < 0.05$ ), with more State players born in January (4.9%,  $p < 0.05$ ). Age-policy changes at the National level reduced birth distribution bias for some months, however the RAE remained for March, June and July (3.9%, 6.1%, 4.3%,  $p < 0.05$ ). State U16s and National players had 2-9% lower birth frequencies for November - December births compared general population.

**Conclusions:** Selection bias exists towards older players is present at the AFL's State U16, and is maintained at State and National level combines. Age-policy changes are only partially successful at addressing the RAE at the National level, with alternative strategies also recommended in order to address the RAE across the AFL talent pathways.

**Keywords:** talent identification, development, recruitment, selection bias, team sport, birth date distribution

## INTRODUCTION

The relative age effect (RAE) is a demographic characteristic where a bias exists towards selecting athletes born earlier in a defined age group year comparative to those born later<sup>1-3</sup>. The prevalence of the RAE has been described in several team sports (i.e., ice hockey, baseball, soccer, and basketball)<sup>2-8</sup>. A common environmental constraint in junior sport is the placement of children into annual age-grouped teams to balance competition between players of similar skill and maturity<sup>8, 9</sup>. As such, RAE usually occurs in more physically demanding sports, with up to a year of developmental variation in skill and maturity levels arising amongst players within a single age group<sup>4, 8, 10</sup>. This developmental variation between chronological age and biological maturation is considered an individual constraint amongst

players<sup>3-5, 9</sup>. The task constraints within the game, player position, and competition level in Australian football (AF) place value on skill, physical strength, speed, and aerobic capacity. As such AF is susceptible to the RAE within talent development pathways, as there is an increased pressure to identify and select talented players into highly competitive junior state and national competitions<sup>2, 9, 11-17</sup>. The consequence of the RAE is that talented late-developers may be overlooked at talent selection points, as early developers exhibit the physical and skill characteristics valued by coaches and talent scouts<sup>2, 8, 9, 11-17</sup>.

The Australian Football League (AFL) participation pathway is comprised of the local participation pathway and the talent pathway, with many elite level players progressing through the latter<sup>18, 19</sup>. The first major AFL talent selection point is the State U16, with players recruited from the local participation pathway into a representative team consisting of the most talented players from each Australian State<sup>18</sup>. Talented local level players overlooked at the State U16 level may be invited by the AFL to attend the State and National level combines, with subsequent selection into these development squads<sup>18, 19</sup>. Elite AF players are usually selected through the annual AFL National Draft, with most players nominated from National junior teams<sup>18, 20</sup>.

Specific to this investigation, a selection bias in birth distributions of National junior players drafted into the AFL has been reported, with more players born in the first half of the selection year (60% vs. 40%)<sup>2</sup>. Furthermore, 56% of State junior Under 18 (U18) AFL draftees were born in the first half of the year compared to the second half (44%)<sup>6</sup>. Contrary to this, a reverse RAE exists for mature aged AF draftees (those drafted over the age of 20), with 63% born in the first half and 37% in the second half<sup>2</sup>. The bias in birth distribution within junior talent levels of the AFL pathway may be attributed to the differences observed in biological maturation between talent selected and non-selected AF players' of similar age<sup>2, 11-17</sup>. These differences have also been observed in local level players aged between 11 and 19 years, with biological maturation having strong positive correlations with 20-m sprint time, aerobic capacity, and high-intensity game running<sup>17, 21</sup>. As such, the RAE is linked to athlete dropout rates, with players born later in the selection year having a performance disadvantage compared to older players, thus contributing to them being overlooked for representative AF squads<sup>1, 4, 16, 17, 21</sup>. However, to date no research has assessed the prevalence of the RAE in

the AFL's State U16 level, with further analysis required to determine whether RAE exists within this AFL talent pathway level.

Numerous policy changes have been suggested to eliminate or reduce the RAE in individual and team sports, with many involving the modification of age-groupings for competition <sup>6, 8, 9, 22, 23</sup>. Further policy change recommendations include; grouping players based on their biological maturity <sup>22, 24</sup>, shifting selection dates for talent and elite teams <sup>8, 9, 23</sup>, and allocating uniform numbers based on the relative age of players <sup>8</sup>. Policy modifications specifically targeting the RAE require sporting organisation's to make dramatic changes to their competition structures, with organisation seeking more simple methods to reduce the RAE <sup>8</sup>. As such, it is difficult to implement and test these policy changes within a sporting organisation's talent identification structure, leading to limited research regarding the impact of policy change on reducing the RAE <sup>8</sup>. Some studies have found changing selection dates only shifted the bias to the first month of the new selection year <sup>16, 24</sup>. However, selection bias in junior soccer was reduced when numbering players shirts according to their relative age within the team, allowing talent scouts to clearly identify early and late developing players <sup>8</sup>.

The AFL have implemented two changes (in 2003 and 2008, see Table 1) to talent selection policies between 1999 and 2016. These policy changes were specifically aimed at minimising the impact of the RAE on players transitioning through the development pathway. The policies imposed restrictions on the age in which players were invited to attend National Draft camps, and elite club's ability to select players through the AFL's National Draft. However, to date there is no empirical evidence concerning the impact these policy changes had on reducing the RAE.

While there is evidence of the RAE in AF, no studies have analysed the RAE in the modern era (past 17 years) of the AFL's National, State, and State U16 testing combines. The annual combines are physical and skill testing days for talent identification of elite (National) and sub-elite (State) junior players, as well as being the entry point into the AFL's talent pathway (U16s) <sup>14, 20, 25, 26</sup>. The point at which the RAE originates within the AFL talent pathway should be identified to allow more targeted selection interventions that address the RAE. It is unknown whether the distribution of players selected to participate from each year quartile differs between those at the National, State, and U16 combines. Furthermore, it is unclear

whether the age-policy changes regarding players invited to the AFL National Draft has affected the RAE at this level. The aim of this study was to i) determine the prevalence of the RAE across the AFL talent pathway between 1999 and 2016, and ii) analyse the influence that age-policy changes of National Draft invitees have had on the RAE at the National level.

## METHODS

This study used a retrospective cross-sectional analysis to assess the RAE and impact of the AFL's age-policy changes within the junior National, State, and State U16s Combines held between 1999 and 2016. Date of birth (DOB) data was obtained for players attending the AFL National Combine ( $n = 1111$ , age:  $18.3 \pm 0.8$  years), State Combine ( $n = 803$ , age:  $19.1 \pm 1.7$  years), and State U16 Combine ( $n = 663$ , age:  $15.9 \pm 0.4$  years). National player data was available for all years between 1999-2016, with State and State U16 player data only available between 2004-2016 and 2008-2016 respectively. Players were classified by the Combine level they attended (National, State, State U16), then further classified into birth month (1 to 12; starting with January as '1'), and quartile (Q1: January – March, Q2: April – June, Q3: July – September, Q4: October – December) categories.

The frequency of male births by month in the general population was obtained from statistics on monthly live births between 1981 and 2000 reported by the Australian Bureau of Statistics<sup>27</sup>. Birth statistics were calculated for three different periods to match (as close as possible) the birth cohorts for the three combine groups: the AFL National Combine (birth years 1981-1998), the State Combine (birth years 1985-1997), and State U16 Combine (birth years 1992-2000). Ethics approval for this research was obtained by the Victoria University Human Research Ethics Committee.

Changes in age eligibility policies that effects a players' invitation to an AFL National Draft Combine between 1999 and 2016 were accounted for within the analysis. The policy changes imposed by the AFL regarding age of eligible Draft attendees are presented in Table 1. To account for age-related policies imposed on player attendance at the Draft for a given year, three periods were identified between 1999 and 2016. Pre-2003 was considered as between 1999-2003, where players were required to turn 17 years by June 30. The second policy period

was determined as the years between 2004-2008, where player eligibility based on birth month was shifted from June to April and players were required to turn 17 years by April 30. Post-2009 was established as the years between 2009-2016, with all eligible players required to turn 18 by December 31<sup>st</sup> in the year of the draft. Within each period, National Combine players were further divided into 17 and 18-year-old sub-groups for analysis, as eligibility policies differed by birth year. For example, with the pre-2003 only those 17-year-olds born before July could be observed. Since 100% of the 17-year-olds were to fall between January-July, the general population proportions in Q1 and Q2 are normalized to sum to 100% in the pre-2003 comparison. All 17-year-olds were excluded from analysis in Post-2009 as, during these years, the acquisition of 17-year-olds became limited to trades for a select number of teams and were eliminated from 2013 on.

### **Data Analysis**

All statistical analyses and figures were conducted and produced using RStudio® statistical computing software version 1.0.136 (RStudio, Boston, Massachusetts). Differences in the Combine and age-matched general population birth month and quartile frequencies were assessed with chi-squared ( $\chi^2$ ) analyses. Comparisons were conducted separately for National (18-year-old players only), State, and State U16 groups. A p-value of  $< 0.05$  was the criteria for a significant difference in distributions (global difference). To understand the time-periods contributing to global differences, individual proportion tests were undertaken for each birth month and quartile against its general population estimate<sup>28</sup>. When global differences were found in birth distributions, these further analyses were used to interpret where and in what direction the largest differences occurred. Odds ratios (OR) were used as the effect size for the relative age effect and were calculated as the player sample odds against the Australian general population odds for each AFL player level.

For the National Combine group, further chi-squared analysis was conducted to account for the varying eligibility rules for 17 and 18-year-olds (Table 1). In these analyses, separate groups were created for 17 and 18-year-olds for Pre-2003 (18y:  $n = 211$ , 17y:  $n = 104$ ), 2004-2008 (18y:  $n = 195$ , 17y:  $n = 58$ ) and Post-2009 (18y:  $n = 435$ , 17y:  $n = 46$ ) based on the associated age-policy changes for 17 and 18-year-olds in the National Combine sub-group.

For the Pre-2003 and 2004-2008 periods, 17 and 18-year-olds in the National Combine sub-group were separated. The birth month of this sub-group was contrasted against the general population, adjusting for any non-eligible months in the 17-year-old group (Pre-2003: July – December; 2004-2008: May – December). Strict cut-off dates with respect to birth month only affected 17-year-olds, as such global redefinition of the month/quartile categories was not undertaken for all birth-year groups. Instead, the general population birth month proportions were adjusted to reflect the truncation due to eligibility rules for all comparisons against the 17-year-old birth-year group. The 18-year-old players were compared against all months in the general population, with no age restrictions placed on this group. This allowed for normalising of the year proportions for the 17-year-olds for all years prior to 2008.

In addition to assessing the players separately by birth-year group, a combined analysis was also performed with the 17 and 18-year-olds for the National players. In these analyses, the combined proportion of players in a given birth month (quartile) and rule period were compared against an adjusted general population comparison, which was equal to the weighted average of the general population comparisons used in the birth-year specific comparisons, with weight equal to the proportion of each birth-year of the player sample and period. A Chi-squared test was performed to determine the overall agreement between the combined player birth month (quartile) distributions against the general population for each period.

## RESULTS

### Under 16s

The birth month distribution for the Under 16s player group differed significantly from the distribution in the age-matched general population ( $\chi^2 = 62.61$ ,  $p < 0.001$ , Figure 1). The month-by-month comparisons of State U16s birth distributions showed higher representation in the first months of the year and a lower representation in the later months of the when compared with the general population. Also, more players (>2%) were born in January ( $n = 81$ , OR: 1.53), February ( $n = 67$ , OR: 1.32) and March ( $n = 75$ , OR: 1.33) compared to those born in the general population (Figure 1). Similarly, the months of November ( $n = 32$ ,

OR: 0.59) and December ( $n = 19$ , OR: 0.34) had birth month frequencies 3% or less ( $p < 0.05$ ) than the general population (Figure 1).

Year-quartile distributions differed significantly between the Under 16s and the age-matched general population (Figure 1;  $\chi^2 = 50.80$ ,  $p < 0.001$ ). Higher frequencies in birth rates were observed for Q1 (8.7%,  $n = 223$ , OR: 1.53,  $p < 0.05$ ) and Q2 (3.6%,  $n = 189$ , OR: 1.20,  $p < 0.05$ ) (see Figure 1). Furthermore, the frequencies were less (-9.8%,  $n = 98$ , OR: 0.53,  $p < 0.05$ ) for Q4 than the age-matched general population (Figure 1). There were only trivial differences in birth month distributions for Q3 between the U16s and general populations. Between quartile comparison found differences between all quartiles, the largest observed difference being between Q1 and Q4 (OR: 2.92). However slight decreases in birth distribution occurred between each quartile (Q1vQ2 OR: 1.26, Q1vQ3 OR: 1.72, Q2vQ3 OR: 1.37, Q2vQ4 OR: 2.31, Q3vQ4 OR: 1.69).

### State

Like the Under 16s there were substantially different patterns of birth month distributions for State Combine players compared with the general population both by month ( $\chi^2 = 38.83$ ,  $p < 0.001$ , Figure 1) and quartile (State,  $\chi^2 = 22.47$ ,  $p < 0.001$ , Figure 1). The main differences between the State players and general population were found in January (4.9%,  $n = 106$ , OR: 1.69,  $p < 0.05$ ) and November (-2.4%,  $n = 44$ , OR: 0.67,  $p < 0.05$ ), with no substantial differences in frequency observed for any other month (see Figure 1). The State level demonstrated similar patterns as the Under 16s group for Q1; with more births in Q1 (7.2%,  $n = 257$ , OR: 1.43,  $p < 0.05$ ) than the age-matched general population (Figure 1). However, the distributions for State level was less consistent across Q2-Q4 (Q2:  $n = 181$ , Q3:  $n = 189$ , Q4:  $n = 176$ ), with only trivial differences observed between player birth distributions and the age-matched general population. Comparison between State player birth quartiles found Q1 with substantially more players compared to Q2, Q3 and Q4 (Q1vQ2 OR: 1.58, Q1v Q3 OR: 1.49, Q1v Q4 OR: 1.67). Quartiles Q2-Q4 were all similar in distribution (OR: 0.95-1.12).

### National

The distribution of birth month for 18-year-old National Combine players between 1999 and 2016 was substantially different to the general population both by month ( $\chi^2 = 129.13$ ,  $p <$

0.001) and quartile ( $\chi^2 = 98.01$ ,  $p < 0.001$ ) (see Figure 1). Furthermore, more players were born in March (2.1%,  $n = 91$ , OR: 1.26), June (3.0%,  $n = 94$ , OR: 1.40), and July (2.2%,  $n = 90$ , OR: 1.29), but less in November and December (-6.8% each, November:  $n = 9$ , OR: 0.13, December:  $n = 11$ , OR: 0.15,  $p < 0.05$ ) than the general population (Figure 1). Every quartile for the National group was substantially different to the age matched general population. Specifically, quartiles 1, 2 and 3 all had more players born (Q1: 5.5%,  $n = 255$ , OR: 1.32, Q2: 4.4%,  $n = 247$ , OR: 1.25 and Q3: 4.8%,  $n = 255$ , OR: 1.27,  $p < 0.05$ , Figure 1) than the general population, with quartile 4 having substantially less National players (-14.7%,  $n = 83$ , OR: 1.34,  $p < 0.05$ ) born. Comparing between National player birth quartiles, Q1vQ2 (OR: 1.05), Q1vQ3 (OR: 1.00), and Q2vQ3 (OR: 0.95), were all similar. However, Q4 had substantially less player than Q1, Q2 and Q3 (Q1vQ4 OR: 3.86, Q2v Q4 OR: 3.68, Q3v Q4 OR: 3.86).

#### **Age-Combined National 17 and 18-year-olds**

A significant difference between the birth month observed and expected 17 and 18-year-old proportions and the Australian general population for each and age-policy period (Pre-2003:  $\chi^2 = 27.10$ , 2004-2008:  $\chi^2 = 48.23$ , Post-2009:  $\chi^2 = 69.95$ ,  $p < 0.05$ ). Similar differences were also found for observed and expected birth quartiles (Pre-2003:  $\chi^2 = 14.53$ , 2004-2008:  $\chi^2 = 29.31$ , Post-2009:  $\chi^2 = 54.61$ ,  $p < 0.05$ ). The greatest monthly difference between observed and expected 17 and 18-year-old proportions and the general population for Pre-2003 was in January (2.7%), March (2.1%), November (-4.3%) and December (-4.1%). The greatest monthly differences for 2004-2008 were found in June (4.7%), February (3.6%), July (3.3%), November (-5.4%) and December (-6.3%). Post-2009 was similar with the largest differences observed for January (3.9%), November (-6.7%) and December (-6.5%), when compared to the general population.

Quartile comparisons for each age-policy period also had significant differences between the birth month observed and expected 17 and 18-year-old proportions and the Australian general population (Pre-2003:  $\chi^2 = 14.53$ , 2004-2008:  $\chi^2 = 29.31$ , Post-2009:  $\chi^2 = 54.61$ ,  $p < 0.05$ ). For Pre-2003, the largest difference between observed and expected pooled 17 and 18-year-old players and the general population was found in Q1 (4.8%) and Q4 (-8.0%). Between 2004-2008 the greatest observed difference was noted for Q1 (4.9%), Q3 (5.6%), and Q4

(13.1%), and for Post-2009 being Q1 (8.0%) and Q4 (-14.9%) when compared to the general population.

### **Influence of policy changes**

The National combine players birth rate distribution was partially impacted by the age-policy changes imposed by the AFL, as differences in birth distribution were not isolated to the first half of the selection year after the policies were modified. However, within the 18-year-old sub-group (Pre-2003, 2004-2008, and Post-2009), substantial differences remained in age-matched birth month distributions across all three policy periods (Pre-2003:  $\chi^2 = 29.74$ , 2004-2008:  $\chi^2 = 46.18$ , Post-2009:  $\chi^2 = 70.28$ , Figure 2). Specifically, when compared to the general population, significantly more 18-year-old players were observed to be born in June (6.1%,  $n = 28$ ) and July (4.3%,  $n = 25$ ) during the 2004-2008 age-policy restriction, and in March (3.9%,  $n = 55$ ,  $p < 0.05$ ) of the Post-2009 age restrictions. No other differences in birth distribution between the National 18-year-olds and general population were observed. Furthermore, age-policy changes did not affect player birth distributions for November (Pre-2003: -6.5%,  $n = 3$ , 2004-2008: -6.9%,  $n = 2$ , and Post-2009: -6.7%,  $n = 5$ ,  $p < 0.05$ ) or December (Pre-2003: -6.2%,  $n = 4$ , 2004-2008: -8.1%,  $n = 0$ , and Post-2009: -6.5%,  $n = 7$ ,  $p < 0.05$ ), with significantly less players born in these months compared to the general population.

The AFL imposed age-policy changes did not affect birth month distribution for the 17-year-old National players as several months found significant differences between players and the general population. Birth month distributions for the 17-year-old National players found no substantial differences between birth frequencies and the general population for either policy period (Pre-2003:  $\chi^2 = 6.53$ , 2004-2008:  $\chi^2 = 4.17$ , Figure 2). Similarly, no difference was observed for individual month distribution Pre-2003 or 2004-2008 for the 17-year-old group.

### **DISCUSSION**

The aim of this study was to identify the origins of the RAE, and effect of age-policy interventions on birth month distributions of AFL players selected to attend the National,

State and State U16 combines between 1999 and 2016. This study compared player birth month representation with what would be expected in the absence of the RAE. Testing this required comparison of the birth month distribution against the age-matched Australian general population for each given year. For all three levels of the AFL talent pathway, substantially more players were born earlier in the year than the accompanying age-matched Australian birth rates. Despite policy changes implemented by the AFL that modified the age of players invited to participate in the AFL National Draft Combine, the RAE was also evident in both the State and State U16s levels prior to reaching National level. It should also be noted that age-policy changes did not influence birth distribution at the National level. These findings have implications for the selection of players into the AFL talent pathway as those born earlier in the selection year are more likely to be chosen than those born later in the selection year. Furthermore, age-policy changes may not have an effect on birth distribution at the National level as the RAE is occurring earlier in the AFL talent pathway.

The birth rate distribution favouring earlier months in the year was observed at the State U16 combine levels. As the State U16 combine is considered one of the first talent selection points of the AFL talent pathway, it is evident that RAE effect is occurring for players aged 15 and 16 years. Like other sports and age brackets, AFL players born earlier in the year are more likely to be selected into a State U16 competition<sup>3, 16, 29</sup>. This phenomenon is partially explained by variability in biological maturity of players creating differences in anthropometric measures, running fitness, and match running performance in AF players aged 14-16 years<sup>21</sup>. Furthermore, late maturing AF players under 19 years are at a physical disadvantage when compared with their early maturing counterparts<sup>17, 21</sup>. Similarly, longitudinal evaluations of anthropometric and physical characteristics of adolescent rugby league players indicated early maturing players were larger and exhibited superior physical performances than late maturing players<sup>29</sup>. A similar scenario in junior AFL may explain the occurrence of RAEs within the State U16s competition, as early maturing athletes are more likely to be selected into the AFL's talent pathway.

The RAE was also observed in the State and National level combines, with birth rate of players in these levels favouring the first quartile of the year. However, when comparing by month, the State level players exhibited a more balanced birth rate distribution than the National and State U16 players, with only January showing a higher birth rate for this level. This difference

may be caused by the variability in the age range for players attending the State combine, as older players are able to participate. One study reported that the RAE was reversed in mature age ( $\geq 20$  years) AFL draftees<sup>2</sup>. Players attending the State combine in this study were approximately 1 year older than those invited to the National combine, therefore the RAE in this level of testing may be confounded by the variable nature of the mature players' attendance.

The age-policy changes imposed by the AFL did influence the birth distribution of the National level players, as substantial differences in birth distribution was not isolated to the first half of the selection year after the policies were modified. However, March, June and July were observed to have a higher player birth rate, with November and December still exhibiting lower birth rates when compared with the general population. This bias was evident when 17 and 18-year-old National players were combined, and when only 18-year-old were grouped for comparison with the expected Australian general population. Delaying player selection has been emphasised as a method of targeting the RAE in team sports such as soccer, rugby, basketball, volleyball and cricket<sup>1, 6, 29</sup>. Previous work also found that allocating jumper number according to a players age relative to their team has successfully removed the RAE in junior soccer talent selection<sup>8</sup>. Though the policy changes outlined in this study can only be considered partially successful as birth distribution bias was still evident in several months. Furthermore, the RAE was already present at the State U16s level, which may restrict a late-developing player's access to higher-level coaching and athlete development programs, creating a further talent gap between players<sup>1, 7, 30</sup>. It has also been found that place of birth in conjunction with birth quartile can effect an athletes chance of being selected into a talent development pathway<sup>7</sup>. Unfortunately, the birth location of players in this study was not analysed and may be a limitation. The outcomes in this study demonstrated that whilst policy changes partially addressed the bias in birth distribution at the National level only, the RAE was still evident within the younger talent levels. As such, imposing age-policy restrictions in combination with uniform changes that clearly identify player ages at the local and state competitions, may allow for fewer players to be overlooked for selection into the AFL's talent pathways because of the time of year in which they were born.

## CONCLUSION

This study determined that birth distribution bias exists for AFL players attending the State U16, State and National Combines across a substantial time period (1999 and 2016). Furthermore, it examined the effect of AFL imposed age-policy changes that specifically address the RAE at the National level. A bias in birth distribution towards the first quartile of the year at the State U16, State and National levels was evident in the AFL talent pathway, with players born earlier in the year more likely to be invited to participate at the annual AFL combines. Changes to age-policy were only partially successful within the National 18-year-old sub-group, as RAE bias was no longer evident in the first half of the selection year. However, the RAE was still observed post-policy change, with more players born in the months of June and July, and no change to number of players born in November and December. The selection bias of players born earlier in the year at State U16s level may have a flow on effect into the higher levels of the talent pathway. Therefore, policy changes regarding age selection rules of players attending the National Draft Combine may not affect the RAE prevalence, as the phenomenon was observed to occur at the State U16s, State and the 17-year-old National sub-group levels. The AFL talent pathway should incorporate selection opportunities for players born later in a given selection year, which balances out the RAE's occurring at the junior level.

## PRACTICAL APPLICATIONS

- Recruiters considering talented AFL players across the AFL talent pathway should consider age selection bias when analysing players from junior levels.
- The AFL talent pathway may benefit from creating multiple talent identification points that specifically target players who may have been overlooked due to the month they were born.
- Alternative strategies regarding the relative age of players being selected into AFL talent pathways should be explored to further reduce the prevalence of the RAE in the sport.

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ACCEPTED MANUSCRIPT

## REFERENCES

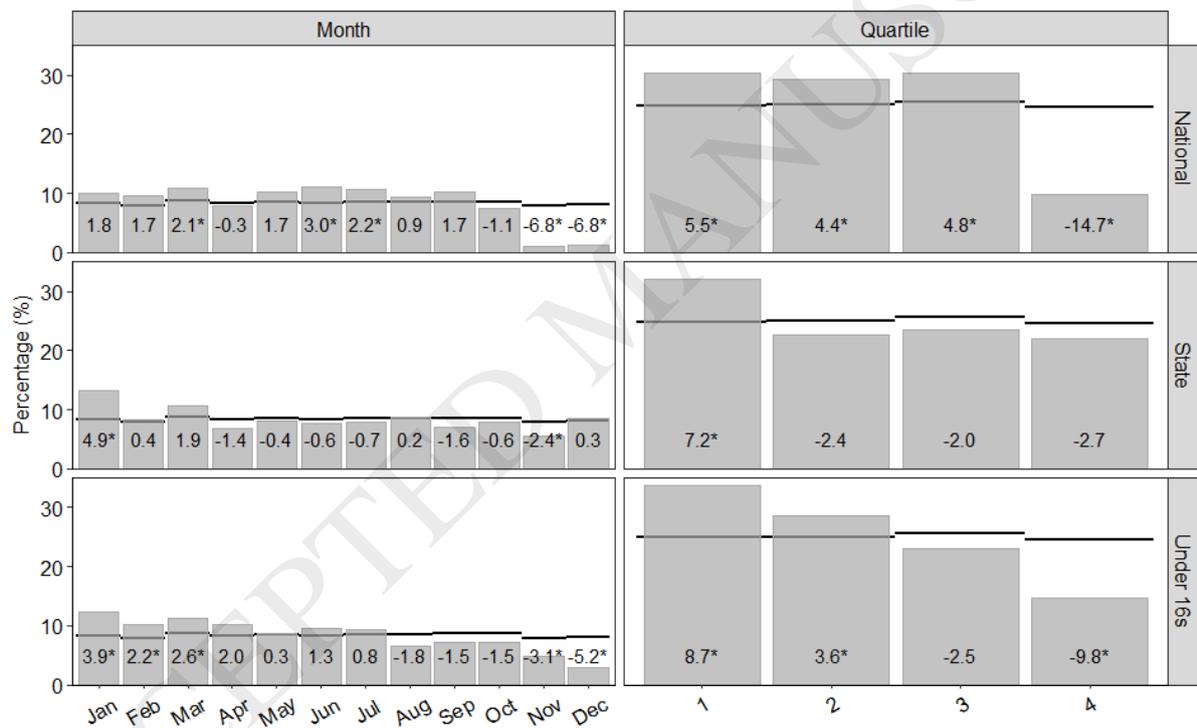
1. Andronikos G, Elumaro AI, Westbury T, et al. Relative age effect: implications for effective practice. *J Sports Sci.* 2016; 34(12):1124-1131.
2. Coutts AJ, Kempton T, Vaeyens R. Relative age effects in Australian Football League National Draftees. *J Sports Sci.* 2014; 32(7):623-628.
3. Simmons C, Paull GC. Season-of-birth bias in association football. *J Sports Sci.* 2001; 19(9):677-686.
4. Coblely S, Baker J, Wattie N, et al. Annual age-grouping and athlete development. *Sports Med.* 2009; 39(3):235-256.
5. Van den Honert R. Evidence of the relative age effect in football in Australia. *J Sports Sci.* 2012; 30(13):1365-1374.
6. Woods CT, Robertson SJ, Gustin PB. Does relative age distribution influence the physical and anthropometric profiles of drafted under 18 Australian footballers? An investigation between the 2010 and 2013 seasons. *Talent Dev Excellence.* 2015; 7(1):83-90.
7. Finnegan L, Richardson D, Littlewood M, et al. The influence of date and place of birth on youth player selection to a National Football Association elite development programme. *Sci Med Football.* 2017; 1(1):30-39.
8. Mann DL, van Ginneken PJMA. Age-ordered shirt numbering reduces the selection bias associated with the relative age effect. *J Sports Sci.* 2017; 35(8):784-790.
9. Wattie N, Schorer J, Baker J. The relative age effect in sport: A developmental systems model. *Sports Med.* 2015; 45(1):83-94.
10. Baxter-Jones AD. Growth and development of young athletes. *Sports Med.* 1995; 20(2):59-64.
11. Keogh J. The use of physical fitness scores and anthropometric data to predict selection in an elite under 18 Australian rules football team. *J Sci Med Sport.* 1999; 2(2):125-133.
12. Veale JP, Pearce AJ, Buttifant D, et al. Anthropometric profiling of elite junior and senior Australian football players. *Int J Sports Physiol Perform.* 2010; 5(4):509-520.
13. Veale JP, Pearce AJ, Koehn S, et al. Performance and anthropometric characteristics of prospective elite junior Australian footballers: A case study in one junior team. *J Sci Med Sport.* 2008; 11(2):227-230.
14. Woods CTE, Raynor AJ, Bruce L, et al. Predicting playing status in junior Australian Football using physical and anthropometric parameters. *J Sci Med Sport.* 2015; 18(2):225-229.
15. Young WB, Pryor L. Relationship between pre-season anthropometric and fitness measures and indicators of playing performance in elite junior Australian Rules football. *J Sci Med Sport.* 2007; 10(2):110-118.

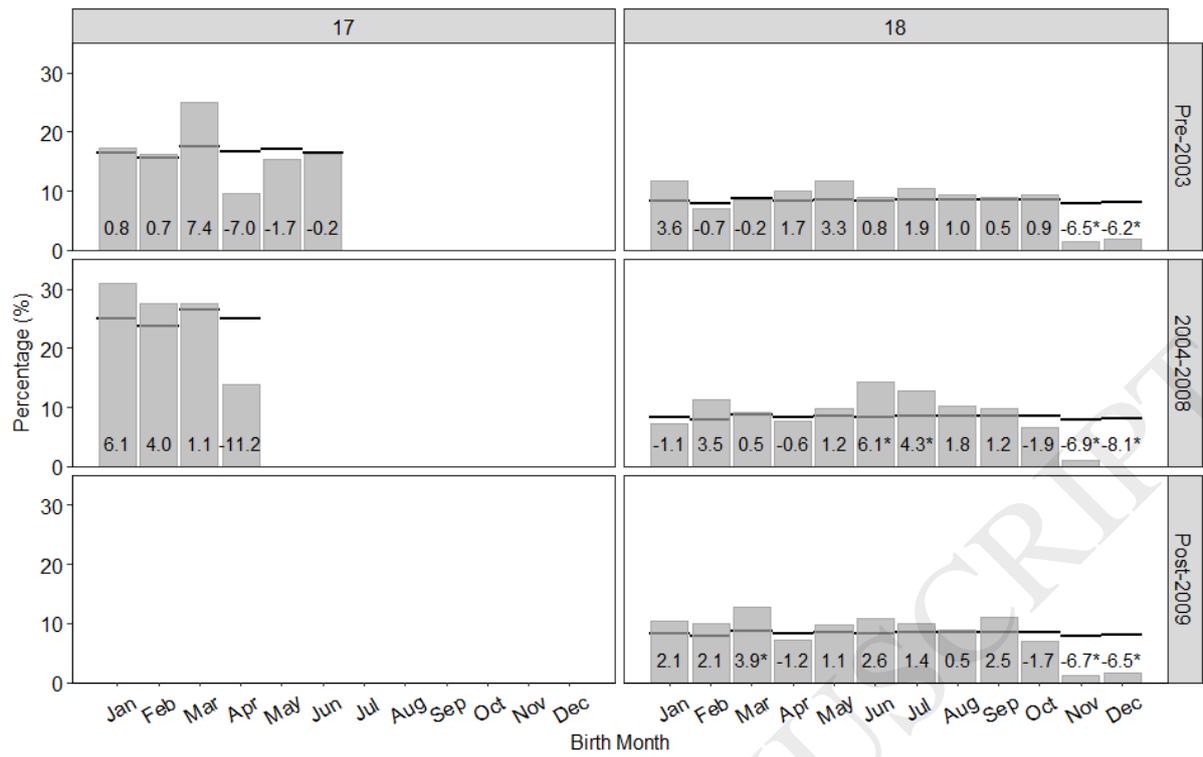
16. Till K, Cogley S, Wattie N, O'Hara J, et al. The prevalence, influential factors and mechanisms of relative age effects in UK Rugby League. *Scand J Med Sci Sports*. 2010; 20(2):320-329.
17. Gastin PB, Bennett G, Cook J. Biological maturity influences running performance in junior Australian football. *J Sci Med Sport*. 2013; 16(2):140-145.
18. Haycraft JAZ, Kovalchik S, Pyne DB, et al. Physical characteristics of players within the Australian Football League participation pathways: a systematic review. *Sports Medicine Open*. 2017; 3(1):46.
19. AFL Development Pathway. Participation and talent pathways. Available at: <http://www.aflcommunityclub.com.au/index.php?id=26>. Accessed 10 May 2016.
20. Pyne DB, Gardner AS, Sheehan K, et al. Fitness testing and career progression in AFL football. *J Sci Med Sport*. 2005; 8(3):321-332.
21. Gastin PB, Bennett G. Late maturers at a performance disadvantage to their more mature peers in junior Australian football. *J Sports Sci*. 2014; 32(6):563-571.
22. Musch J, Grondin S. Unequal competition as an impediment to personal development: A review of the relative age effect in sport. *Dev Rev*. 2001; 21(2):147-167.
23. Hurley W. Equitable birthdate categorization systems for organized minor sports competition. *Euro J Oper Res*. 2009; 192(1):253-264.
24. Musch J, Hay R. The relative age effect in soccer: Cross-cultural evidence for a systematic discrimination against children born late in the competition year. *Sociol Sport J*. 1999; 16(1):54-64.
25. Woods CT, Cripps A, Hopper L, et al. A comparison of the physical and anthropometric qualities explanatory of talent in the elite junior Australian football development pathway. *J Sci Med Sport*. 2016.
26. Woods TEC, Raynor JA, Bruce L, et al. The use of skill tests to predict status in junior Australian football. *J Sports Sci*. 2015; 33(11):1132-1140.
27. Australian Bureau of Statistics. Births, by year and month of occurrence, by state. Available at: [http://stat.data.abs.gov.au/Index.aspx?DataSetCode=BIRTHS\\_MONTH\\_OCCURRENCE](http://stat.data.abs.gov.au/Index.aspx?DataSetCode=BIRTHS_MONTH_OCCURRENCE). Accessed 30 May 2017.
28. Newcombe RG. Two-sided confidence intervals for the single proportion: comparison of seven methods. *Stat Med*. 1998; 17(8):857-872.
29. Till K, Cogley S, O'Hara J, et al. Considering maturation status and relative age in the longitudinal evaluation of junior rugby league players. *Scand J Med Sci Sports*. 2014; 24(3):569-576.
30. Ford PR, Williams MA. No relative age effect in the birth dates of award-winning athletes in male professional team sports. *Res Q Exerc Sport*. 2011; 82(3):570-573.

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**Figure 1.** Birth month and quartile distribution of AF players attending the National, State, and State U16 combine tests between 1999 and 2016 compared with the Australian general population birth distribution (black line). Differences in percentage between players born per month and the Australian population is noted within the bars. \*  $P < 0.05$ .

**Figure 2.** Effect of the implementation of age-policy changes between 1999 and 2016 on birth month distribution of 17 and 18-year-olds attending the AFL National Draft Combine. Monthly player birth rates are compared with the Australian general population (black line), with the percentage differences noted within the bars. \*  $P < 0.05$ .





**Table 1.** AFL National Draft Combine birth month codes based on player invitee age rules and policy changes between 1999 to 2016.

**Table 1.** AFL National Draft Combine birth month codes based on player invitee age rules and rule changes between 1999 and 2016.

<b>Draft Years</b>	<b>Analysis sub-section</b>	<b>Draft Selection Rule</b>
1999-2003	Pre-2003	Players required to turn 17 years by June 30
2004-2008	2004-2008	Players required to turn 17 years by April 30
2009	Post-2009	New AFL team introduced (Gold Coast Suns, GC)– able to select 12 players turning 17 years by 1 <sup>st</sup> January. All other players required to turn 18 years in draft year
2010	Post-2009	New AFL team introduced (Greater Western Sydney, GWS) – able to select 12 players turning 17 years by 1 <sup>st</sup> January. All other players required to turn 18 years in draft year
2011	Post-2009	GC trade rights to 2 players aged 17 years by 1 <sup>st</sup> January. All other players required to turn 18 years in draft year.
2012	Post-2009	GWS trade rights to 2 players aged 17 years by 1 <sup>st</sup> January. All other players required to turn 18 years in draft year.
2013- Current	Post-2009	All players turn 18 years in draft year