

Relative age effects in women's and girls' cricket

The purpose of this study was to examine the prevalence of relative age effects (RAEs) across the England and Wales Cricket Board (ECB) women's and girls' national talent pathway. Birthdates were recorded of youth players in Regional Festivals ($n = 108$), School Games ($n = 48$), and England U19 World Cup Squad 2023 ($n = 15$), as well as senior players in England T20 ($n = 47$), England ODI ($n = 41$), and England Test ($n = 30$) teams. Chi-square tests and odds ratios with 95% confidence intervals were used to compare observed and expected birthdate distributions. A selection **asymmetry** toward relatively older players was evident in all youth cohorts and skill-sets (i.e., batters, bowlers). In contrast, more relatively younger batters and bowlers were selected in all senior cohorts. These data suggest RAEs are prevalent throughout the ECB women's and girls' national talent pathway **producing asymmetrical birthdate distributions**. It is important policy makers and practitioners working within women's and girls' cricket across England and Wales acknowledge these **selection asymmetries**, as well as implement strategies to facilitate a more appropriate and equitable development pathway that provides all future cricketers with the opportunity to fulfil their potential.

Keywords: Talent identification; talent development; expertise; youth cricket; batting; bowling.

Introduction

Over the last decade, there has been an increased focus on developing the participation and professionalism of women's cricket in England and Wales. In 2014, the England and Wales Cricket Board (ECB) invested in 18 new professional contracts for female cricketers (Nicholson, 2020). However, over the next six years, there was no increase in the number of professional contracts, and in 2020 there were still fewer than 20 female professional cricketers in the UK (ECB, 2022b). Fresh injections of funding into women's cricket by the ECB and the formation of the regional structure in 2020, however, has resulted in more professional contracts for female cricketers. As of February 2023, there are 80 professional female cricketers, ten contracts from each of the eight regions, plus those on the ECB central contracts (ECB, 2022b).

To help grow the game, the ECB and other organisations have created initiatives nationwide to encourage females to become involved in cricket. Initiatives such as "All Stars Cricket", "Dynamos Cricket", "Take Her Lead", and "Chance to Shine" have been established, and with the support of cricket clubs and county age group squads, there is now a structured player pathway into talent identification programmes, such as regional academies, for female cricketers (ECB, 2022a). The goal of these talent pathway programmes is to identify a developing cricketer with the potential to become a successful senior performer (Till & Baker, 2020). However, selection into talent pathways is often objectively unclear and rely heavily on coaches, teachers, or scouts' perceptions of a young players potential (Lascu et al., 2020; Till & Baker, 2020). Young athletes are likely being selected into talent pathways based on current ability, rather than potential ability, as predicting future performance is difficult (Koz et al., 2012), and selecting talent at very young ages is even less accurate (Till et al., 2016). This comes with a range of implications for talent identification, and one of the most prominent and influential factors that may create biases in selection are relative age effects (RAEs) (McAuley et al., 2023; Till & Baker, 2020).

Due to the organisation of youth sport into annual age-groups, RAEs refer to the over-representation of those born nearer the beginning of the cut-off date compared to those who are born towards the end (Kelly, Till, et al., 2021; Wattie et al., 2015). This has been highlighted extensively in

soccer (Carling et al., 2008; Doncaster et al., 2024; Doyle & Bottomley, 2018; Figueiredo et al., 2019; Kelly et al., 2020; Radnor et al., 2021), but also in other popular UK sports including rugby union (Kelly, Till, et al., 2021), basketball (Kelly, Jiménez Sáiz, et al., 2021), and cricket (Jones et al., 2018; Kelly, Brown, et al., 2022; Radnor et al., 2023). In the context of cricket, Kelly, Brown and colleagues (2022) reported that selection into the ECB national talent pathway for males was biased towards those born earlier in the selection year. Specifically, odds of being selected for regional U15 and U17 squads as well as the U19 national squad as a cricketer born in the first quartile of the selection year (i.e., September to November) was 1.8 to 3.8 times more likely than a player born in the last quartile (June to August) (Kelly, Brown, et al., 2022). Even in younger age groups (U9-17) research has highlighted a relative age bias for county cricket pathways, with recent data highlighting that 62% of academy cricketers from England and Wales were born in the first half of the selection year (September to February), and 38% being born from the first birth quartile (BQ1) (Radnor et al., 2023). These findings suggest that relatively older boys are selected from a very young age and become exposed to a wealth of opportunities (e.g., greater access to coaching, competition, facilities, specialist support) that relatively younger players are not subjected to, which can have a major impact upon subsequent developmental outcomes (Till & Baker, 2020).

Interestingly, at the senior level, the influence of relative age on selection is more varied. For England senior squads, across all formats of cricket (i.e., T20, ODI, Test), there were no RAEs present (Kelly, Brown, et al., 2022), with similar findings have been reported in Australian senior state level cricket (Connor et al., 2019). Conversely, over a 20-year period, a selection of “super-elite” male cricketers displayed a bias towards relatively older players when all skill-sets were combined (Jones et al., 2018). The players skill-set (i.e., batting and bowling) also seems to influence RAEs, with more relatively older batters and spin bowlers are selected for senior teams, whereas more relatively younger pace bowlers are selected for the national squads (Kelly, Brown, et al., 2022). The reduced influence of RAEs at senior levels suggests more relatively younger players are selected into these senior squads, and recent research exploring the transition from youth to senior levels of the ECB national talent pathway in males confirm this (Kelly, Brown, et al., 2022). There appears to be a “reversal effect”,

where relatively younger players are significantly more likely to transition from youth to senior levels when compared to their relatively older counterparts (Brustio et al., 2023, 2024; Kelly, Brown, et al., 2022). However, similar studies in female cricket are non-existent, and since previous research has showed RAEs can impact sexes differently (Andrew et al., 2022), the current research in men and boys should not be generalised for women and girls.

Based on current relative age research in youth sport, male RAEs appear to be more pronounced, whereas female RAEs appear to be more inconsistent (Smith et al., 2018). Research conducted in female sport has reported a relative age bias in tennis (Gerdin et al., 2018), swimming (Staub et al., 2020), soccer (Brustio et al., 2023), and rugby union (Kelly, Jackson, et al., 2022). However, there is also research highlighting the absence of RAEs in female soccer (Andrew et al., 2022), rugby union (Kelly et al., 2024), and female athletics (Brazo-Sayavera et al., 2017). From the limited research into RAEs in female cricket, Connor and colleagues (2019) reported a relative age bias in U15 and U18 squads playing in the National Junior Championships in Australia, but not at senior state level cricket. More recently, Runswick et al. (2024) investigated 84 players (aged 15 to 21 years) enrolled on regional academy programmes within the eight women's professional cricket regions across England and Wales, revealing significant RAEs favouring relatively older players. However, the profile of females being selected into talent pathways in England as well as the transition from youth to senior levels in female cricket more generally has not been established.

Due to the specific relative age mechanisms between the two sexes (Kelly, Jackson, et al., 2022), it is essential to recognise that findings from the many male studies may not be transferable to female cohorts, thus research is needed to better understand RAEs specifically in women's and girls' cricket. Selection asymmetries favouring chronologically older players at youth, but not senior level, questions the efficacy of selection processes. Since talent pathways 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 important to understand selection asymmetries to help inform future selection decisions into these talent pathways. Therefore, the purpose of this study was to examine the prevalence of RAEs across the ECB women's and girls' national talent pathway.

Methods

Sample

The participants in this study were chosen as part of the ECB national talent pathway between 2011 and 2023 ($n = 289$). The time span for each cohort varied depending on the availability of data. Comprehensive datasets were collected for each cohort to ensure the most accurate representation. Following the structure of the ECB national talent pathway, participants were categorized into one of the following groups: (a) Regional Festivals ($n = 108$) between the years of 2021 to 2022, (b) School Games ($n = 48$) between the years of 2021 to 2022, (c) England U19 World Cup Squad 2023 ($n = 15$), (d) England T20 ($n = 47$) between the years of 2011 to 2023, (e) England ODI ($n = 41$) between the years of 2011 to 2022, and (f) England Test ($n = 30$) between the years of 2011 to 2022¹. All information was gathered from the publicly accessible Cricket Archive (2023).

Procedure

In accordance with the annual age group cut-off dates in England, this approach segmented the year into four equal birth quartiles (BQs), starting from September 1st as the first month and concluding with August 31st as the twelfth month (Kelly, Brown, et al., 2022). Each participant was then assigned a BQ that corresponded with their birth date, allowing for the creation of an observed BQ distribution within each cohort of the ECB national talent pathway. The resulting BQ distributions from each group were then compared to National Norms, which represent the expected BQ distribution based on average national live births (Office for National Statistics, 2015). To assess the likelihood of reaching senior international status (including England T20, ODI, and Test levels) after entering the talent pathway at the youth stage, the senior BQ distributions were contrasted with the Regional BQ distribution (i.e., comparing entry and expertise; Kelly, Brown, et al., 2022). Additionally, players were categorized based on their skill sets, distinguishing between batters and bowlers. Batters were identified as those who

¹T20, ODI, and Test are three different formats and lengths of match-play in cricket. T20I = Twenty 20 International (20 overs or 120 balls/team (~3hrs)); ODI = One Day International (50 overs or 300 balls/team (all day)), and Test = play until all batters are out (consists of four innings with two per team (played over 4 or 5 days)).

batted for the majority (at least 75%) of their innings in the top six batting positions, while bowlers were defined as those who delivered at least one over in most (at least 75%) games participated in. The specific skill set distributions were as follows: (a) Regional Festivals (40 batters; 68 bowlers), (b) School Games (17 batters; 31 bowlers), (c) U19 World Cup Squad (7 batters; 8 bowlers), (d) England T20 (15 batters; 32 bowlers), (e) England ODI (17 batters; 24 bowlers), and (f) England Test (12 batters; 18 bowlers). Lastly, the numbers of games played by each participant were also compiled according to their BQ distributions.

Data Analysis

To compare the BQ distributions of each cohort against the expected BQ distributions, a chi-square (χ^2) goodness of fit test was used according to McHugh (2013). To assess the magnitude of differences between BQ distributions, Cramer's V was used with conventional effect size thresholds (0.06 > = small, 0.17 > = medium, and 0.29 > large) (Cohen, 1988). To compare the likelihood of each BQ being selected, odds ratios (ORs) and 95% confidence intervals (CIs) were calculated, with statistical significance set at $p < 0.05$.

Results

Number of Players

When analysing the number of players, there was a significant difference between the School Games ($\chi^2(df = 3) = 19.32, p < 0.001, V = 0.37$) and U19 World Cup Squad ($\chi^2(df = 3) = 9.41, p = 0.024, V = 0.46$) BQ distributions when compared to National Norms, with large effect sizes (see **Table 1**). The ORs identified an increased likelihood of relatively older players being selected, with the highest being BQ1 vs. BQ4 for both School Games (OR 7.67; CI 1.81–32.52) and the U19 World Cup Squad (OR 8.00; CI 0.66–97.32). In comparison, there were no significant differences in Regional or senior (i.e., England T20, England ODI, and England Test) BQ distributions when compared to National Norms.

Insert **Table 1** near here

With regards to skill-sets, significant differences were present in School Games batters ($\chi^2(df = 3) = 15.27, p = 0.002, V = 0.27$) and bowlers ($\chi^2(df = 3) = 8.41, p = 0.038, V = 0.24$), with medium effect sizes favouring those who were relatively older. The highest ORs were BQ1 vs. BQ4 for both batters (OR 11.00; CI 0.93–130.33) and bowlers (OR 6.00; CI 1.00–35.91). In contrast, no significant different BQ distributions were observed in batters and bowlers of Regional or senior cohorts when compared to National Norms (see **Figure 1**).

Insert **Figure 1** near here

When comparing the senior cohorts BQ distributions with the expected BQ distributions based on the Regional cohort, there were no significant differences when grouping batters and bowlers together (see **Table 2**). However, there were significant differences with large effect sizes regarding bowlers of England T20 ($\chi^2(df = 3) = 8.12, p < 0.044, V = 0.29$) and England ODI ($\chi^2(df = 3) = 8.64, p < 0.034, V = 0.35$). The ORs identified an increased likelihood of relatively younger bowlers to transition to the senior cohorts, with the highest being BQ3 vs. BQ2 for England T20 (OR 3.33; CI 0.81–13.64) and BQ3 vs. BQ1 for England ODI (OR 4.00; CI 0.80–20.02).

Insert **Table 2** near here

Number of Matches Played

When analysing the number of matches played, there was a significant difference between the Regional BQ distribution when compared to National Norms, with a medium effect size ($\chi^2(df = 3) = 87.30, p < 0.001, V = 0.22$; see **Table 3**). Significant ORs identified an increased likelihood of relatively older players being selected, with the highest being BQ1 vs. BQ3 (OR 2.39; CI 1.71–3.33). Similarly, there was a significant difference between the School Games ($\chi^2(df = 3) = 95.39, p < 0.001, V = 0.43$) and U19 World Cup Squad ($\chi^2(df = 3) = 34.03, p < 0.001, V = 0.38$) BQ distributions when compared to the National Norms, with large effect sizes. The ORs identified an increased likelihood of relatively older players being selected, with the highest being BQ1 vs. BQ4 for both School Games (OR 13.41; CI 5.59–32.17) and the U19 World Cup Squad (OR 43.00; CI 5.43–340.38). Significant differences were also present in the senior BQ distributions of the England T20 ($\chi^2(df = 3) = 330.47, p < 0.001, V = 0.26$), England ODI ($\chi^2(df = 3) = 139.04, p < 0.001, V = 0.18$), and England Test ($\chi^2(df = 3) = 15.60,$

$p = 0.001$, $V = 0.22$) players when compared to the National Norms, with medium effect sizes. However, the ORs identified an increased likelihood of relatively younger players being selected, with the highest being BQ3 vs. BQ1 for England T20 (OR 4.37; CI 3.48–5.49) and England ODI (OR 2.68; CI 2.14–3.37), and BQ4 vs. BQ1 for England Test (OR 3.50; CI 1.46–8.41).

Insert **Table 3** near here

With regards to skill-sets, significant differences were present in batters ((Regional ($\chi^2(df = 3) = 65.45$, $p < 0.001$, $V = 0.25$), School Games ($\chi^2(df = 3) = 77.57$, $p < 0.001$, $V = 0.32$), U19 World Cup Squad ($\chi^2(df = 3) = 8.75$, $p = 0.003$, $V = 0.26$)) and bowlers ((Regional ($\chi^2(df = 3) = 29.44$, $p < 0.001$, $V = 0.20$), School Games ($\chi^2(df = 3) = 27.81$, $p < 0.001$, $V = 0.23$), U19 World Cup Squad ($\chi^2(df = 3) = 15.80$, $p < 0.001$, $V = 0.39$)), with medium to large effect sizes in both batters and bowlers favouring those who were relatively older in all cohorts. The highest ORs for batters was BQ1 vs. BQ3 in Regional (OR 3.05; CI 1.95–4.79), and BQ1 vs. BQ4 in School Games (OR 14.25; CI 4.44–45.78) and U19 World Cup Squad (OR 31.00; CI 3.55–270.78), whereas the highest ORs for bowlers was BQ2 vs. BQ4 in Regional (OR 2.24; CI 1.35–3.70), BQ1 vs. BQ4 in School Games (OR 12.33; CI 3.28–46.31), and BQ2 vs. BQ4 in U19 World Cup Squad (OR 21.00; CI 2.31–191.18) (see **Figure 2**).

Insert **Figure 2** near here

When comparing the senior cohorts BQ distributions with the expected BQ distributions based on the Regional cohort, there were significant differences with large effect sizes in all cohorts: (a) England T20 ($\chi^2(df = 3) = 1254.84$, $p < 0.001$, $V = 0.51$), (b) England ODI ($\chi^2(df = 3) = 714.89$, $p < 0.001$, $V = 0.41$), and (c) England Test ($\chi^2(df = 3) = 53.72$, $p < 0.001$, $V = 0.40$). Significant ORs identified an increased likelihood of relatively younger players to transition to the senior cohorts, with the highest being BQ3 vs. BQ1 in England T20 (OR 10.45; CI 8.25–13.25) and England ODI (OR 6.41; CI 5.06–8.12), and BQ4 vs. BQ1 in England Test (OR 7.78; CI 3.17–19.06).

With regards to skill-sets, significant differences were present in batters ((England T20 ($\chi^2(df = 3) = 773.96$, $p < 0.001$, $V = 0.54$), England ODI ($\chi^2(df = 3) = 683.06$, $p < 0.001$, $V = 0.54$), England Test ($\chi^2(df = 3) = 49.22$, $p < 0.001$, $V = 0.52$)) and bowlers ((England T20 ($\chi^2(df = 3) = 526.19$, $p < 0.001$, $V = 0.49$), England ODI ($\chi^2(df = 3) = 139.49$, $p < 0.001$, $V = 0.27$), England Test ($\chi^2(df = 3) =$

11.17, $p = 0.011$, $V = 0.27$)), with large effect sizes in batters and medium to large effect sizes in bowlers favouring those who were relatively younger in all cohorts (see **Table 4**). The highest ORs for batters was BQ4 vs. BQ1 in England T20 (OR 15.80; CI 11.11–22.46), England ODI (OR 12.79; CI 8.96–18.27), and England Test (OR 28.80; CI 5.70–145.56), whereas the highest ORs for bowlers was BQ3 vs. BQ1 in England T20 (OR 6.30; CI 4.59–8.65), England ODI (OR 3.02; CI 2.19–4.17), and England Test (OR 3.33; CI 1.02–10.90).

Insert **Table 4** near here

Discussion

This study examined the prevalence of RAEs across the ECB women's and girls' national talent pathway, as well as exploring its impact on the youth to senior transitions in female cricketers for the first time. The main findings revealed a selection asymmetry favouring relatively older players across all youth cohorts (i.e., Regional Festivals, School Games, U19 World Cup) and skill-sets (i.e., batters, bowlers). However, in senior cohorts (i.e., England T20, England ODI, England Test) this selection asymmetry reversed, as more relatively younger batters and bowlers were selected compared to their relatively older counterparts. These data suggest that RAEs are prevalent throughout the ECB women's and girls' national talent pathway and are contributing to biased selection processes.

The overrepresentation of relatively older youth players in this study aligns with previous research on male (Kelly, Brown, et al., 2022; Radnor et al., 2023) and more specifically female (Connor et al., 2019; Runswick et al., 2024) cricketers. For instance, initial research by Connor et al. (2019) showed that earlier born U15 and U18 female players were overrepresented compared to their later born peers in the National Junior Championships in Australia between 2011 and 2015. Likewise, Runswick et al. (2024) recently found significant RAEs favouring relatively older players in women's professional cricket regions across England and Wales. Both of these studies also revealed that skill-set moderated RAEs in female players, whereby there was a greater overrepresentation of earlier born batters compared to bowlers (Connor et al., 2019; Runswick et al., 2024). This corresponds with the findings

of this study, as whilst we found RAEs were evident in both skill sets, selection asymmetries were generally more pronounced in batters.

These differing skill-set effects align with the distinct developmental trajectories of male batters and bowlers (Brown et al., 2021), and may reflect greater attention on power hitting across the women's and girls' talent pathway (McErlain-Naylor et al., 2021). Other potential explanations for skill-sets moderating RAEs in cricket have been proposed by Kelly, Brown, et al. (2022). These include batters requiring a larger accumulation of practice to develop the necessary perceptual-cognitive skills (Weissensteiner et al., 2008), which may increase RAEs as it is more challenging for relatively younger players to 'catch-up'. Whereas bowlers require more time to achieve the physiological requisites (Pyne et al., 2006), which may reduce RAEs as relatively younger players have a greater opportunity to 'catch-up'. More research is required to fully understand the mechanisms underpinning these skill-set differences in both the women's and men's formats. However, irrespective of the underlying cause, it is important stakeholders employed in this specific sport setting acknowledge that players of different positions have diverse developmental trajectories (Brown et al., 2023).

The over-representation of relatively younger senior players in this study is relatively novel in comparison with previous research on senior female cricketers (Connor et al., 2019), but aligns with some findings from recent research on senior male cricketers (Kelly, Brown, et al., 2022). For instance, Connor et al. (2019) reported that there were no significant differences in the birthdate distributions of senior state level Australian female or male cricket players; although, descriptively there were more relatively older players selected. In an examination of the ECB men's national talent pathway, Kelly, Brown, et al. (2022) found that whilst there were no significant differences in senior cohorts with regards to the number of players selected, from a matches played perspective, significant differences were observed that favoured earlier born players. Interestingly, however, when analysing the likelihood of achieving senior international levels following entry into the talent pathway at youth level, Kelly, Brown, et al. (2022) reported that relatively younger players were significantly more likely to successfully transition compared to their relatively older counterparts, which corresponds with our findings.

Explaining the exact cause of RAEs at youth level or reversal effects at senior level in this study is challenging. Initially, RAEs had been attributed to the enhanced physiological skills of early maturing, relatively older athletes (Cobley et al., 2009; Wattie et al., 2015). It is important to recognise, however, that RAEs and maturity-related biases are two different constructs that work independently (Towlson et al., 2021), and recent research has suggested that there is limited correlation between physical performance and relative age (Parr et al., 2020; Radnor et al., 2021). Rather, RAEs are perhaps more likely to reflect a combination of factors, including psycho-social development and earlier access to coaching and facilities, although this has received limited research attention. As for reversal effects, the 'underdog hypothesis' has been proposed (Gibbs et al., 2012), whereby the comparatively greater challenge experienced by relatively younger players during early development necessitates the need to develop psychological, social, technical, and tactical skills to remain competitive. These skills then become more valuable towards adulthood as the advantages that accompany older relative ages attenuate, which could also help explain these current results (Kelly et al., 2020). However, Gibbs et al. (2012) only looked at RAEs in isolation without accounting for contextual, balancing factors of advantage (e.g., maturation, training age/experience and/or genetic factors). It could be argued that as RAEs (naturally) decrease, later born players will (naturally) have higher 'conversion rates'. Perhaps this occurs as a simple regression to the mean rather than as a 'mechanism/reversal effect'.

The findings of this study also align with previous suggestions that task and environmental constraints, such as the level of competitive play as well as the depth, maturity, and formality of competition, may moderate RAEs in particular sports contexts (Cobley et al., 2009; Smith et al., 2018; Wattie et al., 2015). For instance, when examining the trend across different levels of competitive play in youth cohorts, the magnitude of RAEs increased at higher competitive tiers. This may be explained by the increased importance placed on winning at international level, which consequently, amplifies the pressure to identify and select the highest performing (i.e., relatively older) players. The decreased prevalence of RAEs across the senior cohorts, however, may reflect that many players of senior squads developed during a period where the women's game had lower funding as well as less structured and formalised selection processes, which when combined with a much smaller pool of potential players,

likely reduced RAEs. Similar findings have been reported in other sports settings such as the comparisons between established and emerging soccer nations (McAuley et al., 2024). As women's cricket continues to grow, it will be important to monitor the longitudinal prevalence of RAEs to better understand how increased participation, popularity, and competition influence selection processes.

Whilst this study presents novel evidence on RAEs in a previously unstudied population, there are some limitations that should be considered when interpreting the present findings. Although three youth cohorts were examined, it is important to recognise that these were cross-sectionally examined and do not provide a complete representation of the entire population within the ECB women's and girls' talent pathway. Moreover, skill-sets (i.e., batters, bowlers) were analysed to account for the diverse developmental trajectories different playing positions may have, however, other roles (e.g., wicket keeper, fielder) and more specific skill-sets (e.g., seam bowler, spin bowler) do exist that could further impact RAEs. As the women's game has only recently begun to become more professionalised, the current lack of available data prevented the inclusion of additional players and more precise positional analyses. Moving forward, it will be important for future studies to use the larger sample sizes that become available to conduct more representative, position specific, longitudinal research. Lessons learned from the men's game should be acknowledged so the same issues are not recreated during this initial growth of professionalisation, and this selection bias is addressed immediately. To that end, multidimensional approaches will be important to better understand how other potential biases (e.g., maturation, training age/experience levels, birthplace effects, ethnicity, relative access to wealth) interact with RAEs to influence development and selection in the women's game (Brown et al., 2024).

Conclusion

This study investigated the prevalence of RAEs in the ECB women's and girls' national talent pathway. Key findings revealed, at youth level, players who are born earlier in the selection year are significantly more represented, whereas, at senior level, players who are born later in the competitive year are significantly more represented. This selection asymmetry towards relatively older players at youth, but not senior level, questions the efficacy of current selection process within the ECB women's

and girls' national talent pathway. It is important policy makers and practitioners working within female cricket across England and Wales acknowledge these selection asymmetries. Key industry stakeholders should collaborate with researchers to design, implement, and evaluate strategies, such as age-ordered shirt numbering for (extended) trials/training (Mann & van Ginneken, 2017), annual reporting, and appropriate coach education to facilitate a more appropriate and equitable development pathway, which provides all future female cricketers with the opportunity to fulfil their potential.

References

- Andrew, M., Finnegan, L., Datson, N., & Dugdale, J. H. (2022). Men Are from Quartile One, Women Are from? Relative Age Effect in European Soccer and the Influence of Age, Success, and Playing Status. *Children*, 9(11), 1747. <https://doi.org/10.3390/children9111747>
- Brazo-Sayavera, J., Martínez-Valencia, M. A., Müller, L., Andronikos, G., & Martindale, R. J. J. (2017). Identifying talented track and field athletes: The impact of relative age effect on selection to the Spanish National Athletics Federation training camps. *Journal of Sports Sciences*, 35(22), 2172–2178. <https://doi.org/10.1080/02640414.2016.1260151>
- Brown, T., Cook, R., Gough, L. A., Khawaja, I., McAuley, A. B. T., & Kelly, A. L. (2024). Exploring the Multidimensional Characteristics of Selected and Non-Selected White British and British South Asian Youth Cricketers: An Exploratory Machine Learning Approach. *Youth*, 4(2), Article 2. <https://doi.org/10.3390/youth4020048>
- Brown, T., McAuley, A. B. T., Khawaja, I., Gough, L. A., & Kelly, A. L. (2023). Talent identification and development in male cricket: A systematic review. *Journal of Expertise*, 6(2), 176–206.
- Brown, T. W., Gough, L. A., & Kelly, A. L. (2021). Performance trajectories of bowlers and batters from youth level to senior professional status in cricket. *International Journal of Performance Analysis in Sport*, 22(1), 1–15. <https://doi.org/10.1080/24748668.2021.1993028>
- Brustio, P. R., McAuley, A. B. T., Ungureanu, A. N., & Kelly, A. L. (2024). Career trajectories, transition rates, and birthdate distributions: The rocky road from youth to senior level in men's European football. *Frontiers in Sports and Active Living*, 6. <https://doi.org/10.3389/fspor.2024.1420220>
- Brustio, P. R., Stival, M., & Boccia, G. (2023). Relative age effect reversal on the junior-to-senior transition in world-class athletics. *Journal of Sports Sciences*, 41(9), 903–909. <https://doi.org/10.1080/02640414.2023.2245647>
- Brustio, P. R., Modena, R., Boccia, G., Vogliazzo, M., & Kelly, A. L. (2023). Youth-to-senior transition in women's and girls' football: Towards a better understanding of relative age

- effects and gender-specific considerations. *PLOS ONE*, *18*(5), e0283781.
<https://doi.org/10.1371/journal.pone.0283781>
- Carling, C., Le Gall, F., Reilly, T., & Williams, A. M. (2008). Do anthropometric and fitness characteristics vary according to birth date distribution in elite youth academy soccer players?: Relative age effect in elite youth soccer. *Scandinavian Journal of Medicine & Science in Sports*, *19*(1), 3–9. <https://doi.org/10.1111/j.1600-0838.2008.00867.x>
- Cobley, S., Baker, J., Wattie, N., & McKenna, J. (2009). Annual age-grouping and athlete development: A meta-analytical review of relative age effects in sport. *Sports Medicine*, *39*(3), 235–256. <https://doi.org/10.2165/00007256-200939030-00005>
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. L. Erlbaum Associates.
- Connor, J. D., Renshaw, I., & Doma, K. (2019). Moderating factors influence the relative age effect in Australian cricket. *PeerJ*, *7*, e6867. <https://doi.org/10.7717/peerj.6867>
- CricketArchive. (2023). <https://cricketarchive.com/>
- Doncaster, G., Kelly, A. L., McAuley, A. B. T., Cain, A., Partington, M., Nelson, L., & O’Gorman, J. (2024). Relative Age Effects and the Premier League’s Elite Player Performance Plan (EPPP): A Comparison of Birthdate Distributions Within and Between Age Groups. *Journal of Science in Sport and Exercise*. <https://doi.org/10.1007/s42978-024-00285-w>
- Doyle, J. R., & Bottomley, P. A. (2018). Relative age effect in elite soccer: More early-born players, but no better valued, and no paragon clubs or countries. *PLOS ONE*, *13*(2), e0192209.
<https://doi.org/10.1371/journal.pone.0192209>
- ECB. (2022a). *Womens’s and Girls’ Player Pathway*.
<https://resources.ecb.co.uk/ecb/document/2022/03/28/121fa7be-7260-48a2-85d3-c5931d66a3bb/Women-Girls-pathway-graphic.pdf>
- ECB. (2022b, October 28). *The ECB increase funding for the professional women’s domestic game (online)*. <https://www.ecb.co.uk/news/2877898/the-ecb-increase-funding-for-the-professional-womens-domestic-game>

- Figueiredo, A. J., Coelho-e-Silva, M. J., Cumming, S. P., & Malina, R. M. (2019). Relative age effect: Characteristics of youth soccer players by birth quarter and subsequent playing status. *Journal of Sports Sciences*, 37(6), 677–684. <https://doi.org/10.1080/02640414.2018.1522703>
- Gerdin, G., Hedberg, M., & Hageskog, C.-A. (2018). Relative Age Effect in Swedish Male and Female Tennis Players Born in 1998–2001. *Sports*, 6(2), 38. <https://doi.org/10.3390/sports6020038>
- Gibbs, B. G., Jarvis, J. A., & Dufur, M. J. (2012). The rise of the underdog? The relative age effect reversal among Canadian-born NHL hockey players: A reply to Nolan and Howell. *International Review for the Sociology of Sport*, 47(5), 644–649. <https://doi.org/10.1177/1012690211414343>
- Jones, B. D., Lawrence, G. P., & Hardy, L. (2018). New evidence of relative age effects in “super-elite” sportsmen: A case for the survival and evolution of the fittest. *Journal of Sports Sciences*, 36(6), 697–703. <https://doi.org/10.1080/02640414.2017.1332420>
- Kelly, A. L., Coutinho, D., Radnor, J. M., Burke, K., Barrell, D., Jackson, D., & Brustio, P. R. (2024). Disentangling Gender and Relative Age Effects in Women's and Girls' Rugby Union. *Journal of Functional Morphology and Kinesiology*, 9(2), 61. <https://doi.org/10.3390/jfmk9020061>
- Kelly, A. L., Jiménez Sáiz, S. L., Lorenzo Calvo, A., de la Rubia, A., Jackson, D. T., Jeffreys, M. A., Ford, C., Owen, D., & Santos, S. D. L. D. (2021). Relative Age Effects in Basketball: Exploring the Selection into and Successful Transition Out of a National Talent Pathway. *Sports (Basel, Switzerland)*, 9(7), 101. <https://doi.org/10.3390/sports9070101>
- Kelly, A. L., Brown, T., Reed, R., Côté, J., & Turnnidge, J. (2022). Relative Age Effects in Male Cricket: A Personal Assets Approach to Explain Immediate, Short-Term, and Long-Term Developmental Outcomes. *Sports*, 10(3), 39. <https://doi.org/10.3390/sports10030039>
- Kelly, A. L., Jackson, D. T., Barrell, D., Burke, K., & Till, K. (2022). The relative age effect in male and female English age-grade rugby union: Exploring the gender-specific mechanisms that underpin participation. *Science and Medicine in Football*, 6(3), 277–284. <https://doi.org/10.1080/24733938.2021.1955145>

- Kelly, A. L., Till, K., Jackson, D., Barrell, D., Burke, K., & Turnnidge, J. (2021). Talent Identification and Relative Age Effects in English Male Rugby Union Pathways: From Entry to Expertise. *Frontiers in Sports and Active Living*, 3, 640607. <https://doi.org/10.3389/fspor.2021.640607>
- Kelly, A. L., Wilson, M. R., Gough, L. A., Knapman, H., Morgan, P., Cole, M., Jackson, D. T., & Williams, C. A. (2020). A longitudinal investigation into the relative age effect in an English professional football club: Exploring the 'underdog hypothesis.' *Science and Medicine in Football*, 4(2), 111–118. <https://doi.org/10.1080/24733938.2019.1694169>
- Koz, D., Fraser-Thomas, J., & Baker, J. (2012). Accuracy of professional sports drafts in predicting career potential: Professional sports drafts. *Scandinavian Journal of Medicine & Science in Sports*, 22(4), e64–e69. <https://doi.org/10.1111/j.1600-0838.2011.01408.x>
- Lascu, A., Spratford, W., Pyne, D., & Etxebarria, N. (2020). Practical application of ecological dynamics for talent development in cricket. *International Journal of Sports Science & Coaching*, 15(2), 227–238. <https://doi.org/10.1177/1747954120908816>
- Mann, D. L., & van Ginneken, P. J. M. A. (2017). Age-ordered shirt numbering reduces the selection bias associated with the relative age effect. *Journal of Sports Sciences*, 35(8), 784–790. <https://doi.org/10.1080/02640414.2016.1189588>
- McAuley, A. B. T., Baker, J., Johnston, K., Doncaster, G., & Kelly, A. L. (2024). *Selection and re-selection throughout a national talent pathway: Exploring longitudinal relative age effects in Northern Ireland male soccer* [Manuscript submitted for publication]. Research for Athlete and Youth Sport Development (RAYSD) lab, Birmingham City University.
- McAuley, A. B. T., Baker, J., Johnston, K., Varley, I., Herbert, A. J., Suraci, B., Hughes, D. C., Tsaprouni, L. G., & Kelly, A. L. (2023). Talent inclusion and genetic testing in sport: A practitioner's guide. *Current Issues in Sport Science (CISS)*, 8(1), 008. <https://doi.org/10.36950/2023.1ciss008>
- McErlain-Naylor, S. A., Peplow, C., Grimley, J., Deshpande, Y., Felton, P. J., & King, M. A. (2021). Comparing power hitting kinematics between skilled male and female cricket batters. *Journal of Sports Sciences*, 39(21), 2393–2400. <https://doi.org/10.1080/02640414.2021.1934289>

McHugh, M. L. (2013). The Chi-square test of independence. *Biochemia Medica*, 23(2), 143–149.

<https://doi.org/10.11613/BM.2013.018>

Nicholson, R. (2020). *The history of women's cricket – from England's greens to the world stage [internet]*. <https://www.bournemouth.ac.uk/news/2020-03-05/opinion-history-womens-cricket-eng-lands-greens-world-stage>.

Office for National Statistics. (2015). *Number of live births by date, 1995 to 2014, in England and Wales*.

<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/livebirths/adhocs/005149numberoflivebirthsbydate1995to2014inenglandandwales>

Parr, J., Winwood, K., Hodson-Tole, E., Deconinck, F. J. A., Hill, J. P., Teunissen, J. W., & Cumming, S. P. (2020). The Main and Interactive Effects of Biological Maturity and Relative Age on Physical Performance in Elite Youth Soccer Players. *Journal of Sports Medicine*, 2020(1), 1957636. <https://doi.org/10.1155/2020/1957636>

Pyne, D. B., Duthie, G. M., Saunders, P. U., Petersen, C. A., & Portus, M. R. (2006). Anthropometric and strength correlates of fast bowling speed in junior and senior cricketers. *Journal of Strength and Conditioning Research*, 20(3), 620–626. <https://doi.org/10.1519/R-18315.1>

Radnor, J. M., Oliver, J. L., Dobbs, I., Wong, M., Brown, T. W., Lloyd, R. S., & Kelly, A. L. (2023). Selection into youth cricket academies: The influence of relative age and maturity status. *Journal of Sports Sciences*, 41(3), 272–279. <https://doi.org/10.1080/02640414.2023.2208924>

Radnor, J. M., Staines, J., Bevan, J., Cumming, S. P., Kelly, A. L., Lloyd, R. S., & Oliver, J. L. (2021). Maturity Has a Greater Association than Relative Age with Physical Performance in English Male Academy Soccer Players. *Sports*, 9(12), 171. <https://doi.org/10.3390/sports9120171>

Runswick, O. R., Ould-Dada, H., & Lewis, D. (2024). The developmental activities of women's professional pathway cricketers. *Journal of Sports Sciences*, 42(6), 547–557.

<https://doi.org/10.1080/02640414.2024.2351290>

- Smith, K. L., Weir, P. L., Till, K., Romann, M., & Cobley, S. (2018). Relative Age Effects Across and Within Female Sport Contexts: A Systematic Review and Meta-Analysis. *Sports Medicine*, 48(6), 1451–1478. <https://doi.org/10.1007/s40279-018-0890-8>
- Staub, I., Stallman, R. K., & Vogt, T. (2020). The relative age effect in German 11- to 18-year-old male and female swimmers. *German Journal of Exercise and Sport Research*, 50(4), 453–462. <https://doi.org/10.1007/s12662-020-00677-4>
- Till, K., & Baker, J. (2020). Challenges and [Possible] Solutions to Optimizing Talent Identification and Development in Sport. *Frontiers in Psychology*, 11, 664. <https://doi.org/10.3389/fpsyg.2020.00664>
- Till, K., Cobley, S., Morley, D., O'hara, J., Chapman, C., & Cooke, C. (2016). The influence of age, playing position, anthropometry and fitness on career attainment outcomes in rugby league. *Journal of Sports Sciences*, 34(13), 1240–1245. <https://doi.org/10.1080/02640414.2015.1105380>
- Towlson, C., MacMaster, C., Parr, J., & Cumming, S. (2021). One of these things is not like the other: Time to differentiate between relative age and biological maturity selection biases in soccer? *Science & Medicine in Football*, 6(3), 273–276. <https://doi.org/10.1080/24733938.2021.1946133>
- Weissensteiner, J., Abernethy, B., Farrow, D., & Müller, S. (2008). The development of anticipation: A cross-sectional examination of the practice experiences contributing to skill in cricket batting. *Journal of Sport & Exercise Psychology*, 30(6), 663–684. <https://doi.org/10.1123/jsep.30.6.663>
- Wattie, N., Schorer, J., & Baker, J. (2015). The Relative Age Effect in Sport: A Developmental Systems Model. *Sports Medicine*, 45(1), 83–94. <https://doi.org/10.1007/s40279-014-0248-9>

Table 1. The observed and expected BQ distributions of the ECB talent pathway and senior international cohorts according to number of players.

Cohort	BQ1	BQ2	BQ3	BQ4	Total	χ^2	P	Cramer's	BQ1 vs. BQ4 OR	BQ4 vs. BQ1 OR
					(<i>n</i>)	(<i>df</i> = 3)		V	(CI)	(CI)
National Norms	25.46%	24.47%	24.65%	25.42%						
Regional	34	33	20	21					1.62	
All	31.48%	30.56%	18.52%	19.44%	108	6.34	0.096	0.14	(0.76-3.47)	
Regional	15	11	6	8					1.88	
Batters	37.50%	27.50%	15.00%	20.00%	40	4.4	0.221	0.19	(0.55-6.39)	
Regional	19	22	14	13					1.46	
Bowlers	27.94%	32.35%	20.59%	19.12%	68	3.41	0.333	0.13	(0.55-3.87)	
School Games	23	15	7	3					7.67	
All	47.92%	31.25%	14.58%	6.25%	48	19.32	<0.001	0.37	(1.81-32.52)	
School Games	11	4	1	1					11	
Batters	64.71%	23.53%	5.88%	5.88%	17	15.27	0.002	0.27	(0.93-130.33)	
School Games	12	11	6	2					6	
Bowlers	38.71%	35.48%	19.35%	6.45%	31	8.41	0.038	0.24	(1.00-35.91)	
U19 World Cup	8	6	1	0					8	
All	53.33%	40.00%	6.67%	0.00%	15	9.41	0.024	0.46	(0.66-97.32)	
U19 World Cup	5	2	0	0					5	
Batters	71.43%	28.57%	0.00%	0.00%	7	4.61	0.202	0.47	(0.27-91.52)	
U19 World Cup	3	4	1	0					3	
Bowlers	37.50%	50.00%	12.50%	0.00%	8	3.08	0.379	0.36	(0.15-59.89)	
England T20	10	11	15	11						1.1
All	21.28%	23.40%	31.91%	23.40%	47	1.43	0.699	0.10		(0.34-3.55)
England T20	2	5	3	5						2.5
Batters	13.33%	33.33%	20.00%	33.33%	15	1.85	0.604	0.20		(0.29-21.40)
England T20	8	6	12	6						0.75
Bowlers	25.00%	18.75%	37.50%	18.75%	32	3.13	0.371	0.18		(0.18-3.17)
England ODI	9	9	14	9						1
All	21.95%	21.95%	34.15%	21.95%	41	2	0.573	0.13		(0.28-3.57)
England ODI	4	3	4	6						1.5
Batters	23.53%	17.65%	23.53%	35.29%	17	1.01	0.799	0.14		(0.23-9.80)
England ODI	5	6	10	3						0.6
Bowlers	20.83%	25.00%	41.67%	12.50%	24	4.6	0.204	0.25		(0.10-3.72)
England Test	4	9	9	8						2
All	13.33%	30.00%	30.00%	26.67%	30	2.47	0.480	0.17		(0.42-9.42)
England Test	1	4	2	5						5
Batters	8.33%	33.33%	16.67%	41.67%	12	3.32	0.344	0.30		(0.34-72.77)
England Test	3	5	7	3						1
Bowlers	16.67%	27.78%	38.89%	16.67%	18	2.65	0.449	0.22		(0.13-7.57)

Bold font denotes statistically significant chi-square at $p < 0.05$.

Table 2. Entry vs. Expertise according to number of players.

Cohort	BQ1	BQ2	BQ3	BQ4	Total (n)	χ^2 (df = 3)	p	Cramer's V	BQ4 vs. BQ1 OR (CI)
England T20	10	11	15	11	47	7.28	0.064	0.23	1.83
All (Expected distribution *)	15	14	9	9					(0.56-6.03)
England T20	2	5	3	5	15	3.11	0.374	0.26	4.17
Batters (Expected distribution *)	5	4	3	3					(0.47-36.74)
England T20	8	6	12	6	32	8.12	0.044	0.29	1.25
Bowlers (Expected distribution *)	10	10	6	6					(0.29-5.41)
England ODI	9	9	14	9	41	7.72	0.052	0.25	1.63
All (Expected distribution *)	13	12	8	8					(0.45-5.82)
England ODI	4	3	4	6	17	3.7	0.296	0.27	3
Batters (Expected distribution *)	6	5	3	3					(0.46-19.59)
England ODI	5	6	10	3	24	8.64	0.034	0.35	0.96
Bowlers (Expected distribution *)	8	7	4	5					(0.16-5.90)
England Test	4	9	9	8	30	6.08	0.108	0.26	3
All (Expected distribution *)	9	9	6	6					(0.62-14.62)
England Test	1	4	2	5	12	5.14	0.162	0.38	10
Batters (Expected distribution *)	4	4	2	2					(0.65-154.40)
England Test	3	5	7	3	18	5.4	0.144	0.32	2
Bowlers (Expected distribution *)	6	6	3	3					(0.24-16.61)

* Expected distribution calculated from Regional BQ distribution. Bold font denotes statistically significant chi-square at $p < 0.05$.

Table 3. The observed and expected BQ distributions of the ECB talent pathway and senior international cohorts according to number of matches played.

Cohort	BQ1	BQ2	BQ3	BQ4	Total	χ^2	p	Cramer's	BQ1 vs. BQ4 OR	BQ4 vs. BQ1 OR
National Norms	25.46%	24.47%	24.65%	25.42%	(n)	(df = 3)		V	(CI)	(CI)
Regional	217	199	88	100	605	87.3	<0.001	0.22	1.41	
All	35.92%	32.96%	14.57%	16.56%						
Regional	139	108	44	58	349	65.45	<0.001	0.25	2.4	
Batters	39.83%	30.95%	12.61%	16.62%						
Regional	78	91	44	42	256	29.44	<0.001	0.20	1.86	
Bowlers	30.59%	35.69%	17.25%	16.47%						
School Games	94	44	26	7	171	95.39	<0.001	0.43	13.41	
All	54.97%	25.73%	15.21%	4.09%						
School Games	57	21	7	4	89	77.57	<0.001	0.32	14.25	
Batters	64.04%	23.60%	7.87%	4.49%						
School Games	37	23	19	3	82	27.81	<0.001	0.23	12.33	
Bowlers	45.12%	28.05%	23.17%	3.66%						
U19 World Cup	43	32	2	0	77	34.03	<0.001	0.38	43	
All	55.85%	41.56%	2.60%	0.00%						
U19 World Cup	31	11	0	0	42	8.75	0.003	0.26	31	
Batters	73.81%	26.19%	0.00%	0.00%						
U19 World Cup	12	21	2	0	35	15.8	<0.001	0.39	12	
Bowlers	34.29%	60.00%	5.71%	0.00%						
England T20	144	328	609	525	1606	330.47	<0.001	0.26		3.65
All	8.97%	20.42%	37.92%	32.69%						
England T20	51	210	278	337	876	209.31	<0.001	0.28		6.61
Batters	5.82%	23.97%	31.74%	38.47%						
England T20	93	118	331	188	730	193.81	<0.001	0.30		2.02
Bowlers	12.74%	16.16%	45.34%	25.75%						
England ODI	180	343	468	409	1400	139.04	<0.001	0.18		2.27
All	12.86%	24.50%	33.43%	29.21%						
England ODI	54	173	255	288	770	170.06	<0.001	0.27		5.33
Batters	7.01%	22.47%	33.12%	37.40%						
England ODI	126	170	213	121	630	40.02	<0.001	0.15		0.96
Bowlers	20.00%	26.98%	33.81%	19.21%						
England Test	10	33	32	35	110	15.6	0.001	0.22		3.5
All	9.09%	30.00%	29.09%	31.82%						
England Test	2	18	16	24	60	17.4	<0.001	0.31		12
Batters	3.33%	30.00%	26.67%	40.00%						
England Test	8	15	16	11	50	3.71	0.295	0.16		1.38
Bowlers	16.00%	30.00%	32.00%	22.00%						

Bold font denotes statistically significant chi-square at $p < 0.05$.

Table 4. Entry vs. Expertise according to number of matches played.

Cohort	BQ1	BQ2	BQ3	BQ4	Total (n)	χ^2 (df = 3)	<i>p</i>	Cramer's V	BQ4 vs. BQ1 OR (CI)
England T20	144	328	609	525	1606	1254.84	<0.001	0.51	7.92
All (Expected distribution *)	576	529	233	265					(6.27-10.02)
England T20	51	210	278	337	876	773.96	<0.001	0.54	15.8
Batters (Expected distribution *)	349	271	110	146					(11.11-22.46)
England T20	93	118	331	188	730	526.19	<0.001	0.49	3.76
Bowlers (Expected distribution *)	223	261	126	120					(2.69-5.24)
England ODI	180	343	468	409	1400	714.89	<0.001	0.41	4.93
All (Expected distribution *)	503	461	204	232					(3.90-6.23)
England ODI	54	173	255	288	770	683.06	<0.001	0.54	12.79
Batters (Expected distribution *)	307	238	97	128					(8.96-18.27)
England ODI	126	170	213	121	630	139.49	<0.001	0.27	1.78
Bowlers (Expected distribution *)	193	225	108	104					(1.26-2.52)
England Test	10	33	32	35	110	53.72	<0.001	0.40	7.78
All (Expected distribution *)	40	36	16	18					(3.17-19.06)
England Test	2	18	16	24	60	49.22	<0.001	0.52	28.8
Batters (Expected distribution *)	24	19	8	10					(5.70-145.56)
England Test	8	15	16	11	50	11.17	0.011	0.27	2.58
Bowlers (Expected distribution *)	15	18	9	8					(0.74-9.01)

* Expected distribution calculated from Regional BQ distribution. Bold font denotes statistically significant chi-square at $p < 0.05$.

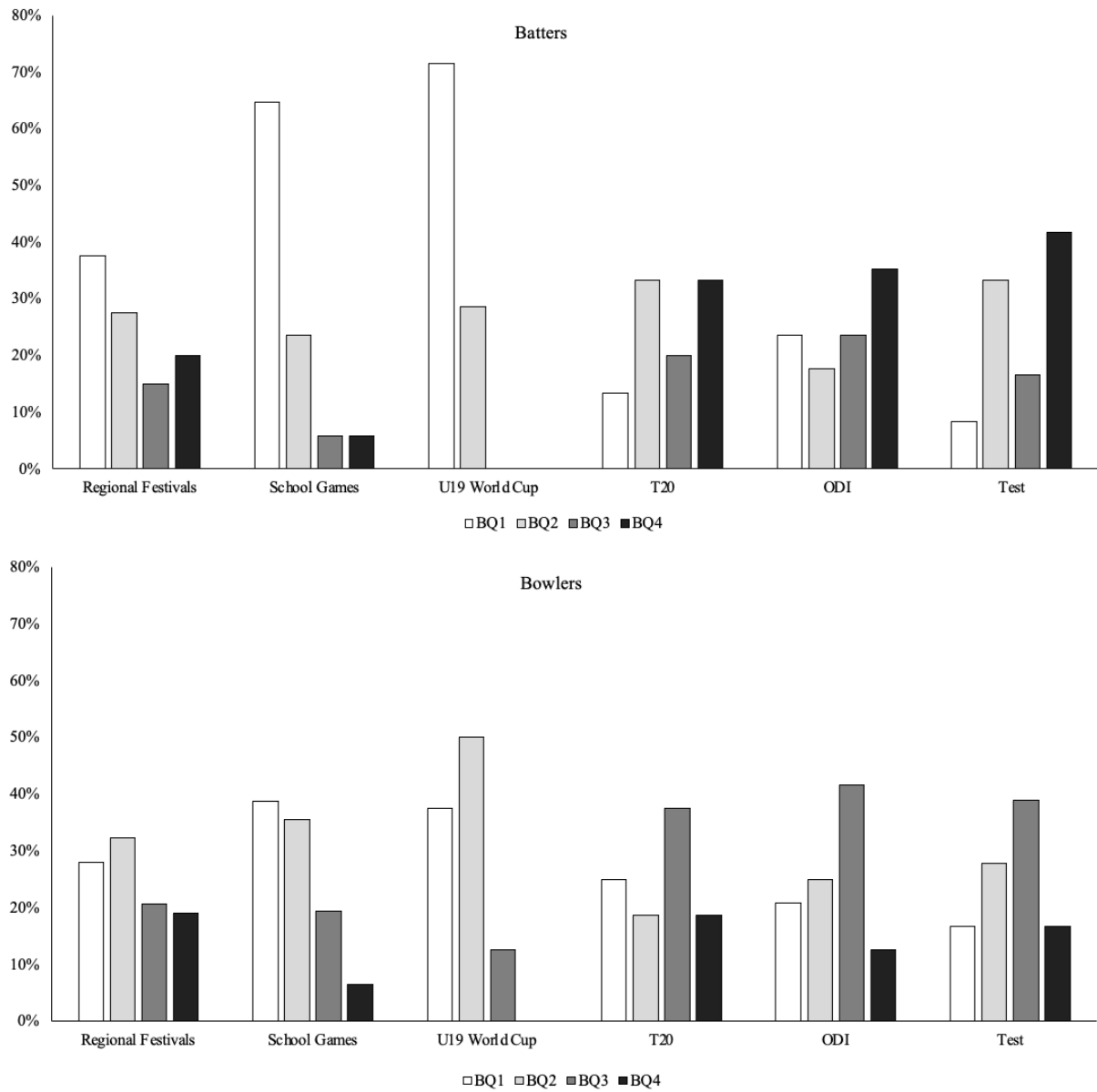


Figure 1. Birth quarter (BQ) distributions of batters and bowlers according to number of players.

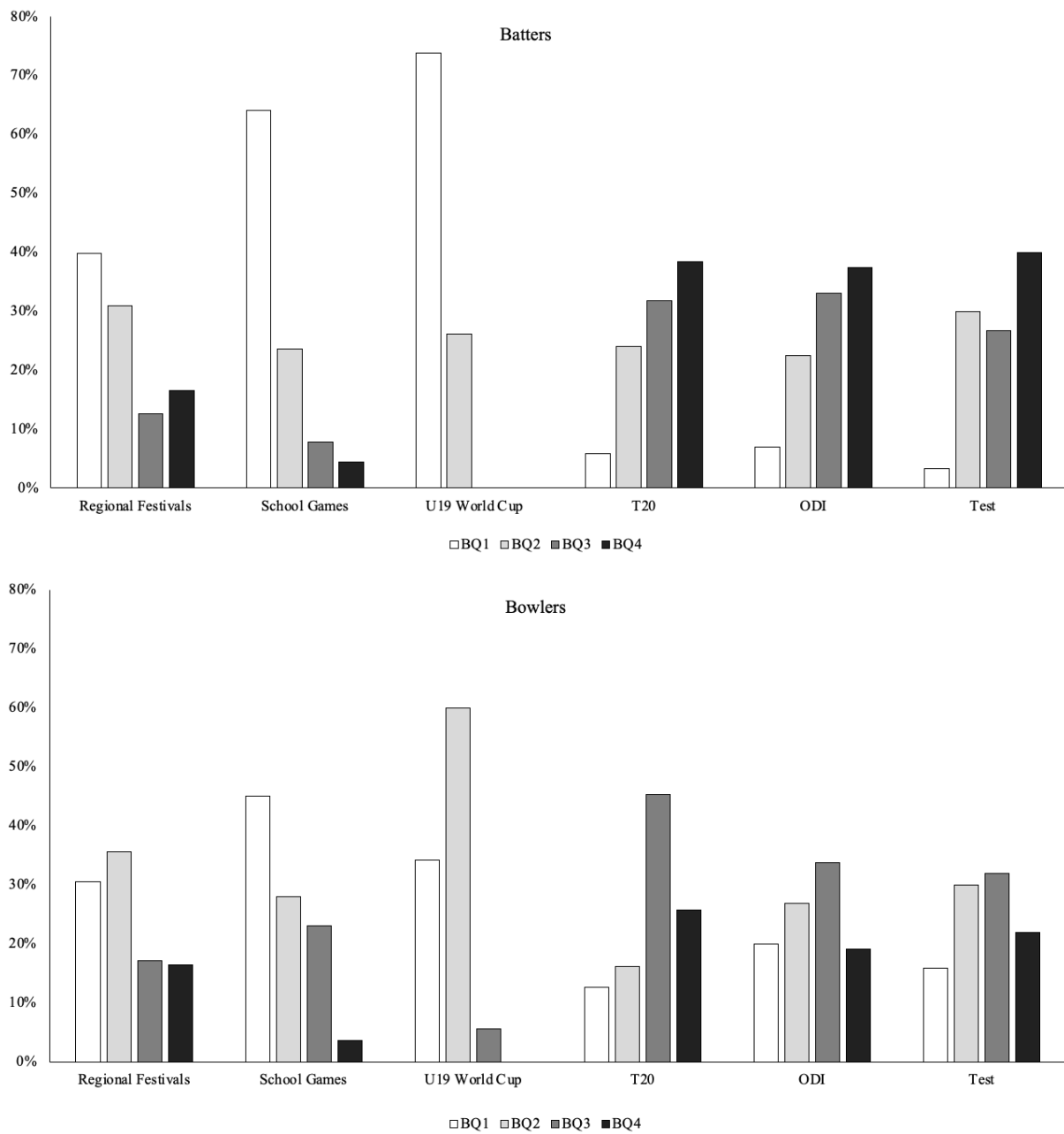


Figure 2. Birth quarter (BQ) distributions of batters and bowlers according to number of matches played.