Bio-banding in Academy Football: Player's Perceptions of a Maturity-Matched Tournament

Abstract

Player perceptions of participation in a football (soccer) tournament bio-banded for biological maturity status were the focus of study. Players (n=115) from three professional academies completed a post-tournament questionnaire addressing experiences of participation in the bio-banded and traditional age group formats. One sample means t-tests, magnitude-based inferences and ANOVA and thematic analysis of qualitative data derived from several open-ended questions were used. The quantitative and qualitative results indicated two major benefits of bio-banding: first, early maturing boys perceived the format as providing greater physical and technical challenge, and in turn new opportunities and challenges; and second, late maturing players perceived the format as offering less physical and technical challenge, which permitted greater opportunity to demonstrate technical and tactical abilities, and potentially aiding the retention of these players. The players understood and enjoyed the bio-banded competitions, and also perceived less injury risk. All players in the three maturity groups reported more opportunity to engage in leadership behaviours, to influence game-play and to express themselves on the ball in the bio-banded format. Overall, the bio-banded format, may facilitate the development of both early and late maturing academy players.

Key Words: Maturation, Puberty, Soccer, Adolescence, Youth Sport

Introduction

Individual differences in growth and maturation are central to the identification and development of talented youth soccer players. Youth of the same chronological age, both non-athletes and athletes, vary considerably in maturity status, and youth soccer players of the same chronological age have been shown to vary by as much as five years in terms of skeletal age (Johnson, 2015; Malina, 2011; Malina et al., 2018).

Biological maturity status is well-documented as a predictor of physical performance and selection in youth football (Meylan et al., 2010). Early maturing boys, including youth soccer players, tend to possess greater stature, absolute mass and relative lean mass (Malina et al., 2004, 2013). They also perform better on tests of speed, strength and power (Figueiredo et al., 2009; Malina et al., 2007b; Meylan et al., 2010). This translates to a potential advantage in the sport; early maturing boys reach higher peak speeds, cover greater high-speed distances, and are more frequently involved in high-intensity actions (Buchheit and Mendez-Villanueva, 2014). Strength and performance advantages associated with early maturation contribute to the likelihood of these boys being identified as talented and recruited into professional academies. The selection bias towards advanced maturity status emerges in football at approximately 12-13 years and increases with age and level of competition (Coelho-e-Silva et al., 2010; Figueiredo et al., 2009; Johnson, Farooq and Whiteley, 2017; Malina, 2011; Malina et al., 2018). Early maturing players are more likely to have access to specialist coaching, training resources and higher standards of competition and challenge (Malina, 2003; Bloom and Sosniak, 1985; Malina et al., 2015). In contrast, late maturing youth are more likely to be overlooked, excluded and/or denied these developmental opportunities (Cobley, 2016). A recent study of Swiss junior footballers demonstrated that late maturing players remain disadvantaged, despite being more technically and psychologically gifted (Zuber, Zibung and Conzelmann, 2016). It is possible that some of the

late maturing players were relatively young for their age-group and also less advanced in growth (i.e., smaller). In contrast, a study of the youth characteristics of U13 and U15 soccer players who were playing regionally and nationally as adults indicated no differences in the skeletal maturity and pubertal status (Figueiredo et al., 2019).

While early maturation may afford an initial athletic advantage in sports, it may be counterproductive in the long-term. The pressures to succeed within the academy system may encourage early maturing boys to play to their strengths, perhaps encouraging the development of physical rather than technical proficiency (Malina et al., 2015). Competing against physically smaller and less able players, early maturing boys may experience less challenge which may, in turn, may limit the development of the psychological, technical and tactical skills that are requisite for success at the adult level (Cumming et al., 2018). This lack of challenge may be a concern, as maturity-associated advantages in size and function are attenuated and/or reversed in late adolescence and adulthood (Lefevre, 1990; Malina et al., 2015). Although it is often argued that late maturing players may benefit in the long-term from exposure to greater challenge; this rationale applied only if the players are retained within the academy programs. Of relevance, late maturing youth represented less than 5% of U15 and U17 cohorts in an English academy (Johnson et al., 2017).

By inference, there is a need for effective strategies that both retain late maturing players and provide an additional challenge to early maturing players. Bio-banding is a strategy that groups athletes based on maturity status rather than chronological age (Cumming et al., 2017b). It is designed to promote competitive equity and athlete safety by limiting maturity-related variation in size and athleticism (Baxter-Jones, 1995; Gallagher, 1969; Malina and Beunen, 1996; Seefeldt, 1981). Bio-banding is an adjunct to, and not as a direct replacement for age group training and competition, and does not preclude the consideration of both psychological and technical abilities. Moreover, available evidence

suggests that bio-banding has the potential to benefit both early and late maturing players (Cumming et al., 2017b; Cumming et al., 2017a, Reeves et al., 2017).

The bio-banded football format was first evaluated in a Premier League tournament involving academy players from four professional teams who were grouped by biological maturity status rather than chronological age (Cumming et al., 2017a). Players 11 to 14 years who had attained 85.0% to 90.0% of predicted adult stature at the time of observation were grouped together for three competitive games. Experiences and perceptions of players in the bio-banded tournament were analysed with focus groups and qualitative methods. Early and late maturing players described the experiences as positive and noted that the bio-banding format presented unique challenges and learning experiences. Reasons for supporting the bio-banding format, however, varied relative to their maturity status. Early maturing players considered bio-banded games to be more physically and technically challenging, and required them to adopt a more team-oriented playing style, make decisions and release the ball more quickly. Bio-banding also provided an opportunity to learn from older and more experienced players. Late maturing players described their experience as less physically challenging, but appreciated the opportunity to adopt positions of leadership, to impact gameplay, and to demonstrate a wider range of their physical, technical and tactical skills. Similar benefits of bio-banding were also reported by academy stakeholders (staff, players and parents) in a recent evaluation of a seven-week training program in which players were bio-banded by maturity status at a premier league club (Reeves et al., 2018).

While the results of initial bio-banding competitions show promise, more research is required to better understand and validate the potential benefits and limitations of the protocol. The purpose of this study is to evaluate the perceptions and evaluations of youth football players to competing in a bio-banding tournament, and the extent to which the perceptions and evaluations were related to maturity status using. A mixed-methods approach

was used to compare player perceptions and experiences of competing in a bio-banded tournament relative to regular age group competition.

Materials and Methods

Participants

Participants were U10 through U15 academy football players (N=115), from three professional clubs. When registering for the three academies, parents/guardians and players provided informed consent to the routine collection of data as part of the program and potential use for research. All measurements were taken on a voluntary basis and participants had the right to opt out of assessment. The project and the right to use the retrospective data were approved by the three clubs and the ethics committee of the host institution.

Maturity Assessment

The maturity status of all players was estimated the week prior to the tournament. Heights and weights of each player were measured by trained staff. Heights of the biological parents of each player were self-reported and subsequently adjusted for over-estimation (Epstein et al., 1995). The chronological age, height and weight of the player and mid-parent (mean of the heights of both parents) were used to predict adult height using equations developed on youth in south-central Ohio in the United States (Khamis and Roche, 1994). The median error for predicted adult height in boys between 4 and 17 years of age was 2.2 cm.

The height of each player was then expressed as a percentage of his predicted adult height; this was the indicator of maturity status at the time of the competition (Roche et al., 1983). The percentage of predicted adult stature of each player was converted to a z-score relative to age-specific reference values for males in the University of California, Berkeley, longitudinal study (Bayer and Bailey, 1959). Premier Leagues PMA software was used to

generate maturity classifications based on z-scores: average or on-time (z-score between +0.5 and -0.5), early (z-score >+0.5), and late (z-score <-0.5). The 115 players were classified as follows: on time, 68; early, 35; late 12.

Maturity classifications based on percentage of predicted adult height had moderate concordance with maturity classifications based on skeletal age in youth American football players 9-14 years (Malina et al., 2007a) and soccer players 11-15 years (Malina et al., 2012) players and also had concurrent and predictive validity in samples of North American and European youth (Smart, Cumming, Sherar, Standage, Neville, & Malina, 2012).

Tournament

Players were grouped into three maturity bands based on percentage of predicted adult height attained at the time of the tournament: 80-85%; 86-90% and 91-95% of predicted adult stature. The bands were selected to approximate phases of the adolescent growth spurt, about the time of take-off, the interval between take-off and peak height velocity (PHV), and the interval of PHV and post-PHV (Malina, Cumming, Rogol, Coelho-e-Silva, Figueredo, Konarski and Koziel, in revision). The bands were also broad enough to allow each club to field a full complement of players.

Teams from the three clubs played each other in several formats: small sided - 6v6 and 7v7, and traditional - 11v11. Club teams were split into two for the 6v6 and 7v7 formats; as such, six teams competed in these formats. The 6v6 and 7v7 teams of the respective clubs were combined into a single team for the 11v11 format. Details pertaining to the specific game formats are presented in the appendix.

Questionnaire

A questionnaire (Figure 1) consisting of nine items was used to estimate and compare player experiences of competing in bio-banded and regular age group games. Each item was developed on the basis of the perceived advantages and disadvantages of bio-banding documented in previous research (Cumming et al., 2018, Reeves et al., 2018). The single items, though not amenable to tests of internal reliability, have been shown to be valid estimates of relevant constructs in several studies and often exceeded the validity coefficients of multi-item scales (Burisch, 1984; Raffety, Smith, & Ptacek, 1997; Russell, Weiss, & Mendelsohn, 1989). Single item measures have also been equally valid when measuring contextual differences within constructs that are sufficiently narrow and/or unambiguous, e.g., job satisfaction (Wanous et al., 1997). They are also more practical in time-sensitive settings (post-tournament) and when working with youth who may resent and/or not understand multiple-item scales.

Participants responded to each of eight items on 5 point Likert scale. Items 1 and 2 assessed the degree to which the players felt they understood and enjoyed the bio-banded format. Items 3 through 8 addressed potential advantages and disadvantages of bio-banding compared to age group competitions: presented less (1-2) or more (4-5) opportunity or challenge, with a score of 3 indicating no difference between formats. The last question (9) was open-ended was framed to provide players with the option of adding further qualitative comments concerning the competitive formats, i.e., did or did not like the bio-banding format and what they did or did not like about the bio-banding format, and also to capture perceived advantages and/or disadvantages not addressed in previous items. The questions were as follows:

1. Do you feel you understand the concept of bio-banding? (1 = Not at all; 5 = completely)

2. Did you enjoy the bio-banding tournament? (1 = Not at all; 5 = Yes, would like to do it again)
3. Did you feel more or less likely to get injured? (1 = Less; 5 = More)
4. Did you feel more or less of a leader than in your normal age group? (1 = Less; 5 = More)
5. Could you express yourself on the ball more or less than your normal age group? (1 = Less; 5 = More)
6. Did you feel like you were more or less of an influence on the games compared to your normal age group? (1 = Less; 5 = More)
7. Did you find the game more or less of a physical challenge compared to playing in your normal age group? (1 = Less; 5 = More)
8. Did you find the game more or less of a challenge technically compared to playing in your normal age group? (1 = Less; 5 = More)
9. Any further comments on why you did/did not like bio-banding?

Analysis

A series of univariate ANOVAs with a Bonferroni post hoc test were used to address maturity-associated variation in player responses. One sample mean t-tests, by maturity status, were conducted for items three to eight to determine the degree to which the players perceived the bio-banded format to differ from age group competitions. For each item, the observed mean was compared with the response that indicated no difference between the bio-banded and age group competition formats (i.e., 3 = same as age group competition). Subsequent tests of equivalence using Cohen's d as an effect size, 90% confidence intervals, and pre-determined upper and lower equivalence bounds of ±0.25, were conducted to determine if the differences were sufficient to be worthy of practical consideration (Lakens et al., 2018). Corresponding effect sizes representing the magnitude of the perceived differences between the bio-banded and traditional age group formats for questions 3 to 8 are illustrated in Figure 1. SPSS (Version 24) was used for analyses.

An inductive thematic analysis was conducted on the qualitative data generated by the open-ended questions (item 9). In keeping with guidelines established by Braun and Clarke (2006), this approach aims to identify, interpret and analyse common patterns within a data

set, and to generate a series of themes that facilitate further interpretation and elaboration of the statistical findings.

One author initially examined the transcripts for general codes; subsequently, the research team reviewed and discussed the collation of preliminary themes. With this approach, the derivation of each theme was triangulated among four members of the research team to maximise accuracy and reliability (Braun et al, 2016). Key extracts were subsequently categorised into each of the identified themes.

Results

Responses of players classified by maturity status to the eight questions are summarized in Table 1. The results suggest that they understood the concept of bio-banding (4.00±0.98). Late maturing players reported the highest level of understanding, but differences among the maturity groups did not differ significantly ($p>0.05$).

Players perceived the bio-banding format as enjoyable and generally wished to participate in this format again (4.19±0.93). Although early and on-time maturing players reported the highest levels of enjoyment, player responses did not differ significantly among the three maturity groups ($p>0.05$).

From an injury perspective, players in the three maturity groups perceived the bio-banded games as less risky but as not equivalent to age group competitions (early, $t(34)= -2.31$, $p<0.05$, Cohen's $d= -0.39$; on-time, $t(67)= -3.55$, $p<0.001$, Cohen's $d= -0.43$; late, $t(11)= -2.57$, $p<0.05$, Cohen's $d= -0.74$.). The magnitude of the effects varied from moderate to large, but did not differ significantly among the maturity groups (Table 1).

Players in each maturity group perceived the bio-banded format as providing greater opportunity to assume leadership roles but as not equivalent to age group competition (early,

t(34)= 1.81, p<0.03, Cohen's d= 0.306; on-time, t(67)= 3.21, p<0.01, Cohen's d= 0.39; late, t(11)= 3.00, p<0.01, Cohen's d= 0.87). The magnitude of the differences varied from small to large, and did not differ significantly among the maturity groups (Table 1).

Early and on time players perceived bio-banding as offering more opportunity to express themselves on the ball (early, t(34)= 5.37, p<0.001, Cohen's d= 0.91; on-time, t(67)=4.04, p<0.001, Cohen's d=0.49) and to exert their influence during the game (early, t(34)= 3.32, p<0.01, Cohen's d= 0.56, on-time, t(67)=4.93, p<0.001, Cohen's d=0.60). The perceived opportunities of the bio-banding format were perceived as not equivalent to age group games, and by inference suggested a practical benefit of bio-banding. Late maturing players also reported more opportunity to express themselves on the ball (t(11)= 2.23 p<0.05, Cohen's d= 0.64) and to exert their influence (t(11)= 1.62, p=0.06, Cohen's d= 0.47). The effect for 'ability to express oneself on the ball' achieved statistical significance. Both opportunities were considered as not equivalent to those experienced in age group competitions. Nevertheless, the perceptions of the players of contrasting maturity status did not differ (Table 1).

From a physical perspective, early maturing players described the bio-banded games as more challenging but as not equivalent to age group competition, t(34)= 1.99, p<0.05, Cohen's d= 0.34. Players classified as 'on time', however, perceived the physical challenge as equivalent to age group competition, but the difference was not significant t(67)= 0.14, p>0.05, Cohen's d= 0.02. Late maturing players described bio-banded games as physically less challenging than and as not equivalent to age group games, t(11)= -4.31, p<0.001, Cohen's d= -1.24. Both early maturing and on time players perceived the games as more physically challenging than did late maturing players (Table 1).

With respect to technical challenges, early maturing players described the bio-banded games as more challenging than and as not equivalent to age group competitions, $t(34)= 1.97$, $p<0.05$, Cohen's $d=0.33$. In contrast, the players on-time and late maturing perceived the technical challenges experienced in bio-banded games as not different from, yet not equivalent to, those experienced in age group competition; on-time, $t(67)= 0.86$, $p>0.05$, Cohen's $d= 0.10$, late $t(11)= -1.47$, $p>0.05$, Cohen's $d= -0.42$. Early maturing players perceived the games a more technically challenging than on time and late maturing players (Table 1).

>>> Figure 1. *Each question regarding the bio-banded tournament split by maturity status- early, on-time and late.* <<<

Four themes emerged from the qualitative analysis as central to player perceptions of the bio-banded tournament (Table 2): (1) *Overall experience* considered the general evaluation of the bio-banded tournament and individual experiences in the different game formats; (2) *Optimal Physical Challenge* reflected the perceptions of players regarding physical differences, benefits and challenges presented by the bio-banded tournament; (3) *Technical and Tactical Challenge* considered player experiences regarding the technical and tactical aspects of the bio-banded tournament, including benefits of playing with and against players of mixed chronological age and maturity status, opportunities to use, develop and demonstrate technical competence/excellence, and/or associated tactical challenges and adaptations; and (4) *Psychosocial Challenge* represented player perceptions of learning experiences and social benefits and challenges of the bio-banded format. Selected player quotations for each theme are presented in Table 2.

>>> Table 2. *Qualitative perceptions and evaluations of the bio-banded tournament* <<<

Discussion

Perceptions and evaluations of academy football players to participation in a tournament bio-banded for biological maturity status were considered. Most players believed that they understood the concept of bio-banding, but not all players were able to effectively differentiate between the concepts of growth and maturation. One player, reported some confusion as to "why other players within the same band were bigger", contending, "surely bio-banding is used to balance the physical area out" (OM). This misunderstanding was consistent with previous work (Reeves et al., 2018) and highlighted the importance of educating players, coaches and parents on the concepts related to growth, maturity status and timing, and the role bio-banding. Grouping players by maturity status is designed to attenuate but does not eliminate maturity-associated differences in size and function. Players of the same maturity status can still differ in size and function (strength, speed, and power) due in large part to genotypic factors. Players who are early maturing, yet constitutionally short in stature, must still learn to play with their genetically taller peers. Nevertheless, bio-banding has the potential to reduce the degree to which individual differences in size and athleticism impact player development and success.

Consistent with previous research, players described the experiences of competing in the bio-banded tournament as enjoyable (Cumming et al., 2017a). Players also described the bio-banding format as a "new and different experience" (OM) and welcomed the change from age group competition, "I liked it because it provided a different experience to playing in normal age group games" (EM). The experiences of players maturing early and on-time were reported as marginally more enjoyable than those of late maturing players, though the differences were not statistically significant. Early and on-time players may enjoy and see

greater value in the greater physical and technical challenges afforded when playing with and against older and/or more experienced peers. While the process of 'playing down' did not appear to adversely impact the enjoyment of the tournament expressed by late maturing players, it has been suggested that such strategies may result in late maturing players as feeling stigmatized for being less capable (Reeves et al., 2018). In this regard, education on the nature and purpose of bio-banding may mitigate such a consequence. Future research should perhaps address how alternative game formats, such as bio-banding impact, athlete enjoyment associated with participation in sport (Visek et al., 2015).

Early, on-time and late maturing players perceived markedly less risk of injury in bio-banded compared to age group competitions (Figure 1). Nevertheless, the extent to which the bio-banded formats can actually reduce injury risk has not been addressed. Logically, parity in body size and athleticism should reduce the likelihood of injury, specifically injury associated with collision or physical contact. The impact of size and maturity status upon injury risk, however, remains unclear. Nevertheless, age, height, weight and estimated maturity status (percentage of predicted adult height) were not associated with risk of injury among youth American football players 9-14 years (Malina et al., 2006). Contrary to expectations, greater size was associated with an increased likelihood of injury in youth rugby (Quarrie et al., 2001). The latter study involved older adolescents and young adults (20.6±3.7 years) and the findings may not generalize to youth samples and also to a different sport.

Consistent with previous research (Cumming et al., 2017a), players reported greater feelings of leadership in the bio-banded format than in age group competition. Enhanced opportunities for leadership were perceived by all maturity groups and may reflect the process of having to play with new teammates. Of interest, the effect was greatest for chronologically older late maturing players, who may perceive increased expectations to

assume positions of leadership when playing with younger players (Cumming et al., 2017a). The development of leadership is a key objective in the English Football Association Four-Corner Player Development model and is also considered an important determinant for success at the adult level. Bio-banding may beneficially influence group dynamics by placing greater emphasis on social skills such as leadership, teamwork, and communication. There is a need to systematically the potential social benefits of bio-banding and how format specifically challenges players varying in maturity status.

From a technical perspective, early and late maturing players reported more and less challenge, respectively. Competing against older and more experienced players, early maturing players are no longer able to use their physical advantages and must rely on technical and tactical skills to succeed. They also must adjust their game to a style of play that is faster and more sophisticated. This challenge for early maturing players was reinforced in the qualitative data e.g. “It gave me the chance to improve both technically and physically” (EM). While late maturing players considered the game less technically challenging, they reported greater opportunity to express themselves and to influence the game. This was consistent with previous observations (Cumming et al. 2017a) which showed that late maturing players found bio-banded games less physically and technically challenging, but appreciated the increased opportunities to use and demonstrate their physical and technical competencies. In contrast, the bio-banded format had only a trivial effect on technical challenges experienced by players on-time in maturity status, which suggested that the technical demands were similar to age group competitions. Perceptions of technical challenge also varied by maturity status in the present study, which was generally consistent with observations that bio-banding was associated with twice the frequency of dribbling and passing compared to age-group competitions (Thomas et al., 2017).

Player perceptions of physical challenge varied with maturity status. Early maturing players described the bio-banded format as more physically challenging than age group competition, consistent with previous observations (Cumming et al., 2017a). Challenge has long been recognized as a requisite successful athletic development (Gould, et al., 2002; Toering, et al., 2009). Due to physical and athletic advantages, early maturing players may not experience optimal levels of challenge in age group competitions. The bio-banded format addresses this issue by allowing early maturing players to benefit from the same challenges that are believed to give late maturing players an edge in adulthood (Krogman 1959; Cumming et al. 2017b). The qualitative data suggested that early maturity players appreciated such opportunities, relishing the chance "to play with older and physically more mature players" (EM). Players maturing 'on-time', in contrast, reported little to no differences in physical challenges between the bio-banded and age group formats, whereas late maturing players considered the bio-banded format to be less physically challenging. The preceding was consistent with previous observations of the bio-banded format (Cumming et al., 2017a). Less challenge, however, does not necessarily imply less opportunity for development. Late maturing players have previously described bio-banded formats as affording greater opportunities to use and demonstrate their physical and technical/tactical skills, adopt positions of leadership and exert greater command over the game. Such formats also enable coaches and scouts to evaluate late maturing players in an alternative environment and look beyond individual differences in physical maturity. Greater physical equity may allow academies to maintain more late-maturing players and judge the players on their current level of physical development as expressed in the comment of a late maturing player that he felt "more physically matched" within bio-banded games.

Although the results are interesting and consistent with previous research, limitations of the study should be noted. The results are limited to players from three professional

academies who competed in the specific tournament format. The results may thus not generalize to youth of different chronological ages and levels of maturity, to grassroots football, or to athletes competing in other sports. Bio-banding appears most suitable to the interval of adolescence when maturity associated differences in both size and function are at their greatest, about 11-15 years (Malina et al., 2004). Consistent with observations on skeletal ages of youth soccer players (Johnson et al., 2017; Malina, 2011, Malina et al., 2018), the proportion of late maturing players involved in the tournament was relatively small.

It should also be noted that a small minority of players described their experiences of participating in the bio-banded format as negative, "I didn't enjoy the tournament as I felt we didn't learn anything throughout the day" (EM). The comment raises additional questions that merit attention: (1) at what specific chronological ages is bio-banding more or less effective; (2) do coaches perceive advantages and disadvantages of bio-banding; (3) how does the bio-banded format impact technical and physical parameters of game performance.

In summary, this study investigated the evaluations of professional academy football players who participated in a tournament in which they were grouped by estimated maturity status rather than chronological age. The findings indicated that players both understood and enjoyed the bio-banded format and that the strategy was perceived as affording more opportunity for players to express themselves, adopt positions of leadership, and influence gameplay. Early maturing players perceived the bio-banded games as more physically and technically challenging, whereas, late maturing players found them less so. This study supports the contention bio-banding, as an adjunct to age group competition, can contribute positively to the holistic development of young football players.

Acknowledgements:

The authors would like to acknowledge the support of the academy players and staff at A.F.C Bournemouth, Watford FC, and Exeter City FC for participating in and helping organize this tournament.

Declaration of interest statement:

The authors express no conflicts of interest.

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Tables:

Table 1: Descriptive statistics (means and standard deviations) for responses of players classified by estimated maturity status to each question and results of the ANOVAs comparing the three maturity groups

	Early (n=35)		On Time (n=68)		Late (n=12)		F	Eta Squared
	Mean	SD	Mean	SD	Mean	SD		
Do you feel you understand the concept of bio-banding?	4.09	0.82	3.88	1.09	4.42	0.67	1.72	.03
Did you enjoy the bio-banded tournament?	4.23	1.03	4.22	0.93	3.92	0.52	0.59	.01
Did you feel more or less likely to be injured?	2.66	0.87	2.57	1.00	2.17	1.12	1.16	.02
Did you feel more or less of a leader than in your normal age group?	3.26	0.85	3.37	0.95	3.58	0.67	0.61	.01
Could you express yourself more or less than in your normal age-group?	3.69	0.76	3.49	0.97	3.58	0.90	0.57	.01
Did you feel you were able to have more or less of an influence compared to your normal age group?	3.46	0.82	3.51	0.87	3.42	0.90	0.10	.00
Did you find the games more or less of a physical challenge compared to age groups?	3.29[a]	0.86	3.01[b]	1.15	1.83[ab]	0.94	8.65*	.13
Did you find the games more or less of a technical challenge compared to age groups?	3.66[ac]	0.73	3.10[c]	0.96	2.67[a]	0.78	7.28*	.12

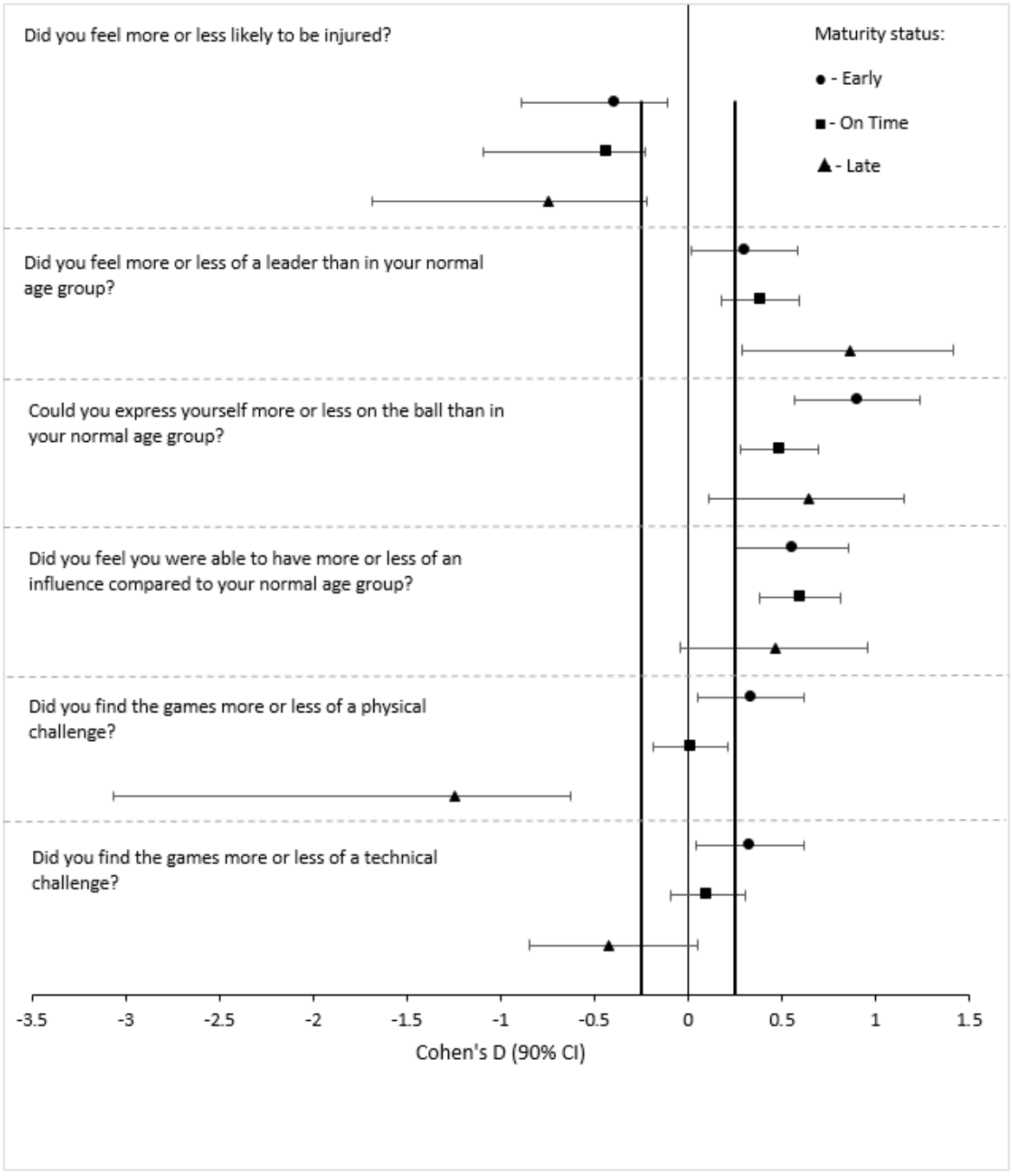
*P<0.001
[a] = Significant difference between Early and Late Maturers
[b]= Significant difference between On-Time and Late Maturers
[c]= Significant difference between Early and On-Time Maturers

Table 2. *Qualitative perceptions and evaluations of players to participation in the bio-banded tournament*

Theme	Qualitative Evidence
1. OVERALL EXPERIENCE	
General Enjoyment	I liked it because it was a new and different experience (OM) I liked it because it provided a different experience to playing in normal age group games (EM) It was a fun experience (EM) It was well-organized and fun (EM)
2. OPTIMAL PHYSICAL CHALLENGE	It gave me the chance to feel what it was like playing against other players of similar physicality (EM) It was a fun experience and physically challenging (EM) I liked that I got the chance to play with older and physically more mature players (EM) I liked it because we were better matched physically and was therefore challenging (OM) I liked it because you got to play with people both older and younger than you but of the same physicality (OM) I enjoyed playing others of similar physicality (OM) I felt we were more physically matched (LM) I liked it because I found it more competitive compared to the normal GPs (EM) I liked it because I could physically compete against the others (OM) It was a good test of strength, more so than what I experience in my normal age group (OM) I liked it because it was challenging (OM)
3. TECHNICAL AND TACTICAL CHALLENGE	
Opportunities to use, develop and demonstrate technique	Playing in the bio-bands enabled me to focus more on my technical game rather than worrying about the physicality (OM) It gave me the chance to improve both technically and physically (EM)
Tactical Adaptation	I felt that those I played within the bio-banded team didn't make the runs like those in my normal age group; restricted my ability to play through balls like I usually do (OM)
4. PSYCHOSOCIAL CHALLENGE	
Self-confidence and growth	I felt that those I played within the bio-banded team didn't make the runs like those in my normal age group; restricted my ability to play through balls like I usually do (OM) I liked the bio-banding as it enabled me to express myself (OM) It resulted in me being more confident in myself (EM) I felt more able to express myself (LM)
Peer pressure	I didn't like the bio-banding as I felt under pressure from the older ones in the group meaning I couldn't try things (OM)

NB: EM = Early Maturer, OM = On-time Maturer, LM = Late Maturer

Figure 1: Responses to six specific questions by players of contrasting maturity status to participation in the bio-banded tournament. Data points represent Cohen's d effect size and confidence intervals. The vertical lines represent the threshold for the smallest worthwhile effect size (Cohens d effect size of 0.2 to-0.2=small).



Appendix

Table: Bio-banded Tournament game formats.

Game Format		**Percentage of Predicted Adult Stature Bands**		
		80-85%	86-90%	91-95%
6v6	Pitch Size (Meters)	45 x 30	48 x 36	48 x 36
	Ball Size	4	5	5
	Match Duration/ Rest (Mins)	4 / 4-5	4 / 4-5	4 / 4-5
	Goal Size (Meters)	2 x 4	2 x 4	2 x 4
7v7	Pitch Size (Meters)	53.8 x 31.6	53.8 x 31.6	60.2 x 39.6
	Ball Size	4	5	5
	Match Duration (Mins)	8	8	8
	Goal Size (Meters)	1.95 x 3.75	1.95 x 3.75	2.25 x 5.5
11v11	Pitch Size (Meters)	72.5 x 49	98.6 x 61.8	98.6 x 61.8
	Ball Size	4	5	5
	Match Duration (Mins)	20	20	20
	Goal Size (Meters)	2.2 x 6.55	2.59 x 7.5	2.59 x 7.5