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Selection into youth cricket academies: The influence of relative age and maturity status

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ABSTRACT

The aim of the study was to examine the birth quartile and maturity status distributions of male academy cricketers. Participants included 213 junior cricket players, aged between 9 and 18 years. Players were separated into birth quartiles and also grouped as early, average or late maturers. For the whole cohort, there was a medium effect bias towards players born in BQ1, but the number of early, average and late maturers was as expected. However, there were significantly more early maturers in the U10 and U11 groups than expected, and maturity distributions of the BQ groups showed that there was a small effect size bias towards early maturers in BQ4. Selection biases towards cricketers who are born earlier in the competitive year are consistent from U9 to U16, but more prevalent in the U12 and U14 age groups. There is a bias towards early maturers at U10 and U11, but this reduces as age increases. Practitioners working in academy pathways should be encouraged to assess the maturity status of players to assist in the retention and progression of players. Relative age effects should also be considered, and strategies may be required to identify players born later in the year.

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Boys; peak-height-velocity; maturation; birth-quartile

Introduction

Pathways towards expertise in cricket are designed by organisations to prepare young players for professional competition (English et al., 2018). However, an increasing amount of research suggests that selection into talent development programmes is not objectively clear and often relies heavily on key stakeholders' (e.g., administrators, coaches, practitioners, scouts and selectors) perceptions of an athlete's potential (Lascu et al., 2020). Many developmental programmes in cricket have established systems that encourage earlier age-specialisation (Brown et al., 2022). For instance, selection into First-Class County cricket talent pathways in England and Wales often takes place as young as aged 9 years (ECB, 2018); however, this approach has been widely associated with significant pitfalls. Specifically, questions remain over the lack of evidence to accurately predict future performance capabilities in adulthood based on early selection and performance (Till & Baker, 2020). This can lead to biases during recruitment into these talent pathways (e.g., relative age effects and maturity-related biases; Baker et al., 2019) and possibly fostering negative outcomes from specialised environments (e.g., overuse injury and overtraining; Bergeron et al., 2015).

Relative age effects (RAEs) show that when athletes are banded according to (bi)annual-age groups, those who are born near the beginning of the cut-off date are often overrepresented compared to those who are born towards the end of the cut-off date. This has been highlighted predominantly in soccer (Carling et al., 2008; Doyle & Bottomley, 2018; Figueiredo et al., 2019; Kelly et al., 2020) but also in rugby (Kelly et al., 2021), basketball (Ibáñez et al., 2018), ice hockey (Hancock, 2021; Hancock, Ste-Marie, et al., 2013; Nykodým et al., 2020) and cricket (Jones et al., 2018). Despite youth cricketers being vulnerable to RAEs, research specifically in cricket has mainly focused on adult populations (Jones et al., 2018; Low et al., 2015). As an example, Low et al. (2015) used the career batting averages of England and Wales senior county players to create samples of high-performing and low-performing batters. The data indicated that "high-performers" were 1.6 times more likely to be born in birth quarter one (BQ1) compared to BQ4, whereas there was no significant difference in the BQ distribution for the low performers.

Possible explanations that have been offered for RAEs include the enhanced physiological and psychosocial skills of relatively older athletes, which often allows them to outperform their relatively young but age-matched peers (Cobley et al., 2009; Cumming et al., 2018). However, recent research has suggested that physical differences between birth quartiles are non-existent, and there is limited correlation between physical performance and relative age in youth soccer players (Parr et al., 2020; Radnor, Staines, et al., 2021). Conversely, there is often a strong correlation between maturation and physical performance (Parr et al., 2020; Radnor, Staines, et al., 2021), and many sports are dominated by early maturers (Hill et al., 2019; Myburgh et al., 2016; Till et al., 2014). It is important to

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recognise that RAEs and maturity-related biases are two different constructs that work independently (Towlson et al., 2021). Within annual age group structures, for instance, relative age can cause an inter-individual difference of up to 1 year, whereas a maturation variation can be up to 5 years (Malina et al., 2015). Moreover, the impact of maturity-related biases has been estimated as being ten times more influential on selection into talent pathways compared to RAEs (Johnson et al., 2017).

Selection biases towards early-maturing young athletes in sport have become increasingly documented (Kelly & Williams, 2020). As an example, research into academy football has shown how players are chosen largely based on an earlier maturity status, which emerges at U12 and exacerbates at U15 and U16 whereby no late maturing players were selected (Hill et al., 2019). In general, due to natural increases in muscle mass and strength that coincide with maturation (Malina et al., 2004), underpinned by structural and neural changes (Dotan et al., 2012; Radnor, Oliver, et al., 2021; Tumkur Anil Kumar et al., 2021), early maturers are often physically superior to their less mature counterparts (Wattie et al., 2008), resulting in the selection biases. Despite its widespread popularity, maturity-related biases in cricket talent pathways are yet to be explored, regardless of the fact that physical ability is correlated with cricket performance in senior cricket players, especially bowling performance (Vickery et al., 2018). Notably, Pyne et al. (2006) showed that greater peak bowling velocity (i.e., the speed in which a bowler delivers the ball) in youth cricketers was positively associated with higher scores in the static jump and bench throw tests, as well as greater body mass and percentage muscle mass.

Since talent development systems are designed to identify and develop those who have the potential to achieve expertise at adulthood rather than outperform peers at age group levels, it is worthwhile exploring maturity-related biases in youth cricket to better understand current selection and development procedures. However, the birthdate distribution and maturity status of first-class county academies in cricket are yet to be examined. Thus, the purpose of this study was to investigate the birth quartile and maturity timing distributions in academy cricket players from U9 to U16. In accordance with previous research, it was hypothesised that there would be more early maturers in comparison to late maturers and that the majority of players would be from birth quartile one.

Methods

Participants

Participants included 213 male junior cricket players from two professional county cricket academies in the UK. Descriptive statistics for all anthropometric variables for each age group are presented in Table 1.

None of the players reported injuries at the time of testing, and all participated regularly in cricket training sessions without formal strength and conditioning activities. Parental consent and participant assent were collected for all elements of the study, in addition to a standardised health questionnaire. Ethical approval was granted by the University Research Ethics Committee for all elements of the study (Sta-1346).

A sample of 598 age-matched school boys were used as reference data to compare the timing of maturity, to account for the bias towards chronological age in the Mirwald et al. (2002) equation. These age groups were clustered as shown in Table 2 to produce reference data for age at PHV.

Procedures

Anthropometrics

All participants were measured for chronological age (years), standing height (cm), sitting height (cm), leg length (cm) and body mass (kg). Using these measures, age at peak height velocity (APHV [years]) and maturity offset (years) were calculated (Mirwald et al., 2002). Standing and sitting height were measured using the nearest 0.1 cm with the use of a stadiometer (SECA, 321, Vogel & Halke, Hamburg, Germany). Participants sat on a 50 cm box with feet elevated off the

Table 1. Descriptive statistics for individual age groups.

	Age (years)	Age at PHV (years)	Maturity Offset (years)	Z-Score	Height (cm)	Weight (kg)
U9	9.64 ± 0.32	12.95 ± 0.33	−3.31 ± 0.23	−0.97 ± 0.83	138.5 ± 4.9	33.9 ± 3.4
U10	10.56 ± 0.28	13.14 ± 0.42	−2.58 ± 0.49	−0.49 ± 1.05	144.7 ± 5.9	40.1 ± 7.6
U11	11.53 ± 0.31	13.47 ± 0.55	−1.94 ± 0.58	−0.85 ± 1.07	150.7 ± 8.8	44.0 ± 9.2
U12	12.32 ± 0.28	13.92 ± 0.48	−1.61 ± 0.56	0.02 ± 0.93	152.1 ± 6.9	43.6 ± 9.5
U13	13.60 ± 0.30	14.36 ± 0.64	−0.76 ± 0.70	0.21 ± 0.92	163.5 ± 9.5	57.6 ± 8.7
U14	14.31 ± 0.31	14.47 ± 0.59	−0.16 ± 0.65	0.37 ± 0.85	168.6 ± 8.2	62.6 ± 9.2
U15	15.55 ± 0.30	14.57 ± 0.60	0.98 ± 0.70	0.51 ± 0.86	175.1 ± 6.3	71.3 ± 6.5
U16	16.51 ± 0.36	14.66 ± 1.01	1.85 ± 1.08	0.48 ± 1.43	178.9 ± 8.0	73.3 ± 8.4

PHV: peak-height-velocity; Z-score indicates difference between average age at PHV for cricket players versus general population. Minus number indicates earlier maturity.

Table 2. Descriptive statistics for reference sample of school-aged boys.

Age Group	Age (years)	APHV (years)	Height (cm)	Body mass (kg)
9–10	9.84 ± 0.61	13.34 ± 0.40	140.4 ± 5.3	34.6 ± 6.6
11–12	12.07 ± 0.55	13.91 ± 0.52	150.6 ± 8.5	44.5 ± 10.2
13–15	14.33 ± 0.82	14.21 ± 0.70	165.4 ± 10.0	58.0 ± 13.9
16–17	17.05 ± 0.62	14.32 ± 0.71	177.8 ± 8.0	72.2 ± 12.8

APHV: age at peak-height-velocity.

ground when being measured for sitting height. Leg length was determined by subtracting sitting height from standing height. Body mass was measured to the nearest 0.1 kg on an electronic scale (SECA, 321, Vogel & Halke, Hamburg, Germany).

Birthdate distribution

As the school year and academy cut-off dates in the UK are organised using 1 September until 31 August, the 12 months of the year were divided into four birth quartiles (BQs), conforming to the strategy used to examine RAEs in other UK-populated studies (e.g., Cumming et al., 2018; Kelly et al., 2020; Parr et al., 2020). September, October and November were classified as "BQ1", December, Januaryand February classified as "BQ2", March, April and May classified as "BQ3" and June, July and August as "BQ4". Each player was assigned a BQ based on their birthdate within the selection year.

Maturity distribution

Maturity offset, the time before or after PHV, was predicted for each player with sex-specific equations (Mirwald et al., 2002). The equations included interaction terms for leg length and sitting height, chronological age and leg length, chronological age and sitting height and the weight-by-height ratio. Subtracting chronological age from maturity offsets provided a predicted APHV, and this was used to determine each player as early, average or late maturing, relative to the APHV of the general population. Z-scores were created using the mean and standard deviation of APHV for the chronological age groups from the general population data (see Table 2), and players with a z-score <1.00 were classified as early maturing, −0.99–0.99 as average and >1.00 as late maturing.

Statistical analyses

Frequency counts were used to determine the number of players within each birth quartile (BQ1 to BQ4) and each maturity bracket (early, average and late) for each age group. For the BQ distribution, chi-square (χ^2) analysis was used to compare the observed sample against the expected distribution based on population values (Office for National Statistics, 2015).

The following equation was used to calculate the chi-square (χ^2) value.χ

$$X^2 = \sum \frac{(observed - model)2}{model} \quad (1)$$

In this instance, the model values were calculated based on the national norms, which was 25.5% for BQ1, 24.5% for BQ2, 24.7% for BQ3 and 25.4% for BQ4 (Office for National Statistics, 2015). The difference between the number of players observed in each BQ and the number expected based on national norms was then squared and divided by the expected number and then added together to give the chi-squared value.

The same equation 1 was used to calculate the maturity distribution, with chi-square (χ^2) analysis being used to compare maturity distributions to what would be expected based on a normal distribution using z-scores of −1 and+1 as the thresholds (15.85% each as early and late maturers and 68.3% as average maturers). The expected number of early, average and late maturers based on the normal distribution was then subtracted from the observed number in each maturity group, squared and divided by the expected number before the results for each group being summed to give the chi-square value.

As this test does not reveal the magnitude of the difference between quartile distributions for significant chi-square 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 would indicate a small effect size, 0.17 or more would indicate a medium effect size and 0.29 or more would indicate a large effect size (Cohen, 1988). Furthermore, the analysis of the adjusted standardised residuals was completed using equation 2 to identify frequencies that were greater than 1.96 or less than −1.96 z-scores ($p < 0.05$), highlighting a significant difference in the expected distribution for each age group.

$$\text{Standardised residuals} = \frac{observed - model}{\sqrt{model}} \quad (2)$$

Results

The descriptive statistics for anthropometrics are presented in Table 1. As expected, age, height, weight, age at PHV and maturity offset all increased with each chronological age group.

The sample's BQ distributions were significantly skewed, with a medium effect size compared to national norms (χ^2 (df = 3) = 20.4, p < 0.05, V = 0.179). The adjusted residuals showed that there were significantly more BQ1's than expected based on national norms in the whole sample, while there were significantly less BQ3's than expected (Figure 1). The adjusted residuals for individual age groups highlighted significantly more BQ1's than expected and significantly less BQ2's than expected for U12 and U14 groups (Figure 2).

The maturity band distributions in the sample were significantly skewed, with a trivial effect size compared to normal distribution (χ^2 (df = 2) = 0.309, p < 0.05, V = 0.027). There were significantly more early maturers in the U10 and U11 than expected based on age-matched general population data (p < 0.05; Figure 3).

Finally, the maturity timings of the different BQ's showed that there was a significantly smaller effect size *(χ^2 (df = 2) = 0.192, p < 0.05, V = 0.021)*, with significantly more early maturers in BQ4 than expected based on normal distribution (Figure 4).

Discussion

The main findings of the current study were that there was a relative age bias within the academies, with 62% of the whole sample being born in the first half of the academic year (BQ1 or BQ2 – September to February) and 38% being born in BQ1. Furthermore, the maturity status of selected players was as expected, with a similar number of early, on-time and late maturers as national norms. However, there was a selection bias towards early maturers in the U10 and U11 age groups, and the data also suggested that early maturers were over-represented in BQ4. Therefore, the hypothesis can partially be accepted as there was a bias towards early maturers but only in

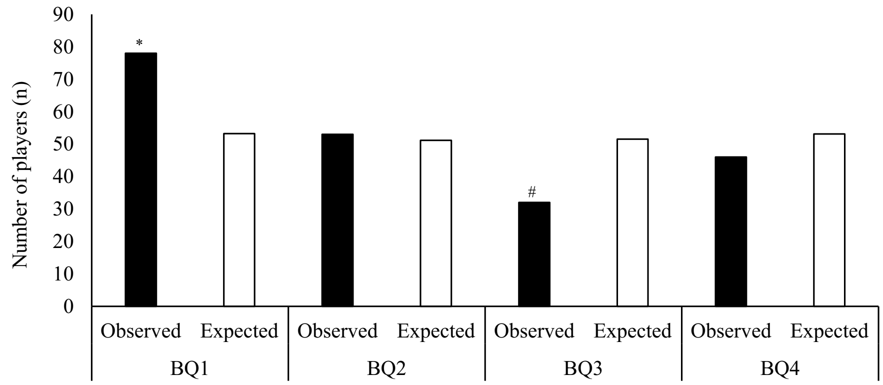

Figure 1. Observed versus expected distribution of birth quartile compared to national norms. * Indicates significantly more than expected ($p < 0.05$) # Indicates significantly less than expected ($p < 0.05$) Note: BQ: birth quartile

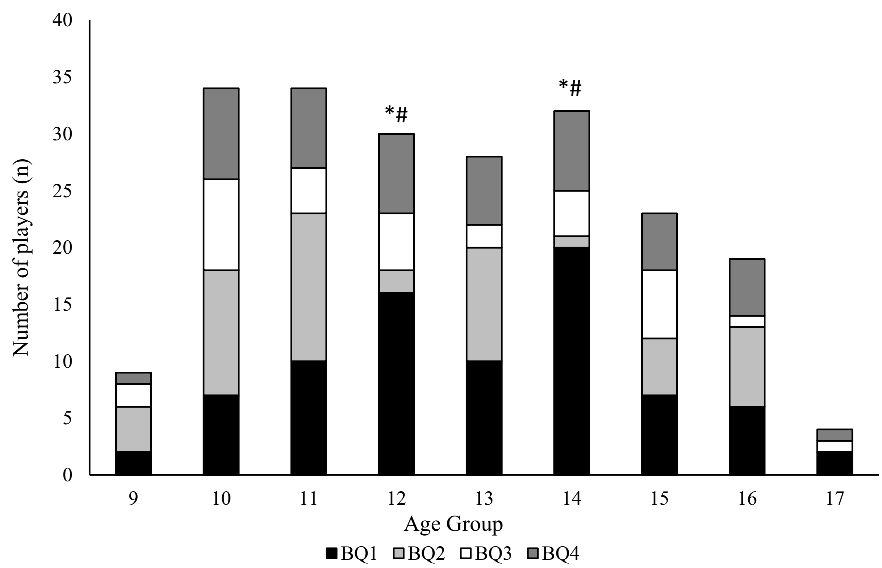

Figure 2. Number of players from each birth quartile for each age group. *indicates significantly more BQ1 maturers than expected #indicates significantly less BQ2 maturers than expected Note: BQ: birth quartile

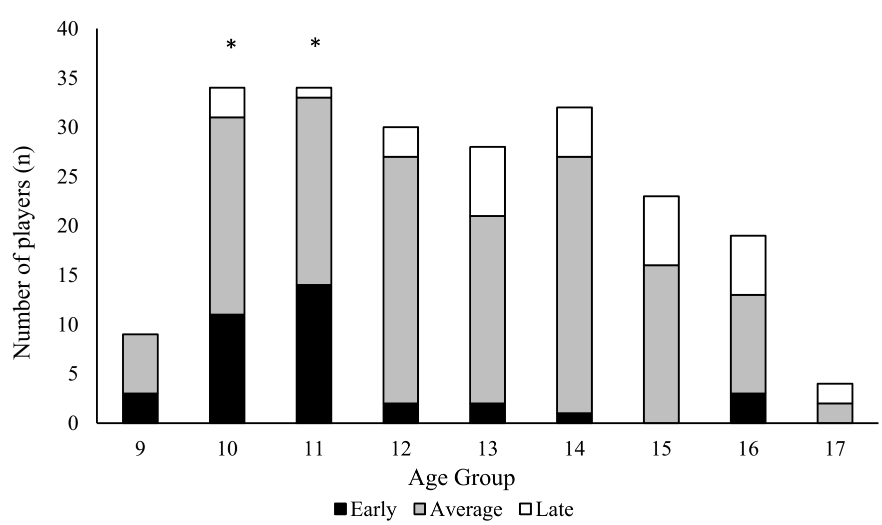

Figure 3. Number of early, average and late maturers for each age group. *indicates significantly more early maturers than expected

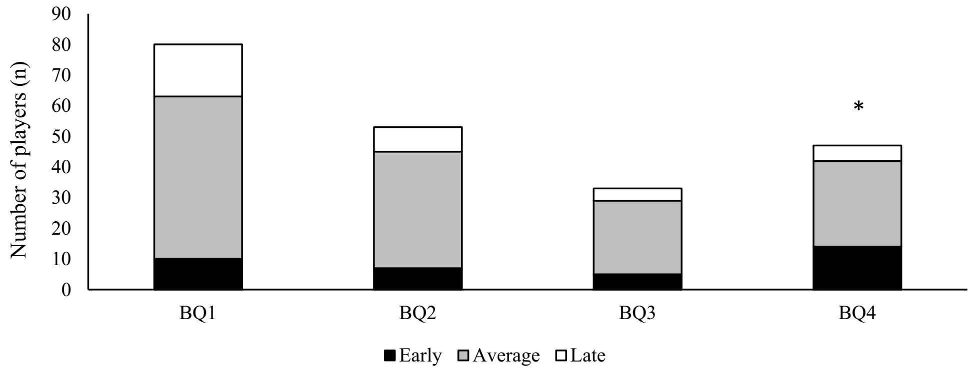

Figure 4. Number of early, average and late maturers for each birth quartile. *indicates significantly more early maturers than expected Note: BQ: birth quartile

the younger age groups, and there were more players born in BQ1 than other quartiles.

The findings surrounding RAEs are similar to previous research in youth cricket, where Connor et al. (2019) revealed that players born in the first quartile of the Australian youth national championship cricket season were significantly over-represented in male U15, U17 and U19, as well as female U15 and U18 levels (BQ1 = 34–38%), compared to BQ4 (16–20%). Previous research has highlighted that there is limited physical benefit of being born early in the year (Parr et al., 2020; Radnor, Staines, et al., 2021); however, relatively older players may benefit from being included in talent pathways due to their age and then receiving a range of opportunities, such as gaining access to quality coaching, facilities, higher competition levels and holistic development (Kelly et al., 2022; Lascu et al., 2020). Additionally, many of the benefits and reasons why there are RAEs during talent identification processes may be due to psychological constructs, such as self-perception (Cumming et al., 2018; Hancock, Adler, et al., 2013). It is often assumed that relatively older youth are further advanced in maturation and possess greater anthropometric qualities and superior performance characteristics (Cobley et al., 2009); however, recent findings have suggested this is not always the case (Parr et al., 2020; Radnor, Staines, et al., 2021). Rather, RAE in childhood is perhaps more likely to reflect age-related variations in a variety of other factors, including neuromuscular maturation, behavioural development, experience and training history (Wattie et al., 2015). The evidence would also suggest that strategies designed to address RAEs should focus on these attributes listed above and be introduced from early childhood.

Research into academy soccer has shown that players are chosen largely based on an earlier maturity status, which emerges at U12 and exacerbates at U15 and U16 where no late maturing players were selected (Hill et al., 2019). However, within the current study, the opposite was true, whereby there was a bias towards early maturers in U10 and U11 age groups before early maturers represented a lower percentage than later maturers in U12 to U16. The advantage of being an early maturer is the physical superiority a player will have over their later maturing counterparts (Parr et al., 2020; Radnor, Staines, et al., 2021). Physical qualities have been linked to improved batting performance (Miyaguchi & Demura, 2012) due to their role in producing faster bat swing velocity (Szymanski et al., 2009). However, research has identified limited correlations between upper body strength and batting performance in provincial-level cricketers (Taliep et al., 2010). Research has also highlighted that batting performance is not solely reliant on bat speed but other factors such as impact location, underpinned by timing, can also dictate shot success (Peploe et al., 2018, 2019). Therefore, successfully intercepting a cricket ball requires superior visuomotor skills (Connor, Farrow & Renshaw, 2018) and increased strength and power, which may explain the lack of bias towards earlier maturers that are seen in other sports (Hill et al., 2019; Parr et al., 2020; Radnor, Staines, et al., 2021). Earlier maturers seem to have a more intense growth spurt than late maturers (Tanner & Whitehouse, 1976), and these faster growth rates may result in greater or more prevalent temporary disruptions to motor co-ordination, termed "adolescent awkwardness" (Quatman-Yates et al., 2012). If motor co-ordination is reduced, timing and coordination tasks may be negatively influenced, potentially leading to reduced cricket performance and possible deselection of the earlier maturers during their periods of rapid growth.

From a bowling perspective, anthropometric and physical characteristics have been shown to predict fast bowling skills in junior cricketers (Pyne et al., 2006). Therefore, the earlier maturers who have strength and power advantages over their less mature counterparts may have specialised early as fast bowlers. Early specialisation has been linked to reduced motor skill development (Mostafavifar et al., 2013) and heightened injury risk (Myer et al., 2015). Additionally, fast bowling has a high injury risk in youth cricket (Milson et al., 2007; Stretch, 2014). For example, in a prospective injury surveillance study on school boy cricketers in South Africa, 67 injuries were reported during the season, with fast bowling accounting for 50.7% of these (Milson et al., 2007). In addition, injury incidence trends among U15, U17 and U19 school-boy cricketers highlighted fast bowling as the primary activity (48%) leading to an injury, irrespective of age (Stretch, 2014). As such, it could be suggested that those bowlers who follow an early specialisation trajectory may be at greater risk of developing overuse injuries, which could hinder their development towards staying in the talent pathway in the older age groups (Niemeyer et al., 2006), resulting in a lower early maturer distribution in the older age groups.

Finally, later maturing players must possess or develop superior technical and psychosocial abilities if they are to remain competitive within their age groups, rather than rely on their strength and power, which reflects the "underdog hypothesis" (Gibbs et al., 2012; Kelly et al., 2020). Developing or possessing these qualities results in later maturers being more successful at the adult level (Cumming et al., 2018) and may see them catch up and overtake their early maturing counterparts in the older age groups (Till et al., 2014). This has been seen in youth soccer players, where 48 boys aged 14 years playing in the Serbian youth soccer Division One were tracked over an 8-year period. The authors found that, of the original sample of late maturing boys who made up 21% of the total sample at 14 years of age, 60.1% successfully transitioned to the professional level. It therefore seems that professional status in sport may gradually exclude early maturing boys and favour late maturing boys as age increases (Ostojic et al., 2014).

The percentage of late maturers was greatest in BQ1 (~21%) compared to the other quartiles (~11–15%), and there was also a higher percentage of early maturers in BQ4 (~30%), compared to the other quartiles (~13–15%). Furthermore, 50% of the late maturers were born in the first quartile. These findings add further support to the notion that maturation and relative age are different constructs and that being relatively younger does not necessarily mean athletes are late maturers (Towlson et al., 2021). However, these findings do suggest that early maturing cricket players were overrepresented in the last BQ, whereas late maturing athletes were overrepresented in the first BQ, suggesting that relatively younger cricket players may only have an initial opportunity of selection if they were early maturing, whereas relatively older athletes have an increased likelihood for selection independent of their biological maturity status (Radnor, Staines, et al., 2021).

Limitations

While the current study is novel, being one of the first studies to report maturity and birth quartile bias in a large population of youth cricket players, certain limitations need to be acknowledged. Somatic maturity was estimated using an equation which is known to be biased to chronological age at the time of prediction and also results in reduced variation in the timing of age at PHV (Kozieł & Malina, 2018). This is evident in results from both cricket and general populations in this study, with predicted age at PHV increasing with advancing chronological age, and with the standard deviation in predicted age at PHV predominantly <0.65 year. Longitudinal data would suggest variability in age at PHV should be between 0.7 and 1.0 y (Mirwald et al., 2002), and a threshold of ±1 year from mean predicted age at PHV has previously been used to classify young athletes into maturity categories (Kozieł & Malina, 2018). In the present study, when classifying young cricketers as either early, on-time or late maturing, the lowered variability in the predictive equation was controlled for by using z-scores rather than an arbitrary cut-off of ± 1 year around the mean age of PHV. Furthermore, the bias towards chronological age was controlled by calculating z-scores in comparison to age-matched peers from the general population. While the present study included a reasonably sized sample of academy cricketers, a larger sample size would have allowed a more in-depth analysis of maturity status within each chronological age group. Additionally, while references have been made to cricket role (e.g., batter and bowler), this is somewhat speculative as the cricket discipline was not collected. Future research should ensure that the discipline is assessed along with maturation and relative age to determine differences between roles and cricket.

Conclusion

Selection biases towards cricketers who were born earlier in the competitive year are consistent from U9 to U16, but more prevalent in U12 and U14 age groups. There seems to be a bias towards early maturers at U10 and U11, but the maturity bias reduces as age increases, resulting in more late maturers than early maturers in the development pathway from U12 to U16. While relatively older players might be selected regardless of maturity status, relatively younger players may need to be early maturers to be selected, as evidenced by significantly more early maturers in BQ4 than expected. Therefore, for practitioners working in academy pathways, it is recommended that maturity status of players is assessed and monitored and should be used to assist in the evaluation of players from a holistic viewpoint, to ensure late maturers are not excluded at an early age. However, further research is required into youth cricket and talent development pathways to better understand the nature and sources of the selection biases and how this may influence cricket discipline while optimising the opportunities for all youth players.

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Author contributions

Conceptualisation, J.M.R., J.L.O. and A.L.K; methodology, J.M.R., J.L.O. and R.S. L.; validation, J.M.R., J.L.O. and A.L.K.; data curation, T.B., I.D. and M.W.; formal analysis, J.M.R.; writing – original draft preparation, J.M.R.; writing – review and editing, A.L.K., J.L.O., T.B., I.D., M.W. and R.S.L.; project administration, J.M.R.

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